

EASTRIDGE TO BART REGIONAL CONNECTOR PROJECT

CAPITOL EXPRESSWAY LIGHT RAIL PROJECT

SPECIFICATIONS – 95% SUBMITTAL VOLUME 1 Divisions 1-10

JUNE 2020

**Eastridge to BART Regional Connector: Capitol Expressway Light Rail Project
 CONTRACT C801
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END OF SECTION

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SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

- A. The work of this Contract is the Capitol Expressway Light Rail Project, an extension of the existing Capitol Avenue Light Rail Transit System, located within the City of San Jose, County of Santa Clara. Work extends along Capitol Avenue and Capitol Expressway from Wilbur Avenue near the existing Alum Rock LRT Station to Quimby Road.
- B. This contract includes but is not limited to the following work:
1. Preparing and maintaining staging/storage areas at VTA provided property locations.
 2. Demolition of existing improvements as necessary for construction of new facilities including portions of existing streets.
 3. Utility construction and relocation including construction of storm drain systems and sanitary sewer pipelines.
 4. Coordination of utility relocations by PGE, ATT, San Jose Water Company and others.
 5. Construct ductbank infrastructure for PGE power supply to Traction Power sites.
 6. Earthwork including project related rough grading.
 7. Furnishing and installing pre-construction test piles and performing pile tests.
 8. Construction of a cast-in-place post-tensioned concrete aerial guideway structure to support the light rail trackway and Story Station, including one (1) precast concrete girder span over Tully Road. Aerial guideway structure construction also includes driven precast, prestressed concrete pile foundations, cast in drilled hole (CIDH) pile foundations, and steel pipe pile foundations, concrete abutments, and retained fill supporting wall systems at the guideway approaches.
 9. Construction of one aerial Light Rail Transit (LRT) passenger station at Story Road, called Story Station, and one at-grade LRT station adjacent to the Eastridge Transit Center, called Eastridge Station, including canopy shelters, signals/communications houses, signage, furnishings and amenities.
 10. Construction of a pedestrian overcrossing structure, four (4) station access structures including three (3) passenger elevator towers, three (3) elevator machine rooms, three (3) storage rooms and one (1) electrical room at the Story Station.
 11. Construction of at-grade trackway for ballasted trackwork, which also includes excavation, installation of underdrain, subballast, ballast, TDA based underlayment, ties, and rail.

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12. Construction of direct fixation track on the aerial guideway. Direct fixation track includes second pour concrete plinth with pedestal, direct fixation fasteners and rail.
13. Construction of ballasted special trackwork, which includes one (1) Number 8 double crossover, two (2) Number 8 turnouts and one (1) Number 4 turnout.
14. Furnishing, installing and testing of a Traction Electrification System (TES), including overhead contact system, (OCS) and Traction Power Substations (TPSS).
15. Furnishing, installing and testing of parallel aerial feeders for OCS from approximately TPSS 27 to north of Alum Rock Station.
16. Furnishing, installing and testing of complete LRT communications system.
17. Designing, furnishing, installing and testing complete LRT signal system.
18. Furnishing, installing and testing of a complete Intrusion Detection System (IDS).
19. Furnish and install Automatic Fare Collection systems at the passenger stations.
20. Construction of Combined Systems Duct bank and/or cable trough (CSD) to provide cableways for all traction power, OCS, Train Signals, communications, Intrusion Detection and other systems.
21. Furnishing and installing conduits, pull boxes and junction boxes for lighting and communication systems.
22. Furnishing and installing all lighting and electrical systems for street lighting, pedestrian level lighting, and LRT platform lighting.
23. Reconstruction of Eastridge Park and Ride Lot in stages while maintaining access for VTA bus patrons.
24. Design, furnish and install a photovoltaic system in the VTA park and ride lot at Eastridge Station. Obtain PG&E permits and billing approvals.
25. Design and construct canopy shelters at the VTA park and ride lot.
26. Furnishing and installing plumbing system and drainage for passenger stations, pedestrian overcrossing, and aerial structures.
27. Relocate Bus Rapid Transit (BRT) Shelter south of Ocala Avenue – salvage, repair and reinstall existing facilities, construct new foundations and reconnect lighting systems.
28. Traffic control for streets affected by construction operations.
29. Street lighting and traffic signal work including modifications of existing facilities.
30. Furnish, install and test traffic signal interconnect.
31. Construction of street improvements. including but not limited to concrete barriers, sidewalks, curbs, gutters, bus pads, curb ramps and pavement conforms, and all needed

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- modifications to the existing storm water drainage, sanitary sewer and potable water facilities.
32. Construction of stormwater treatment facilities including bioretention areas and self-retaining areas.
 33. Construction of ornamental metal fences, chain link fencing, and railing.
 34. Landscaping, irrigation and hardscape installation.
 35. Coordination of work including coordination with other parties working at or near the site of the Work including communications work.
 36. Implementation of a Construction Implementation Management Plan (CIMP).
 37. Obtaining all permits and necessary approvals from local agencies having jurisdiction.
 38. Planning and conducting an Integrated Start up and Testing program project prior to start of revenue operations.
 39. Procure and supply and deliver to VTA spare parts as specified.

1.02 PROJECT WORK NOT IN THIS CONTRACT

- A. Other parties including the VTA and utility agencies may be performing work at or near the site of the Work for this Contract.
- B. VTA will endeavor to advise Contractor on the known schedules of other parties performing work at or near the Worksite for this Contract and will review with Contractor the Construction Schedule to seek a mutually acceptable resolution of conflicts.
- C. It shall be understood that the nature of the Work is such that the presence and activities of other parties performing work at or near the Worksite cannot be precisely anticipated, and it shall also be understood that Contractor must have flexibility in its schedule to accommodate unexpected activities of other parties at the Worksite.
- D. Cooperate with other parties performing work at or near the Worksite; and, if necessary, revise Contractor schedule to allow such work by other parties to be performed in a timely manner. Refer to Section 01 12 16, Work Sequence and Constraints.
- E. Selection and procurement of materials and drawing submittals indicated on the plans as NIC (Not in Contract) is not included in the contract.

1.03 IDENTIFIED AGENCIES

- A. VTA has endeavored to identify agencies having jurisdiction over the Work. The list is not necessarily complete, and Contractor must be bound by requirements of other agencies having jurisdiction over the Work.

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- B. The identified agencies include:
1. County of Santa Clara
 2. City of San Jose Department of Transportation
 3. City of San Jose Department of Public Works
 4. City of San Jose Parks, Recreation and Neighborhood Services
 5. Santa Clara Valley Water District
 6. Pacific Gas and Electric Company
 7. San Jose Water Company
 8. San Jose Municipal Water
 9. Comcast
 10. AT&T
 11. County of Santa Clara Road and Airports Department
 12. Federal Aviation Administration
 13. Regional Water Quality Control Board
 14. Caltrans
 15. City of San Jose Fire Marshal

1.04 INSPECTIONS BY CITY AND COUNTY

- A. Contractor must allow inspection of the Worksite or work premises during business hours for the purpose of ensuring that the premises and the business are in compliance with the terms and conditions of the Approval and with the requirements of the City of San Jose Code, County of Santa Clara, standard specifications and details and other local, State, and Federal laws and regulations.

1.05 CONTRACTOR'S USE OF THE SITE OF THE WORK

- A. Contractor shall limit use of the site of the Work to allow for:
1. Work by other parties.
 2. VTA occupancy.
 3. Adjacent public use.
- B. Contractor shall coordinate use of the site of the Work with the VTA.
- C. An area for Contractor's laydown will be provided by the VTA.
- D. Contractor shall store materials and equipment under Contractor's control in a manner that shall not interfere with public safety and convenience nor with operations of VTA or other parties. Storage shall be in compliance with approved Storm Water Pollution Prevention Plan (SWPPP) and the requirements of the local jurisdictional authorities.
- E. Contractor shall procure and maintain additional storage or work areas as needed for operations outside the site of the Work.
- F. Contractor shall obtain written permission for use of areas outside of the site of the Work from property owners and jurisdictional authority. If applicable, Contractor shall submit and obtain approvals of traffic control plans for streets affected by use of the aforementioned areas from the local jurisdictional authorities.

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- G. Contractor shall provide parking facilities for contractor personnel and subcontractors and shall prohibit parking of contractor personnel and subcontractor personnel vehicles on public streets. Contractor's parking facilities shall not impair or interfere with existing community parking and traffic conditions.
- H. Contractor shall prohibit refueling at the site and shall comply with restrictions of the SWPPP.
- I. Contractor shall comply with all applicable articles of the project approved Construction Implementation Management Plan (CIMP)

1.06 INFORMATION AVAILABLE TO THE CONTRACTOR (MATERIALS INFORMATION)

- A. The Contractor shall refer to Section 7.64, Information Available to the Contractor, of the General Conditions for limitations in the use of this information. Contractor shall read and be thoroughly familiar with the above mentioned reports prior to bidding and commencing the work. The Contractor shall be responsible for any conclusions drawn from the information presented.
 - 1. Eastridge to BART Regional Connector (EBRC), Capitol Expressway Light Rail (CELR) Project - Drainage and Stormwater Treatment Report
 - 2. EBRC, CELR – Operations Plan
 - 3. EBRC, CELR – Geotechnical Report
 - 4. EBRC, CELR – Hazardous Materials Report

1.07 MEASUREMENT AND PAYMENT

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection therewith will be considered incidental to the item of work to which they pertain.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

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SECTION 01 12 16

WORK SEQUENCE AND CONSTRAINTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for sequencing the work in coordination with work by other entities and constraints imposed, to maintain public traffic and to coordinate work activities and schedules with those of other entities.

1.02 RELATED SECTIONS

- A. Section 6.6, Contract Data Requirements, of the Special Conditions
- B. Section 6.11, Work Sequence and Constraints
- C. Section 01 55 26, Traffic Control

1.03 SUBMITTALS

- A. Submit Staging Plans to VTA for review and approval before start of work. The submittal shall include the sequence of construction activities, time, date, days of work, and durations. These shall conform to VTA, Santa Clara County, and City of San Jose requirements
- B. Refer to Section 01 55 26, Traffic Control, for submittal of traffic control working drawings for each staged activity.
- C. Submit list of construction equipment to be used near PG&E Gas Transmission Lines.
- D. Submit list of construction equipment to be used near Reid-Hillview Airport. Contractor shall comply with FAA requirements for marking and lighting in accordance with FAA Advisory circular 70/7460-1 L Change 2.

1.04 ORDER OF WORK

- A. Order of Work shall conform to the provisions in Section 6.6, Contract Data Requirements, of the Special Conditions, and this Section.
- B. Contractor shall submit construction sequencing and work schedule. The construction sequencing shall NOT interrupt VTA operations unless specific approval is given per Section 6.15, Contractor Safety and Light Rail Transit Operations.
- C. Schedule Work in conformance with the as specified.
- D. Non-conflicting work in subsequent stages may proceed concurrently with work in preceding stages with approval of the VTA, provided satisfactory progress is maintained in said preceding stages of construction and provided no additional inconvenience is incurred by public traffic as a result of performing the work out of sequence.

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1.05 WORK BY OTHER ENTITIES

- A. Refer to Section 6.17, Contractor Cooperation and Coordination, of the Special Conditions. The exercise of the right reserved by VTA to permit other contractors and persons to do work in or about the contract area does not in any way, nor to any extent, relieve Contractor from liability for loss or damage to the Work due to or resulting from his operations.
- B. The VTA will decide disputes regarding performance of Work, access to the site, cleaning up of the site, and priority of performance between various contractors working for the VTA within the contract area and in adjacent areas.
- C. These provisions also apply to the relations between Contractor and utility companies performing work in connection with the project. Contractor shall permit free and clear access to utility personnel for purposes of inspections, maintenance, providing for additional service requirements, and construction of new facility.
- D. The following contracts are scheduled to be working within the limits of the Contract:
 - 1. PG&E Transmission Line Relocation
 - 2. PG&E Gas Distribution Relocation (PM 35073148)
 - 3. PG&E Electric Distribution Relocation (PM 35058704)
 - 4. San Jose Water Company Relocation (N06-050)
 - 5. MCI Fiber Relocations
 - 6. Zayo Fiber Relocations
 - 7. AT&T communications Relocations
- E. In addition to projects listed herein, there will be or may be other public and private projects in the vicinity of the work which may affect Contractor's schedule and operations including such things as traffic control and lane closures.

1.06 MEASUREMENT AND PAYMENT

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection therewith will be considered incidental to the item of work to which they pertain.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 PG&E GAS TRANSMISSION PIPELINE REQUIREMENTS

- A. Project work will be conducted in proximity to PG&E's 2-34" and 1-20" high pressure gas transmission lines. If travel over PG&E ROW is required, Contractor shall coordinate with PG&E's Gas Transmission Pipeline Engineer for conditions for specific equipment to travel over the pipeline.

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- B. Work over the gas transmission line shall be conducted in accordance with all state, local and PG&E regulations.
- C. A PG&E Gas Transmission Standby Inspector must be present during any excavations within 10 feet of the gas lines. This includes all grading, trenching, substructure depth verifications (potholes), asphalt or concrete demolition/removal, removal of trees, signs, and light poles. This inspection can be coordinated through the Underground Service Alert (USA) service at 811 or 1-800-227-2600. A minimum notice of 48 hours is required. Ensure the USA markings and notifications are maintained throughout the duration of your work.
- D. At any time, PG&E may need to access, excavate, and perform work on the gas pipeline. Any construction equipment, materials, or spoils may need to be removed upon notice. Any temporary construction fencing installed within PG&E’s easement would also need to be capable of being removed at any time upon notice. Any plans to cut temporary slopes exceeding a 1:4 grade within 10 feet of a gas transmission pipeline need to be approved by PG&E Pipeline Services in writing prior to performing the work.
- E. To prevent damage to the buried gas pipeline, there are weight limits that must be enforced whenever any equipment gets within 10 feet of traversing the pipe. The table below lists the maximum half axle limits for wheeled vehicles and equipment at various depths of cover. Half axle weight is defined as the gross weight upon any one wheel, or wheels, supporting one end of an axle.

Wheel Weight Limits – Ocala Ave & Capitol Expressway, San Jose			
COVER	34” L-300A Lb. per wheel	34” L-300B Lb. per wheel	20” L-100 Lb. per wheel
less than 2 ft.	hand dig	hand dig	hand dig
2 ft.	10,000	8,700	1500
3 ft.	16,000	13,000	1600
4 ft.	24,000	17,500	-
5 ft.	34,000	22,500	-
6 ft.	45,500	27,000	-

Ensure a list of the axle weights of all equipment being used is available for PG&E’s Standby Inspector. To confirm the depth of cover, the pipeline may need to be potholed by hand digging. Due to the complex variability of tracked equipment, vibratory compaction equipment, and cranes, PG&E must evaluate those items on a case-by-case basis prior to use over the gas pipeline. Contractor shall provide a list of any proposed equipment of this type noting model numbers and specific attachments. No equipment may be set up over the gas pipeline while operating. Ensure crane outriggers are at least 10 feet from the centerline of the gas pipeline. Transport trucks must not be parked over the gas pipeline while being loaded or unloaded.

- F. Contractor shall maintain a minimum of 36 inches of cover over gas pipelines (or existing grade if less) and a maximum of 7 feet of cover at all locations. The graded surface cannot exceed a cross slope of 1:4.

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- G. Any excavations within 2 feet of a gas pipeline must be dug by hand. Water jetting to assist vacuum excavating must be limited to 1000 psig and directed at a 40° angle to the pipe. All pile driving must be kept a minimum of 3 feet away. Any plans to expose and support a PG&E gas transmission pipeline across an open excavation need to be approved by PG&E Pipeline Services in writing prior to performing the work.
- H. PG&E Pipeline Services must review and approve all plans to bore across or parallel to (within 10 feet) a gas transmission pipeline. There are stringent criteria to pothole the gas transmission facility at regular intervals for all parallel bore installations. For bore paths that cross gas transmission pipelines perpendicularly, the pipeline must be potholed a minimum of 2 feet in the horizontal direction of the bore path and a minimum of 12 inches in the vertical direction from the bottom of the pipe with minimum clearances measured from the edge of the pipe in both directions. Standby personnel must watch the locator trace (and every ream pass) the path of the bore as it approaches the pipeline and visually monitor the pothole (with the exposed transmission pipe) as the bore traverses the pipeline to ensure adequate clearance with the pipeline. The pothole width must account for the inaccuracy of the locating equipment.
- I. All utility crossings of a gas pipeline should be made as close to perpendicular as feasible (90°+/- 15°). All utility lines crossing the gas pipeline must have a minimum of 12 inches of separation from the gas pipeline. Parallel utilities, pole bases, water line kicker blocks, storm drain inlets, water meters, valves, back pressure devices or other utility substructures are not allowed in the PG&E gas pipeline easement. If previously retired PG&E facilities are in conflict with proposed substructures, PG&E must verify they are safe prior to removal. This includes verification testing of the contents of the facilities, as well as environmental testing of the coating and internal surfaces. Timelines for PG&E completion of this verification will vary depending on the type and location of facilities in conflict.
- J. No structures (permanent or temporary) are to be built within 10 feet from edge of the PG&E gas pipeline, in plan view.
- K. Care must be taken to ensure the safety and accessibility of the pipelines. Permanent fencing is not allowed within PG&E easements except for perpendicular crossings which must include a 16-foot-wide gate for vehicular access. Gates will be secured with PG&E corporation locks.
- L. Landscaping must be designed to allow PG&E to access the pipeline for maintenance and not interfere with pipeline coatings or other cathodic protection systems. Trees or deep-rooted shrubs shall not be located within 10 feet of the edge of the gas pipeline. Removal of trees is acceptable; however, if stumps or roots are to be removed, further evaluation will be required to ensure that their removal will not interfere with the pipelines.
- M. PG&E pipelines are protected from corrosion with an “Impressed Current” cathodic protection system. Any proposed facilities, such as metal conduit, pipes, service lines, ground rods, anodes, wires, etc. that might affect the pipeline cathodic protection system must be reviewed and approved by PG&E Corrosion Engineering.
- N. PG&E needs to maintain pipeline marker signs for gas transmission pipelines in order to ensure public awareness of the presence of the pipelines. With prior written approval from PG&E Pipeline Services, an existing PG&E pipeline marker sign that is in direct conflict with proposed developments may be temporarily relocated to accommodate construction work. The pipeline marker must be moved back once construction is complete.

END OF SECTION 01 12 16

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SECTION 01 20 00

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for measurement and payment as they apply to the Work.
- B. Measurement methods specified in the individual Sections of these Specifications shall govern if different from the method(s) specified herein.

1.02 MEASUREMENT OF QUANTITIES

- A. Measurement Standards: All work to be paid for at a Contract price per unit of measurement will be measured by VTA in accordance with US Customary Units.
- B. Measurement by Weight:
 - 1. Reinforcing steel, steel shapes, castings, miscellaneous metal, metal fabrications, and similar items to be paid for by weight shall be measured by scale weight for the type and quantity of material actually furnished and used.
 - 2. Unless shipped by rail, material to be measured and paid for by weight shall be weighed on sealed scales regularly inspected by the State Division of Measurement Standards or its designated representative, furnished by and at the expense of the Contractor. All weighing, measuring, and metering devices shall be suitable for the purpose intended and shall conform to the tolerances and specifications as outlined in Title 4, Chapter 9 of the California Administrative Code, Division 5, and these Specifications. Use platform scales of sufficient size and capacity to permit the entire vehicle or combination of vehicles to rest on the scale platform while being weighed. Combination vehicles may be weighed as separate units provided they are disconnected while being weighed. Have all scales inspected and certified as often as VTA may deem necessary to ascertain accuracy. Costs incurred as a result of regulating, adjusting, testing, inspecting, and certifying scales shall be borne by the Contractor.
 - 3. A licensed weighmaster shall weigh all materials weighed on scales furnished by the Contractor. VTA may be present to witness the weighing and to check and compile the daily record of such scale weights; however, in any case the Contractor shall furnish weight slips and daily summary weigh sheets. The Contractor shall furnish a duplicate weight slip or a load slip for each vehicle weighed and deliver the slip to VTA at the point of delivery of the material.
 - 4. If the material is shipped by rail, the certified car weights will be accepted, provided that only actual weight of material will be paid for and not minimum car weights used for assessing freight tariff. Car weights will not be acceptable for material to be passed through mixing plants. Material to be measured by weight shall be weighed separately for each bid item under which it is to be paid.
 - 5. Trucks used to haul material being paid for by weight shall be weighed empty daily and at such additional times as VTA may require. Each truck shall bear a plainly legible identification

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mark. VTA may require the weight of the material verified by weighing empty and loaded trucks on such other scales as VTA may designate.

C. Measurement by Volume:

1. Measurement by volume will be by the cubic dimension listed or indicated in the Schedule of Quantities and Prices. Method of volume measurement will be by the unit volume in place or removed as indicated on the Contract Plans or as specified.
2. When material is to be measured and paid for on a volume basis and it is impractical to determine the volume by the specified method of measurement, or when requested by the Contractor in writing and accepted by VTA in writing, the material will be weighed in accordance with the requirements specified for weight measurement. Such weights will be converted to volume measurement for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by VTA and shall be agreed to by the Contractor before such method of measurement of pay quantities will be accepted.

D. Measurement by Area: Measurement by area will be by the square dimension indicated on the Contract Plans or as specified. Method of square measurement will be as specified.

E. Linear Measurement: Linear measurement will be by the linear dimension listed or indicated in the Schedule of Quantities and Prices. Unless otherwise indicated, items, components, or work to be measured will be measured at the centerline of the item in place.

F. Measurement by Unit: Measurement by the unit will be measured by the unit from actual count.

G. Lump-Sum Measurement:

1. Lump-sum measurement will be for the entire item, unit of work, structure, or combination thereof, as specified and as listed or indicated in the Schedule of Quantities and Prices with pay limits for the item of work shown on the Plans.
2. If the Contractor requests progress payments for lump-sum contracts or lump-sum items or amounts in the Schedule of Quantities and Prices, such progress payments will be made in accordance with a well-balanced, detailed program of payment-apportioning, prepared by the Contractor and submitted to VTA for approval.
3. Such program for each applicable lump-sum item shall show fixed measurable quantities where possible and unit prices therefor as allocated by the Contractor to the different features of the work and major subdivisions thereof. The summation of extensions of quantities and unit prices and related costs shall equal the amount of the lump-sum contract price or lump sum bid item indicated in the Schedule or Quantities and Prices.

1.03 ALLOWANCES

- A. Allowances specified in the Contract documents shall cause the work so covered to be furnished and performed for such sums as acceptable to VTA and shall include the cost to the Contractor, less any applicable trade discounts, of materials and equipment to be delivered and installed.

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- B. Contractor's costs for unloading, handling, labor, installation costs, overhead, profit and other expenses contemplated shall not be deducted from the Allowance but shall be included in the Contract Price.

1.04 FIELD MEASUREMENT FOR PAYMENT

- A. VTA will verify the computed quantities of work performed and submitted by the Contractor, and of materials and equipment delivered to the site, for payment purposes.
- B. The Contractor shall assist VTA in the taking of measurements by providing all equipment, workers, and survey crews as required to measure quantities in accordance with the provisions for measurement specified herein. Unless otherwise specified, all quantities shall be calculated using dimensions shown on the Contract Plans. No allowance will be made for specified tolerances.

1.05 REJECTED, EXCESS, OR WASTED MATERIAL

- A. Quantities of material wasted or disposed of in a manner not called for under the Contract; rejected loads of material, including material rejected after it has been placed by reasons of the failure of the Contractor to conform to the provisions of the Contract; material not unloaded from the transporting vehicle; material placed outside the lines indicated on the Contract Plans or established by VTA; or material remaining on hand after completion of the work, will not be paid for, and such quantities shall not be included in the final total quantities. No additional compensation will be permitted for loading, hauling, and disposing of rejected material.

1.06 SCOPE OF PAYMENT

- A. The contract lump sum and unit prices paid for the various items and classifications of work shall include full compensation for furnishing all labor, materials, tools, equipment, transportation, services, and incidentals as specified in Section 7.56, Compensation, of the General Conditions, and for performing all work necessary for completing the construction or installation of the item or work classification, unless stated otherwise.

1.07 MEASUREMENT AND PAYMENT

- A. Full compensation for conforming to the requirements of this Section involving measurement and payment shall be considered as included in the contract prices paid for the various contract items of work involved and no additional compensation will be allowed therefore.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 20 00

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SECTION 01 42 00

REFERENCE STANDARDS, ABBREVIATIONS AND DEFINITIONS

PART 1 – GENERAL

1.01 SUMMARY

- A. The Section identifies and describes associations, agencies, and other organizations that may be addressed or referenced in the Specifications and specifies the requirements for their contractual application.
- B. Abbreviations, acronyms and definitions applicable to the specifications are also included.

1.02 REFERENCE STANDARDS

- A. When reference is made to codes, regulations, reference standards and specifications, perform work conforming to the edition in effect on the day the Notice to Bidders is dated except as otherwise noted.
- B. References are made to recognized standards by use of the acronyms listed below. Addresses are included for the convenience of Contractor, and the accuracy is not warranted by VTA.

AAR	Association of American Railroads
AASHTO	American Association of State Highway & Transportation Officials 341 National Press Building Washington, DC 20004
ACI	American Concrete Institute Box 19150 Redford Station Detroit, MI 48219
ACIL	American Council of Independent Laboratories 1725 K Street, NW Washington, DC 20006
ACP	American Concrete Pipe Association 8320 Old Courthouse Rd. Vienna, VA 22180
ADAAG	Americans with Disabilities Act Accessibility Guidelines Architectural and Transportation Barriers Compliance Board 1111 18th Street, NW, Suite 501 Washington, DC 20036
AI	The Asphalt Institute Asphalt Institute Building College Park, MD 20740
AISC	American Institute of Steel Construction

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	1221 Avenue of the Americas New York, NY 10020
AISI	American Iron and Steel Institute 150 East 42nd Street New York, NY 10017
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018
AOAC	Association of Official Analytical Chemists Box 540, Benjamin Franklin Station Washington, DC 20044
APTA	American Public Transit Association Suite 200 1225 Connecticut Ave., N.W. Washington, DC 20036
AREMA	American Railway Engineering and Maintenance of Way 8201 Corporate Drive, Suite 1125 Landover, MD 20785-2230
ASNT	American Society for Non-Destructive Testing, Inc. 4153 Arlingate Plaza Columbus, OH 43228-0518
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
AWPA	American Wood-Preservers' Association 1625 Eye Street, NW Washington, DC 20006
AWPB	American Wood Preservers Bureau 2772 S. Randolph Street Arlington, VA 22206
AWPI	American Wood Preservers Institute 1641 Old Meadow Road McLean, VA 22101
AWS	American Welding Society, Inc. 2501 NW 7th Street Miami, FL 33125
AWWA	American Water Works Association 6666 W. Quincy Avenue Denver, CO 80235

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BIA	Brick Institute of America 1750 Old Meadow Road McLean, VA 22101
CCR	California Code of Regulations
Cal/OSHA	Title 8, Industrial Relations
Caltrans	California Department of Transportation Publication Distribution Unit 1900 Royal Oaks Drive Sacramento, CA 95819
CBC	California Building Code, Title 24 California Building Standards Commission 428 J Street, Suite 450 Sacramento, CA 95814
CE	Corps of Engineers (U. S. Dept. of the Army) Washington, DC 20315
CRSI	Concrete Reinforcing Steel Institute 228 North LaSalle Street Chicago, IL 60601
EIA	Electronic Industries Association 2500 Wilson Boulevard Arlington, VA 22201-3834
FS	Federal Specifications 5801 Tabor Ave. Philadelphia, PA 19120
IPCEA	Insulated Power, Cable Engineering Association 192 Washington Street Belmont, MA 02178
IEEE	Institute of Electrical and Electronics Engineers, Inc. 345 E. 47th. St. New York, NY 10017
IE	Illuminating Engineer Society (Same as IEEE)
ITE	Institute of Transportation Engineers 525 School Street N.W. Washington, DC
MSS	Manufacturers Standardization Society of Valve and Fittings

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	1815 N. Ft. Myers Dr. Arlington, VA 22209
NACE	National Association of Corrosion Engineers Box 1499 Houston, TX 77001
NCMA	National Concrete Masonry Association 6845 Elm Street McLean, VA 22101
NCPWB	National Certified Pipe Welding Bureau 5530 Wisconsin Ave, Suite 750 Washington, DC
NEC	National Electrical Code by NFPA
NEMA	National Electrical Manufacturers Association 55 East 44th Street New York, NY 10017
NFPA	National Fire Protection Association Battery March Park Quincy, MA 02269
NRCA	National Roofing Contractors Association 1515 North Harlem Oak Park, IL 60302
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration 555 Griffin Square Building Dallas, TX 75202
PCA	Portland Cement Association Old Orchard Road Skokie, IL 60076
PCI	Prestressed Concrete Institute 20 North Wacker Drive Chicago, IL 60606
RTA	Railway Tie Association 314 North Broadway St. Louis, MO 63102
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council 4400 5th Avenue

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	Pittsburgh, PA 15213
TIA	Telecommunications Industry Association
UL	Underwriters' Laboratories, Inc. 207 East Ohio Street Chicago, IL 60615
WCLIB	West Coast Lumber Inspection Bureau P.O. Box 25406 Portland, OR 97225

1.03 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

Ac.	Acre
ADA	Americans with Disabilities Act.
AWG	American Wire Gauge.
CCTV	Closed Circuit Television.
CF	Cubic foot or cubic feet
CSJ	City of San Jose
CY	Cubic yard or cubic yards.
dBa	Adjusted-weighted noise power in dB referred to -85 dBm.
DBm	dB referred to 1 milliwatt.
°C	degree Celsius
FTA	Federal Transit Administration, United States Department of Transportation.
FT/ft.	Foot or feet.
ft. ²	Square foot or feet
ft. ³	Cubic foot or feet
Gal.	Gallon
Hz	Hertz (cycles per second).
IN/in.	Inch or inches.

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I/O	Input/Output.
LF	Linear foot
LRT	Light rail transit.
LRV	Light rail vehicle.
LS	Lump sum
Lux	Lumen/m
Mbps	Megabits per second.
Mg	Megagram
MN	Meganewton
MPa	Megapascal
MT	Maintenance telephone.
NIC	Not in Contract.
NTP	Notice to Proceed.
OCC	Operations Control Center.
PacBell	Pacific Bell Telephone
PA	Public Address.
PCM	Pulse Code Modulation.
RH	Relative Humidity.
Rms	Root mean square.
RS-232	Electrical Standard for Balanced Voltage Digital Circuits.
RS-485	Standard for Data Communication Equipment.
RTU	Remote Terminal Unit.
SAV	Stand-Alone Validator.
SCC	Santa Clara County
SCADA	Supervisory Control and Data Acquisition System.
SCCTA	Santa Clara County Transportation Agency.

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SCCTD	Santa Clara County Transit District.
SCVTA	Santa Clara valley Transportation Authority
SF	Square foot
T1	PCM Carrier System, 24 voice channels, 1.544 Mbps.
TVM	Ticket Vending Machine.
VMB	Visual Message Board.
VTA	See SCVTA

B. Electrical and Signal Abbreviations – Wherever in these Contract Documents these abbreviations are used, the intent and meaning shall be as follows:

Amp	Ampere
ABS	Automatic Block System
AC	Alternating Current
AFO	Audio Frequency Overlay
AH	Ampere hours
BAT	Battery
BER	Bit Error rate
BIL	Basic Impulse level
BKR	Breaker
C	Conduit/Conductor
CHGR	Charger
CKT	Circuit
CO	Conduit Only with pull wire
CONN	Connection
CSD	Combined System Duct
CTRLR	Controller
Cu	Copper

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DC	Direct Current
EPR	Ethylene propylene rubber
ETFE	Ethylene Tetrafluoroethylene
FUT	Future
GFCI	Ground fault circuit interrupter
GND	Ground
Hz	Hertz (cycles per second)
IJ	Insulated Rail Joint
INSUL	Insulated
INT	Interface
JB	Junction Box
kcmil	Thousands of circular mils (formerly MCM)
kV	Thousand volts
L	Inductance
LED	Light Emitting diode
LIU	Line Interface unit
LTG	Lightning
MBS	Manual Block System
megohms	one million ohms
MH	Manhole
MP	Mile Post
NEG	Negative
NC	Normally Closed
NO	Normally Open
NR	Negative Return

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OCS	Overhead Contact System
PB	Pull Box
POS	Positive
PWR	Power
R	Resistance
X	Receiver
sec	Seconds
SIG	Signal
STR	Stranded
SW	Switch
TB	Terminal Block
TES	Traction Electrification System
T.O.	Turn Out
TPSS	Traction Power Substation
TWC	Train-to-Wayside communications
TX	Transmitter
UPS	Uninterruptible power supply
VA	Volt-Ampere.
VAC	Volts, Alternating Current.
VDC	Volts, Direct Current.
W	Watt(s).

C. General Definitions: Additional definitions are included below and elsewhere in the technical specifications.

1. **Ballast:** Integral part of the track structure, generally composed of graded crushed stone in which ties are embedded.
2. **Caltrans Standard Plans:** Standard Plans of the State of California, Department of Transportation, dated July 2018.

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3. **Caltrans Standard Specifications:** The Standard Specifications of the State of California, Department of Transportation, dated July 2018.
4. **City Standard Details:** The Standard Details of the City of San Jose dated July, 1992 with addenda.
5. **City Standard Specifications:** The Standard Specifications of the City of San Jose dated July, 1992 with addenda.
6. **County Standard Details:** The Standard Details Manual of the Santa Clara County Roads and Airports dated September 1997, with Standard Details Amendments dated June 30, 2014.
7. **County Standard Specifications:** The Standard Specifications of the Santa Clara County Roads and Airports dated May 2000, with Standard Specifications Amendments dated January 7, 2011.
8. **District:** Santa Clara Valley Transportation Authority. (Note: The abbreviations VTA, SCVTA, SCCTD and SCCTA all refer to District.)
9. **Drawings:** Plans, Contract Drawings.
10. **Engineer:** VTA's Authorized Representative.
11. **Laboratory:** The Materials & Research Testing Laboratory of the County of Santa Clara, or other laboratories authorized by VTA to test materials and work involved in the Contract.
12. **Pavement:** The uppermost layer of material placed on the traveled way or shoulders. This term is used interchangeably with surfacing.
13. **Plans:** The plans, profiles, cross sections, and drawings, or reproductions thereof, approved by the Engineer, including approved Change Orders, showing the location, character, dimensions, and details of the Work.
14. **Roadway:** The right-of-way or areas reserved and secured for construction of sidewalks, curbs, slopes, ditches, channels, roads, shoulders, and appurtenances.
15. **Special Provisions:** Technical Specifications.
16. **State:** As used in the Standard Specifications, shall be interpreted to mean VTA.
17. **Subballast:** Material superior in composition to the subgrade material which provides a semi-imperious layer between the track ballast and the subgrade to facilitate better drainage and distribution of loads to subgrade..
18. **Subcontractor:** A person, firm, partnership, joint venture, or corporation having a direct contract with the Contractor and not with VTA, for performing work or labor, specially fabricating and installing a portion of the work, or rendering services to the Contractor.

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19. **Subgrade:** That portion of the undisturbed roadway, trackway or station platform on which Pavement, Surfacing, Base, Subbase, Ballast, Subballast, or a layer of any other material is placed.
20. **Surfacing:** The uppermost layer of material placed on the traveled way or shoulders. This term is used interchangeably with pavement
21. **Technical Specifications:** Section 8 of the Contract Documents. Reference to the Technical Specifications shall by definition include reference to other portions of the Contract Documents including Section 4 Contract Forms and Prices, Section 7 General Conditions and Section 6 Special Conditions.
22. **Track:** The two rails, crossties, ballast, and appurtenances in ballasted sections; or the two rails, concrete slab, and appurtenances in embedded sections.
23. **Trackway:** The right-of-way or areas secured for construction of tracks and appurtenances.
24. **Work:** The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction, all in accordance with the terms of the Contract Documents.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

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SECTION 01 43 26

INTEGRATED START-UP TESTING AND INSPECTING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for providing project testing and inspection.

1.02 RELATED SECTIONS

- A. Section 6, Special Conditions

1.03 SUBMITTALS

1.04 MEASUREMENT AND PAYMENT

- A. Measurement:

1. Integrated Start-Up and Testing and Inspection shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.

- B. Payment:

1. The lump sum payment for Integrated Start-Up and Testing and Inspection shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in providing integrated start up, system testing and rail activation, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

PART 2 – PRODUCTS

PART 3 – EXECUTION

END OF SECTION 01 43 26

**SPECIFICATION NEEDS FURTHER
COORDINATION WITH VTA PRIOR TO
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SECTION 01 51 36

WATERING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for developing a water supply, furnishing and applying water as necessary for the Work.

1.02 REFERENCE STANDARDS

- A. State of California, Department of Transportation (Caltrans), Standard Specifications:
 - 1. Section 10-6, Watering

1.03 MEASUREMENT AND PAYMENT

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection therewith will be considered incidental to the item of work to which they pertain.

PART 2 – PRODUCTS

2.01 DEVELOP WATER SUPPLY

- A. Develop water supply shall conform to the requirements of Section 10-6, Watering, of the Caltrans Standard Specifications, and these technical specifications.

2.02 RECLAIMED WATER

- A. If reclaimed waste water is developed for use on the project, it shall meet the California Department of Health Services water reclamation criteria and the Regional Water Quality Control Board requirements. Contractor shall obtain either a waste water discharge permit or a waiver from the Regional Water Quality Control Board. Copies of permits or waivers from the Regional Water Quality Control Board for sources not listed in the "Materials Information" shall be delivered to VTA before using reclaimed waste water on the Work.
- B. The work shall comply with City of San Jose Use of Reclaimed Water Ordinance.
- C. Nonpotable water used in the mixing and curing of concrete shall not change the setting time of Portland cement more than 25 percent or a reduction in the mortar strength of 5 percent at 14 days or cause the concrete to discolor or etch the surface.
- D. Nonpotable water shall not be conveyed in tanks or drain pipes which will be used to convey potable water. There shall be no connection between nonpotable water supplies and potable water supplies. Nonpotable water supply, tanks, pipes, and all other conveyances of nonpotable water shall be labeled:

NONPOTABLE WATER

DO NOT DRINK

PART 3 – EXECUTION

3.01 GENERAL

- A. Water for compacting embankment material, subbase, base and surfacing material and for controlling dust shall be applied by means of pressure-type distributors or pipe lines with a spray system that will ensure a uniform application of water. Either means used shall have a positive means of shut-off.

END OF SECTION 01 51 36

SECTION 01 52 00
CONSTRUCTION FACILITIES

PART 1 – GENERAL

1.01 SUMMARY

- A. This contract includes but is not limited to the following work:
 - 1. Temporary sanitary facilities
 - 2. Engineer's field office
 - 3. Contractor's field office
 - 4. Storage and parking areas
 - 5. Enclosed storage and shops
 - 6. Protective barricades and safety precautions
 - 7. Temporary fencing
 - 8. Security

1.02 RELATED SECTIONS

- A. Section 6.16, Contractor Safety and Light Rail Transit Operations, of the Special Conditions
- B. Section 7.34, Contractor's Work Area, of the General Conditions
- C. Section 7.35, Temporary Construction Facilities and Utilities, of the General Conditions
- D. Section 7.39, Cooperation/Coordination and Work by Others, of the General Conditions
- E. Section 7.45, Protection and Restoration of Property, of the General Conditions
- F. Section 7.52, Protection of Completed Portions of Work, of the General Conditions
- G. Section 01 57 23 - Temporary Storm Water Pollution Controls
- H. Section 32 31 13 - Chain Link Fences, Railing and Gates

1.03 SUBMITTALS

- A. Contractor will submit:
 - 1. General arrangement and layout drawings showing arrangement of all temporary facilities including all offices, parking, material storage areas, and material laydown areas.

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2. Detailed drawings of the Engineer's Office.
3. Catalog cuts and product literature for Engineer's Office.

1.04 MEASUREMENT AND PAYMENT

- A. Measurement: Construction Facilities shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Construction Facilities shall include full compensation for the various contract items of work described in this section and no additional compensation will be allowed therefore.

1.05 GOVERNING LAWS

- A. Temporary facilities will be in compliance with applicable federal, state, and local utility laws, rules, and regulations. Nothing in these Contract Documents will be construed to permit work not conforming to such codes and regulations.

1.06 TEMPORARY SANITARY FACILITIES

- A. Provide adequate temporary toilet conveniences, washing facilities, and drinking water for the use of all employees and persons engaged on or about the Work, including Subcontractors and their employees. Drinking water will be potable, and drinking water facilities will be clean and sanitary.
- B. Locate sanitary facilities where approved by authorities having jurisdiction and maintain in a clean and sanitary condition during the course of the Work. Include a secondary containment pan under each sanitary sewer facility in conformance with the project's SWPPP requirements. Keep such facilities adequately supplied with toilet paper, paper toweling, paper cups, and related supplies as required.
- C. At completion of the Work, sanitary facilities will be properly disinfected and all evidence of same removed from the site.

1.07 ENGINEER'S FIELD OFFICE

- A. Requirements:
 1. Provide mobile units or temporary buildings, with water, sanitary facilities, electrical power, and parking facilities, hereinafter called the "Engineer's field office," for use of the Engineer and VTA representatives in administering the Contract. The Engineer's field office will be situated in the work area at a location approved by the Engineer, adjacent to the Contractor's field office. The Engineer's field office will be completely furnished and ready for occupancy by the VTA within 10 days after the effective date of the Notice to Proceed.
 2. The Engineer's field office will be maintained and serviced by the Contractor, as herein specified, until the final invoice has been submitted by the Contractor and approved by the VTA. The Contractor will then remove or dispose of the field office off the site at Contractor's expense.

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3. Mobile units will have all the features specified herein. If the Contractor elects to provide a building or buildings in lieu of mobile units, the buildings will conform to local building codes and will have the basic features specified herein, with substitute materials allowable subject to approval of the Engineer.

- B. Contractor shall obtain and pay all costs for hauling, building, and connection permits. The Contractor shall provide the office within 10 days after the effective date of the Notice to Proceed, as identified in the approved baseline schedule, and shall be maintained continuously to no less than 21 days after the final acceptance of the project, unless otherwise directed by the Engineer.

- C. The office shall be located onsite, and access to a field office trailer shall be available by a minimum 15 feet wide all weather driveway to the nearest paved roadway. The access roadway and parking area will be graded for drainage and surfaced with six inches of aggregate base over tensile fabric in an approved manner.

- D. Provide and maintain in the site vicinity all-weather parking for a minimum of 5 vehicles of pick-up truck size.

- E. The Contractor shall maintain the field office in good and acceptable appearance and shall provide daily cleaning service and constant maintenance and replenishment of paper towels paper cups, soap, toilet paper, and bottled water service.

- F. All materials will be good commercial quality. Provide a trailer-type mobile structure, 12 feet by 60 feet, as manufactured by Porta House Mobiles, Gelco Space Mobiles, Mobile Modular, or approved equal with the following features:
 1. All metal frame
 2. Metal or wood exterior, sides and roof
 3. Insulated double walls, floor and roof
 4. Acoustic tile ceiling
 5. Openings: at least 8 windows fitted with insect screens, blinds, and security screens and 2 entrance doors
 6. Self-contained, built-in electric heater with central air-conditioning unit capable of automatically maintaining an office temperature of 70 degrees F within a range of outside shade temperatures between 25 and 90.
 7. Water heater
 8. Fluorescent ceiling lights to provide 100 foot-candles at desk height and fifteen 100 volts AC duplex receptacles
 9. Exterior lighting over entrance doors of at least 100 watts with flood light type fixtures
 10. Minimum interior ceiling height of 8 feet
 11. Railed metal or wood stairway to entrances

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12. Railed metal or wood wheelchair ramp to entrances
 13. Entrance doors with cylinder locks and 5 sets of keys
 14. Floor plan shall include two 12' X 12' offices, common area, 5' long counter top with upper and lower cabinets, and restroom with water supply. Engineer to approve actual floor plan before ordering the field office facility
 15. Full perimeter skirting
 16. Exterior and interior surfaces, other than factory finished, painted with two coats of an approved paint of a color or colors approved by the Engineer. No painting will be required on aluminum or stainless steel surfaces
 17. Interior walls and ceilings paneled with finished plywood or gypsum wallboard of not less than one-half inch thickness, or other suitable material.
 18. Floors covered with resilient flooring material such as vinyl composition tile or sheet vinyl flooring. Floors will be constructed to withstand a live load of 50 psf.
 19. Two rest rooms minimum, each with lavatory, water closet, mirror, soap holder, toilet paper holder, and paper towel dispenser. Provide one rest room (men's) with urinal. Both rest rooms will comply with State and Federal accessibility requirements. Water supply connection shall be from a connection to a domestic water service, and water closets may be self-contained, flushing chemical units. Lavatory, urinal, and water closet waste may drain into a self- contained holding tank.
 20. Entrance doors will comply with applicable State and Federal accessibility requirements.
 21. Lighting of 100 foot-candles minimum at desk height uniformly in all areas except rest rooms. Provide rest rooms with adequate lighting.
 22. Duplex electrical receptacles around interior walls and exterior walls at an approximate spacing of 10 feet on center.
 23. An automatically controlled fire sprinkler system.
 24. An automatically controlled heating/cooling system.\
- G. Furnishings: At a minimum, provide the following furnishings:
1. Four 30"X60" office desks with 6 drawers (2 with locks) and padded, upholstered swivel chairs
 2. One drafting table not less than 36"X60"
 3. Two metal drafting stools with back rests
 4. One supply cabinet with not less than 15 square feet of shelf space\
 5. Two 1'X3'X6' high bookcases

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6. One bottled water dispenser that provides hot and cold water, including continuous bottled water supply
 7. One 12-cup coffee maker
 8. One full size refrigerator, 8.0 cf min.
 9. Four personal wastebaskets
 10. Two paper recycling bins
 11. Two 3’X4’ dry erase boards
 12. One coat rack
 13. One conference room table large enough to accommodate ten chairs
 14. Ten conference room chairs.
- H. Equipment: Equipment furnished shall be standard quality and new, or like-new in appearance and function. At a minimum provide the following equipment:
1. One digital photo copier/printer/scanner, Savin 8030P or approved equal. The Contractor shall obtain and pay for a service contract with local representative of the photo copying machine vendor or manufacturer for availability of a service representative to perform on-site service and repair.
 2. A copy of the service contract shall be furnished to the Engineer upon delivery of the copying machine at the site.
 3. A 24”X36” plotter.
- I. Utilities: Provide all required utilities and make all utility hook-ups, including water, power, sewer, telephone and FAX machine (separate telephone lines), unlimited High speed internet service (fiber optic if available in the area), and pay all charges associated therewith. ,telephone and facsimile (FAX) service, and electrical utility connections as required.
- J. Services: Provide maintenance, utility, and janitorial services throughout the specified period as follows:
1. Repair and daily cleaning of the field office, parking, and access area.
 2. The furnishing of drinking water, paper cups and towels, toilet paper, light bulbs, and such other basic necessities required for the operation and maintenance of the field office. For mobile units with holding tanks, provide periodic removal of waste material and cleaning of holding tank as required. Provide self-contained water storage tank with fresh, potable water as required. Refill when tank is down to 1/4 full.
 3. Provide security measures and area protection equivalent to that used by the Contractor for the Contractor's Worksite shop and field office facilities.

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4. Provide services for utilities, including monthly charges, account fees, service charges, connection fees and deposits. Telephone service will include long distance costs.

1.08 CONTRACTOR'S FIELD OFFICE

- A. The Contractor will provide and maintain, in good condition, on the site or near the site as approved by the Engineer, a temporary field office of suitable size for construction administrative operations and consultations with representatives of the VTA.
- B. The Contractor's field office will contain a complete set of Contract Documents.
- C. The Contractor will make arrangements and pay all costs, including service and toll charges, until Substantial Completion of the Work, for temporary telephone service in the temporary field office, for use by the Contractor and Subcontractors, for purposes related to the Work.

1.09 STORAGE AND PARKING AREAS

- A. The Contract Drawings may indicate work areas available to the Contractor for storage of materials and for parking of construction equipment. If so indicated, these areas will be provided to the Contractor for the durations indicated in the Contract documents. Additional work and storage space, if required, will be provided by the Contractor at Contractor's expense.
- B. The Contractor will provide parking facilities for the Contractor's personnel, Subcontractors, supplier's delivery vehicles, and authorized visitors. Off-site parking facilities (if any) will not impair or interfere with existing community parking and traffic conditions, regulations, and restrictions.

1.10 ENCLOSED STORAGE AND SHOPS

- A. The Contractor will provide all temporary storage and shop rooms that may be required at the Worksite for safe and proper storage of tools, materials, and equipment. Construct such rooms only in locations indicated or as approved by the Engineer, and so as not to interfere with the proper installation and completion of other work.
- B. Remove such rooms within three days of receipt of notices from the Engineer that removal is necessary, and incur all expenses for such removal.
- C. Storage of gasoline or similar fuels will conform to NFPA regulations and local fire department regulations and will be confined within definite boundaries apart from buildings as approved by the Engineer and the City of San Jose fire marshal.

1.11 PROTECTIVE BARRICADES AND SAFETY PRECAUTIONS

- A. Construct and maintain barricades, lights, shoring, and warning signs as required by Federal and State safety ordinances and as required to protect VTA, County or City property from injury or loss and as necessary for the protection of the public and adjacent properties. Provide walks around obstructions made in a public place for persecuting the Work. Leave all protection in place and maintain until removal is authorized.

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- B. Guard and protect all workers, pedestrians, and the public from excavations, construction equipment, obstructions, and other dangers with adequate railings, guard rails, temporary walks, barricades, warning signs, directional signs, overhead protection, planking, decking, danger lights, and other suitable safeguards.
- C. Flaggers will be provided to direct or divert pedestrian or vehicular traffic when necessary as specified in Section 01 57 23 - Temporary Storm Water Pollution Controls.

1.12 TEMPORARY FENCING

- A. The Contractor will furnish, construct, maintain, and later remove temporary fencing around the Worksite perimeter as indicated.
- B. Except as otherwise specified herein, temporary fencing will conform to Section 32 31 13 - Chain Link Fences, Railings and Gates.
- C. Used materials may be employed for temporary fencing, provided such used materials are good, sound, and are suitable for the purpose intended.
- D. Fencing materials may be commercial quality, provided the dimensions and sizes of said materials are equal to, or greater than, the dimensions and sizes indicated in Section 32 31 13 - Chain Link Fences, Railings and Gates. Additional fencing options include the following:
 - 1. Posts may be either metal or wood.
 - 2. Galvanizing and painting of steel items will not be required.
 - 3. Treating wood with wood preservatives will not be required.\
 - 4. Concrete footings for metal posts will not be required, except where portable footings are required for temporary anchorage of posts.
- E. Temporary fencing that is damaged from any cause during the progress of the Work will be repaired or replaced by the Contractor at no additional cost to the VTA.
- F. When no longer required for the Work, temporary fencing will be removed. Removed fencing and related materials will become the property of the Contractor and will be removed from the Worksite, except as otherwise provided herein.
- G. Holes caused by the removal of temporary fences will be properly filled to match adjacent surfaces.

1.13 TEMPORARY ACCESS FACILITIES

- A. Contractor will construct, maintain, and later remove temporary access facilities as required by Engineer.
- B. All areas affected by the Contractor-constructed temporary facilities will be restored to their original condition upon removal of temporary facilities, as required by Engineer.

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1.14 SECURITY

- A. Provide such watchmen, patrols, fencing, alarm system and other security means as required to adequately protect the work and to protect materials and equipment stored at the site of the work and elsewhere, and to protect the interests of the Contractor, the VTA, and all parties having such interest, until completion of the work and its Acceptance of the Work by the VTA.
- B. Storage areas will be suitably fenced and lighted and routinely patrolled by security guards.
- C. The VTA assumes no responsibility for protection of structures and finished work or for loss of materials and equipment from the time that Contract operations have commenced until Acceptance of the Work.
- D. If watchman service is deemed necessary by the Contractor, such protection will be provided by the Contractor, and all costs therefore will be paid for by the Contractor.
- E. Damaged, lost, or stolen materials and equipment, whether or not stored or already installed, will be replaced by the Contractor with new specified materials and equipment, including reinstallation where applicable, at no additional cost to the VTA.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 CLOSEOUT

- A. Upon completion of the Work, or prior thereto when required by the Engineer, remove temporary facilities' structures and installations from the VTA's, County's and City's property.
- B. Return exterior areas utilized for temporary facilities to their original, natural state or, when called for on the Contract Documents, complete such areas as indicated.

END OF SECTION 01 52 00

SECTION 01 55 24

CONSTRUCTION AREA SIGNS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing construction area signs and removal of signs following completion of the Work.
- B. The Contractor shall furnish and install construction area signs as shown on the plans to provide for advance warning and for the safety of the traveling public.
- C. When Contractor's operations (including storage of materials, equipment, or earthwork) obstruct business signage from the public for more than 4 hours or interfere with business access, Contractor shall propose adequate, temporary signage subject to approval by the VTA and shall furnish, install, maintain, and eventually remove the temporary signs when, in the opinion of the VTA, they are no longer needed.
- D. Traffic control working drawings, submitted under Section 01 55 26, Traffic Control, shall include construction area signage for motorist and pedestrian safety in accordance with Section 01 55 26, Traffic Control, and jurisdictional requirements. Traffic control drawings shall also include construction area signage for business access.
- E. All construction area signs and traffic control drawings shall be approved by Santa Clara County through the encroachment permit process prior to implementation in the field.

1.02 RELATED SECTIONS

- A. Section 01 55 26, Traffic Control

1.03 REFERENCE STANDARDS

- B. State of California, Department of Transportation (Caltrans), Standard Specifications:
 - 1. Section 12, Temporary Traffic Control
 - 2. Section 82, Signs and Markers

1.04 MEASUREMENT AND PAYMENT

- A. Full compensation for providing furnishing, erecting, maintaining, and removing any additional construction area signs including temporary business signage and additional signage that the Contractor may deem necessary shall be considered as included in the bid item for TRAFFIC CONTROL and no additional compensation will be allowed therefor.

PART 2 – PRODUCTS

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2.01 MATERIALS

- A. Furnish construction area signs in accordance with the provisions in Section 12, "Temporary Traffic Control," of the Standard Specifications and these technical specifications.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Construction area signs shall be placed as shown on the contract plans, the traffic control drawings and where determined necessary by the VTA.
- B. If discrepancies exist between actual field conditions and conditions shown on the Plans, the Contractor shall make necessary adjustments to the layout of to make system workable as shown on the Plans and as approved by the VTA.
- C. Excavate post holes by hand, except power equipment may be used if it is determined that there are no utility facilities in the area of the proposed post holes.
- D. Construction area signs shall be installed, maintained, and removed when no longer required in accordance with the provisions in Section 12, Temporary Traffic Control, of the Caltrans Standard Specifications and these technical specifications.

3.02 MAINTENANCE

- A. Signs shall be kept clean and in good repair by the Contractor.
- B. Contractor shall cover construction area signs when no longer appropriate for the conveyance of vehicular and pedestrian traffic through the work area as directed by the VTA and City.
- C. Contractor shall remove and replace with new signs damaged or unreadable signs within 48 hours as directed by the VTA, County, and City.

3.03 REMOVAL

- A. Upon completion of work under the contract, construction area signs shall become the property of Contractor.
- B. Remove construction area signs when directed by the VTA.
- C. Repair holes and damage caused by placement of construction area signs.

END OF SECTION 01 55 24

SECTION 01 55 25

SIGNING AND DELINEATION MATERIALS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes list of signing and delineation materials which have been prequalified and tested by the California State Department of Transportation (Caltrans).
- B. Approval of these materials does not preclude the VTA from sampling and testing any of the signing and delineation materials or products at any time.
- C. None of the signing and delineation materials and products listed below shall be used in the work unless such material or product is listed on the VTA's List of Approved Traffic Products.
 - 1. Temporary pavement markers
 - 2. Striping and pavement marking tape
 - 3. Pavement markers, reflective and non-reflective
 - 4. Flexible Class 1 delineators and channelizers
 - 5. Railing and barrier delineators
 - 6. Sign sheeting and base materials
 - 7. Reflective sheeting for barricades
 - 8. Reflective sheeting for channelizers
 - 9. Reflective sheeting for markers and delineators
 - 10. Reflective sheeting for traffic cone sleeves
 - 11. Reflective sheeting for barrels and drums

1.02 RELATED SECTIONS

- A. Section 01 55 26, Traffic Control
- B. Section 32 17 24 Traffic Stripes, Pavement Markings, and Pavement Markers

1.03 SUBMITTALS

- A. Submit a Certificate of Compliance as specified in the Caltrans Standard Specification for each signing and delineation material and product. Said certificate shall also certify that the signing and delineation

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material or product conforms to the prequalified testing and approval of the VTA and was manufactured in accordance with the approved quality control program

- B. Submittals for Addition to VTA's List: Materials and products will be considered for addition to said approved prequalified and tested list if the manufacturer of the material or product submits to the VTA a sample of the material or product. The sample shall be sufficient to permit performance of all required tests. Approval of such materials products will be dependent upon a determination as to compliance with the specifications and any test the VTA may elect to perform

1.04 MEASUREMENT AND PAYMENT

- A. Full compensation for all work under this Section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefore.

PART 2 – PRODUCTS

2.01 LIST

- A. Signing and delineation materials shall conform to the requirements of the Standard Specifications, and shall be on the Caltrans Authorized Materials List for signing and delineation materials and products.

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 55 25

In Progress-Not For Review

SECTION 01 55 26

TRAFFIC CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes requirements for providing temporary traffic control and detour plans, obtaining applicable permits, complying with local jurisdictional agency requirements, adapting the traffic control and detour plans to changing conditions, and providing temporary pedestrian facilities.
- B. This Section includes requirements for flagging and traffic handling equipment and devices for use by Contractor in discharging its responsibilities for convenience of the public and public traffic.
- C. This Section includes requirements for steel plating of trenches and other depressions in areas in or adjacent to public traffic.
- D. Providing temporary traffic control devices includes installing, placing, maintaining, repairing, replacing, and removing temporary traffic control devices.

1.02 RELATED SECTIONS

- A. Section 01 12 16, Work Sequence and Constraints
- B. Section 01 55 24, Construction Area Signs
- C. Section 03 11 14 Falsework
- D. Section 10 14 53, Roadway Signage
- E. Section 34 41 13, Traffic Signals

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI):
 - 1. California Manual of Uniform Traffic Control Devices (CA MUTCD).
- B. State of California, Department of Transportation (Caltrans), Standard Specifications:
 - 1. Section 12 Temporary Traffic Control.
 - 2. Section 15 Existing Facilities.

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- 3. Section 81-3 Pavement Markers
- 4. Section 82 Signs and Markers.
- 5. Section 84 Markings
- C. City of San Jose, Department of Public Works, Standard Specifications:
 - 1. Section 12 Construction Area Traffic Control Devices
- D. County of Santa Clara Standard Specifications, May 2000 and Amended January 7, 2011.
 - 1. Section 7-22 Public Convenience and Public Safety
 - 2. Section 12 Construction Area Traffic Control Devices

1.04 SUBMITTALS

- A. Contractor shall submit traffic control working plans for each staged activity or detour that requires re-routing of traffic, including re-routing of pedestrian and bicycle traffic or a lane closure to VTA for review and appropriate action. These working drawings shall be submitted no less than 25 working days before performing the staged activity or detour that affects the traffic flow. The construction dates shall be in accordance with the approved construction schedule. Include haul routes and provisions for access to and egress from medians. Include construction area signage and signage for business access on traffic control working drawings.
 - 1. VTA reserves the option to revise the drawings as deemed necessary to comply with site specific conditions. Contractor shall not detour traffic or interfere with the normal flow of traffic until Contractor's detour and traffic control plans are approved by VTA.
 - 2. Traffic control drawings not relieve Contractor from submitting traffic control working plans for approval as specified herein.
- B. Steel Plating: Submit working drawings showing layout of steel plating for the intersections including detailing showing how plates are prevented from shifting, the means taken to ensure bicycle safety, and the protection of existing paving to remain. Submit any requests for exceptions to the requirements specified herein for steel plating to VTA in writing. For steel plates spanning more than 4 feet, submit structural design prepared and signed by a civil engineer currently registered in the State of California.

1.05 SYSTEM DESCRIPTION

- A. A traffic control system shall consist of all flagging, traffic control submittals, construction traffic control devices, in accordance with the requirements of the local jurisdiction.
- B. Attention is directed to Section 7-1.03, Public Convenience, and Section 12, Temporary Traffic Control, of the Caltrans Standard Specifications, and Section 7.22.01, Public Convenience, of the County Standard Specifications and these Technical Specifications. Contractor shall maintain property and pedestrian access and bicycle routes at all times.
- C. Contractor shall be responsible for obtaining approvals and permits for traffic control plan, including temporary and interim traffic signals, closure of part or all roads or streets, and diversion of traffic.

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Such approval shall be obtained from VTA and Santa Clara County. Necessary submittals and approvals shall be shown in Contractor's Progress Schedule, with time allowances for submittals, resubmittals, and approvals.

- D. Detour Plans: Traffic control working drawings shall include detour Plans indicating the following:
1. The extent and configuration of traffic pattern changes, including beginning and completion dates of the work and duration of temporary and interim traffic control.
 2. The means and devices for traffic control, including:
 - a. Details of temporary signal operation
 - b. Details of type and locations of signs, portable changeable message signs, arrow boards, striping, markers, barriers, delineators, and other devices.
 3. Description of the work, time required for roadway closure and detours, method of roadway repairs and paving conforms before opening, and required construction area signs.
 4. Haul routes and ingress to and egress from medians.
- E. Traffic control working drawings submitted by Contractor shall include specific details for transportation of materials and equipment to and from the Worksite. These details shall include haul routes and times, ingress/egress locations, methods of delivery, and traffic control measures to be taken to provide safe ingress/egress without disruption to the traveling public. These delivery plans are required for each traffic stage and delivery location. Deliveries requiring a lane closure are not allowed during peak traffic hours which are from 6:00 AM to 9:00 AM and from 3:00 PM to 7:00 PM on weekdays.
- F. Closures and detours shall conform to the following:
1. Contractor may not impact traffic or close traffic lanes during peak commute hours. Peak commute hours are on weekdays from 6 a.m. until 9 a.m. and from 3 p.m. until 7 p.m. Lane closures hours shall conform to the requirements of the lane closure charts. Contractor shall fully close lanes before intersections and not within intersections to avoid traffic merging within the intersection.
 2. Signs of all complete road closures and detours will be posted, and notices distributed to adjacent and fronting businesses and residents 2 weeks in advance of the road closure.
 3. All road closures shall be coordinated with, and approved by, the traffic engineers of the relevant authorities before providing the required advance notifications.

1.06 SEQUENCING AND SCHEDULING

- A. Contractor shall notify VTA of Contractor's intent to begin work at least 10 working days before work is begun. Contractor shall cooperate with local authorities relative to handling traffic through the area.
- B. Vehicular Traffic: The traveled way shall be open for use by public traffic when construction operations are not actively in progress.
- C. Pedestrian walkways shall be provided to allow unimpeded pedestrian movement along streets and at crosswalks. At least one side of the street shall be open to pedestrian traffic at all times. If Contractor requires closure of a pedestrian walk or crosswalk, an alternate and convenient walk shall

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be provided during such closure. All temporary pedestrian paths shall be ADA compliant and shall be appropriately signed.

- D. Designated legal holidays are: January 1st, the third Monday in February, the last Monday in May, July 4th, the first Monday in September, November 11th, Thanksgiving Day, the day following Thanksgiving, and December 25th. When a designated legal holiday falls on a Sunday, the following Monday shall be a designated legal holiday. When a designated legal holiday falls on a Saturday, the preceding Friday shall be a designated legal holiday.
- E. Minor deviations from the requirements of this Section concerning hours of work which do not significantly change the cost of the work may be permitted upon the written request to VTA. Permission may be granted if, in the opinion of VTA, public traffic will be better served and the work expedited. Such deviations shall not be adopted until VTA has indicated its written approval. All other modifications will be made by contract change order.
- F. Contractor shall provide construction area signs to notify bike riders and pedestrians of pending bike and pedestrian route closures and detours at least 1 week in advance of closure.
- G. Lane reductions are not allowed on arterial streets on weekdays between 6:00 AM to 9:00 AM, and between 3:00 PM to 7:00 PM.

1.07 MEASUREMENT AND PAYMENT

- A. Measurement: TRAFFIC CONTROL shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for TRAFFIC CONTROL shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing TRAFFIC CONTROL, complete in place, and shown on the drawings, including temporary pedestrians and bicycle facilities, temporary HMA pavement, temporary traffic signals, police enforcement, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

PART 2 PRODUCTS

2.01 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES

Construction area traffic control devices shall conform to Section 12, “Temporary Traffic Control,” of Caltrans Standard Specifications

PART 3 EXECUTION

3.01 MAINTENANCE AND CONTROL OF TRAFFIC

- A. Furnish, install, maintain, and remove when no longer required, traffic control and protective devices required on the approved traffic plan. Traffic control and protective devices shall include temporary directional electrical warning signs (arrow boards), detour signs, informational signs; temporary barricades and guard rails; temporary lighting, temporary traffic signals, overhead warning lights, and flashing lights; removal of permanent and temporary pavement markings; and the services of qualified flagmen. Maintain communication with VTA regarding Contractor's operations in maintaining and controlling traffic. Street and road closures shall comply with the requirements of the lane closure charts and these Technical Specifications.

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- B. Redirecting Traffic:
1. Channelizing, shifting of traffic lanes, and barricading of traffic in connection with the work will be done in accordance with the approved traffic plan. Existing local standards for signing and marking of construction areas will apply in addition to the requirements of these Technical Specifications.
 2. When required by these Technical Specifications, shown on the drawings, or required by responsible public agencies, construct, maintain, and remove detours for the use of public traffic.
 3. The failure or refusal of Contractor to construct and maintain detours at the proper time shall be sufficient cause for closing down the work, at Contractor's expense, until such detours are in satisfactory condition for use by public traffic.
- C. Temporary Closing: Before temporarily closing to traffic part of any street, sidewalk, or other access or to changing traffic patterns from those indicated on the drawings, obtain approval from VTA at least 2 weeks before such closures or changes are made. VTA will obtain approval from the jurisdictional authorities. Deviations will be for an emergency condition affecting life and property only, and Contractor shall immediately notify VTA and the appropriate jurisdictional agency of any such emergency changes. Copies of approvals shall be furnished to VTA. Contractor shall obtain approval for any closures as required in the encroachment permit for the impacted jurisdiction.
- D. Contractor's Surface Operation: Schedule and conduct excavation or construction activities as required to permit opening of the street areas to traffic without unnecessary delays or provide supplemental access.
- E. Temporary Walkways: In areas where removal of existing sidewalks is necessary, maintain access to adjacent businesses, entrances, and properties by temporary walkways having a width of not less than 4 feet, or as shown in the drawings. All temporary walkways shall be ADA compliant. Refer to pedestrian facilities specified herein.
- F. Intersections: When an intersection is indicated on the drawings or on Contractor's traffic control working drawings to remain open during construction within the intersection, phase construction so that the required number of traffic lanes on each street will be provided at all times during these operations. During falsework installation, traffic in intersection shall be fully maintained except where closure has been previously approved. Trenches or open excavations shall be adequately bridged at the end of each work day where traffic lanes are to be open to traffic.
- G. Temporary Paving and Patching: Construct, maintain, and remove temporary pavement and patching required to safely and expeditiously handle vehicle and pedestrian traffic, within or adjacent to the construction site. Temporary pavement and patching composition shall conform to the specifications of the local jurisdictional agency. Any construction, maintenance, or removal required by Contractor's operations off site shall conform to the requirements specified herein.
- H. Maintenance of Traffic Control System:
1. Contractor shall check the traffic control area and reset all disturbed signs and traffic control devices immediately on a continuous 24-hour basis including weekends and holidays. All inapplicable signs shall be removed or covered during periods not needed.
 2. If ordered by the VTA, the contractor shall furnish and install additional traffic control devices, or provide flagmen, to ensure public safety or public convenience. Upon failure of Contractor to provide flagmen, or to properly provide, erect, maintain, or remove

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traffic control devices when ordered to do so by VTA, VTA will be at liberty, without further notice to Contractor, to provide the necessary flagmen, traffic control devices, or local reserve police forces, and deduct all of the costs thereof from any payments due to the Contractor.

- I. Contractor shall maintain access for fire, ambulance and law enforcement emergency vehicles at all times. Said access requirements may require Contractor to temporarily suspend its operations until the emergency is over.

- J. Contractor shall coordinate its Plans for control of traffic with local authorities having jurisdiction over the area and shall cooperate with such authorities during the period of control of traffic.
 - 1. The traffic engineering division or field inspector of the authority having jurisdiction shall be advised by Contractor of Contractor's Plans for implementing the approved traffic control measures at least 48 hours in advance of execution of such control measures.

3.02 CONSTRUCTION OPERATIONS UNDER TRAFFIC

- A. General: Construction equipment is defined for the purposes of this Section as all types of equipment, vehicles, and tools used in connection with construction work. The term workers include every person or firm performing work in or adjacent to public streets.

- B. Construction Equipment: When in traffic lanes, operate vehicles and equipment at normal traffic speeds. If this is not practicable, display a slow moving vehicle emblem in accordance with the Motor Vehicle Code. Construction equipment shall not be parked in any lane currently open for use by normal traffic. Equipment parked or stored at the worksite shall be behind a guard rail, barrier, curb, or other protective device.

- C. One-Way Traffic: Construction equipment shall be operated in traffic lanes only in the designated direction of travel for respective lanes, and with required traffic control and safety devices.

- D. Construction Operations:
 - 1. No construction work involving occupancy of traffic lanes shall be performed during adverse weather conditions or adverse road conditions except when so authorized by VTA and traffic shall be properly safeguarded by the use of flashers and lights in addition to the signs and other markings prescribed herein. During these periods no construction deliveries shall take place over a travel lane or immediately adjacent thereto.

 - 2. When traffic conditions dictate, VTA may require Contractor to modify its work operation for such length of time as required to alleviate the hazardous traffic conditions.

- E. Equipment Travel: Any construction equipment or material required in construction which exceeds the maximum vehicle dimensions enumerated in the Motor Vehicle Code shall be moved only in accordance with the established State and local regulations. Such oversize load shall not be moved over the streets of the local jurisdictional agency without first obtaining an oversize permit from the appropriate agency.

- F. Crossing Traffic Lanes: When crossing open traffic lanes by construction equipment is necessary, such crossing shall be safeguarded with flagmen.

- G. Flagmen: Provide qualified flagmen thoroughly instructed in flagging procedures as required to safeguard and maintain vehicle and pedestrian traffic. Flagmen shall perform their duties

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courteously and in such manner as will ensure the safety and convenience of the traffic within the limits of the guarded area. Traffic shall not be flagged to a stop unless necessary for safety.

- H. Removal of Traffic Control Devices: Temporary signs, barricades, barrier curbs, drums, and cones used to safeguard traffic in connection with construction work shall be removed at the close of the work day or as scheduled in the approved traffic plan, unless the state of the work is such that warning devices are still needed and are adapted for night use.
- I. Storage: No material shall be stored on any public right-of-way without approval from VTA and local agencies.
- J. Contractor shall obtain a City of San Jose hauling permit, if required.

3.03 TRAFFIC CONTROL

- A. Contractor shall control the flow of traffic in the area of the Work as necessary.
 - 1. Methods and procedures for such control shall be coordinated with VTA and shall be subject to VTA's approval.
- B. Not less than 10 working days before performing staged activity or detour affecting the flow of traffic, Contractor shall notify VTA of intent to perform such work.
 - 1. Such notification shall be accompanied by a detour plan.
 - 2. VTA and local jurisdiction will review Contractor's detour plan for approval. Contractor shall cooperate with such authorities during the period of control of traffic.
 - 3. Contractor shall not detour traffic without prior written approval of the detour plan.
- C. Parking:
 - 1. Contractor shall keep the area of work free of parked vehicles. Contractor shall make its own arrangements relative to keeping the working area clear of parked vehicles.
 - 2. Contractor shall not park vehicles of Contractor or Contractor's employees on the traveled way or shoulders, even if such areas are closed to the public.
- D. Contractor shall observe laws and rules of traffic when moving Contractor's vehicles or equipment on roadways open to the public.
- E. Contractor shall not allow vehicles to stop in temporary traffic lanes or in loading, unloading, or storage areas.
 - 1. NO STOPPING, NO PARKING, and TOW AWAY warning signs shall be posted by Contractor in accordance with the approved traffic plan.

3.04 TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE

- A. Traffic control system for lane closure shall conform to the provisions in Section 12, "Temporary Traffic Control," of Caltrans Standard Specifications and these Technical Specifications.

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- B. The provisions in this Section will not relieve Contractor from the responsibility to provide additional devices or take the measures as may be necessary to comply with Section 7-22, Public Convenience and Public Safety, or as directed by the VTA.
- C. During traffic stripe operations and pavement marker placement operations using bituminous adhesive, traffic shall be controlled, at the option of Contractor, with either stationary or moving type lane closures. During all other operations traffic shall be controlled with stationary type lane closures.
- D. If any component in the traffic control system is displaced, or ceases to operate or function as specified, from any cause, during the progress of the Work, Contractor shall immediately repair the component to its original condition or replace the component and shall restore the component to its original location.
- E. Stationary Type Lane Closure: When lane closures are made for work periods only, at the end of each work period, all components of the traffic control system, except portable delineators placed along open trenches or excavation adjacent to the traveled way, shall be removed from the traveled way and shoulder. If Contractor so elects, the components may be stored at selected central locations, approved by VTA, within the limits of the right of way.
- F. Each vehicle used to place, maintain and remove components of a traffic control system on multilane highways shall be equipped with a Type II flashing arrow sign which shall be in operation when the vehicle is being used for placing, maintaining, or removing the components. Vehicles equipped with Type II flashing arrow sign not involved in placing, maintaining, or removing the components when operated within a stationary type lane closure shall only display the caution display mode. The sign shall be controllable by the operator of the vehicle while the vehicle is in motion. The flashing arrow sign shown on the Plans shall not be used on the vehicles which are doing the placing, maintaining and removing of components of a traffic control system, and shall be in place before a lane closure requiring its use is completed.
- G. Moving Type Lane Closure: Flashing arrow signs used in moving lane closures shall be truck-mounted. Changeable message signs shall be truck-mounted and the full operation height of the bottom of the sign may be less than 7 feet above the ground, but should be as high as practicable.
- H. Lane Closure Charts for lane closures on Capitol Expressway are attached to this Specification.
- I. Portable changeable message signs (PCMS) shall be installed at locations shown in the drawings, as directed by the VTA, and in advance of the first warning sign for each:
1. Stationary or moving lane closure
 2. Expressway closure
 3. Intersection closure (all approaches)
 4. Shoulder Closure
 5. Speed reduction zone

PCMS shall be installed 5 days prior to the start of the work activity requiring the sign with advance notification messages, or as directed by the VTA. PCMS shall start displaying the message 15 minutes prior to closing a lane, intersection, or road, or as directed by the VTA.

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3.05 PEDESTRIAN AND BICYCLE FACILITIES

- A. Pedestrian Facilities, General:
 - 1. Pedestrian walkways shall have skid resistant surfaces and shall be free of irregularities.
 - 2. Hand railings shall be provided on each side of temporary pedestrian walkways as necessary to protect pedestrian traffic from hazards due to construction operations and adjacent vehicular traffic and to prevent pedestrian movement to construction areas and vehicular traffic lanes.
 - 3. Protective overhead covering shall be provided as necessary to provide protection from falling objects and drip from overhead structures.
 - 4. Railings and walkways shall be maintained in good condition by Contractor. Walkways shall be kept free of obstructions or hazards. Slope of ramp shall be a maximum of 1:12.
- B. Temporary pedestrian walkways that are constructed shall be provided with surfacing of asphalt concrete, Portland cement concrete, or timber.
- C. Railings for temporary walkways shall be constructed of wood, S4S, and shall be painted white.
- D. If a street or lane closure will block a bicycle route or pedestrian sidewalk, provide signs adjacent to proposed closure at least 1 week in advance of closure. Provide alternative bicycle and pedestrian routes.

3.06 FLAGGERS AND POLICE OFFICERS

- A. Flaggers shall be provided per the provisions in Section 12, “Temporary Traffic Control” of Caltrans Standard Specifications, while assigned to traffic control, shall perform.
- B. Contractor shall be responsible for providing uniformed police officers through the local enforcement agency per the provisions of Section 7-22, “Public Convenience and Public Safety” of County of Santa Clara Standard Specifications, City of San Jose Standard Specifications, and as directed by the VTA.
- C. Contractor shall provide flaggers and police officers at intersections, and any other locations as directed by the VTA, during nearby school’s special events during weekdays or weekends.

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3.07 PLATING

- A. Wherever traffic is permitted over or adjacent to trenches and other depressions, Contractor shall furnish and maintain steel plating unless other means of protecting the public and the work are accepted by VTA (and the local jurisdictional authority). Plates shall be secured against movement including shifting and rocking by use of adjustable cleats, shims, and other devices such as anchors and keys. No gaps between plates and other deficiencies hazardous to bicycles shall be allowed; and the existing pavement shall be protected from damage.
- B. Steel plating shall have a non-skid surface.
- C. Steel plates used for bridging shall extend 12 in. minimum beyond the edges of trenches.
- D. Steel plates shall conform to the following minimum thicknesses:

Trench Width	Minimum Plate Thickness
12 in	1/2 in
18 in	3/4 in
24 in	7/8 in
35 in	1 in
4 ft	1 1/2 in

Note: For spans greater than 4 feet, prepare and submit a structural design as specified under "Submittals" herein.

- E. Within the City of San Jose, Contractor shall prepare for placement of plates over trench by grinding a relief 12 in wide on each side of the trench by the thickness of the steel plate so that the surface of the steel plate is level with the adjacent pavement surface.

3.08 TEMPORARY TRAFFIC SIGNAL SYSTEM

Temporary signal systems shall conform to the provisions of Section 12-3.33, "Temporary Signal Systems," and Section 87-20, "Temporary Electrical Systems" of Caltrans Standard Specifications.

Temporary signal systems shall operate on a continuous 24-hour basis, unless traffic is controlled by flaggers.

Temporary signal system shall include temporary wireless interconnection and communications at each intersection. Temporary CCTV cameras shall provide real time video to the County Traffic Operations Center.

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3.09 LANE CLOSURE CHARTS

Chart No. 1																									
Expressway Lane Requirements																									
County: Santa Clara										Route/Direction: NB/SB Capitol Expressway															
Closure limits: Between Capitol Avenue and Eastridge Loop																									
Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon– Fri	1	1	1	1	1	1	1	3	3	3	2	2	2	2	2	2	3	3	3	3	2	2	2	1	1
Sat– Sun	1	1	1	1	1	1	3	3	3	2	2	2	2	2	2	3	3	3	3	2	2	2	1	1	
Legend:																									
1 Provide at least 1 through expressway lane open in the direction of travel.																									
2 Provide at least 2 adjacent through expressway lanes open in the direction of travel.																									
3 Provide at least 3 adjacent through expressway lanes open in the direction of travel.																									
Work is allowed within the highway where a shoulder or lane closure is not required.																									
REMARKS:																									

Chart No. 2																									
City Street Lane Requirements																									
County: Santa Clara										Route/Direction: NB/SB N Capitol Avenue															
Closure limits: Between Mabury Road and Capitol Expressway																									
Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon– Fri	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	2	2	2	2	1	1	1	1	1	
Sat– Sun	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	2	2	2	2	1	1	1	1	1	
Legend:																									
1 Provide at least 1 city street lane open in the direction of travel.																									
2 Provide at least 2 city street lane open in the direction of travel.																									
Work is allowed within the highway where a shoulder or lane closure is not required.																									
REMARKS:																									

END OF SECTION 01 55 26

Chart No. 1 Expressway Lane Requirements																										
County: Santa Clara							Route/Direction: Capitol Expwy Southbound																			
Closure limits: North of Capitol Av to Capitol Ave/Excalibur Dr Intersection																										
Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Mon– Fri	1	1	1	1	1	1	3	3	3	3	2	2	2	2	2	3	3	3	3	3	3	2	2	2	1	1
Sat– Sun	1	1	1	1	1	1	1	1	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2	2	1	
Legend:																										
1 Provide at least 1 through expressway lane open in the direction of travel.																										
2 Provide at least 2 adjacent through expressway lanes open in the direction of travel.																										
3 Provide at least 3 adjacent through expressway lanes open in the direction of travel.																										
Work is allowed within the highway where a shoulder or lane closure is not required.																										
REMARKS:																										

Chart No. 2 Expressway Lane Requirements																									
County: Santa Clara							Route/Direction: Capitol Expwy Southbound																		
Closure limits: From Capitol Ave/Excalibur Dr Intersection to Story Rd Intersection																									
Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon– Fri	1	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1
Sat– Sun	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1
Legend:																									
1 Provide at least 1 through expressway lane open in the direction of travel.																									
2 Provide at least 2 adjacent through expressway lanes open in the direction of travel.																									
3 Provide at least 3 adjacent through expressway lanes open in the direction of travel.																									
Work is allowed within the highway where a shoulder or lane closure is not required.																									
REMARKS:																									

Chart No. 3																										
Expressway Lane Requirements																										
County: Santa Clara										Route/Direction: Capitol Expwy Southbound																
Closure limits: From Story Rd Intersection to Ocala Ave Intersection																										
Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Mon– Fri	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1
Sat– Sun	1	1	1	1	1	1	1	1	1	2	2	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1
Legend:																										
1 Provide at least 1 through expressway lane open in the direction of travel.																										
2 Provide at least 2 adjacent through expressway lanes open in the direction of travel.																										
3 Provide at least 3 adjacent through expressway lanes open in the direction of travel.																										
Work is allowed within the highway where a shoulder or lane closure is not required.																										
REMARKS:																										

Chart No. 4																										
Expressway Lane Requirements																										
County: Santa Clara										Route/Direction: Capitol Expwy Southbound																
Closure limits: From Ocala Ave Intersection to Cunningham Ave Intersection																										
Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Mon– Fri	1	1	1	1	1	1	1	3	3	2	2	2	2	2	2	3	3	3	3	3	3	2	2	1	1	1
Sat– Sun	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	2	2	2	2	2	1	1	1	
Legend:																										
1 Provide at least 1 through expressway lane open in the direction of travel.																										
2 Provide at least 2 adjacent through expressway lanes open in the direction of travel.																										
3 Provide at least 3 adjacent through expressway lanes open in the direction of travel.																										
Work is allowed within the highway where a shoulder or lane closure is not required.																										
REMARKS:																										

Chart No. 5
Expressway Lane Requirements

County: Santa Clara	Route/Direction: Capitol Expwy Southbound
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Closure limits: [From Cunningham Ave Intersection to Eastridge Loop Intersection](#)

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Mon– Fri	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>
Sat– Sun	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	

Legend:

1 Provide at least 1 through [expressway](#) lane open in the direction of travel.

2 Provide at least 2 adjacent through [expressway](#) lanes open in the direction of travel.

3 Provide at least 3 adjacent through [expressway](#) lanes open in the direction of travel.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

SECTION 01 58 13

PROJECT IDENTIFICATION SIGNS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements for installing Project Identification Signs and removal and disposal of signs following completion of the Work.
- B. Project Identification Signs include two Federal Transit Administration (FTA) signs furnished and installed by the Contractor and two VTA signs (including support assembly) furnished by VTA and installed by Contractor.
- C. Details of Project Identification Sign construction and legends are shown on figures appended to this Section title:
 - 1. Federal Transit Administration (FTA) Sign.
 - 2. Sign Assembly Detail.
 - 3. VTA sign.

1.02 RELATED SECTIONS

- A. Section 6.6, Contract Data Requirements, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 7.51, Disposal of Materials, of the General Conditions
- D. Section 31 00 00, Earthwork

1.03 MEASUREMENT AND PAYMENT

- A. The contract lump sum price paid for Project Identification Signs shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in installing signs, and complete removal and disposal of signs as directed by VTA, and no additional compensation will be allowed therefor.

1.04 DESCRIPTION

- A. Project Identification Signs include signs as shown in Section 01 58 13, Project Identification Signs, Attachment A, and installed by the Contractor (including support assembly).
- B. Details of Project Identification Sign construction and legends are shown on figures appended to this Section, titled:
 - 1. Project Identification Sign Assembly Detail.
- C. Size of signs will be as shown on appended figure unless variance is required to meet special or local requirements; however, proportions of signs to be maintained.

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1.05 SUBMITTALS

- A. Submittals' General Requirements: Refer to Section 6.6, Contract Data Requirements, of the Special Conditions, and Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions.
- B. Shop Drawings: For each Project Identification Sign show and describe:
 - 1. Panel with the specified text, logos, and other painted features.
 - 2. Supports, attachment, and installation details.
 - 3. Materials of construction and the type of paint and colors.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Sign Panels: Standard waterproof exterior grade plywood sheets.
- B. Paint: Exterior gloss enamel with a clear graffiti-proof coating.
- C. Supports: Douglas Fir construction grade.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Construct and erect two Federal Transit Administration signs, at locations selected by VTA. When signs are located over sidewalk areas, place sign panel so that bottom of sign be minimum 7 ft above sidewalk.
 - 1. Size of signs will be as shown on appended figure unless variance is required to meet special or local requirements; however, proportions of signs to be maintained.
- B. Mount signs on freestanding fixed posts painted white. FTA signs shall be mounted under VTA signs to be furnished and installed by the VTA on sign assemblies furnished and installed by Contractor.
- C. Supports:
 - 1. For each sign, provide at least two posts of size shown on appended figures.
 - 2. Provide attachment devices, fasteners, and other necessary hardware and materials.
- D. Painting: Both sides and all edges.
- E. Prior to excavating post holes, locate existing utilities and perform potholing in accordance with the requirements of Section 31 00 00, Earthwork.
- F. Excavate post holes by hand, except power equipment may be used if it is determined that there are no utility facilities in the area of the proposed post holes.

3.02 MAINTENANCE

- A. Signs, including VTA-furnished signs, shall be kept clean and in good repair by the Contractor.

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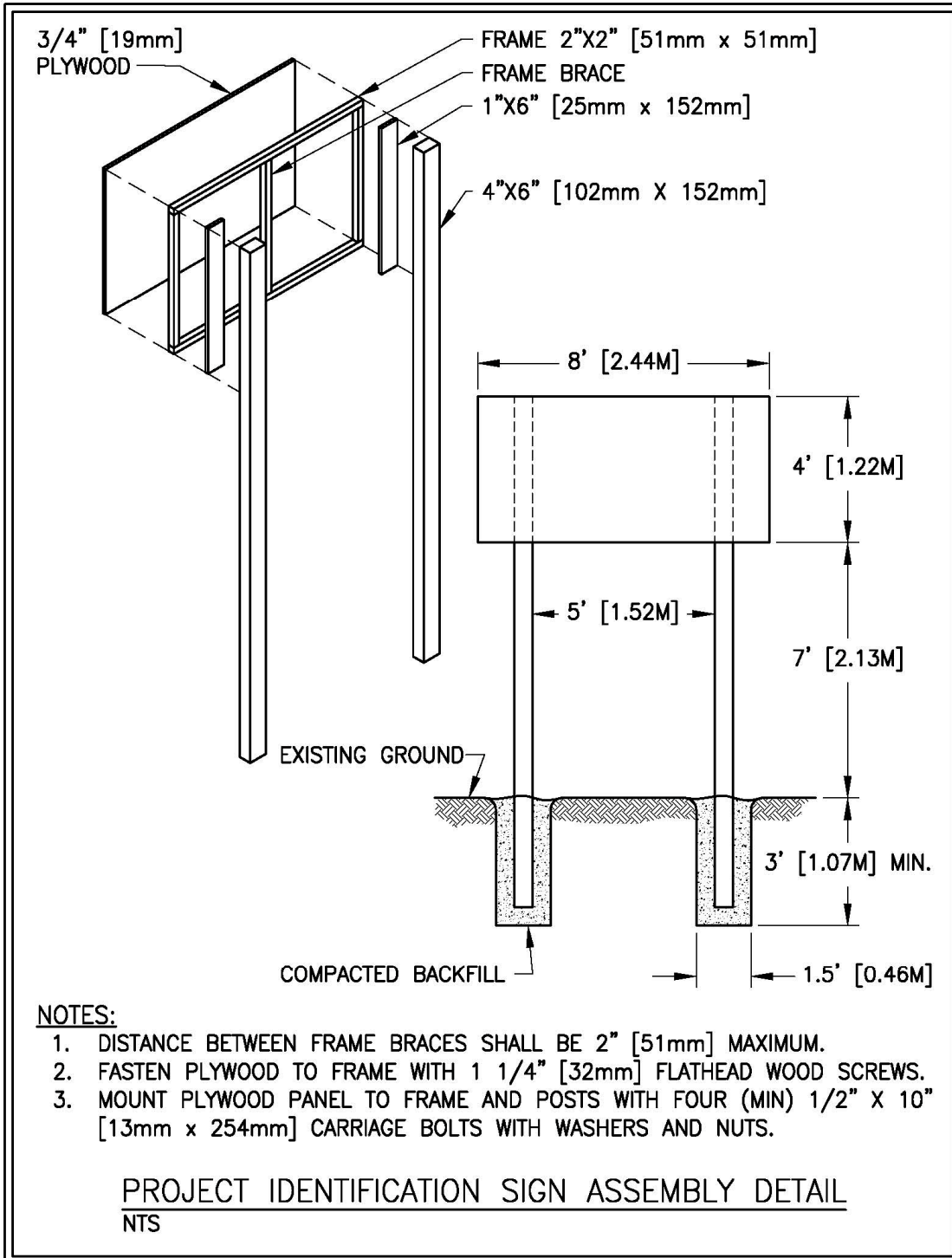
3.03 REMOVAL

- A. Upon completion of work under contract, Project Identification Signs, including the VTA- furnished signs, shall become the property of Contractor and shall be removed and disposed of in accordance with Section 7.51, Disposal of Materials, of the General Condition.
- B. Remove and dispose of Project Identification Signs only when directed by VTA.
- C. Repair holes and damage caused by placement of project identification signs.

END OF SECTION 01 58 13

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NOTES:

1. DISTANCE BETWEEN FRAME BRACES SHALL BE 2" [51mm] MAXIMUM.
2. FASTEN PLYWOOD TO FRAME WITH 1 1/4" [32mm] FLATHEAD WOOD SCREWS.
3. MOUNT PLYWOOD PANEL TO FRAME AND POSTS WITH FOUR (MIN) 1/2" X 10" [13mm x 254mm] CARRIAGE BOLTS WITH WASHERS AND NUTS.

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SECTION 01 71 13

MOBILIZATION

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for site mobilization.

1.02 REQUIREMENTS

- A. Mobilization shall consist of preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment supplies, including incidentals to the project site; for the establishment of offices, buildings, Site Surveys, and other facilities necessary for work on the project; for all other work and operations which shall be performed or costs incurred before beginning work on the various contract items on the project site.

1.03 MEASUREMENT AND PAYMENT

- A. Payments for Mobilization will be made as follows:
1. When the monthly partial payment estimate of the amount earned, not including the amount earned for mobilization, is 5 percent or more of the original Contract amount, 50 percent of the contract item price for mobilization or 5 percent of the original Contract amount, whichever is the lesser, will be included in said estimate for payment.
 2. When the monthly partial payment estimate of the amount earned, not including the amount earned for mobilization, is 10 percent or more of the original Contract amount, the total amount earned for mobilization shall be 75 percent of the contract item price for mobilization or 7.5 percent of the original Contract amount, whichever is the lesser, will be included in said estimate for payment.
 3. When the monthly partial payment estimate of the amount earned, not including the amount earned for mobilization, is 20 percent or more of the original Contract amount, the total amount earned for mobilization shall be 95 percent of the contract item price for mobilization or 9.5 percent of the original Contract amount, whichever is the lesser, will be included in said estimate for payment.
 4. When the monthly partial payment estimate of the amount earned, not including the amount earned for mobilization, is 50 percent or more of the original Contract amount, the total amount earned for mobilization shall be 100 percent of the contract item price for mobilization or 10 percent of the original Contract amount, whichever is the lesser, will be included in said estimate for payment.
 5. After acceptance of the Contract, the amount, if any, of the contract item price for mobilization in excess of 10 percent of the original Contract amount will be included for payment of the final estimate.

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PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 71 13

SECTION 01 71 23

FIELD ENGINEERING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for construction surveys and other measurements as required to establish lines, slopes, continuous profile grade for track roadway and crossing streets; center lines, bench marks and other controls deemed necessary for the Work.

1.02 SUBMITTALS

- A. The Contractor shall submit the name and address of a Land Surveyor, licensed in the State of California, who will be directly responsible for the survey work, for approval, a minimum of 10 days prior to commencing the survey work.
- B. Upon request of the Engineer, field notes, calculations, and other documents shall be submitted to verify the accuracy of the field engineering work. Field notes for quantity computations for payment shall be submitted at least 5 days in advance of the Engineer's calculation of progress estimates.
- C. Within 30 days of completion of the work, two sets of field notes, calculations, drawings and other documents necessary to accomplish the field engineering work for this contract shall be submitted.
- D. Submit seven copies of calculations used in establishing survey points, temporary benchmarks, stakes for centerlines and other control stakes for line and grade of the work. Submit information within five working days of installation of stakes in the field.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall provide his own surveyor for construction staking. The Contractor shall assume full responsibility for the accuracy of the measurements and controls provided by him. The Engineer reserves the right to verify the grades and locations. Any discrepancies from the grades and locations shown on the plans shall be corrected by the Contractor at no cost to VTA.
- B. VTA will provide, at no cost to the Contractor, control survey baseline, monuments and bench marks as shown on the plans. The Contractor shall be held responsible for the preservation of all monuments and bench marks, as provided by VTA, and other existing property boundaries and survey monuments of record requiring replacement during construction shall be done by a licensed surveyor and at no cost to VTA. In addition, the Contractor shall protect all survey markers found during construction. The Contractor shall perform survey to verify and document existing track alignment, monuments, and bench marks prior to removal of existing track. The Contractor shall pay to VTA all costs of re-establishing monuments identified in the contract drawings if they are disturbed or destroyed. The Contractor shall immediately notify the Engineer of any discrepancies in the control survey.
- C. The Contractor shall immediately notify the Engineer in writing of obvious errors or omissions in the plans identified during construction plan review and preparation of stake out documents.

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1.04 ACCURACY

- A. Control traverse field surveys and computations, including surveys of main control lines to determine alignment of major structure components, shall be performed to an accuracy of at least 1:25000.
- B. The tolerances generally applicable in setting survey stakes shall be as set forth below. Such tolerances shall not supersede stricter tolerances required by the plans or Specifications, and shall not otherwise relieve the Contractor of responsibility for measurements in compliance therewith.
- C. Tolerances in setting survey shall not exceed the following:

<u>Survey Stake or Markers</u>	<u>Distance</u>	<u>Tangent</u>	<u>Curve</u>
Markers on hubs and monuments on centerlines and offset centerlines	1:10,000	0.01 ft.	10 sec.
Intermediate stakes or markers on centerlines and offset centerlines for:			
Rough excavation and embankment for trackway, roadways, and work not otherwise provided	1:2,000	0.01 ft.	1 min.
Equipment installation	As required by manufacturer		
Roadway surfacing, steel reinforcement, and other formed concrete	1:5,000	0.02 ft.	1/2 min.

Offset Grade stakes or Markers for:

<u>Survey Stake or Markers</u>	<u>Horizontal Distance</u>	<u>Elevation</u>
Rough excavation and embankment for trackway, roadways, and work not otherwise provided	0.01 ft.	0.10 ft.
Trimming or preparation of subgrade for trackway, roadway, and concrete structures	0.05 ft.	0.05 ft.
Track, roadway surfacing, formed concrete	0.01 ft.	0.01 ft.
Conduit, Junction Boxes, Vaults	0.02 ft.	0.01 ft.
Equipment Installation	As required by manufacturer	

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1.05 QUALITY CONTROL

- A. The Contractor shall assign a competent Professional Licensed Land Surveyor to perform or direct all necessary work to layout all items described in the specifications and indicated on the contract drawings.
- B. The Professional Licensed Land Surveyor whose resume and credentials have been reviewed and approved by the Engineer prior to commencement of work shall be the only authorized individual to perform work as described herein.
- C. The Final approval of the Professional Licensed Land Surveyor rests with the Engineer.
- D. If for any reason, and at any time, the candidates submitted by the Contractor is not acceptable to the Engineer, or becomes unacceptable, the Contractor shall propose additional candidates.
- E. If for any reason the Contractor wishes to replace the approved Professional License Land Surveyor at any time during the performance of the contract, the Contractor shall submit the resume and other credentials of its new candidate to the Engineer for approval. No substitution shall be allowed without the Engineer's written approval.

1.06 DIARY AND FIELD NOTES

- A. A daily diary shall be maintained of all work performed by the survey crews. This diary or daily record shall include the date, weather, crew, type and location of work being performed, and work accomplished.
- B. Field notes shall be maintained for all items of survey work and measurements. Notes shall be neat, legible, precise and sufficiently detailed.
- C. All construction field notes shall be accurate, clear, and complete, and shall be recorded on standard note weather proof forms.

1.07 CONSTRUCTION STAKES

- A. PK nails or other types of permanent markers shall be set at intervals not more that 10 feet apart for track center lines or layout lines.
- B. Points that may be disturbed or destroyed during construction shall be referenced to safe and stable locations.

1.08 BENCH MARKS

- A. The bench marks shown on the plans shall be checked for location and elevations, and additional bench marks shall be installed as required. Bench marks shall not be set on utility poles.

1.09 MEASUREMENT AND PAYMENT

- A. Full compensation for conforming to the requirements of this Section involving field engineering shall be considered as included in the contract prices paid for the various contract items of work involved and no additional compensation will be allowed therefore.

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PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION 01 71 23

SECTION 01 74 12

CLEANING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for maintaining a clean, orderly, hazard-free Worksite and final cleaning for VTA's occupancy.

1.02 RELATED SECTIONS

- A. Section 01 11 00, Summary of Work.
- B. Section 01 12 16, Work Sequence and Constraints
- C. Section 01 74 15, Dust Control
- D. Section 01 74 19, Construction Site Management

1.03 SUBMITTALS

- A. Submit a detailed list of volatile and potential contaminants planned or expected to be present at the Worksite and how they will be mitigated if spilled.

1.04 JOB CONDITIONS

- A. Safety Requirements: Maintain the Worksite in a neat, orderly, and hazard-free condition until final acceptance of the Work in conformance with the local governmental and CAL OSHA requirements. Keep catwalks, underground structures, Worksite walks, public sidewalks, roadways, and streets, along with public and private walkways adjacent to Worksite, free from hazards caused by construction activities. Inspect those facilities regularly for hazardous conditions caused by construction activities.
- B. Hazards Control:
 - 1. Store volatile wastes in covered metal containers, and remove those wastes from Worksite daily.
 - 2. If volatile and/or noxious substances are being used in spaces which are not naturally ventilated, provide artificial ventilation
 - 3. Conform to applicable Federal, State and local rules and regulations for hazard controls, including those covering hazardous communications.
 - 4. Submit a detailed list of volatile and potential contaminants planned or expected to be present at the Worksite and how they will be mitigated if spilled.
- C. Access: Maintain the Worksite in such a way as to permit access by others; refer to Section 01 11 00, Summary of Work, and Section 01 12 16, Work Sequence and Constraints.

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1.05 MEASUREMENT AND PAYMENT

- A. Full compensation for Cleaning shall be considered as included in the contract prices paid for the various contract items of work involved and no additional compensation will be allowed thereof.

PART 2 – PRODUCTS

2.01 CLEANING MATERIALS

- A. Use the type of cleaning materials recommended by the manufacturer of the surfaces to be cleaned. Products used in this Section shall be selected by the Contractor, subject to approval by the VTA.

PART 3 – EXECUTION

- A. Clean the Worksite every workday during the construction of the Contract. Maintain structures, grounds, railroads and other areas of Worksite, including public streets and public and private properties immediately adjacent to Worksite, free from accumulations of waste materials caused by construction operations. Place waste materials in metal containers.
- B. Remove or secure loose material on open decks and on other exposed surfaces at the end of each workday, or more often, in a manner which will maintain the Worksite hazard-free. Secure material in a manner which will prevent its dislodgment by wind and other forces.
- C. Control dust in accordance with Section 01 74 15, Dust Control.
- D. Promptly empty waste containers when they become full but in no case less frequently than once a week, and legally dispose of the contents at dumping areas off VTA's property.
- E. Control the handling of waste materials. Do not permit materials to be dropped or thrown from structures.
- F. Immediately remove spillages of construction-related material from haul routes.
- G. Clean only when dust and other contaminants will not precipitate upon newly painted surfaces.

3.02 FINAL CLEANUP

- A. Inspect interior and exterior surfaces, including concealed spaces, in preparation for completion and acceptance.
- B. Remove dirt, dust, litter, corrosion, solvents, discursive paint, stains, and extraneous markings.
- C. Remove surplus materials, except those materials intended for maintenance.
- D. Remove tools and equipment used in the construction, except that for VTA's property.
- E. Remove detachable labels and tags. File them with the manufacturer's specifications for that specific material for VTA's records.

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- F. Repair damaged materials to the specified finish, or remove and replace.

END OF SECTION 01 74 12

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SECTION 01 74 15

DUST CONTROL

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for dust control including application water or dust palliatives for the alleviation or prevention of dust nuisance
- B. Dust resulting from Contractor's performance of work, either inside or outside the right-of-way, shall be controlled by Contractor

1.02 RELATED SECTIONS

- A. Section 01 51 36, Watering
- B. Section 01 52 00, Construction Facilities

1.03 REFERENCED STANDARDS

- A. State of California, Department of Transportation (Caltrans), Standard Specifications:
 - 1. Section 10-5, Dust Control
 - 2. Section 18, Dust Palliatives

1.04 PROJECT SITE CONDITIONS

- A. It is understood that the provisions of Section 10-5, Dust Control, of the Caltrans Standard Specifications will not prevent Contractor from applying water or dust palliative for its convenience if Contractor so desires; however, Contractor shall endeavor, whenever possible, to restrict the use of water to control dust for its convenience.

1.05 MEASUREMENT AND PAYMENT

- A. Full compensation for dust control shall be considered as included in the contract prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

PART 2 – PRODUCTS

2.01 WATER

- A. As specified in Section 01 51 36, Watering.

2.02 DUST PALLIATIVE

- A. Dust palliative shall conform to the provisions of Section 18, Dust Palliatives, of the Caltrans Standard Specifications.

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PART 3 – EXECUTION

3.01 GENERAL

- A. Perform dust control in accordance with the provisions of Section 18, Dust Palliatives, of the Caltrans Standard Specifications and in conformance with the approved SWPPP as applicable. During the progress of Work, Contractor shall keep the entire Worksite free of dust. Spillage resulting from hauling operations along or across existing streets, roads, paths or access routes shall be removed immediately by Contractor.
- B. Contractor shall govern its operations and construction methods at all times so as to prevent any dust problems within the area of work, along haul routes, and along adjacent properties. Contractor shall provide the water wagons, water, labor, or any material or equipment required to provide adequate control of dust to the complete satisfaction of VTA.
- C. Dust problem is defined as any visible airborne particles within the project site and project haul routes that are a result of Contractor's activities.
- D. When airborne particles are visible and VTA orders a dust control application, such work shall be performed within the same day.
- E. If the dust control application is not performed when requested by VTA, the work will be done by VTA forces and the costs deducted from Contractor's payment.
- F. Street sweepers with wet dust control systems will be allowed as an alternative for dust control on paved approaches to the project. Power brooms or other similar devices without wet dust control systems will not be allowed.
- G. Any damage, and the cost of such damage, resulting from dust caused by Contractor's activities, shall be the complete and sole responsibility of Contractor.

3.02 APPLICATION

- A. For use with water, perform dust control work as specified in Section 01 51 36, Watering, and as directed by VTA.
- B. Apply dust palliative in accordance with the provisions of Section 18, Dust Palliatives, of the Caltrans Standard Specifications, these technical specifications, and as directed by VTA.
- C. Contractor shall enclose, cover, water twice daily or apply non-toxic soil binders to exposed stockpiles, debris, dirt, and sand.
- D. All active construction areas shall be sprinkled at least 2 times daily.
- E. All unpaved access roads, parking areas and staging areas shall be sprinkled at least 3 times daily.
- F. On unpaved areas, maximum speed of vehicles shall be 15 MPH.
- G. All paved access roads, parking areas and staging areas shall be swept daily.

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- H. All trucks hauling soil, sand, aggregate or other loose material shall maintain at least two (2) feet of freeboard or be covered.
- I. Any time soil material is carried onto adjacent public streets, the material shall be immediately swept up to the satisfaction of VTA.
- J. Contractor shall hydroseed or apply non-toxic soil stabilizers to inactive construction areas in accordance with the requirements of Section 01 52 00, Construction Facilities.
- K. Contractor shall replant vegetation in disturbed areas as quickly as possible.

3.03 DUST CONTROL

- A. The Contractor shall provide dust control at all times, including holidays and weekends, as required to abate dust nuisance on and about the site which is a result of construction activities. Dust control shall be by means of sprinklered water or by other approved methods, except that chemicals, oil, or similar palliative shall not be used.
- B. Quantities and equipment for dust control shall be sufficient to effectively prevent dust nuisance on and about the jobsite; and when weather conditions warrant, sprinklering equipment shall be on hand at all times for immediate availability.
- C. The Engineer shall have authority to order dust control work whenever conditions warrant, and there shall be no additional cost to VTA therefor. Dust control shall be effectively maintained whether or not the Engineer orders such work.
- D. Complaints from the public shall be reported to the Engineer and shall be acted on immediately.
- E. Where earthwork operations are in progress, keep exposed earth surfaces dampened continuously. Also, keep dirt access ways and roads dampened continuously.
- F. If portions of the site are temporarily inactive or abandoned for whatever reason, provide dust control and abatement continuously during such periods of inactivity.
- G. Where dust resulting from construction activities has collected on public sidewalks and streets, hose down such sidewalks and streets to abate flying dust particles. Clean all sidewalks and streets from accumulated dirt and dust.

END OF SECTION 01 74 15

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SECTION 01 74 19

CONSTRUCTION SITE MANAGEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This work includes preventing and controlling spills, dewatering, and managing materials, waste, and non-storm water. Also includes air control, dust control, noise control, and handling of cultural resources.
- B. Implement effective handling, storage, usage, and disposal practices to control material pollution and manage waste and non-storm water at the job site before they come in contact with storm drain systems and receiving waters.

1.01 RELATED SECTIONS

- A. Section 01 74 15, Dust Control
- B. Section 02 61 00, Contaminated Soil Management
- C. Section 02 80 00, Hazardous Material Abatement

1.02 REFERENCED STANDARDS

- A. State of California, Department of Transportation (Caltrans), Standard Specifications:
 - 1. Section 10-5, Dust Control,

1.03 MEASUREMENT AND PAYMENT

- A. The contract lump sum price paid for Construction Site Management shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in spill prevention and control, material management, waste management, nonstormwater management, and dewatering activities, including identifying, sampling, testing, handling, and disposal of soil and hazardous waste resulting from contractor's activities, as shown on the plans, as specified in the technical specifications and Special Conditions, and as directed by VTA and no additional compensation will be allowed therefore..

1.04 REFERENCES

- A. 40 Code of Federal Regulations CFR Parts 110, 117 and 302
- B. California Code of Regulations (CCR), Title 22, Section 66262

1.05 SUBMITTALS

- A. Submit the following:
 - 1. Material Safety Data Sheet at least 7 days before material is used or stored.
 - 2. Monthly inventory records for material used or stored.
- B. Submit written approval from the local health agency, city, county, and sewer district before discharging from a sanitary or septic system directly into a sanitary sewer system.

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- C. Submit a Construction Noise Mitigation Plan for Approval.
- D. Submit a Mitigation Monitoring and Reporting Plan (MMRP) for Approval.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Refer to Bay Area Air Quality Management District, Air Quality Guidelines Table 8-3, Additional Construction Mitigation Measures items 4, 5, 7-13.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Keep materials or waste storage areas clean, well-organized, and equipped with enough cleanup supplies for the material being stored.
- B. Implement spill and leak prevention procedures for chemicals and hazardous substances stored on the job site. Whenever you spill or leak chemicals or hazardous substances at the job site, you are responsible for all associated cleanup costs and related liability.
- C. Report minor, semi-significant, and significant or hazardous spills to the VTA immediately.
- D. As soon as it is safe, contain and clean up spills of petroleum materials and sanitary and septic waste substances listed under 40 CFR, Parts 110, 117, and 302.

3.02 MINOR SPILLS

- A. Minor spills consist of quantities of oil, gasoline, paint, or other materials that are small enough to be controlled by a 1st responder upon discovery of the spill. Clean up a minor spill using the following procedures:
 - 1. Contain the spread of the spill
 - 2. Recover the spilled material using absorption
 - 3. Clean the contaminated area
 - 4. Dispose of the contaminated material and absorbents promptly and properly under “Waste Management” of these Technical Specifications

3.03 SEMI-SIGNIFICANT SPILLS

- A. Semi-significant spills consist of spills that can be controlled by a 1st responder with help from other personnel. Clean up a semi-significant spill immediately using the following procedures:
 - 1. Contain the spread of the spill.
 - 2. On paved or impervious surfaces, encircle and recover the spilled material with absorbent materials. Do not allow the spill to spread widely.
 - 3. If the spill occurs on soil, contain the spill by constructing an earthen dike and dig up the contaminated soil for disposal.
 - 4. If the spill occurs during precipitation, cover the spill with 10-mil plastic sheeting or other material to prevent contamination of runoff.
 - 5. Dispose of the contaminated material promptly and properly under 3.08 Waste Management of this Section.

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3.04 SIGNIFICANT OR HAZARDOUS SPILLS

- A. Significant or hazardous spills consist of spills that cannot be controlled by job site personnel. Immediately notify qualified personnel of a significant or hazardous spill. Take the following steps:
1. Do not attempt to clean up the spill until qualified personnel have arrived
 2. Notify the VTA and follow up with a report
 3. Obtain the immediate services of a spill contractor or hazardous material team
 4. Notify local emergency response teams by dialing 911 and county officials by using the emergency phone numbers retained at the job site
 5. Notify the California Emergency Management Agency State Warning Center at (916) 845-8911
 6. Notify the National Response Center at (800) 424-8802 regarding spills of Federal reportable quantities under 40 CFR 110, 119, and 302
 7. Notify other agencies as appropriate, including:
 - a. Fire Department
 - b. Public Works Department
 - c. Highway Patrol
 - d. City Police or County Sheriff's Department
 - e. Department of Toxic Substances
 - f. California Division of Oil and Gas
 - g. Cal/OSHA
 - h. Regional Water Resources Control Board
- B. Prevent a spill from entering stormwater runoff before and during cleanup activities. Do not bury or wash the spill with water.

3.05 MATERIAL MANAGEMENT

- A. Minimize or eliminate discharge of material into the air, storm drain systems, and receiving waters while taking delivery of, using, or storing the following materials:
1. Hazardous chemicals, including acids, lime, glues, adhesives, paints, solvents, and curing compounds
 2. Soil stabilizers and binders
 3. Fertilizers
 4. Detergents
 5. Plaster
 6. Petroleum materials, including fuel, oil, and grease
 7. Asphalt and concrete components
 8. Pesticides and herbicides
- B. Employees trained in emergency spill cleanup procedures must be present during the unloading of hazardous materials or chemicals.
- C. Use less hazardous materials if practicable.
- D. The following activities must be performed at least 100 feet from concentrated flows of stormwater, drainage courses, and inlets if within the floodplain and at least 50 feet if outside the floodplain, unless otherwise approved by the VTA:
1. Stockpiling materials

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2. Storing pile-driving equipment and liquid waste containers
3. Washing vehicles and equipment in outside areas
4. Fueling and maintaining vehicles and equipment

3.06 MATERIAL STORAGE

A. If materials are stored:

1. Store liquids, petroleum materials, and substances listed in 40 CFR 110, 117, and 302 and place them in secondary containment facilities as specified by US DOT for storage of hazardous materials.
2. Secondary containment facilities must be impervious to the materials stored there for a minimum contact time of 72 hours.
3. Cover secondary containment facilities during non-working days and whenever precipitation is forecasted. Secondary containment facilities must be adequately ventilated.
4. Keep secondary containment facilities free of accumulated rainwater or spills. After precipitation, or in the event of spills or leaks, collect accumulated liquid and place it into drums within 24 hours. Handle the liquid as hazardous waste under 3.08 Waste Management of this Section unless testing confirms that the liquid is nonhazardous.
5. Do not store incompatible materials, such as chlorine and ammonia, in the same secondary containment facility.
6. Store materials in their original containers with the original material labels maintained in legible condition. Immediately replace damaged or illegible labels.
7. Secondary containment facilities must have the capacity to contain precipitation from a 24-hour-long, 25-year storm, plus 10 percent of the aggregate volume of all containers or the entire volume of the largest container within the facility, whichever is greater.
8. Store bagged or boxed material on pallets. Protect bagged or boxed material from wind and rain during non-working days and whenever precipitation is forecasted.
9. Provide sufficient separation between stored containers to allow for spill cleanup or emergency response access. Storage areas must be kept clean, well organized, and equipped with cleanup supplies appropriate for the materials being stored.
10. Repair or replace perimeter controls, containment structures, covers, and liners as necessary. Inspect storage areas before and after precipitation and at least weekly during other times.

3.07 STOCKPILE MANAGEMENT

- A. Minimize stockpiling of materials at the job site.
- B. Implement water pollution control practices within 72 hours of stockpiling material or before a forecasted storm event, whichever occurs first. If stockpiles are being used, do not allow soil, sediment, or other debris to enter storm drains, open drainages, and watercourses.
- C. Active and inactive soil stockpiles must be:
 1. Covered with soil stabilization material or a temporary cover.
 2. Surrounded with a linear sediment barrier.
- D. Stockpiles of asphalt concrete and PCC rubble, HMA, aggregate base, or aggregate subbase must be:
 1. Covered with a temporary cover.
 2. Surrounded with a linear sediment barrier.

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- E. Stockpiles of pressure-treated wood must be:
 - 1. Placed on pallets
 - 2. Covered with impermeable material
- F. Stockpiles of cold mix asphalt concrete must be:
 - 1. Placed on an impervious surface
 - 2. Covered with an impermeable material
 - 3. Protected from stormwater run-on and runoff
- G. Control wind erosion year round in accordance with Section 01 74 15, Dust Control and Section 10-5, Dust Control, of the Caltrans Standard Specifications.
- H. Repair or replace linear sediment barriers and covers as needed to keep them functioning properly. Whenever sediment accumulates to 1/3 of the linear sediment barrier height, remove the accumulated sediment.

3.08 WASTE MANAGEMENT

- A. Solid Waste
 - 1. Do not allow litter, trash, or debris to accumulate anywhere on the job site, including storm drain grates, trash racks, and ditch lines. Pick up and remove litter, trash, and debris from the job site at least daily. Cover waste containers at the end of each work day and when it is raining. The WPC manager must monitor solid waste storage and disposal procedures on the job site. If practicable, recycle nonhazardous job site waste and excess material. Furnish enough closed-lid dumpsters of sufficient size to contain the solid waste generated by work activities. When refuse reaches the fill line, empty the dumpsters. Dumpsters must be watertight. Do not wash out dumpsters at the job site. Furnish additional containers and pick up dumpsters more frequently during the demolition phase of construction.
 - 2. Solid waste includes:
 - a. Brick
 - b. Mortar
 - c. Timber
 - d. Metal scraps
 - e. Sawdust
 - f. Pipe
 - g. Electrical cuttings
 - h. Nonhazardous equipment parts
 - i. Styrofoam and other packaging materials
 - j. Vegetative material and plant containers from highway planting
 - k. Litter and smoking material, including litter generated randomly by the public
 - l. Other trash and debris
 - 3. Furnish and use trash receptacles in the job site yard, field trailers, and locations where workers gather for lunch and breaks.

3.09 HAZARDOUS WASTE AND CONTAMINATION

- A. If hazardous waste is, or will be, generated on the job site, the contractor's Water Pollution Control (WPC) manager must be thoroughly familiar with proper hazardous waste handling and emergency procedures under 40 CFR § 262.34(d)(5)(iii) and must have successfully completed training under 22 CA Code of Regs § 66265.16.
- B. The WPC manager must:
 - 1. Oversee and enforce hazardous waste management practices

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2. Inspect all hazardous waste storage areas daily, including all temporary containment facilities and satellite collection locations
3. Oversee all hazardous waste transportation activities on the job site
- C. Submit a copy of uniform hazardous waste or contaminated soils manifest forms to the VTA within 24 hours of transporting hazardous waste as specified in Section 02 61 00, Contaminated Soil Management, Section 02 80 00, Hazardous Material Abatement, and as directed by VTA.
- D. Submit receiving landfill documentation of proper disposal to the VTA within 7 days of hazardous waste or contaminated soils transport from the project.

3.10 HAZARDOUS WASTE MANAGEMENT PRACTICES

- A. Handle, store, and dispose of hazardous waste under 22 CA Code of Regs Div 4.5 and as indicated in Section 02 61 00, Contaminated Soil Management, Section 02 80 00, Hazardous Material Abatement, and as directed by VTA
- B. Use the following storage procedures:
 1. Store hazardous waste and potentially hazardous waste separately from nonhazardous waste at the job site.
 2. For hazardous waste storage, use metal containers approved by the United States Department of Transportation for the transportation and temporary storage of hazardous waste.
 3. Store hazardous waste in sealed, covered containers labeled with the contents and accumulation start date under 22 CA Code of Regs, Div 4.5. Labels must comply with the provisions of 22 CA Code of Regs, Div 4.5. § 66262.31 and § 66262.32. Immediately replace damaged or illegible labels.
 4. Handle hazardous waste containers such that no spillage occurs.
 5. Store hazardous waste away from storm drains, watercourses, moving vehicles, and equipment.
 6. Furnish containers with adequate storage volume at convenient satellite locations for hazardous waste collection. Immediately move these containers to secure temporary containment facilities when no longer needed at the collection location or when full.
 7. Store hazardous waste and potentially hazardous waste in secure temporary containment enclosures having secondary containment facilities impervious to the materials stored there for a minimum contact-time of 72 hours. Temporary containment enclosures must be located away from public access. Acceptable secure enclosures include a locked chain link fenced area or a lockable shipping container located within the project limits.
 8. Design and construct secondary containment facilities with a capacity to contain precipitation from a 24-hour-long, 25-year storm; and 10 percent of the aggregate volume of all containers, or the entire volume of the largest container within the facility, whichever is greater.
 9. Cover secondary containment facilities during non-working days and if a storm event is predicted. Secondary containment facilities must be adequately ventilated.
 10. Keep secondary containment facility free of accumulated rainwater or spills. After a storm event, or in the event of spills or leaks, collect accumulated liquid and place into drums within 24 hours. Handle these liquids as hazardous waste unless testing determines them to be nonhazardous.
 11. Do not store incompatible wastes, such as chlorine and ammonia, in the same secondary containment facility.
 12. Provide sufficient separation between stored containers to allow for spill cleanup or emergency response access. Storage areas must be kept clean, well organized, and equipped with cleanup supplies appropriate for the wastes being stored.

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13. Repair or replace perimeter controls, containment structures, covers, and liners as necessary. Inspect storage areas before and after a storm event, and at least weekly during other times.

3.11 HAZARDOUS WASTE STORAGE

- A. Do not:
1. Overfill hazardous waste containers
 2. Spill hazardous waste or potentially hazardous waste
 3. Mix hazardous wastes
 4. Allow hazardous waste or potentially hazardous waste to accumulate on the ground
- B. Dispose of hazardous waste within 90 days of the start of generation. Use a hazardous waste manifest and a transporter registered with the DTSC and in compliance with the CA Highway Patrol Biennial Inspection of Terminals Program to transport hazardous waste to an appropriately permitted hazardous waste management facility.

3.12 DUST CONTROL FOR HAZARDOUS WASTE OR CONTAMINATION

- A. Excavation, transportation, and handling of material containing hazardous waste or contamination must result in no visible dust migration.
- B. Have a water truck or tank on the job site at all times while clearing and grubbing and performing earthwork operations in work areas containing hazardous waste or contamination.

3.13 STOCKPILING OF HAZARDOUS WASTE OR CONTAMINATION

- A. Do not stockpile material containing hazardous waste or contamination unless ordered. Stockpiles of material containing hazardous waste or contamination must not be placed where affected by surface run-on or run-off.
- B. Cover stockpiles with 13 mil-minimum thickness of plastic sheeting or 1 foot of nonhazardous material. Do not place stockpiles in environmentally sensitive areas. Stockpiled material must not enter storm drains, inlets, or waters of the State.
- C. Water trucks/buffalos must be labeled accordingly “Potable” or “Non-Potable” water.

3.14 CONTRACTOR-GENERATED HAZARDOUS WASTE

- A. You are the generator of hazardous waste generated as a result of materials you bring to the job site. Use hazardous waste management practices if you generate waste on the job site from the following substances:
1. Petroleum materials
 2. Asphalt materials
 3. Concrete curing compound
 4. Pesticides
 5. Acids
 6. Paints
 7. Stains
 8. Solvents
 9. Wood preservatives
 10. Roofing tar

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11. Road flares

12. Lime

13. Glues and adhesives

14. Materials classified as hazardous waste under 22 CA Code of Regs, Div 4.5

- B. If hazardous waste constituent concentrations are unknown, use a laboratory certified by the ELAP under the California Department of Public Health to analyze a minimum of 4 discrete representative samples of the waste to determine whether it is a hazardous waste and to determine safe and lawful methods for storage and disposal. Perform sampling and analysis in compliance with US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) and under 22 CA Code of Regs, Div 4.5.
- C. Use your US EPA Generator Identification Number and sign hazardous waste manifests for the hazardous waste you generate.
- D. Identify contaminated soil resulting from spills or leaks by noticing discoloration, or differences in soil properties. Immediately notify the VTA of spills or leaks. Clean up spills and leaks under the VTA's direction and to the satisfaction of the VTA. Soil with evidence of contamination must be sampled and analysis performed by a laboratory certified by ELAP.
- E. If sampling and analysis of contaminated soil demonstrates that it is a hazardous waste, handle and dispose of the soil as hazardous waste. You are the generator of hazardous waste created as the result of spills or leaks for which you are responsible.
- F. Prevent the flow of water, including ground water, from mixing with contaminated soil by using one or a combination of the following measures:
1. Berms
 2. Cofferdams
 3. Grout curtains
 4. Freeze walls
 5. Concrete seal course
- G. If water mixes with contaminated soil and becomes contaminated, sample and analyze the water using a laboratory certified by the ELAP. If analysis results demonstrate that the water is a hazardous waste, manage and dispose of the water as hazardous waste.

3.15 HAZARDOUS WASTE TRANSPORT AND DISPOSAL

- A. Dispose of hazardous waste within California at a disposal site operating under a permit issued by the California Department of Toxic Substance Control (DTSC).
- B. The VTA will obtain the US EPA Generator Identification Number for hazardous waste disposal, if required.
- C. The VTA will sign all hazardous waste manifests. Notify the VTA 7 days before the manifests are to be signed.
- D. The Contractor will not be considered a generator of the hazardous waste and will not be obligated for further cleanup, removal, or remedial action for such material if handled or disposed of under these specifications and the appropriate State and federal laws and regulations and county and municipal ordinances and regulations regarding hazardous waste.

3.16 PAINT WASTE

- A. Clean water-based and oil-based paint from brushes or equipment within a contained area in a way that does not contaminate soil, receiving waters, or storm drain systems.

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- B. Handle and dispose of the following as hazardous waste: paints, thinners, solvents, residues, and sludges that cannot be recycled or reused.
- C. When thoroughly dry, dispose of the following as solid waste: dry latex paint, paint cans, used brushes, rags, absorbent materials, and drop cloths.

3.17 CONCRETE WASTE

- A. Use practices to prevent the discharge of asphalt concrete, PCC, and HMA waste into storm drain systems and receiving waters.
- B. Collect and dispose of asphalt concrete, PCC, and HMA waste generated at locations where:
 - 1. Concrete material, including grout, is used
 - 2. Concrete dust and debris result from demolition
 - 3. Sawcutting, coring, grinding, grooving, or hydro-concrete demolition creates a residue or slurry
 - 4. Concrete trucks or other concrete-coated equipment is cleaned at the job site

3.18 SANITARY AND SEPTIC WASTE

- A. Do not bury or discharge wastewater from a sanitary or septic system within the job site. A sanitary facility discharging into a sanitary sewer system must be properly connected and free from leaks. Place a portable sanitary facility at least 50 feet away from storm drains, receiving waters, and flow lines.
- B. Comply with local health agency provisions if using an on-site disposal system.

3.19 LIQUID WASTE

- A. Use practices that will prevent job-site liquid waste from entering storm drain systems and receiving waters. Liquid wastes include the following:
 - 1. Drilling slurries or fluids
 - 2. Grease-free and oil-free wastewater and rinse water
 - 3. Dredgings, including liquid waste from cleaning drainage systems
 - 4. Liquid waste running off a surface, including wash or rinse water
 - 5. Other nonstormwater liquids not covered by separate permits
- B. Hold liquid waste in structurally sound, leak-proof containers, such as roll-off bins or portable tanks. Liquid waste containers must be of sufficient quantity and volume to prevent overflow, spills, and leaks. Store containers at least 50 feet from moving vehicles and equipment. Remove and dispose of deposited solids from sediment traps unless the VTA approves another method. Liquid waste may require testing to determine hazardous material content before disposal.
- C. Disposal of drilling fluids and residue: If a location approved by the VTA is available within the job site, fluids and residue exempt under 23 CA Code of Regs § 2511(g) may be dried by evaporation in a leak-proof container. Dispose of the remaining as solid waste.

3.20 NON-STORM WATER MANAGEMENT

- A. Water Control and Conservation:
 - 1. Manage water used for work activities in a way that will prevent erosion and the discharge of pollutants into storm drain systems and receiving waters. Obtain authorization before washing anything at the job site with water that could discharge into a storm drain system or receiving waters. Report discharges immediately.

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2. Implement water conservation practices if water is used at the job site. Inspect irrigation areas. Adjust watering schedules to prevent erosion, excess watering, or runoff. Shut off the water source to broken lines, sprinklers, or valves and repair breaks within 24 hours. Reuse water from waterline flushing for landscape irrigation if practicable. Sweep and vacuum paved areas. Do not wash paved areas with water.
3. Direct runoff water, including water from water line repair, from the job site to areas where it can infiltrate into the ground. Do not allow runoff water to enter storm drain systems and receiving waters. Do not allow spilled water to escape filling areas for water trucks. If practicable, water from off-site sources shall be directed around the job site. Minimize the contact of off-site water with job site water.

B. Illegal Connection and Discharge Detection and Reporting:

1. Before starting work, inspect the job site and the job site's perimeter for evidence of illicit connections, illegal discharges, and dumping. After starting work, inspect the job site and perimeter on a daily schedule for illicit connections and illegal dumping and discharges.
2. Whenever illegal connections, discharges, or dumping are discovered, notify the VTA immediately. Do not take further action unless ordered. Assume that unlabeled or unidentifiable material is hazardous.
3. Look for the following evidence of illicit connections, illegal discharges, and dumping:
 - a. Debris or trash piles.
 - b. Staining or discoloration on pavement or soils.
 - c. Pungent odors coming from drainage systems.
 - d. Discoloration or oily sheen on water.
 - e. Stains and residue in ditches, channels, or drain boxes.
 - f. Abnormal water flow during dry weather.
 - g. Excessive sediment deposits.
 - h. Nonstandard drainage junction structures.
 - i. Broken concrete or other disturbances at or near junction structures.

C. Vehicle and Equipment Cleaning

1. Limit vehicle and equipment cleaning or washing at the job site except what is necessary to control vehicle tracking or hazardous waste. Notify the VTA before cleaning vehicles and equipment at the job site with soap, solvents, or steam. Contain and recycle or dispose of resulting waste under "Waste Management" of these Technical Specifications, whichever is applicable. Do not use diesel to clean vehicles or equipment. Minimize the use of solvents.
2. Clean or wash vehicles and equipment in a structure equipped with disposal facilities. You may wash vehicles in an outside area if the area is:
 - a. Paved with asphalt concrete, HMA, or PCC.
 - b. Surrounded by a containment berm.
 - c. Equipped with a sump to collect and dispose of wash water.
3. Use as little water as practicable whenever washing vehicles and equipment with water. Hoses must be equipped with a positive shutoff valve.
4. Discharge liquid from wash racks to a recycling system or to another system approved by the VTA. Remove liquids and sediment as necessary.

D. Vehicle and Equipment Fueling and Maintenance

1. If practicable, perform maintenance on vehicles and equipment off-site.
2. If fueling or maintenance must be done at the job site, assign a site or sites, and obtain authorization before using them. Minimize mobile fueling and maintenance activities. Fueling and maintenance activities must be performed on level ground in areas protected from stormwater run-on and runoff.
3. Use containment berms or dikes around fueling and maintenance areas. Keep adequate quantities of absorbent spill-cleanup material and spill kits in the fueling or maintenance area and on fueling trucks.

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- Dispose of spill-cleanup material and kits immediately after use under “Waste Management” of these Technical Specifications. Use drip pans or absorbent pads during fueling or maintenance.
4. Do not leave fueling or maintenance areas unattended during fueling and maintenance activities. Fueling nozzles must be equipped with an automatic shutoff control. Nozzles must be equipped with vapor-recovery fueling nozzles where required by the Air Quality Management District. Secure nozzles in an upright position when not in use. Do not top off fuel tanks.
 5. Recycle or properly dispose of used batteries and tires under “Waste Management” of these Technical Specifications.
 6. If leaks cannot be repaired immediately, remove the vehicle or equipment from the job site.
- E. Paving, Sealing, Sawcutting, Grooving, and Grinding Activities
1. Prevent material from entering storm drain systems and receiving waters including:
 - a. Cementitious material.
 - b. Asphaltic material.
 - c. Aggregate or screenings.
 - d. Sawcutting, grooving, and grinding residue.
 - e. Pavement chunks.
 - f. Shoulder backing.
 - g. Methacrylate.
 - h. Sandblasting residue.
 2. Cover drainage inlets and use linear sediment barriers to protect downhill receiving waters until paving, sealing, sawcutting, grooving, and grinding activities are completed and excess material has been removed. Cover drainage inlets and manholes during the application of seal coat, tack coat, slurry seal, or fog seal.
 3. Whenever precipitation is forecasted, limit paving, sawcutting, and grinding to places where runoff can be captured.
 4. Do not start seal coat, tack coat, slurry seal, or fog seal activities whenever precipitation is forecasted during the application and curing period. Do not excavate material from existing roadways during precipitation.
 5. Use a vacuum to remove slurry immediately after slurry is produced. Do not allow the slurry to run onto lanes open to traffic or off the pavement.
 6. Collect the residue from PCC grooving and grinding activities with a vacuum attachment on the grinding machine. Do not leave the residue on the pavement or allow the residue to flow across pavement.
 7. You may stockpile material excavated from existing roadways under “Material Management” of these Technical Specifications if approved by the VTA.
 8. Do not coat asphalt trucks and equipment with substances that contain soap, foaming agents, or toxic chemicals.
 9. Park paving equipment over drip pans or plastic sheeting with absorbent material to catch drips if the paving equipment is not in use.
- F. Thermoplastic Striping and Pavement Markers:
1. Do not preheat, transfer, or load thermoplastic within 50 feet of drainage inlets and receiving waters.
 2. Do not unload, transfer, or load bituminous material for pavement markers within 50 feet of drainage inlets and receiving waters.
 3. Collect and dispose of bituminous material from the roadway after removing markers under “Waste Management” of these Technical Specifications.

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G. Pile Driving:

1. Keep spill kits and cleanup materials at pile driving locations. Park pile driving equipment over drip pans, absorbent pads, or plastic sheeting with absorbent material. Protect pile driving equipment by parking on plywood and covering with plastic whenever precipitation is forecasted.
2. Store pile driving equipment on level ground and protect it from stormwater run-on when not in use. Use vegetable oil instead of hydraulic fluid, if practicable.

H. Concrete Curing.

1. Do not overspray chemical curing compounds. Minimize the drift by spraying as close to the concrete as practicable. Do not allow runoff of curing compounds. Cover drainage inlets before applying the curing compound.
2. Minimize the use and discharge of water by using wet blankets or similar methods to maintain moisture when concrete is curing.

I. Concrete Finishing:

1. Collect and dispose of water and solid waste from high-pressure water blasting under “Waste Management” of these Technical Specifications. Collect and dispose of sand and solid waste from sandblasting under “Waste Management” of these Technical Specifications. Before sandblasting, cover drainage inlets within 50 feet of sandblasting. Minimize the drift of dust and blast material by keeping the nozzle close to the surface of the concrete. If the character of the blast residue is unknown, test it for hazardous materials and dispose of it properly.
2. Inspect containment structures for concrete finishing for damage before each day of use and before forecasted precipitation. Remove liquid and solid waste from containment structures after each work shift.

J. Sweeping:

1. Sweep by hand or mechanical methods, such as vacuuming. Mechanical sweepers must have water-spray capability to prevent dust. Do not use methods that use only mechanical kick brooms.
2. Sweep paved roads at construction entrance and exit locations and paved areas within the job site:
 - a. During clearing and grubbing activities.
 - b. During earthwork activities.
 - c. During trenching activities.
 - d. During roadway structural-section activities.
 - e. When vehicles are entering and leaving the job site.
 - f. After soil-disturbing activities.
 - g. After observing off-site tracking of material.
3. Monitor paved areas and roadways within the project. Sweep within:
 - a. 1 hour whenever sediment or debris is observed during activities that require sweeping.
 - b. 24 hours whenever sediment or debris is observed during activities that do not require sweeping.
4. Remove collected material, including sediment, from paved shoulders, drain inlets, curbs and dikes, and other drainage areas. You may stockpile collected material at the job site under “Material Management” of these Technical Specifications. If stockpiled, dispose of collected material at least once per week under “Waste Management” of these Technical Specifications.
5. Keep dust to a minimum during street sweeping activities. Use water or a vacuum whenever dust generation is excessive or sediment pickup is ineffective.
6. Remove and dispose of trash collected during sweeping under “Waste Management” of these Technical Specifications.

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K. Dewatering:

1. Dewatering consists of discharging accumulated stormwater, groundwater, or surface water from excavations or temporary containment facilities.
2. Perform dewatering work as specified for the work items involved, such as temporary active treatment system or dewatering and discharge.
3. If dewatering and discharging activities are not specified under a work item and you perform dewatering activities:
 - a. Conduct dewatering activities in accordance with the State Water Resource Control Board (SWRCB) NPDES dewatering permit requirements.
 - b. Ensure that any dewatering discharge does not cause erosion, scour, or sedimentary deposits that could impact natural bedding materials.
 - c. Discharge the water within the project limits. If the water cannot be discharged within project limits due to site constraints or contamination, dispose of the water in accordance with the SWRCB NPDES permit requirements.
 - d. Do not discharge stormwater or non stormwater that has an odor, discoloration other than sediment, an oily sheen, or foam on the surface. Notify the VTA immediately upon discovering any such condition.

L. Earthwork

1. Construct edge containment structures such as berms, dikes, retaining structures, or compacted soil zones.
2. Remove or treat soils and geologic materials prone to lateral spreading and settling.
3. Install drainage measures to lower the groundwater table below the level of settleable soils pursuant to the California Division of Mines and Geology's Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A (2008).

3.20 AIR QUALITY

A. Signage

1. VTA will post one (1) or more publicly-visible signs with the telephone number and person to contact at VTA with complaints related to excessive dust or vehicle idling. VTA's assigned person will respond to complaints; and if necessary, initiate corrective action within 48 hours.
2. The publicly-posted signs will include the telephone number and person to contact at the Bay Area Air Quality Management District (BAAQMD) Compliance and Enforcement Division in the event that the complainant also wishes to contact the BAAQMD.

B. In addition to limiting dust, criteria pollutants, and precursor emissions associated with project construction, the following BAAQMD-recommended Basic Construction Measures will be included in all construction contract specifications for the proposed project:

1. **Watering:** All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two (2) times per day.
2. **Truck Covering:** All haul trucks transporting soil, sand, or other loose material offsite shall be covered.
3. **Sweeping:** All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
4. **Speed Limits:** Vehicle speeds on unpaved areas shall be limited to 15 miles per hour.

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5. Paving: All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.
6. Equipment Idling: Idling times for construction equipment (including vehicles) shall be minimized either by shutting equipment off when it is not in use, or by reducing the maximum idling time to five (5) minutes. Clear signage of this requirement shall be provided for construction workers at all access points to construction areas.
7. Equipment Condition: All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic, and determined to be running in proper condition prior to operation.

3.21 CULTURAL RESOURCES

- A. In the event previously unknown archaeological materials, including marine shell fragments, fragments of human or animal bone, stone tools, midden soils, historic refuse, or structural remains are encountered during project implementation, all ground-disturbing activities in the vicinity of the discovered materials will be halted until the nature and significance of the find can be evaluated by a qualified archaeologist. In the event of such a discovery, the contractor will notify VTA immediately.
- B. If any human remains are found during construction, provisions of California Health and Safety Code Sections 7050.5 and 7054 and Public Resources Code Sections 5097.9 through 5097.99, as amended per Assembly Bill 2641, shall be followed.

3.22 TRANSPORTATION

- A. Measures shall be implemented to minimize transportation and traffic impacts during construction, such as flagging, signage, barriers, or other devices to warn motorists of construction, and to ensure the safety of workers and equipment.
- B. During closure of vehicle lanes and sidewalks, detour signs shall be placed to guide motorists, bicyclists and pedestrians to alternate routes as appropriate.

3.23 MUD CONTROL

- A. The Contractor shall take proper measures to prevent tracking of mud onto public streets, drives, and sidewalks. Such measures shall include, but are not limited to, covering muddy areas on the site with clean, dry sand.
- B. All egress from the site shall be maintained in a dry condition, and any mud tracked onto streets, sidewalks, or drives shall be immediately removed, and the affected area shall be cleaned. The Engineer may order such work at any time the conditions warrant.
- C. Where trucks will leave a muddy site and enter paved public streets, the Contractor shall maintain a suitable truck wheel-washing facility and crew. All trucks, or other vehicles leaving the site, shall be cleaned of mud and dirt, including mud and dirt clinging to exterior body surfaces of vehicles.
- D. All trucks coming to the jobsite or leaving the jobsite with materials or loose debris shall be loaded in a manner that will prevent dropping of materials or debris on streets. Spillage resulting from hauling operations along or across any public traveled way shall be removed immediately.

3.24 NOISE CONTROL

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- A. Requirements: Minimize noise caused by construction operations, and provide working machinery and equipment fitted with efficient noise suppression devices. Employ other noise abatement measures as necessary for protection of employees and the public. In addition, restrict working hours and schedule operations in a manner that will minimize, to the greatest extent feasible, disturbance to residents in the vicinity of the Work.
- B. Definitions:
1. Daytime refers to the period from 7:00 a.m. to 7:00 p.m. local time daily except Sundays and legal holidays.
 2. Nighttime refers to all other times including all day Sunday and legal holidays.
 3. Construction Limits are defined for the purpose of these noise control requirements as the construction easement boundaries, or property lines as shown on the Contract Drawings.
 4. Zones, Special Zones, and Special Construction Sites outside of the Construction Limits shall be as designated by the local authority having jurisdiction. Such specially designated zones shall be treated by the Contractor as if they were within the Construction Limits.
- C. Monitoring:
1. Monitor noise levels of work operations to assure compliance with the noise limitations specified herein. Retain record of noise measurements for inspection by the Engineer.
 2. Promptly inform the Engineer of any complaints received from the public regarding noise. Describe the action proposed and the schedule for implementation, and subsequently inform the Engineer of the results of the action.
 3. Monitor noise levels day and night and for each new activity or piece of equipment. Start by measuring 3 times a day plus once a night for three consecutive days. Monitor noise levels at least once a week thereafter.
- D. Measurement Procedure:
1. Except where otherwise indicated, perform all noise measurements using the A-weight network and "slow" response of an instrument complying with the criteria for a Type 2 General Purpose sound level meter as described in ANSI S1.4.
 2. Measure impulsive or impact noises with an impulse sound level meter complying with the criteria of IEC 179 for impulse sound level meters. As an alternative procedure, a Type 2 General Purpose sound level meter on C-weighting and "fast" response may be used to estimate peak values of impulsive or impact noises. Transient meter indications of 125 dB C "fast" or higher will be considered as indications of impulsive noise levels of 140 d or greater.
 3. Measure noise levels at buildings affected acoustically by the Contractor's operations at points between 3 feet and 6 feet from the building face to minimize the effect of reflections.
 4. Measure noise levels at points on the outer boundaries of Construction Limits or Special Construction Sites for noise emanating from within.
 5. Where more than one criterion of noise limits is applicable, use the more restrictive requirement for determining compliance.

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E. Continuous Construction Noise: Prevent noise from stationary sources, parked mobile sources, or any source or combination of sources producing repetitive or long-term noise lasting more than a few hours from exceeding the following limits:

1. Maximum Allowable Continuous Noise Level, dBA:

<u>Affected Residential Area</u>	<u>Daytime</u>	<u>Nighttime</u>
Single family residence	60	50
Along an arterial or in multi-family residential areas, including hospitals	65	55
In semi-residential/commercial areas, including hotels	70	60
 <u>Affected Commercial Area</u>		 <u>At All Times</u>
In semi-residential/commercial areas, including schools		65
In commercial areas with no nighttime residency		70
 <u>Affected Industrial Area</u>		
All locations		80

F. Intermittent Construction Noise: Prevent noises from non-stationary mobile equipment operated by a driver or from any source of non-scheduled, intermittent, non-repetitive, short-term noises not lasting more than a few hours from exceeding the following limits:

1. Maximum Allowable Intermittent Noise Level, dBA:

<u>Affected Residential Area</u>	<u>Daytime</u>	<u>Nighttime</u>
Single family residence areas	75	60
Along an arterial or in multi-family residential areas, including hospitals		
In semi-residential/commercial areas, including hotels	80	70
 <u>Affected Commercial Area</u>		 <u>At All Times</u>
In semi-residential/commercial areas, including schools		80
In commercial areas with no nighttime residency		85
 <u>Affected Industrial Area</u>		
All locations		90

G. Indicator and Production Pile Driving Programs: Contractor shall incorporate the following into the pile driving program:

1. Comply with the equivalent noise levels (Leq) limits specified on page 12-8 of FTA 2006 and a maximum noise level limits of 90 dBA (slow) or 125 dBC (fast) for residential buildings,
2. Comply with the maximum vibration limits specified in Table 12-3 of FTA 2006.

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3. Perform a detailed survey and photo documentation prior to construction of all potentially affected wood-frame buildings within 135 ft of the piling activity,
4. Coordinate and perform noise and vibration monitoring at a representative sampling of potentially affected buildings along the Project corridor,
5. Install crack monitors where appropriate and provide photo documentation at all potentially affected buildings during pile driving activity and through construction,
6. Provide a minimum four-week advance notice of the start of piling operations to all affected receptors (e.g., internet, phone and fax), and regular, up-to-date communications. This includes education of the public on the expected noise and vibration.
7. Provide a knowledgeable Community Liaison to respond to questions and complaints regarding pile driving noise and vibration.
8. Provide assistance as needed to nearby residents or offices who may require help relocating valuable items off shelves.
9. Utilize burlap bags to reduce noise and wood block when pile driving becomes more difficult in accordance with Mitigation Monitoring and Reporting Plan (MMRP).

END OF SECTION 01 74 19

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SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements preparatory to final inspection.
- B. Final inspection.
- C. Acceptance of the Work and final payment.

1.02 RELATED SECTIONS

- A. Section 7.55, Final Inspection and Acceptance of All or a Portion of the Work, of the General Conditions
- B. Section 7.62, Final Payment, of the General Conditions
- C. Section 01 74 12, Cleaning
- D. Section 01 78 23, Operation and Maintenance Data
- E. Section 01 78 39, Project Record Documents

1.03 MEASUREMENT AND PAYMENT

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

1.04 REQUIREMENTS PREPARATORY TO FINAL INSPECTION

- A. The Contractor shall request a preliminary final inspection to determine the state of completion of the Work.
- B. The request shall be made in writing, addressed to the Engineer, at least seven days in advance of the requested date of the preliminary inspection.
- C. The Engineer will perform the preliminary inspection within three days of the requested date.
- D. Prior to the requested date of the preliminary inspection, the Contractor shall perform or provide the following, as applicable:
 - 1. Temporary facilities, except as may be required for punch list work, shall be removed from the site.
 - 2. The site and all applicable appurtenances and improvements shall be cleaned as specified

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- in Section 01 74 12, Cleaning.
3. Record drawings and specifications shall be completed, signed, and submitted to the Engineer as specified in Section 01 78 39, Project Record Documents.
 4. Operating instructions for equipment shall be properly mounted and posted as specified in Section 01 78 23, Operation and Maintenance Data.
 5. Guaranties and warranties shall be submitted to the Engineer, as specified in the General Conditions and various sections of the Specifications, along with required operations and maintenance manuals as specified in Section 01 78 23, Operation and Maintenance Data.
- E. The Contractor shall be represented by its principal superintendent and such Subcontractors and Suppliers as may be necessary to answer the questions of the Engineer's inspection team.
- F. Certain elements of the Work, such as mechanical and electrical work, may be scheduled separately at appointed times in order to keep the preliminary inspection more focused and the number of persons in the Engineer's inspection team to a minimum.
- G. From the information gathered from this inspection, the Engineer will prepare a punch list of work to be performed, corrected, or completed.
- H. All work on the punch list shall be completed by the Contractor prior to requesting the final inspection.

1.05 FINAL INSPECTION

- A. When all requirements of the above prepared punch list have been completed, the Contractor shall request the final inspection to determine eligibility for issuance of the Certificate of Substantial Completion.
- B. The request shall be made in writing, addressed to the Engineer, at least seven days in advance of the requested date of the final inspection.
- C. The Contractor shall be represented by its principal superintendent and such Subcontractors and Suppliers as may be necessary to verify the completion of the Work including punch list items.
- D. Depending on the extensiveness of the punch list items, certain elements of the Work may be scheduled separately for final inspection at appointed times.
- E. If the Work has been substantially completed in accordance with the Contract Documents, and only minor corrective measures are required, the Engineer will recommend that VTA issue a Certificate of Substantial Completion, based upon the Contractor's assurance that remaining corrective measures will be completed within the shortest practicable time period. The Engineer will attach a corresponding punch list to the Certificate of Substantial Completion. A fixed schedule for such corrective measures shall be submitted to the Engineer, for approval.
- F. If the Work has not been substantially completed in accordance with the Contract Documents, and corrective measures are still required, a new punch list will be prepared by the Engineer, based on the information gathered from the final inspection, and the Contractor will be required to complete this work and then call for another final inspection, following the procedure outlined above.

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- G. The date of the Certificate of Substantial Completion will establish the completion date of the Work, or portions thereof as specifically referenced in the Certificate, for determining liquidated damages.

1.06 ACCEPTANCE OF THE WORK AND FINAL PAYMENT

- A. Upon completion of the Substantial Completion punch list items, the Engineer will recommend that the VTA formally accept the Work.
- B. Acceptance of the Work will be made in accordance with Section 7.55, Final Inspection and Acceptance of All or a Portion of the Work, of the General Conditions. Final payment will be made in accordance with Section 7.62, Final Payment, of the General Conditions.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 77 00

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for project operation and maintenance data.
- B. Post operating instructions.
- C. Manual description.
- D. Submittal requirements.
- E. Submittal of final Operation and Maintenance (O&M) Manuals.
- F. Off-the-Shelf Equipment Manuals.
- G. Native electronic file format for System Manuals
- H. Format and technical content for System Manuals.
- I. Printed Manual requirements.
- J. Electronic version of Manual (eManual) for System Manuals.
- K. Manual revision control.

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions

1.03 MEASUREMENT AND PAYMENT

- A. Measurement: Operation and Maintenance Data shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Operation and Maintenance Data shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved complying with the requirements of this Section, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.04 REFERENCES

- A. American National Standards Institute (ANSI)

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1. ANSI Y14.5 – Geometric Dimensioning and Tolerancing Standards
2. ANSI Y32.2 - Graphic Symbols for Electrical and Electronics Diagram

1.05 POSTED OPERATING INSTRUCTIONS

- A. Provide, where directed, printed sheets under framed clear acrylic plastic, giving brief, concise operating and maintenance instructions for all items of mechanical and electrical equipment and similar equipment and specialty items, as applicable, at their respective locations.

1.06 OPERATION AND MAINTENANCE MANUAL DESCRIPTION

- A. Manuals shall be provided for all equipment and systems furnished under the Contract that require maintenance, operation, or modification including testing and training equipment. Manuals shall also be provided for other items, such as finishes, when specified in the Contract Specifications. Provide Manuals for each item of equipment and its component parts.
- B. Prepare Manuals in English.
- C. Manuals will be subject to revisions, updates, and other alternations as determined by the VTA.
- D. Manuals shall be provided in one of the three following formats:
 3. Off-the-Shelf Equipment Manuals shall be provided for off-the-shelf items. Such equipment includes sub-assemblies and components that will be replaced instead of repaired or has no need for modifications, drawings, or manual revisions. Off-the- Shelf Equipment Manuals shall conform to the requirements specified in Articles 1.07, 1.08, 1.09 and 1.10 herein.
 4. System Manuals shall conform to the requirements specified herein. System Manuals shall be provided whenever stipulated in the Contract Specifications. Typically, such systems and equipment will include systems and equipment which have been specifically built for VTA and which require repairs and modifications beyond the scope of manufacturer’s pre-existing operation and maintenance instructions. Systems Manuals shall be VTA specific and not include copies of manufacturer’s operation and maintenance instructions and catalog cuts. Submit manufacturer’s operation and maintenance instructions, if required, separately. System Manuals shall conform to the requirements specified herein with the exception of Article 1.10.
 5. Manuals for Elevators: Manuals containing manufacturers’ operation and maintenance instructions and catalog cuts are acceptable for elevator manuals provided the manuals meet the technical content requirements set forth in Article 1.12 in addition to the requirements specified for Off-the –Shelf Equipment Manuals.
- E. Instructions and manuals from suppliers of VTA-furnished equipment will be furnished to the Contractor.

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1.07 SUBMITTALS

- A. General: Refer to Section 6.6.2, Submittals, of the Special Conditions for submittal requirements. Schedule submittal of manuals in coordination with other submittals for the subject system or equipment.
- B. Submit 6 sets of hard copy originals for review of each draft manual and for VTA’s use of each final approval manual. For System Manuals, concurrently submit electronic media samples in native electronic file format with submittal of each draft and final approved manual with the exception of the Outline.
- C. System Manuals shall be submitted in accordance with the following requirements:
 - 1. Submit Outline, Complete Draft, and Pre-Final submittals for review before submitting final version.
 - a. Outline – Submit manual layout, sections and headings after final design of system or equipment has been approved.
 - b. Complete Draft – Submit all text and illustrations. Sample of binder and electronic files prior to first delivery of system or equipment.
 - c. Pre-Final – Submit complete manual in accordance with criteria specified herein.
 - 2. Pre-Final O&M Manual Review: Submit for approval prior to final acceptance tests for the particular system or equipment and no later than 30 days prior to initial training course for VTA personnel.
 - a. Information gathered during final acceptance testing and training courses shall be used to develop final draft version of the manual.
- D. Off-The-Shelf Equipment Manuals:
 - 1. Submit draft Manual for review prior to initial delivery of particular equipment.
 - 2. For elevator Manuals prior to submittal of draft Manual, submit and obtain approval of the proposed Table of Contents including chapter numbers and titles.
- E. One set of each manual will be returned to the Contractor, marked with review-stamp- action-block marks as described in Section 6.6.2, Submittal, of the Special Conditions.
- F. Any non-compliant portions of the manual will be noted in the manual or otherwise communicated to the Contractor in writing by the Engineer.
- G. Revise manual returned to the Contractor marked “NOT APPROVED” and resubmit 6 sets for review within 30 days.

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- H. If the Engineer returns a manual to the Contractor that is marked “Approved” or “Approved as Noted”, make any noted corrections and submit copies of manual to the Engineer in its final printed form.

1.08 SUBMITTAL OF FINAL OPERATION AND MAINTENANCE MANUALS

- A. Schedule: Submit final manuals no later than 30 days following the satisfactory completion of Acceptance tests for the subject system or equipment.
- B. The requirements specified in this Article apply to both System and Off-the-Shelf Equipment Manuals.
- C. Submission of each Manual (except for Off-the-Shelf Equipment Manual) in its final form shall include two CD-ROMS of the electronic version (eManual) along with all native electronic files required to create the submitted Manual. Electronic files shall include a matrix or document showing how the files are set up and how to access them. Include no extraneous files.

1.09 OFF-THE-SHELF EQUIPMENT MANUALS

- A. Obtain through the Engineer a book number assigned by VTA for each manual.
- B. Manuals shall consist of a legible copy of the manufacturer’s operating instructions and other operation and maintenance information available from the manufacturer.
- C. Manuals shall include legible copies of manufacturer’s catalog cuts with specific items bubbled or clearly marked with arrows. When it would be clearer to cross-out irrelevant portions of a page, neatly cross-out irrelevant information using a straight-edge. Manuals shall include catalog pages, manufacturer’s pre-printed maintenance and operations instructions, wiring diagrams, parts lists, warranty slips, and manufacturer’s certificates, as applicable and as required by the Engineer.
- D. Manuals shall contain a Table of Contents that reflects all procedure numbers, page numbers, figure numbers, and tables, as well as the volumes, chapters and/or sections of each manual.
- E. Divide each chapter or section of the manual using divider pages that comply with the requirements specified in Article 1.13 herein.
- F. Manuals for HVAC, Plumbing and Fire Protection equipment shall list the following information:
1. Equipment identification
 2. Make and model
 3. Location of equipment
 4. Filter sizes and quantities
 5. Service and dealer directory including the authorized dealer name, phone number, address, email address, and web site for each piece of equipment.
 6. Valve directory including the valve number, type, size, location and function.

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7. Damper certification and verification.
8. Domestic water system cleaning and disinfection test results and report.
9. Air and water system balance reports.
10. Controls operation and maintenance data with wiring diagrams.
11. Approved seismic restraint inspection report, certified by professional licensed Seismic Engineer or approved representative.
12. Warranties: Submit effective date, expiration date, extent of warranty, name and contact information of firm providing warranty.

G. Binders for each Manual shall comply with the requirements specified in Article 1.13.

1.10 NATIVE ELECTRONIC FILE FORMAT FOR SYSTEM MANUALS

- A. The native electronic file formats are the programs used to create the Operation and Maintenance Manual.
- B. Text pages shall be created using MS Word, latest release in use by VTA.
- C. Parts Lists created for Chapter 7, titled “Illustrated Parts Catalog“(all Volumes), shall be created using MS Excel, latest release in use by VTA.
- D. Illustrations and drawings, including technical illustrations, shall be created using AutoCAD, latest release in use by VTA, in accordance with the Contract Drawings CADD Requirements in the Appendices/VTA Standards. Contract Drawing CADD Requirements Appendix is available upon request.
- E. Text pages containing illustrations shall have the AutoCAD files inserted into the MSWord file as an object. AutoCAD files shall have a white background.

1.11 FORMAT AND TECHNICAL CONTENT FOR SYSTEM MANUALS

- A. Each Manual shall meet the following requirements:
 1. Be developed in conjunction with maintainability requirements.
 2. Be organized so that each major subsystem is treated as an integrated system and not as a grouping of disassociated parts.
 3. Contain data required to maintain equipment during equipment service life.
 4. Contain data required to operate and maintain test equipment during equipment service life.

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5. Contain no extraneous information, such as advertisements or company or manufacturer's logos. Any reference to the manufacturer or contractor, other than necessary references to the equipment in the text, is considered advertisement. Manufacturer or contractor's name shall not appear in the page titles, headers, footers or anywhere else in the document.
 6. Contain all operating instructions. If required, provide a separate operating manual.
 7. Drawings and illustrations shall include details necessary for the installation, maintenance, and repair of equipment provided.
- B. Numbering and Content Minimum Requirements:
1. Obtain through the Engineer a book number assigned by VTA for each Manual.
 2. Each Manual shall be composed of one or more volumes titled and organized by subject matter. Each volume may be contained in one or more binders, if necessary, and shall be designated accordingly (i.e. Volume 1A, Volume 1B, Volume 1C, etc.). Manuals for complex, multi-component systems may be organized into volumes with each volume covering a subsystem or component of the greater system. Multiple volumes shall be used when specified in the Contract Specifications, when required by the Engineer, or when proposed by the Contractor and accepted by the Engineer.
 3. Each volume shall be consecutively numbered (i.e. Volume 1, Volume 2, Volume 3, etc.).
- C. Manual (or Volume in the case of multi-volume Manuals) shall contain a Table of Contents and be organized into nine specific chapters as outlined herein.
1. Chapter 1 – General Information and Specification
 2. Chapter 2 – Theory of Operation
 3. Chapter 3 – Troubleshooting
 4. Chapter 4 – Primary Repair
 5. Chapter 5 – Secondary Repair (Component Level)
 6. Chapter 6 – Preventive Maintenance
 7. Chapter 7 – Illustrated Parts Catalog
 8. Chapter 8 – Miscellaneous
 9. Chapter 9 – Wiring Diagram
- D. Table of Contents shall reflect procedure numbers, page numbers, figure numbers, and tables, as well as the volumes, chapters, and sections of each manual, as applicable. Table of Contents shall list and contain the following:
1. Chapter titles

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2. Section titles
 3. Sub-section titles and corresponding page numbers
 4. Drawing titles, numbers and corresponding page numbers
 5. Figure titles, numbers and corresponding page numbers
 6. Table titles, numbers and corresponding page numbers
 7. Procedure numbers and corresponding page numbers.
- E. Each chapter shall have a Table of Contents which include the following:
1. Section Titles
 2. Sub-section titles and corresponding page numbers
 3. Drawing titles, numbers and corresponding page numbers
 4. Figure titles, numbers and corresponding page numbers
 5. Table titles, numbers and corresponding page numbers
- F. Chapters shall comply with the following requirements:
1. Chapter 1 – “General Information and Specifications”
 - a. A “List of Acronyms and Abbreviations” in the form of a table.
 - b. General non-technical description of equipment, including interface relationships and general functions.
 - c. Pictorial views of the subassembly components and parts described.
 - d. Tables listing the performance specifications of equipment.
 2. Chapter 2 – “Theory of Operation” shall provide a technically detailed description of equipment, by subsystem, including:
 - a. Location of parts in subassembly or component being discussed.
 - b. Location, function, and operation of pertinent controls, gauges, indicators, and switches.
 - c. Subsystem setup and shutdown procedures
 - d. Trouble symptoms and first-response diagnostic methods.
 - e. Emergency procedures and safety requirements.

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- f. Electrical wiring diagrams, electronic schematics, and mechanical configurations.
 - g. Block diagrams of provided subsystems, signal flow diagrams, including interface connections to other subsystems.
 - h. Applicable charts, figures and drawings to be located at the end of text for each subsystem.
3. Chapter 3 – “Troubleshooting” shall contain:
- a. Necessary information for troubleshooting and fault isolation.
 - b. Charts and tables as applicable listing symptoms and probable causes of improper operation or failure of subsystem and probable remedies.
4. Chapter 4 – “Primary Repair” shall contain the following information to allow maintenance to be performed at equipment location site:
- a. Detailed corrective maintenance procedures to be performed on equipment shall include particulars on testing alignment, adjustment and tuning. Include detailed views of mechanical parts or schematics for tests.
 - b. Step-by step procedures of installation and removal of components and subassemblies (field replaceable units).
 - c. Procedures for use of special test equipment.
 - d. Warning and caution notes as required.
 - e. Applicable charts, figures, and drawings to be located at the end of text for each subsystem.
5. Chapter 5 – “Secondary (Component) Repair”, shall contain the following in regard to maintenance to be performed in a shop other than equipment location site:
- a. Detailed corrective maintenance procedure to be performed on subassemblies and components shall include particulars on testing alignment and tuning. Include detailed views of mechanical parts or schematics.
 - b. Step-by-step procedures for installation and removal of parts in assemblies and components.
 - c. Procedures for use of special test equipment.
 - d. Incorporate warning and caution notes, as required.
 - e. Applicable charts, figures and drawings to be located at the end of text for each subsystem.
6. Chapter 6 – “Preventive Maintenance”, shall contain:

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- a. Preventive maintenance procedures, schedules, and tables including lubrication requirements and frequency of application.
 - b. Inspection and maintenance standards, including wear limits, settings, tolerances, and criticality of tolerances.
 - c. Storage instructions for spare parts, special tools and test equipment.
7. Chapter 7 – “Illustrated Parts Catalog”, shall contain:
- a. Instructions for use of Illustrated Parts Catalog.
 - b. Index by subassembly.
 - c. Illustrations which are exploded views of assemblies, components, and parts with leader lines and circled callout numbers to each item.
 - d. Detailed Parts List, including:
 - 1) Figure Number
 - 2) Part index number, not to exceed 19 alphanumeric characters
 - 3) Description of part, including manufacturers and vendor’s part number
 - 4) Equivalent parts available from other manufacturers.
 - 5) Disposition of part (repairable, non-repairable, etc.)
 - 6) Quantity required per assembly
8. Chapter 8 – “Miscellaneous”, shall contain information that is deemed inappropriate for any other chapter including descriptive brochures, manufacturer’s certificates and warranty slips.
9. Chapter 9 – “Wiring Diagrams”, shall contain:
- a. Applicable electrical, electronic, pneumatic, and schematic diagrams.
 - b. Wiring diagrams, including wire color code, size, and rating; terminal and connector pin numbers; and plug and socket numbers.
 - c. Pin-to-pin description of each wire, using wire-marking format. Additionally, wires at each terminal block and each connector shall be independently identified and cross-referenced at the next terminating point.
 - d. Diagram size in accordance with that previously stated in these specifications.
- G. Front Cover Page Specifications
- 1. Front cover page shall be on white bond paper, 8.5” x 11”, 60-pound minimum.

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2. The Engineer will provide artwork for the front cover page. Artwork will include the VTA's logo artwork, title of the manual, book number, volume, user name, issue date, and the VTA's name, address and phone number.

3. Reproduce provided artwork.

H. Paper, Page Layout and Page Numbers

1. Paper used for text and drawings shall be 40-pound bond grade paper. All pages, except for drawings, shall be 8.5 x 11 inches, portrait style. Drawing pages shall be 8.5 x 11 inches or 11 x 17 inches.

2. Pages shall be 3-hole punched.

3. Pages shall be printed double-sided except 11 x 17 inch drawings.

4. Left, right and top margins shall be set at one inch from edge of page; Last line of body text shall be set 1.5 inches from bottom of page; last line of footer text shall be set 0.75 inch from bottom of page.

5. Page numbering depends on the size of the manual. Larger manuals shall be broken up into volumes and have sectional page numbers while smaller ones may be in chapters and sections, and have sequential page numbers (1, 2, 3).

6. As a general rule, number pages Chapter-Section-Page. If the chapters are not broken down into sections, number pages Chapter-Page. Any drawings or illustrations within each chapter shall have figure numbers, also reflecting Chapter-Section-Figure. The same applies for tables.

7. The page number shall appear at the bottom of the page with the book number on the first line, the volume number (if applicable) on the next line and the page number on the last line. Example: Book 50, Volume 10, Page 4-9-1. If the book does not have a volume number, the book number shall appear first, the chapter number shall appear on the next line and the page number on the last line.

8. For double-sided pages, the book, volume, chapter and page numbers shall appear at the bottom of the page, alternately, beginning on the right side for the first and odd- numbered pages of each chapter or section, and the left side for the even-numbered pages. If the book is printed one-sided, the numbers shall appear on the bottom, right- hand corner of each page.

9. The revision date shall appear at the bottom center on all pages with Rev. and the month (first three letters) a forward slash, and the year (last two numbers). Example: Rev. Dec/94.

10. New sections and chapters shall begin on a right-hand facing page. At the end of each chapter or section if there is a blank left-hand page, print on the left-hand page, "This page intentionally left blank," in whatever font style the body text of the document is.

11. Fan-fold 11 x 17 inches pages to 8.5 x 11 inches. For pages larger than 8.5 x 11 inches, display page identification on last fold of folded page so as to be readable without unfolding.

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12. Each 11 x 17 inch illustration shall be considered as one page. There shall be no double page numbering (Example: Page 11/12).
- I. Font and Paragraph Layout: Samples will be provided upon request.
1. Body text shall be 10 pt. Arial font, except as otherwise specified.
 2. Body text shall be left justified, ragged right and single-spaced, with 12 pt separating paragraphs.
 3. Titles and first level headers shall be 10 pt. Arial, unless otherwise specified, bold and all caps. Second level headers or subheadings shall be 10 pt. Arial, bold, and upper and lower case.
 4. Titles of procedures shall be all caps, bold, and centered on the page.
 5. Bullets:
 - a. First level bullets shall be solid style and indented once under margin of last level text, with one space between bullet and beginning of text.
 - b. Next level bullets (used when listing information below a bullet) shall be dash style and indented twice with one space between dash and beginning of text.
 6. Indents shall be 0.5" (five spaces).
- J. Notice Messages:
1. Notice Messages: Warnings, Cautions and Notes are notice messages. They shall all be in bold type with no lines or borders around them. Notice messages shall be formatted as follows:
 - a. "WARNING!" is the most important. It denotes something that is life threatening or can severely damage the equipment or system if the procedure is not followed properly. Warnings shall be in all caps, bold, two points larger than the regular body text, and flush with the section in which they appear. Warnings shall end with an exclamation point.
 - b. "CAUTION:" is used when injury or equipment damage can occur if procedure is not followed properly. Cautions shall be all caps, bold, indented, two points larger than the regular body text, and flush with the section in which they appear. Cautions shall end with a colon.
 - c. "Note:" flags important information. Notes shall be bold, two points larger than the regular body text, and in upper and lower case. Notes shall be indented under margin of last level text (but not underlined).
- K. Technical Illustrations:
1. Draw illustrations, including "exploded" views and illustrated part breakdowns. Utilize illustrations to facilitate descriptions of assemblies and the relationships of components,

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subsystems, and systems. Illustrations shall conform to the requirements and the recommendations of referenced ANSI Standards.

2. Technical illustrations shall comply with the following requirements:
 - a. Illustrations shall include details necessary for the installation, maintenance and repair of all equipment provided.
 - b. Each illustration shall be designated as a “figure”. The word "Figure," accompanying numerical designation and caption shall be the same size, style, and type as the written text. Its physical location shall be the same on each page.
 - c. Figure numbers and descriptions of figures shall be readable in the horizontal position as you read the page from left to right.
 - d. Figures containing graphics, illustrations, diagrams, and similar drawings, shall appear at the end of the applicable section or procedure.
 - e. Pages containing illustrations, charts and tables shall be size 8-1/2 x 11 inches or 11 x 17 inches (fan-folded to 8-1/2 x 11 inches). Pages which are 11 x 17 inches shall be landscape style. These also include Chapter 9 drawings.
 - f. Folded sheets shall display identification on last fold, readable without unfolding.
 - g. Whenever callout numbers are used in an illustration, they shall be circled.
 - h. Graphic symbols used for electrical and electronics shall conform to ANSI Y32.2.
 - i. Graphic symbols used for logic diagrams shall conform to ANSI Y14.5.

L. Revisions to Text and Drawings:

1. Revisions shall be made for design changes, retrofits, and errors as required, and based upon changes generated during testing. These revisions shall be listed on a List of Effective Pages to be issued with each review submittal and revision of the manuals until expiration of the Contract.
2. Include at the beginning of each completed manual or volume, a Configuration Control Record form adhering to the format provided by the Engineer. Form shall include columns for the chapter, page number, BECO number, revision number, revision date, and revision description.
3. Refer to Article entitled “Manual Revision Control” herein for revision requirements applicable to revisions to final draft and approved manuals.

1.12 PRINTED MANUAL REQUIREMENTS

A. Binder Specifications:

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1. Manuals shall be bound in three-ring, O-ring binders, ranging in thickness from one to three inches depending on the size of each volume. If the Engineer accepts use of binders with a thickness greater than 3 inches, binders shall be heavy-duty type acceptable to the Engineer. Binders shall be white in color and have clear plastic slip-in pockets on cover and spine. Cover material shall be virgin vinyl .014 ga. inside and out, sealed over 120 point chip board with serrated hinges. Binders shall be durable and capable of long-time service in maintenance shop environment. Covers shall be oil, water, and wear resistant. Rings shall not bend or misalign under normal shop conditions and should be able to hold contents without bending or misaligning. Binder rings shall be manufacturer's standard diameter designed to accommodate standard three-hole punching. Binders shall contain front and back plastic sheet lifters.
 2. The Engineer will provide artwork for front cover and spine. Label cover and spine with slip-in printed sheets in accordance with format provided by the Engineer. Artwork for front cover and spine will include the name of the manual, volume, book number printed in a visible location. Artwork will include VTA's name and address printed in the lower left hand corner of the cover. Artwork on spine shall begin one inch from top of spine.
 3. Maximum size of binders shall be 11.5 inches high and 11 inches wide.
 4. Binders shall accept 8.5 x 11 inch pages.
 5. Manuals shall lie flat when opened. Pages shall not bind or join when turned for normal reading.
 6. Manuals shall allow enough space for insertion of revised pages.
- B. Divider Page Specifications: Each chapter including the table of contents shall have divider tabs. The chapter number and title shall be printed on both sides of the tab.
1. Divider pages with tabs shall be white in color, 8.5 x 11 inches in size, card stock, and three hole punched for ring binders. Holes shall be reinforced with a strip of mylar.
 2. Tabs shall be white in color with 3/8 inch extension with rounded corners and shall comply with the following requirements:
 - a. Have bold capital letters, Arial font, using black ink and printed on both sides.
 - b. Slide-in type tabs are not acceptable.
 3. Sample of divider tab will be available upon request.
- C. Final Assembly: All hard copies shall be printed out, assembled, and placed in binders. Each volume (if applicable) or book shall be assembled in the following order:
1. The first section for each volume or book shall contain the cover sheet for that volume/book, the VTA Configuration Control Record for that volume/book and the master Table of Contents listing all of the chapters for the entire volume/book. When a volume is contained in more than one binder, each binder shall include a cover sheet, and master Table of Contents for the entire volume/book.

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1.13 ELECTRONIC VERSION OF MANUAL (eManual) FOR SYSTEM MANUALS

- A. The eManual shall be created from the native electronic files, as specified in Article 1.11 entitled “Native Electronic File Format”, using Adobe Acrobat, (latest release in use by VTA).
- B. Each item listed in the Table of Contents shall hyperlink to the corresponding sub-section, drawing, figure, or table.
- C. The Table of Contents shall have Bookmarks to all corresponding pages.
- D. Any references to Figures or Tables within text pages shall be hyperlinked to the referenced document(s).
- E. In Chapter 7, entitled “Illustrated Parts Catalog”, each item number callout in the illustration will be linked to the corresponding sub-assembly or line item number listed in the Parts List.
- F. Link properties shall be as follows unless otherwise noted or approved by the Engineer:
 - 1. Type: Invisible Rectangle
 - 2. Highlight: None
 - 3. Action Type: Go to View
- G. All Chapter PDF files for each Volume shall be on the same CD. The CD shall be labeled according to the book number, book title, volume number, volume title, and creation date.

1.14 MANUAL REVISION CONTROL

- A. Revisions of final draft and approved Manuals shall be listed on a Configuration Control Record form in the front of each Manual. The list shall be issued with each revision and shall show the date of each revision and the page reference.
 - 1. Contractor shall maintain updated lists and revisions in the Manuals until the warranty period expires. Revisions shall be prepared prior to the arrival of altered components, and as soon as possible after procedures are changed or errors are found.
 - 2. Contractor shall provide revisions to the approved Manuals on a not less than quarterly basis during the first 12 months after the final Manuals are delivered, and then on a not less than semi-annual basis for the duration of the warranty period.
 - 3. Contractor shall issue revisions related to major alterations of principal subsystems or assemblies prior to the arrival of components.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Maintenance of Record Documents.
- B. Drawings.
- C. Specifications.
- D. Submission of documents.

1.02 MEASUREMENT AND PAYMENT

- A. The contract lump sum price paid for Project Record Documents shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in producing and maintaining project record documents as stated herein, as directed by VTA, and no additional compensation will be allowed therefor.

1.03 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintain at the jobsite one copy of the following documents for record purposes:
 - 1. Conformed Contract Plans. One set of full size 22 by 34 inch prints shall be maintained for recording "as-built" revisions and special features, and shall be identified as record drawings.
 - 2. Conformed Contract Specifications.
 - 3. Change Orders.
 - 4. Approved Submittals.
 - 5. Design Change Notices (DCNs)
 - 6. Request for Information (RFIs)
 - 7. Inspection Reports.
 - 8. Laboratory Test Records.
 - 9. Field Test Reports and Records.
 - 10. Factory Test Reports and Records.

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- B. Maintain for record purposes at a location approved by the VTA, electronic files for those shop drawings and other documents which are required to be submitted electronically. Ensure that backups of electronic files are made on a regular basis and stored at a remote location.
- C. Store documents used for record purposes in the Contractor's field office or other approved location, apart from documents used for construction. Do not use record documents for construction or fabrication purposes.
- D. Provide files and racks for storage of documents.
- E. File documents in accordance with the filing format of the Contract Specifications, by Section number and title.
- F. Maintain documents in clean, dry, legible condition.
- G. Label each document "Project Record".
- H. Make documents available at all times for inspection by the VTA. Make copies of electronic documents available upon VTA's request.

1.04 DRAWINGS

- A. Record ("As-Built") Drawings:
 - 1. VTA will furnish the Contractor a complete set of full-size copies of the Contract Drawings for the purpose of making prints for Record ("as-built") Drawings.
 - 2. These drawings shall be kept up-to-date and are required to be so certified by the VTA at the time invoices are submitted for progress payments.
 - 3. Maintain record ("as-built") drawings of all work and subcontracts, continuously as the job progresses. A separate set of prints, for this purpose only, shall be kept at the Contractor's field office at all times.
 - 4. Where the Contract Drawings are not of sufficient size, scale, or detail, the Contractor shall furnish its own drawings for incorporation of details and dimensions.
 - 5. During the course of construction, the Contractor shall mark (i.e. red-line) copies of conformed drawings and specifications to record actual construction progress. These documents shall be maintained as the as-built set. All changes must be clearly identified with Change Order (CO), Request for Information (RFI), and/or Field Memo numbers, or other documents that cause as-built documents to be modified. Where more than one change is made in any area of the drawings, the sequence of changes shall be clearly identified graphically, by overlay or by marking a reproducible copy of the preceding changes. Overlays and or new reproducible copies shall be inserted into the as-built drawing set on top of the preceding red-lined construction drawing in a manner which shall preclude losing or damaging documents.
 - 6. The Contractor shall legibly record changes concurrent with the construction progress on a weekly basis, at a minimum. No work shall be covered or concealed (e.g. underground) prior to the changes being recorded. In the event that contract documents are not updated, VTA may withhold part of the Contractor's progress payments until the

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contract documents are updated to the satisfaction of VTA.

7. The Contractor shall red-line construction documents (drawings and specifications) to show as-built conditions, including field changes, which deviate from the initial conformed bid-issued set of contract documents. The location, elevation, and dimensions of each underground or otherwise concealed structure, utility, abandoned cut-off pile, abandoned tieback, subsurface obstruction, and appurtenance not shown on the contract plans or where elevations and dimensions vary from those indicated on the contract plans shall be clearly marked. Reference locations and elevations to permanent surface features shall also be included.
8. The Contractor must use red felt-tip pens to clearly mark up as-built documents. Transparent inks are not allowed.
9. Red-lined construction drawings shall be on full-size (560mm x 860mm) (22" x 34") paper bond media.
10. All changes shall be clearly indicated with a bubble (revision cloud) and an adjacent triangle containing a revision number on the most current drawing and checked against the drawing control log.
11. New drawings developed by the Contractor, e.g. shop drawings and sketches, shall also be included in the as-built drawings set and must meet the following requirements:
 - The drawing information must fit in a standard full-size sheet (560 mm x 860 mm) (22" x 34") including the border frame of the drawing.
 - The drawing and any design calculations or specifications shall be stamped and sealed by an engineer registered in California, complete with the engineer's full signature and registration expiration date.
 - The company name, logo and the contract number shall appear on the drawing.
 - The drawing title, drawing number and sheet number is assigned by the Project Manager, except for Contractor shop drawings. The drawing title, drawing number and sheet number are to be included in the index. The drawings index shall reflect all drawings in the package.
 - New drawings shall be attached to the end of the drawings package.
12. COs shall be added and/or noted (if there are no changes to the drawings and/or specifications) in the contract as-built drawings and specifications. References to COs, field memos, or RFIs shall not be accepted as the sole description of the change. All changes shall be shown complete on the drawings.
13. When VTA issues COs (including Change Notices (CNs) and Design Change Notices (DCNs)), the Contractor shall insert the revised drawings into the conformed set and mark the replaced drawing "SUPERSEDED". If revised half-size drawings are issued, the Contractor shall place a revision cloud and a triangle with the revision number as well as the CO number in the revision block on the drawing. Revised half-size drawings shall be affixed to the back of the previous drawing in the drawing set. Both revision blocks (right and left side) on the drawing must match.

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14. At contract closeout and prior to final acceptance, the Contractor shall submit to VTA a stamped, final, corrected, accurate and complete set of red-lined construction as-built drawings and specifications to show the actual work performed, installed, placed, erected, and applied. Each sheet of the as-built drawings and the cover sheet of the specification book shall be stamped with "PROJECT RECORD DOCUMENTS". Each set shall be initialed and dated by the Contractor's representative responsible for maintaining the contract as-built documents and must also include a log of as-built changes in both hard copy and electronic file, and all relevant contract documents associated with changes to the as-built documents. These items shall be delivered to VTA with a Submittal Cover Letter.

15. Upon receipt of the final as-built documents from the Contractor at contract closeout, the Resident will review the documents for completeness against the VTA log of as-built changes and the VTA copy of red-lined construction contract documents. The Resident will thoroughly check the final submitted as-built documents to ensure that the following requirements have been met:
 - One full-size set of red-lined construction drawings.
 - One set of red-lined project record specifications.
 - A log of as-built changes in both hard copy and electronic file format.
 - All contract documents associated with changes to the red-lined documents, e.g. COs, RFIs, DCNs, CNs, and Field Memos.
 - Any other contract documents that modified or added to the contract.
 - All pages of each document shall be stapled together. Documents shall be hole-punched, folded and secured in standard 2-inch (maximum), 3-ring binders. Each document shall be index tabbed and labeled by Document Type and Document Number (e.g. CO # 1) to facilitate filing and retrieval.
 - Each binder shall be clearly labeled to identify VTA Project Number, Contract Number, and consecutive CO numbers included in their respective binder. Each attachment which is affixed to the project record documents shall also be marked to identify the Contract Number, Document Type and Number, Drawing Number, and Date of Change, and stamped "ATTACHMENT TO PROJECT RECORD DOCUMENTS".
 - Items associated with a CO shall be index tabbed and filed directly after the respective CO, including CN or DCN documents. Index tabbed documents shall be organized in binders in order of ascending CO number.
 - Separate sections shall be reserved in the binders for items other items, including RFIs and Field Memos. Each section shall be organized in order of ascending document number.
 - Documents from other active VTA contracts which generate changes relevant to the as-built documents shall be stapled, hole-punched, folded, index tabbed and secured in binders as described herein. The index tabbed items shall be filed in the appropriate section of the binder.

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- Any voided or superseded documents, whether in part or in total, shall be labeled as such by clear “VOID” or “SUPERSEDED” markings.
- Attachments and field notes added for construction purposes only which are not to be incorporated in the project record documents shall be clearly marked as “NOT FOR PROJECT RECORD DOCUMENTS”.

B. Change Orders:

1. Changes to the Contract Drawings affected by Change Orders shall be incorporated on the prints, and these changes shall be identified by Change Order number and effective date.
2. When revised Contract Drawings are issued as the basis of, or along with, Change Orders, these revised drawings shall be incorporated into the Record ("as-built") Drawing set with appropriate annotation. Drawings deleted by Change Order will not be part of the Record ("as-built") Drawing set. The VTA will furnish the Contractor with reproductions of such revised VTA-furnished Contract Drawings.

C. Submittals:

1. One complete set of approved Submittals, including shop drawings, product data, manufacturers' printed catalog cuts and data, shall be collected and maintained for record purposes.
2. Pages of catalog cuts shall be clear, legible, and permanent. The drawings shall be on vellum or bond paper. Blueprints will not be acceptable. These drawings and catalog cuts shall become the property of the VTA.
3. Submittals shall be filed and maintained separate from Contract Drawings. Shop Drawings shall be filed in 9 inch by 12 inch file folders to the greatest extent possible and shall be indexed as herein before specified.
4. Submittals shall be delivered in new paperboard boxes manufactured for the storage of file folders. Boxes shall have covers and cutout handles, and shall be accurately identified as to the contents. Include a packing list of all boxes and their contents.

D. Electronic Documents: Record (“as-built”) information, as applicable, shall be recorded on an electronic copy of those documents which are required to be submitted electronically.

1. Record documents for each submittal which was required to be prepared and submitted electronically shall include two CD-ROMs of the electronic version. Electronic files shall include a matrix or document showing how the files are set up and how to access them. Include no extraneous files.

1.05 SPECIFICATIONS

A. Contract Specifications:

1. The specifications for record purposes shall be filed in one or more large-ring, 3-ring binder or binders.

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2. Information, changes, and notes shall be recorded in the specifications in blank areas, such as page margins or the backs of opposite pages, or on separate sheets inserted in the binder. All such information, changes, and notes shall be legibly recorded with red pen or red printing as appropriate.
3. In applicable specification sections, record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually furnished and installed, including manufacturer and supplier's address and telephone number.
4. The record specifications shall be complete and shall include all applicable Contract Documents other than drawings.
5. Each section of the contract as-built specifications must also be legibly red-lined by the Contractor to reflect changes made by COs or field conditions. All changes to contract specifications must also be bubbled (revision clouds) with a triangle and a revision number. Tabs shall be placed on specification pages with changes.

B. Change Orders:

1. Change Orders shall be incorporated into the front of the record specifications in reverse chronological order. Use appropriate page dividers to identify Change Orders and to separate Change Orders from the Specifications.
2. In addition, changes to the Specifications effected by Change Order shall be legibly annotated on the affected page or pages of the Specifications or adjacent thereto.

1.06 SUBMISSION OF DOCUMENTS

- A. At completion of the Work, and before requesting final inspection, deliver record documents to the VTA.
- B. For Record (“as-built”) Drawings, submit the blackline print (full size) with revisions incorporated on the prints in red ink. For those documents which are required to be maintained electronically, submit a half-size plot of drawings, full size hard copies of 8 1/2 by 11 inch documents, and electronic files on CD-ROM.
- C. Software:
 1. Submit all documentation, licenses, and electronic media associated with the purchase of commercially available software furnished to the VTA under this Contract. The documentation and media shall be submitted in appropriate storage containers or in the original media packaging.
 2. Where development of User's Guides is specified, User's Guides shall be submitted.
 3. Unless otherwise specified, documentation shall be prepared in accordance with recognized industry standards for such documentation as approved by the VTA.

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- D. Record documents shall be delivered neatly and efficiently filed and packaged in appropriate file storage cabinets or boxes, 12 inches by 16 inches in size. Record (“as-built”) drawings shall be folded correctly, with title block clearly visible on top, to fit neatly in the 12-inch by 16-inch boxes.
- E. Submission of record documents shall be accompanied with a transmittal letter, in triplicate, containing the following information:
1. Date of submission.
 2. Project title and number.
 3. Contractor's name and address.
 4. Title and number of each record document. (Shop Drawings may be grouped in basic categories or divisions of work and by box identification).
 5. Certification that each document as submitted is complete and accurate.
 6. Signature of Contractor, or its authorized representative.
- F. Upon review and acceptance of the Contractor-submitted and stamped project record documents, the Resident Engineer shall sign and date the stamp on the cover sheets of the drawings and specifications and include the contract completion date and the contract numbers. Upon acceptance, the Resident Inspector shall deliver the accepted project record documents to the VTA Surveying Department..

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 78 39

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SECTION 01 78 43

SPARE PARTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing equipment spare parts.

1.02 RELATED SECTIONS

- A. Section 05 52 00, Metal Railings
- B. Section 05 55 16, Metal Stair Nosings
- C. Section 08 71 00, Door Hardware
- D. Section 09 30 00, Tiling
- E. Section 09 91 00, Painting
- F. Section 09 96 23, Graffiti Resistant Coatings
- G. Section 10 44 16, Fire Extinguishers
- H. Section 10 81 13, Bird Control Devices
- I. Section 26 05 45, Systemwide Cable Trough
- J. Section 26 41 23.16, DC Surge Arrester
- K. Section 27 05 00, Common Work Results for Communications
- L. Section 34 11 23, Special Trackwork
- M. Section 34 11 36, Direct Fixation Fasteners
- N. Section 34 21 62, Technical Support
- O. Section 34 21 63, Testing and Commissioning
- P. Section 34 23 13, Overhead Contact System Metal Poles
- Q. Section 34 23 53, Overhead Contact System Installation
- R. Section 34 42 96, Signal System Support

1.03 SUBMITTALS

- A. Refer to Section 7.43, Submittal of Shop Drawings, Product Data and Samples for requirements.

1.04 MEASUREMENT AND PAYMENT

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection therewith will be considered incidental to the item of work to which they pertain.

PART 2 – PRODUCTS

2.01 SPARE PARTS

- A. Provide the following spare parts:

Specification Section	Specification Title	Quantity	Description
05 52 00	Metal Railings (Stations)	2 doz	Fasteners for wire fabric

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Specification Section	Specification Title	Quantity	Description
05 52 00	Metal Railings (Stations)	1 doz	Fence Screen fasteners, each size and type
05 55 16	Metal Stair Nosing	20 lf	Aluminum Base
05 55 16	Metal Stair Nosing	90 lf	Ribbed bar with abrasive filler strips
08 71 00	Door Hardware	2 ea	Maintenance tools, Maintenance instructions
08 71 00	Door Hardware	2 sets	Hardware screws for each type
08 71 00	Door Hardware	40 lf	Silicone gasket seal and adhesive
08 71 00	Door Hardware	2 sets	Silencers
08 80 00	Glazing	2 ea	Window: Laminated-tempered glass, 24"x54" (verify size)
09 30 00	Tiling	2 sf	Porcelain Floor Tile, 8"x8"
09 30 00	Tiling	2 lf	Porcelain Base Tile, 6"x8"
09 30 00	Tiling	2 sf	Porcelain Wall Tile, 8"x8"
09 91 00	Painting	5 gal	Each paint type and color
09 91 00	Painting	5 gal	Each type of primer
09 96 23	Graffiti Resistant Coatings	5 gal	Cleaning solvent
09 96 23	Graffiti Resistant Coatings	25 sf	3M Anti-graffiti film, Clear
10 44 16	Fire Extinguishers	1 ea	Multi-Purpose Dry Chemical Extinguisher
10 44 16	Fire Extinguishers	1 ea	Carbon Dioxide Extinguisher
10 81 13	Bird Control Devices	20 lf	Bird wire system
10 81 13	Bird Control Devices	20 lf	Bird spike strips with adhesive
26 41 23.16	DC Surge Arresters	1 ea	Disconnect Switch Assembly, SU-01
26 05 45	Systemwide Cable Trough	2 ea	Trough Section
26 05 45	Systemwide Cable Trough	2 ea	Trough Section Covers

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Specification Section	Specification Title	Quantity	Description
32 17 26	Tactile Warning Surfacing	16 lf	Detectable Directional Tile with adhesive and fasteners
32 31 10	Wire Fences and Gates	2 doz	Fasteners for each fence type
34 11 23	Special Trackwork	1 ea	left hand curved split switch point with stock rail, blank ends for No. 8 turnout
34 11 23	Special Trackwork	1 ea	right hand curved split switch point with stock rail, blank ends for No. 8 turnout
34 11 23	Special Trackwork	1 ea	frog for No. 8 turnout
34 11 23	Special Trackwork	1 ea	left hand curved split switch point with stock rail, blank ends for No. 8 turnout
34 11 23	Special Trackwork	1 ea	right hand curved split switch point with stock rail, blank ends for No. 8 turnout
34 11 23	Special Trackwork	1 ea	frog for No. 8 turnout
34 11 23	Special Trackwork	1 ea	left hand curved split switch point with stock rail, blank ends for No. 4 turnout
34 11 23	Special Trackwork	1 ea	frog for No. 4 turnout
34 11 23	Special Trackwork	200 ea	lag screw assemblies consisting of lag screw, insulating bushing for 3/4 inch plate thickness, double coil spring washer and flat washer
34 11 23	Special Trackwork	50 ea	9 inch x 19 inch insulating tie pads, blank, without drilling
34 11 23	Special Trackwork	30 ea	9 inch x 25 inch insulating tie pads, blank, without drilling
34 11 23	Special Trackwork	20 ea	9 inch x 37 inch insulating tie pads, blank, without drilling
34 11 23	Special Trackwork	2 ea	No. 1 insulated gauge plates for No. 8 power operated switch location
34 11 23	Special Trackwork	2 ea	No. 2 insulated gauge plates for No. 8 power operated switch location
34 11 23	Special Trackwork	1 ea	Full dimension insulation tie pads for the above 4 switch gauge plates
34 11 36	Direct Fixation Fasteners		Direct Fixation Fasteners
34 21 62	Technical Support	1 ea	15 kV class circuit breaker
34 21 01	Traction Power Basic Electrical Materials And Methods	2 sets	1 of each type fuse used for substation protection and control (1 set per substation)

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Specification Section	Specification Title	Quantity	Description
34 21 01	Traction Power Basic Electrical Materials And Methods	2 sets	1 of each type light or lamp used in the substation building and within each equipment (1 set per substation)
34 21 15	Traction Power Substation Auxiliary Power	2 sets	Battery charger spares - recommended by vendor (1 set per substation)
34 21 17	Hmi And Scada Interface Requirements	1	HMI panel
34 21 17	Hmi And Scada Interface Requirements	2 sets	Minimum of 1 of each type of DIO cards used for substation control and protection including (1 set per substation): 1 analog card 1 DIO (status and indication) card 1 DIO (output/control) card
34 21 01	Traction Power Basic Electrical Materials And Methods	2 sets	1 of each type selector switch used for substation control and protection including (1 set per substation): Circuit breaker control handles, Door switches, Emergency trip switches, Selector switches
34 21 01 34 21 19 34 21 20	Traction Power Basic Electrical Materials And Methods Ac Traction Power Switchgear Dc Traction Power Switchgear	2 sets	Minimum of 1 of each type of meter used including (1 set per substation): AC switchgear Ammeter AC switchgear voltmeter DC switchgear ammeter DC switchgear voltmeter
34 21 01 34 21 19 34 21 20	Traction Power Basic Electrical Materials And Methods Ac Traction Power Switchgear Dc Traction Power Switchgear	2 sets	Minimum of 1 of each type relay used for substation control and protection including (1 set per substation): 1 Main AC breaker protection relays 1 Main DC rectifier circuit breaker protection relays 2 DC feeder Breaker protection relays Auxiliary control relays Lockout relay Timer relay Switchgear frame relay Transfer trip relay OCS voltage monitoring relay Current and Voltage transducers
34 21 19 34 21 20 34 21 23	Ac Traction Power Switchgear Dc Traction Power Switchgear Traction Power Transformer-Rectifier Unit	2 sets	Minimum of 1 of each type of surge arrester assemblies (1 set per substation): Ac switchgear surge arrester assembly DC switchgear surge arrester assembly Rectifier Transformer AC surge arrester assembly Rectifier DC surge assembly

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Specification Section	Specification Title	Quantity	Description
34 21 19	Ac Traction Power Switchgear	1	27 kV class circuit breaker
34 21 20	Dc Traction Power Switchgear	2	800 Vdc class feeder circuit breaker
34 21 23	Traction Power Transformer-Rectifier Unit	2 sets	Minimum of 1 of each type (1 set per substation) : Rectifier-transformer over-temperature detection device Rectifier overtemperature device
34 21 23	Traction Power Transformer-Rectifier Unit	6	Traction rectifier diodes (3 per substation)
34 21 23	Traction Power Transformer-Rectifier Unit	6	Traction rectifier diodes fuses (3 per substation)
34 21 26	DC Pad Mounted Disconnect Switches	2	Voltage sensing relay (1 per substation)
34 21 70	Communciations Equipment	2 sets	1 of each type power supply used for substation protection and control including (1 set per substation) : DC to DC converter (125V dc to 24V dc)
34 21 70	Communciations Equipment	2 sets	Minimum of 1 of each type of communciations components including (1 set per substation) : ethernet switch
34 21 71	Programmable Automation Controllers	2 sets	Minimum of 1 of each type of communciations components including (1 set per substation) : 1 Programmable automation controller (programmed) 1 input module 1 output module
34 21 62	Technical Support	1 ea	27 kV class circuit breaker
34 21 62	Technical Support	1 ea	750 Vdc class feeder circuit breaker
34 21 62	Technical Support	1 ea	Surge arrester assembly
34 21 62	Technical Support	1 ea	Rectifier-transformer over-temperature detection device
34 21 62	Technical Support	6 ea	Traction rectifier diodes
34 21 62	Technical Support	6 ea	Traction rectifier diodes fuses
34 21 62	Technical Support	1 Lot	1 of each type relay used for substation control and protection
34 21 62	Technical Support	1 Lot	1 of each type selector switch used for substation control and protection
34 21 62	Technical Support	1 Lot	1 of each type fuse used for substation protection and control
34 21 62	Technical Support	1 Lot	1 of each type power supply used for substation protection and control
34 23 13	Overhead Contact System Metal Poles	5 ea	TES Pole Type C3-28

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Specification Section	Specification Title	Quantity	Description
34 23 13	Overhead Contact System Metal Poles	1 ea	TES Pole Type C3F-28
34 23 13	Overhead Contact System Metal Poles	1 ea	C3FL
34 23 13	Overhead Contact System Metal Poles	2 ea	TES Pole Type D3-28
34 23 13	Overhead Contact System Metal Poles	1 ea	TES Pole Type D3F-28
34 23 13	Overhead Contact System Metal Poles	1 ea	TES Pole Type E3-30
34 23 13	Overhead Contact System Metal Poles	1 ea	D3FL
34 23 13	Overhead Contact System Metal Poles	2 1 ea	TES Pole Type T2-25
34 23 13	Overhead Contact System Metal Poles	1 ea	TES Pole Type T2-28
34 23 19	OCS Pole Mounted Disconnect Switch	1 as	Pole Mounted Disconnect Switch, DS-01
34 23 46	Section Insulators	1	Section Insulator, SI-01
34 23 53	Overhead Contact System Installation	3 ea	Down Guy Anchor Assembly, DGA-1
34 23 53	Overhead Contact System Installation	3 ea	Down Guy Anchor Plate
34 23 53	Overhead Contact System Installation	1 ea	SCAT Midpoint Anchor, MP-01
34 23 53	Overhead Contact System Installation	2 ea	Counterweight termination Assembly, CW-01
34 23 53	Overhead Contact System Installation	1 ea	Fixed Termination Assembly, FT-01
34 23 53	Overhead Contact System Installation	1 ea	Parallel Feeder Cable Termination Assembly, PFT-01
34 23 53	Overhead Contact System Installation	13 ea	3/4" x 10' Ground Rods with Exothermic Weld Kits
34 23 53	Overhead Contact System Installation	300 LF	Cable 500 kcmil CU Conductor, 2kV EPR
34 23 53	Overhead Contact System Installation	3200 LF	Contact Wire, 350 kcmil, Grooved CU
34 23 53	Overhead Contact System Installation	3200 LF	Messenger Wire, 500 kcmil, Stranded CU
34 23 53	Overhead Contact System Installation	2300 3700 LF	AAC/TW Parallel Feeder Cable 1000kcmil, Stranded AL
34 23 53	Overhead Contact System Installation	110 150 LF	Jumper Wire, 350 kcmil, Class G, Bare, CU
34 23 53	Overhead Contact System Installation	3100 LF	Feeder Cable 500 kcmil, Class C, CU Conductor, 2kV EPR
34 23 53	Overhead Contact System Installation	900 LF	Feeder Jumper 500 kcmil, Class G, CU Conductor, 2kV EPR
34 23 53	Overhead Contact System	50 EA	Parallel Clamp: 350 kcmil Grooved to 350

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Specification Section	Specification Title	Quantity	Description
	Installation		kcml Stranded CU
34 23 53	Overhead Contact System Installation	42 EA	Parallel Clamp: 500 kcml Stranded to 350 kcml Stranded CU
34 23 53	Overhead Contact System Installation	60 EA	Parallel Clamp: 500 kcml Stranded to 500 kcml Stranded CU
34 23 53	Overhead Contact System Installation	40 EA	Parallel Clamp: 500 kcml Stranded CU to 1000 kcml Stranded AL
34 23 53	Overhead Contact System Installation	260 LF	1/2" Kevlar (Phillystran) Rope
34 23 53	Overhead Contact System Installation	200 LF	#4 AWG Stranded Insulated CU Wire
34 23 53	Overhead Contact System Installation	900 LF	4/0 Stranded Bare CU Wire
34 23 53	Overhead Contact System Installation	13 6 ea	Cantilever Arm Assembly, CA-A1, Pull Off
34 23 53	Overhead Contact System Installation	1 3 ea	Cantilever Arm Assembly, CA-A2, Pull Off
34 23 53	Overhead Contact System Installation	1 ea	Cantilever Arm Assembly, CA-A3, Pull Off, (MP)
34 23 53	Overhead Contact System Installation	38 ea	Cantilever Arm Assembly, CA-B1, Push Off
34 23 53	Overhead Contact System Installation	2 ea	Cantilever Arm Assembly, CA-C1
34 23 53	Overhead Contact System Installation	1 ea	Cantilever Arm Assembly, CA-D1
34 23 53	Overhead Contact System Installation	1 ea	Cantilever Arm Assembly, CA-D2
34 23 53	Overhead Contact System Installation	1 ea	Cantilever Arm Assembly, CA-T1
34 23 53	Overhead Contact System Installation	1 ea	Head Span Assembly, HD-01
34 23 53	Overhead Contact System Installation	112 120 ea	Hanger Assembly, HA-01, 5' wire
34 23 53	Overhead Contact System Installation	2 ea	Hanger Assembly HA-02, 5' wire
34 23 53	Overhead Contact System Installation	1 ea	Surge Arrester Assembly, SU-01
34 23 53	Overhead Contact System Installation	16 ea	Pole band, BH-01
34 23 53	Overhead Contact System Installation	1 ea	Pole Bracket Arm, BT-02
34 23 53	Overhead Contact System Installation	1 ea	Pole Bracket Arm, BT-03
34 23 53	Overhead Contact System Installation	1 ea	Pole Bracket Arm, BT-04
34 23 53	Overhead Contact System Installation	1 ea	Parallel Feeder Support AssemblyBracket Arm FSAFBA-01
34 23 53	Overhead Contact System	610 ea	Parallel Feeder Support AssemblyBracket

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Specification Section	Specification Title	Quantity	Description
	Installation		Arm FSAFBA-02
34 23 53	Overhead Contact System Installation	20 ea	Parallel Feeder Suspension Assembly FSA-01
34 23 53	Overhead Contact System Installation	2 ea	In-Span Insulator, Messenger Wire, IS-M1
34 23 53	Overhead Contact System Installation	2 ea	In-Span Insulator, Contact Wire, IS-M1
34 23 53	Overhead Contact System Installation	1 ea	In-Span Insulator, Parallel Feeder Wire, IS-F1
34 42 96	Signal System Support	1 ea	Wayside 3-aspect signal assembly with mast and base, complete
34 42 96	Signal System Support	1 ea	Wayside 4-aspect signal assembly with mast and base, complete
34 42 96	Signal System Support	1 ea	Switch and lock movement layout complete with junction box and all rods
34 42 96	Signal System Support	1 ea	Vital Microprocessor with Modules
34 42 96	Signal System Support	1 ea	Complete audio frequency track circuit transmitter
34 42 96	Signal System Support	1 ea	Complete audio frequency track circuit receiver
34 42 96	Signal System Support	1 ea	Audio frequency track circuit card of each type provided
34 42 96	Signal System Support	1 ea	Impedance bond
34 42 96	Signal System Support	1 ea	Gate arm of each length provided
34 42 96	Signal System Support	1 ea	Complete Sset of gate arm lights including housing and bulbs
34 42 96	Signal System Support	1 ea	Flashing light crossing signal complete with mast and junction box base
34 42 96	Signal System Support	2 ea	TWC Interrogator (HCS-V) Card Cage
34 42 96	Signal System Support	2 ea	TWC Transceiver Card (HCS-V-RT)
34 42 96	Signal System Support	2 ea	TWC Multiplexer Card (HCS-R-MX)
34 42 96	Signal System Support	2 ea	TWC Multiplexer Card (HCS-V-MX)
34 42 96	Signal System Support	2 ea	TWC Relay Output Card (HCS-V-R-O)
34 42 96	Signal System Support	2 ea	TWC Loop Converter, Complete With Sealant
34 42 96	Signal System Support	1 ea	AC Inverter
34 42 96	Signal System Support	1 ea	Battery Charger
34 42 96	Signal System Support	5 ea	TWC Programming Software On CD-ROM
34 71 19.13	Flexible Vehicle Delineators	5 ea	Bollards and fasteners

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- B. Spare Parts for the communication system are specified in Section 27 05 00, Common Work Results for Communications.

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 78 43

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SECTION 02 41 00

DEMOLITION

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for demolishing asphalt pavement, bases, pavements, curbs, gutters, curb and gutters, headers, sidewalks, fences, handrails, and other site features that conflict with the Work.

1.02 RELATED SECTIONS

- A. Section 6.6, Contract Data Requirements, of the Special Conditions
- B. Section 01 74 00, Cleaning, for site cleaning and management.
- C. Section 01 74 15, Dust Control
- D. Section 01 78 39, Project Record Documents
- E. Section 02 41 10, Tree Protection and Removal.
- F. Section 02 41 16, Structure Demolition, for Structure Demolition at 1091 S. Capitol.
- G. Section 02 43 13, BRT Shelter Relocation, for demolition and relocation of the Bus Rapid Transit (BRT) Shelter.
- H. Section 26 50 00, Lighting, for removal of street lighting and changeable message signs.
- I. Section 31 00 00, Earthwork, for removal of roadway subgrade and placement of backfill.
- J. Section 31 23 43, Structure Excavation and Backfill, for excavation and backfill for structures.
- K. Section 32 12 16, Asphalt Paving, for hot mix asphalt restoration
- L. Section 32 33 01, Private Property Demolition and Restoration, for private property demolition and private business sign relocation.
- M. Section 32 17 24, Traffic Stripes, Pavement Markings, and Pavement Markers, for removal of pavement markers.
- N. Section 33 40 00, Storm Drainage Utilities, for removal of drainage facilities.
- O. Section 34 01 23, Track Removal and Salvage, for removal of track.
- P. Section 34 41 13, Traffic Signals, for removal of traffic signals and associated equipment.

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1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI A10.6 Safety Requirements for Demolition Operations
- B. State of California, Department of Transportation (Caltrans), Standard Specifications:
 - 1. Section 15, Existing Facilities
 - 2. Section 17, General

1.04 SUBMITTALS

- A. General: For submittal requirements and procedures, refer to Section 6.6, Contract Data Requirements, of the Special Conditions.
- B. Demolition Plan: Submit a comprehensive demolition plan, describing the proposed sequence, methods, and equipment for demolition, removal, and disposal of structure(s); include salvage if required. Do not proceed with demolition until the Engineer has given written approval of the demolition plan.
- C. Submit copies of demolition, hauling, and debris disposal permits and notices for record purposes. Include description of proposed haul routes.
- D. Utility Severance Certificates: Provide certificates, issued by the utility owners, of severance of utility services for record purposes.
- E. Private Property Owner's Release: If material demolished and removed from the site will be deposited on private property, submit two copies of written releases not more than 15 days before the start of work. Releases shall absolve the VTA from responsibility in connection with the depositing of material on private property, and shall be signed by the owners of such property on which the material will be deposited.
- F. Record Documents: Provide copies of all approved submittals, specified herein, for record purposes in accordance with the requirements of Section 01 78 39, Project Record Documents.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Only items listed in Bid List will be measured for payment.
 - 1. Remove Concrete Sidewalk, Curb Ramps and Driveways shall be measured by the Square Foot.
 - 2. Remove Concrete Median shall be measured by the Square Foot.
 - 3. Remove Concrete Valley Gutter shall be measured by the Square Foot.
 - 4. Remove Asphalt Pavement and Base (12" Depth) shall be measured by the Square Yard.
 - 5. Remove Concrete Curb shall be measured by the Linear Foot.
 - 6. Remove Concrete Curb and Gutter shall be measured by the Linear Foot.
 - 7. Remove Fence shall be measured by the Linear Foot.
 - 8. Remove Handrail shall be measured by the Linear Foot.
 - 9. Remove Metal Beam Guard Rail shall be measured by Linear Foot.

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10. Remove Wall shall be measured by the Linear Foot.
11. Remove Soundwall shall be measured by the Linear Foot.
12. Remove Seat Wall shall be measured by the Linear Foot.
13. Remove Rock Wall shall be measured by the Linear Foot.
14. Clearing and Grubbing shall be measured by the Square Yard.
15. Measurement for Sawcut must be considered as included in the various contract items of work involved.
16. Remove and Re-Establish Survey Monument shall be measured by each monument.

B. Payment: Only items listed for removal in the Bid Item list will be paid in accordance with the bid list.

1. The contract price paid per Square Foot for Remove Concrete Sidewalk, Curb Ramps and Driveways shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing sidewalk, curb ramp and driveways of various types as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
2. The contract price paid per Square Foot for Remove Concrete Median shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing medians of various types, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
3. The contract price paid per Square Foot for Remove Concrete Valley Gutter shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing valley gutters of various types, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
4. The contract price paid per Square Yard for Remove Asphalt Pavement and Base (12" Depth) shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing asphalt complete and base material, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
5. The contract price paid per Linear Foot for Remove Concrete Curb shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing curbs of various types, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
6. The contract price paid per Linear Foot for Remove Concrete Curb and Gutter shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing curb and gutter of various types, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
7. The contract price paid per Linear Foot for Remove Fence shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing fencing, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
8. The contract price paid per Linear Foot for Remove Handrail shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing handrail complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
9. The contract price paid per Linear Foot for Remove Metal Beam Guard Rail shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing metal beam guard rail, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
10. The contract price paid per Linear Foot for Remove Wall shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all

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- Work involved in removing walls of various types, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
11. The contract price paid per Linear Foot for Remove Soundwall shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing soundwalls, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
 12. The contract price paid per Linear Foot for Remove Seat Wall shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing seat walls, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
 13. The contract price paid per Linear Foot for Remove Rock Wall shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing rock walls, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
 14. The contract price paid per Square Yard for Clearing and Grubbing shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in clearing and grubbing the site, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
 15. Full compensation for sawcut must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.
 16. The contract unit price paid for Remove and Re-establish Survey Monument shall include full compensation for furnishing all labor, materials, tools, equipment, and appurtenances for demolition of existing monument, reconstruction of monument, including, but not limited to, formwork, lids and covers, monument disks, and Land Surveying costs, filing County records fees, complete in place, in accordance with these Technical Specifications, and as directed by the VTA.

1.06 REGULATORY REQUIREMENTS

- A. In addition to the foregoing referenced standards, the regulatory requirements that govern the work of this Section include the following governing codes
 1. California Code of Regulations (CCR), Title 8, Chapter 4, Subchapter 4 – Construction Safety Orders.
 2. California Code of Regulations (CCR), Title 24, Part 2, California Building Code, Chapter 33, “Site Work, Demolition and Construction.”

1.07 PERMITS

- A. The Contractor shall obtain all special permits and licenses and give all notices required for performance and completion of the demolition and removal work, hauling, and disposal of debris.

1.08 SITE CONDITIONS

- A. Protection of Persons and Property:
 1. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other measures as necessary to protect the public, workers, and adjoining property from damage from demolition work, all in accordance with applicable codes and regulations.

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2. Open depressions and excavations occurring as part of this work shall be barricaded and posted with warning lights when accessible through adjacent property or through public access. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 3. Protect utilities, pavements, and facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by demolition operations.
- B. Protection of Utilities:
1. Protect active sewer, water, gas, electric, and other utilities; and drainage and irrigation lines indicated or, when not indicated, found or otherwise made known to the Contractor before or during demolition work. If utility is damaged, immediately notify the utility owner for corrective action.
 2. Arrange with and perform work required by utility companies and municipal departments for discontinuance or interruption of utility services due to demolition work.
- C. Noise and Dust Abatement: Comply with requirements specified in Section 01 74 15, Dust Control, and the following:
1. Provide continuous noise and dust abatement as required to prevent disturbance and nuisance to the public and workers and to the occupants of adjacent premises and surrounding areas. Dampen or cover areas affected by demolition operations as necessary to prevent dust nuisance.
 2. When a certain level of noise is unavoidable because of the nature of the work or equipment involved, and such noise is objectionable to the occupants of adjacent premises, make arrangements with the jurisdictional authorities to perform such work or operate such equipment at the most appropriate time periods of the day.
- D. Unknown Conditions:
1. The Contract Drawings and related documents may not represent all surface conditions at the site and adjoining areas. The known surface conditions are as indicated, and shall be compared with actual conditions before commencement of work.
 2. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other such surface fixtures.
 3. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the work until written instructions are received from the Engineer.
 4. Thickness of existing pavements are from previous construction documents, and do not imply the actual depth or thickness of the total pavement or base material, where it occurs. Remove pavement of whatever thickness as required.

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PART 2 – PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FACILITIES

- A. The Contractor shall furnish all materials, tools, equipment, devices, appurtenances, facilities, and services as required for performing the demolition and removal work.
- B. Materials used for backfill shall conform to the requirements for backfill of Section 31 00 00, Earthwork.

PART 3 – EXECUTION

3.01 PRESERVATION OF REFERENCE MARKERS

- A. Record the locations and designation of survey markers and monuments prior to their removal. Provide three reference points for each survey marker and monument removed, established by a licensed civil engineer or land surveyor currently registered in the State of California.
- B. Store removed markers and monuments during demolition work, and replace them upon completion of the work. Re-establish survey markers and monuments in conformance with the recorded reference points. Forward to the Engineer a letter verifying re-establishment of survey markers and monuments, signed by a licensed civil engineer or land surveyor currently registered in the State of California.

3.02 DEMOLITION

- A. Perform demolition in accordance with the approved Demolition Plan. Perform demolition work in accordance with ANSI A10.6 and the California Code of Regulations, Title 8 and Title 24, as applicable.
- B. Cap or plug sanitary sewer in accordance with the details shown on the plans. Cap and plug pipe and other conduits abandoned due to demolition, with approved type caps and plugs as required by the utility owners.
- C. Backfill and compact depressions caused by excavations, demolition, and removal in accordance with applicable requirements of Section 31 00 00, Earthwork.
- D. Trim and remove trees in accordance with applicable requirements of Section 02 41 10, Tree Protection and Removal.
- E. Perform building demolition in accordance with applicable requirements of Section 02 41 16, Structure Demolition.
- F. Perform private property demolition, including signage salvage and relocation, in accordance with applicable requirements of Section 32 33 01, Private Property Restoration.

3.03 REMOVAL

- A. Remove existing pavements, structures, and site improvements that interfere with new construction, where demolition is not indicated.

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- B. Slabs may be broken for drainage and left in place where they are below grade and are not detrimental to the structural integrity of the fill or structure to be placed above, as determined by the Engineer.
- C. Removal shall conform to Section 15, Existing Facilities, of the Caltrans Standard Specifications.
- D. Existing drainage facilities shall be removed in accordance with Section 33 40 00, Storm Drainage Utilities. Frames and grates or covers shall be salvaged.
- E. Holes and depressions caused by the removal of existing facilities shall be backfilled as shown on the Plans, and as specified in Section 31 00 00, Earthwork. Hot Mix Asphalt for pavement restoration shall conform to the provisions in Section 32 12 16, Asphalt Paving.

3.04 SALVAGE

- A. Salvage includes removing, disassembling, cleaning, preparing, marking, bundling, packaging, tagging, hauling, and stockpiling facilities or portions of facilities as described. Cleaning includes removing earth, foreign materials, and concrete.
- B. Salvage or reuse materials and equipment as indicated on the plans and as specified in the Technical Specifications.
- C. Protect metallic coatings on salvaged items. Remove adhering concrete from salvaged items.
- D. Repair, or replace with new material, salvaged material damaged or destroyed due to Contractor's negligence, as determined by the Engineer.
- E. Salvaged material and items must be hauled directly to the specified salvage storage location and stockpiled. Coordinate salvage location with Engineer. If authorized, Contractor may temporarily store salvaged materials at site location and later haul to and stockpile at the specified location.

3.05 REMOVE CONCRETE

- A. Portland Cement Concrete (PCC) including concrete pavement, curb, curb and gutter, driveway, sidewalk, valley gutters, curb ramp, and median islands designated on the plans to be removed, shall be removed and shall conform to the Section 15-1.03B, Removing Concrete, of the Caltrans Standard Specifications, and these Technical Specifications.
- B. Curb, curb and gutter, sidewalk, driveway, curb ramps, median, and concrete pavement shall be removed at construction joints or expansion joints. Coordinate removal limits with Engineer.
- C. Landscaped islands designated on the plans to be removed shall be removed to a depth necessary to remove all roots, stumps, buried logs and other objectionable material. In no case shall the depth of removal be less than 18 inches.

3.06 SAWCUTTING

- A. Where a portion of existing surfacing including curbs and gutters is to be removed, the outline of the area to be removed shall be cut straight, clean and square with a power-driven saw to a full depth before removing the surfacing. Sawcutting shall be done on a neat line with a power-driven saw to an adequate depth to ensure a clean break, but no less than 2 inches, prior to removing the

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surfacing or other facility.

- B. Saw shall utilize a system capable of evacuating sawcut wash prior to its entrance into any waterway or inlet.

3.07 REMOVE FENCE, HANDRAIL AND GUARDRAIL

- A. Existing fences, handrails and guardrails, where shown on the plans to be removed, shall be completely removed including foundation and disposed as shown on the plans and as specified in Section 15, Existing Facilities, of the Caltrans Standard Specifications, these Technical Specifications, and as directed by VTA.
- B. Holes and depressions caused by the removal of existing fences shall be backfilled with suitable native material or as specified in Section 31 00 00, Earthwork.

3.08 REMOVE WALLS

- A. Remove walls and masonry construction to a minimum depth of 2 feet below existing ground level in areas where such items do not interfere with new construction.

3.9 CLEARING AND GRUBBING

- A. Perform Clearing and Grubbing in accordance with Section 17-2, Clearing and Grubbing, of the Caltrans Standard Specifications, and these Technical Specifications.
- B. All activities controlled by Contractor, except cleanup or other required Work, shall be confined within the limits of the areas to be graded.
- C. Nothing herein shall be construed as relieving Contractor of responsibility for final cleanup.
- D. Stockpiling of items removed in conjunction with clearing and grubbing operations by Contractor will not be allowed. Contractor shall remove and dispose of all such materials from the Worksite on the same day as the clearing and grubbing operations.

3.10 DEMOLISH AND RE-ESTABLISH MONUMENT

- A. Contractor shall provide construction survey services and comply with Section 78-2, Survey Monuments, of the Caltrans Standard Provisions, and these Technical Specifications.
- B. Reconstruction of monuments shall be of a type and quality in accordance with Santa Clara County standards and shall be placed in a manner consistent with good and recognized engineer and surveying practices in accordance with the State of California regulations.
- C. In case of accidental damage or displacement of the monuments where, in the opinion of the VTA, new concrete monuments are required, two copies of the field notes showing the new locations, ties, and elevations shall be furnished to the Engineer. New monuments shall be of a type and quality in accordance with Santa Clara County standards and shall be placed in a manner consistent with good and recognized engineer and surveying practices in accordance with the State of California regulations. All costs of monument replacement not shown on the Contract Documents shall be at the Contractor's sole expense.

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3.12 DISPOSAL OF REMOVED MATERIALS AND DEBRIS

- A. Dispose of removed materials, waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction.
- B. Burying of trash and debris on the site will not be permitted. Burning of trash and debris at the site will not be permitted.
- C. Remove trash and debris from the site at frequent intervals so that their presence will not delay the progress of the work or cause hazardous conditions for workers and the public.
- D. Removed materials, trash, and debris shall become the property of the Contractor and shall be removed from the public right of way and disposed of in a legal manner. Location of disposal site and length of haul shall be the Contractor's responsibility.

3.13 CLEANUP

- A. Provide a clean and orderly site at all times in accordance with Section 01 74 00, Cleaning.

END OF SECTION 02 41 00

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SECTION 02 41 10

TREE PROTECTION AND REMOVAL

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for performing tree protection, pruning and removal and other site features that conflict with the Work.

1.02 RELATED SECTIONS

- A. Section 6.6, Contract Data Requirements, of the Special Conditions
- B. Section 01 78 39, Project Record Documents
- C. Section 02 41 00, Demolition, for site demolition, clearing and grubbing and removal of other roadway facilities
- D. Section 32 84 00, Planting Irrigation, for tree and landscape irrigation requirements.
- E. Section 32 93 00, Planting, for tree and landscape planting requirements.

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI A300 Tree Care Operations
 - 2. ANSI Z133 Safety Requirements for Arboricultural Operations
- B. State of California, Department of Transportation (Caltrans), Standard Specifications:
 - 1. Section 17, General.

1.04 SUBMITTALS

- A. General: For submittal requirements and procedures, refer to Section 6.6, Contract Data Requirements, of the Special Conditions.
- B. Contractor must coordinate with VTA and City Arborist for tree removal, including root cutting and pruning, during demolition and underground work.
- C. Arborist Certification by International Society of Arboriculture (ISA).
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain and that interfere with or are affected by demolition or construction.
- E. Record Documents: Provide copies of all approved submittals, specified herein, for record purposes in accordance with the requirements of Section 01 78 39, Project Record Documents.

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1.05 MEASUREMENT AND PAYMENT

A. Measurement:

1. Tree Protection and Pruning shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
2. Remove Tree shall be measured by unit count.

B. Payment:

1. The lump sum payment for Tree Protection and Pruning shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in performing pruning, root pruning, tree protection and signage, including permits as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
2. The contract price paid per unit for Remove Tree shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removing trees, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

A. All tree protection, preservation and pruning performed shall be executed by a Qualified Tree Service company having, in full-time employment, an Arborist certified by ISA. The Arborist must be directly responsible for decisions made and should visit the work sites daily when trimming of tree limbs and roots are to be performed.

B. Pruning shall be performed to the standards of ANSI A300, ANSI Z133, and the ISA Pruning guidelines.

1.07 PERMITS

A. The Contractor shall obtain all permits and give all notices required for performance and completion of the tree removal and pruning.

PART 2 – PRODUCTS

2.01 TREE PROTECTION FENCING

A. Furnish stakes, orange snow fencing and other materials necessary for tree protection.

2.02 MULCH

A. Furnish mulch in accordance with Section 32 93 00, Planting.

PART 3 – EXECUTION

3.01 TREE PROTECTION

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- A. Contractor shall protect from damage all existing vegetation determined by the Engineer to remain on the project site and on adjacent properties. Contractor shall be responsible for the repair of any damage, including that to the adjacent property resulting from failure to comply with the requirements of the Contract Documents or failure to exercise reasonable care in performing the Work.
- B. Tree and Plant Protection includes, but is not limited to the following:
1. The protection of the above and below-ground portions of trees including roots, trunks, branches and foliage. Protection of roots includes reduction and/or prevention of soil compaction caused by vehicles, equipment, materials or foot traffic.
 2. Protective Fencing around trees or group of trees.
 3. Pre-work Clearance Pruning for demolition and construction
 4. Organic mulch placed in tree protection zones
 5. Irrigation of trees before and during demolition and construction in accordance with Section 32 84 00, Planting Irrigation.
 6. Protection and preservation of tree roots relative to soil grubbing, grading, structure or pavement removal, excavations, etc.
 7. Ongoing updating and consultation with the City regarding site work and potential tree impacts.
- C. The Tree Protection Zone (TPZ) is defined as the area inside the tree protection fencing, containing the tree or tree trunks and below some or the entire canopy of the tree or beyond the canopy. The TPZ and tree protection fencing must remain in place prior to any work on site, including demolition, until the Work is complete.
- D. The following practices are prohibited within the TPZ:
1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Placement of outhouses
 4. Foot traffic.
 5. Erection of sheds or structures.
 6. Impoundment of water.
 7. Equipment wash down.
 8. Grubbing of soil surface to remove organic matter.
 9. Disposal of chemicals, petroleum products, or other detrimental substances.
 10. Excavation, grading or other soil disturbance unless otherwise indicated.
 11. Attachment of signs to or wrapping materials around trees unless otherwise indicated on plans.
- E. All trees to be preserved shall be flagged with a distinctive colored ribbon for verification by the Engineer.
- F. If at any time the Contractor judges that the protection of a tree designated to be saved is incompatible with work required, or if operations necessary threaten the health or structural stability of a tree, notify the Engineer immediately the City and do no further work affecting the tree until a written agreement is reached concerning acceptable procedures.
- G. Examine the site to verify that temporary erosion-and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross the TPZ. Contractor shall install 8 or 9 inch diameter straw wattling roll on the

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uphill side of the protective fence to divert runoff from the construction site to the protected trees. The wattle shall be maintained until protective fence is removed from the project site.

- H. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- I. Contractor shall repair or replace protected trees and other vegetation indicated to remain or be relocated that are damaged by construction operations at no additional cost to contract or City. The Engineer shall specify any repair work or replacement value for damaged trees.
- J. Woodchips or another cushioning surface material approved by the City shall be placed over areas where roots are present and construction traffic occurs.
- K. Maintain TPZ and signage in good condition as acceptable to Engineer and remove when construction operations are complete and equipment and materials have been removed from the site. At sites where the excavation has taken place near trees to remain, and many living roots remain exposed to the air, the Contractor shall cover the exposed roots within 2 hours with sand, soil, moist burlap or other means acceptable to the Engineer.

3.02 EXCAVATION

- A. Hand or air spade excavate at edge of each TPZ for grading, trenches and other soil disturbance adjacent to existing trees.
- B. No rototilling or other soil disturbance shall take place within each TPZ before, during, or after demolition or construction, unless designated within construction documents.
- C. Where utility trenches are required within or adjacent to each TPZ, air spade or hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut roots larger than 2 inches in diameter or greater. Cut only smaller roots that interfere with installation of utilities.
- D. Open trenches are not to be routed beneath the dripline of trees that are to be preserved unless this is impossible to avoid; in which case damage may be reduced by careful placement by air spading or hand-digging of trenches to avoid large roots by tunneling under rather than cutting roots greater than 2 inches or greater in diameter.

3.03 TREE PRUNING

- A. Remove branches that are in the path of temporary and permanent construction, or within the work zone margin beyond that construction. Where trees are concerned, minimize the work zone margin to the minimum possible to accomplish demolition or construction work. Notify Engineer of any pruning activities.
- B. Tree pruning shall be performed to balance the crown and eliminate hazards. The main work performed shall be to reduce the sail effect through thinning, reducing end weights, shortening long heavy limbs, removing deadwood, weak limbs and sucker growth. Limbs shall be pruned back to an appropriate lateral branch.

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- C. All final cuts shall be made at the outer edge of the branch collar. The pruning work shall be performed in a safe and proper manner in accordance with ANSI Standards A300 and Z311.
- D. The Contractor shall be responsible for the preservation of all public and private property. Pruning includes the cutting of limbs, cleanup, removal and disposal of cuttings and debris. Elm logs must be properly disposed of per State Quarantine. Work shall be performed by a two-person crew with one climber, one ground person, a dumping chipper truck and chipper, and any other necessary saws, lines, tools and safety equipment. The work area shall have appropriate cones and signs for safe pedestrian and vehicle traffic.

3.04 ROOT PRUNING

- A. Tree roots greater than 3 inches in diameter and less than 12 inches below ground level shall not be cut without approval of the Engineer.
- B. Roots shall be cut clearly, as far from the trunk of the tree as possible. Root pruning shall be to a depth of 18 inches.
- C. Root pruning shall be performed using a Vermeer Root Cutting Machine. Alternate equipment or techniques must be approved by the Engineer.
- D. Root pruning shall be completed prior to base or subgrade preparation, or to any excavation adjacent to the tree.
- E. Prior to root cutting, air spade or hand dig a trench along the edge of the excavation facing the protected tree to the depth of the excavation. The trench must be at least 12 inches wide. Cut exposed roots that need to be removed cleanly back to the trench wall with sharp pruning tools. Do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots. Heavy equipment may be used to continue soil work but the equipment must not contact the roots that have been cut at the edge of the trench, or any soil or roots on the tree-side of the trench.
- F. Exposed roots must be covered with 2 layers of natural burlap or organic mulch that is kept moist until backfilled. The exposed trench wall must be sprayed with water and thoroughly moistened with water prior to placement of burlap.
- G. Backfill as soon as possible according to requirements in Section 32 93 00, Planting. Wet the backfill soil thoroughly as it is placed in the trench.

3.05 TREE REMOVAL

- A. Under no circumstances shall the Contractor remove existing trees that are indicated not to be removed.
- B. Tree removal may not damage existing trees or vegetation to remain; consult with Engineer regarding any conflicts.
- C. Tree removal shall be performed in accordance with Caltrans Standard Specification Section 17-2, Clearing and Grubbing, and these technical specifications.

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3.06 DISPOSAL

- A. Dispose of excess excavated material, displaced trees, trash and debris in accordance with Caltrans Standard Specification Section 17-2, Clearing and Grubbing, and these technical specifications.

END OF SECTION 02 41 10

SECTION 02 41 16
STRUCTURE DEMOLITION

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for demolishing the building at 1091 S. Capitol Avenue and other site features that conflict with the Work.

1.02 RELATED SECTIONS

- A. Section 6.6, Contract Data Requirements, of the Special Conditions
- B. Section 01 74 00, Cleaning
- C. 01 74 15, Dust Control
- D. Section 01 78 39, Project Record Documents
- E. Section 02 41 00, Demolition.
- F. Section 02 80 00, Hazardous Material Abatement
- G. Section 31 00 00, Earthwork, for removal of at-grade features and placement of backfill

1.03 REFERENCED STANDARD

- A. American National Standards Institute (ANSI)
 - 1. ANSI A10.6 Safety Requirements for Demolition Operations
- B. State of California, Code of Regulations (CCR)
 - 1. Title 8
 - 2. Title 24

1.04 SUBMITTALS

- A. General: For submittal requirements and procedures, refer to Section 6.6, Contract Data Requirements, of the Special Conditions.
- B. Structure Demolition Plan: Submit a comprehensive demolition plan, describing the proposed sequence, methods, and equipment for demolition, removal, recycling and disposal of structure(s); include salvage if required. Do not proceed with demolition until the Engineer has given written approval of the demolition plan.
- C. Submit copies of demolition, hauling, and debris disposal permits and notices for record purposes. Include description of proposed haul routes.
- D. Utility Severance Certificates: Provide certificates, issued by the utility owners, of severance of utility services for record purposes. Contractor shall allow 60 days for utility termination of service.

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- E. Private Property Owner's Release: If material demolished and removed from the site will be deposited on private property, submit two copies of written releases not more than 15 days before the start of work. Releases shall absolve the VTA from responsibility in connection with the depositing of material on private property, and shall be signed by the owners of such property on which the material will be deposited.
- F. Record Documents: Provide copies of all approved submittals, specified herein, for record purposes in accordance with the requirements of Section 01 78 39, Project Record Documents.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Structure Demolition 1091 S. Capitol Avenue shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Structure Demolition 1091 S. Capitol Avenue shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in demolishing the building at 1091 S. Capitol Avenue complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.06 DESCRIPTION

- A. Buildings and structure foundations, footings, and foundation systems shall be completely removed.
- B. Utility services to facilities to be removed or demolished shall be disconnected, cut, and capped.
- C. Sewer lateral to the building must be capped at the property limits and surveyed for the purpose of as-built drawing.
- D. Removal of at-grade structures, including but not limited to saw cut, bases, pavements, curbs, gutters, curb and gutters, headers, sidewalks, driveways, or as specified herein, or as directed to complete the new work

1.07 PERMITS

- A. The Contractor shall obtain all special permits and licenses and give all notices required for performance and completion of the demolition and removal work, hauling, and disposal of debris.

1.08 SITE CONDITIONS

- A. Protection of Persons and Property:
 - 1. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other measures as necessary to protect the public, workers, and adjoining property from damage from demolition work, all in accordance with applicable codes and regulations.
 - 2. Open depressions and excavations occurring as part of this work shall be barricaded and posted with warning lights when accessible through adjacent property or through public access. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

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3. Protect utilities, pavements, and facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by demolition operations.
- B. Protection of Utilities:
1. Protect active sewer, water, gas, electric, and other utilities; and drainage and irrigation lines indicated or, when not indicated, found or otherwise made known to the Contractor before or during demolition work. If utility is damaged, immediately notify the utility owner for corrective action.
 2. Arrange with and perform work required by utility companies and municipal departments for discontinuance or interruption of utility services due to demolition work.
- C. Noise and Dust Abatement: Comply with requirements specified in Section 01 74 15, Dust Control, and the following:
1. Provide continuous noise and dust abatement as required to prevent disturbance and nuisance to the public and workers and to the occupants of adjacent premises and surrounding areas. Dampen or cover areas affected by demolition operations as necessary to prevent dust nuisance.
 2. When a certain level of noise is unavoidable because of the nature of the work or equipment involved, and such noise is objectionable to the occupants of adjacent premises, make arrangements with the jurisdictional authorities to perform such work or operate such equipment at the most appropriate time periods of the day.
- D. Unknown Conditions:
1. The Contract Drawings and related documents may not represent all surface conditions at the site and adjoining areas. The known surface conditions are as indicated, and shall be compared with actual conditions before commencement of work.
 2. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other such surface fixtures.
 3. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the work until written instructions are received from the Engineer.
 4. Thickness of existing pavements are from previous construction documents, and do not imply the actual depth or thickness of the total pavement or base material, where it occurs. Remove pavement of whatever thickness as required.

PART 2 – PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FACILITIES

- A. The Contractor shall furnish all materials, tools, equipment, devices, appurtenances, facilities, and services as required for performing the demolition and removal work.

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- B. Materials used for backfill shall conform to the requirements for backfill of Section 31 00 00, Earthwork.

PART 3 – EXECUTION

3.01 STRUCTURE DEMOLITION

- A. Perform demolition in accordance with the approved Demolition Plan. Perform demolition work in accordance with ANSI A10.6 and the California Code of Regulations, Title 8 and Title 24, as applicable.
- B. Demolish adjacent surface improvements in accordance with applicable requirements of Section 02 41 00, Demolition.
- C. Prior to building demolition, perform hazardous material abatement in accordance with applicable requirements of Section 02 80 00, Hazardous Material Abatement.
- D. Backfill and compact depressions caused by excavations, demolition, and removal in accordance with applicable requirements of Section 31 00 00, Earthwork.
- E. Removals shall be conducted to minimize interference with public or private thoroughfares. Removal operations shall result in no visible dust.
- F. Existing utilities shall be disconnected, capped, and removed from the residence to the property line. Coordinate with the respective utility companies to arrange for the removal of their facilities.
- G. Do not remove perimeter fencing adjoining occupied improvements. All existing perimeter fences are to remain undamaged and structurally supported, unless otherwise directed by the Engineer. You are responsible for replacing any perimeter fences that were in good standing prior to demolition but were damaged or removed during demolition.
- H. The structure and appurtenances shall be demolished in an orderly and careful manner. Demolished material shall be immediately removed from the site and disposed of. The Contractor shall use its predetermined local dumpsite(s) for disposal of the demolished improvements. The Contractor responsible for disposal site charges. Existing building material shall not be burned or buried on site. The foundation and slab shall be completely removed.
- I. Footings, foundation walls, below-grade construction and concrete slabs on grade including utility lines shall be demolished and removed to a depth of not be less than three feet below existing ground surface.
- J. All fill and compaction surfaces shall be graded to meet adjacent contours and to provide flow in conformance with existing drainage patterns.

3.02 DISPOSAL OF REMOVED MATERIALS AND DEBRIS

- A. Dispose of removed materials, waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction.

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- B. Burying of trash and debris on the site will not be permitted. Burning of trash and debris at the site will not be permitted.
- C. Remove trash and debris from the site at frequent intervals so that their presence will not delay the progress of the work or cause hazardous conditions for workers and the public.
- D. Removed materials, trash, and debris shall become the property of the Contractor and shall be removed from the public right of way and disposed of in a legal manner. Location of disposal site and length of haul shall be the Contractor's responsibility.

3.03 CLEANUP

- A. Provide a clean and orderly site at all times in accordance with Section 01 74 00, Cleaning.

END OF SECTION 02 41 16

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SECTION 02 43 13

BRT OCALA STATION RELOCATION

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for relocating the Bus Rapid Transit (BRT) Ocala Station located at the southwest corner of Capitol Expressway/Ocala Avenue intersection, including wind screen, bench, art pavers, roof panels, trash cans, leaning rail, street light, utilities, electrical and communications equipment and conduits, and other site features that conflict with the Work as shown on the plans.

1.02 RELATED SECTIONS

- A. Section 6.6, Contract Data Requirements, of the Special Conditions
- B. Section 01 74 00, Cleaning
- C. Section 01 74 15, Dust Control
- D. Section 01 78 39, Project Record Documents
- E. Section 02 41 00, Demolition
- F. Section 03 05 15 Portland Cement Concrete
- G. Section 05 05 60, Metal Welding
- H. Section 05 12 35, Structural Steel
- I. Section 31 00 00, Earthwork for removal of roadway subgrade and placement of backfill
- J. Section 31 23 43, Structure Excavation and Backfill
- K. Section 31 63 29, Drilled Concrete Piers and Shafts

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI A10.6 Safety Requirements for Demolition Operations

1.04 SUBMITTALS

- A. General: For submittal requirements and procedures, refer to Section 6.6, Contract Data Requirements, of the Special Conditions.

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- B. Shelter Relocation Plan: Submit a comprehensive relocation plan for relocating the existing BRT shelter. This plan and supporting calculations should be stamped and signed by a Professional Engineer licensed in the state of California and should describe the proposed sequence, methods, deactivation and reactivation procedures, protection measures, and equipment proposed for removing the existing BRT shelter and relocating to the location as shown on the plans. Shop drawings of the BRT shelter and associated equipment are shown in Attachment A. Do not proceed with removal until the Engineer has given written approval of the relocation plan. The relocation plan also needs to address the following actions:
1. Deactivation of VTA communications equipment and returning equipment to VTA
 2. PG&E power deactivation and relocation
 3. Relocation of the City of San Jose street light behind the platform
 4. Obtaining work authorization from PG&E and the FAA.
 5. Proposed disassembly and reassembly of the shelter structure components if required.
 6. Crane Lifting plans for shelter elements, including temporary stress analysis for lifting forces.
 7. Temporary bracing details to ensure positioning of column base plates for installation on new foundations
 8. Description of temporary storage site and storage methods to protect the existing structure during construction cycle.
 9. Structural calculations to ensure adequacy of elements for temporary stresses during lifting
- C. Record Documents: Provide copies of all approved submittals, specified herein, for record purposes in accordance with the requirements of Section 01 78 39, Project Record Documents.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: BRT Ocala Station Relocation shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for BRT Ocala Station Relocation shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in relocating the BRT Ocala Station in accordance with the approved relocation plan, complete in place, including any necessary disassembling and reassembling of shelter structure components, seals, gaskets and shrouding, wind screen, bench, art pavers, roof panels, trash cans, leaning rail, street light, utilities, electrical and communications equipment and conduits, and other site features to match the originally constructed condition, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

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1.06 SITE CONDITIONS

- A. Protection of Persons and Property:
1. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other measures as necessary to protect the public, workers, and adjoining property from damage from demolition work, all in accordance with applicable codes and regulations.
 2. Open depressions and excavations occurring as part of this work shall be barricaded and posted with warning lights when accessible through adjacent property or through public access. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 3. Protect utilities, pavements, and facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by demolition operations.
- B. Protection of Utilities:
1. Protect active sewer, water, gas, electric, and other utilities; and drainage and irrigation lines indicated or, when not indicated, found or otherwise made known to the Contractor before or during demolition work. If utility is damaged, immediately notify the utility owner for corrective action.
 2. Arrange with and perform work required by utility companies and municipal departments for discontinuance or interruption of utility services due to demolition work.
- C. Noise and Dust Abatement: Comply with requirements specified in Section 01 74 15, Dust Control, and the following:
1. Provide continuous noise and dust abatement as required to prevent disturbance and nuisance to the public and workers and to the occupants of adjacent premises and surrounding areas. Dampen or cover areas affected by demolition operations as necessary to prevent dust nuisance.
 2. When a certain level of noise is unavoidable because of the nature of the work or equipment involved, and such noise is objectionable to the occupants of adjacent premises, make arrangements with the jurisdictional authorities to perform such work or operate such equipment at the most appropriate time periods of the day.
- D. Unknown Conditions:
1. The Contract Drawings and related documents may not represent all surface conditions at the site and adjoining areas. The known surface conditions are as indicated, and shall be compared with actual conditions before commencement of work.
 2. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other such surface fixtures.
 3. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the work until written instructions are received from the Engineer.

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4. Thickness of existing pavements are from previous construction documents, and do not imply the actual depth or thickness of the total pavement or base material, where it occurs. Remove pavement of whatever thickness as required.

PART 2 – PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FACILITIES

- A. The Contractor shall furnish all materials, tools, equipment, devices, appurtenances, facilities, and services as required for performing the demolition and removal work.
- B. Materials used for backfill shall conform to the requirements for backfill of Section 31 00 00, Earthwork.
- C. Materials used for constructing shelter and windscreen drilled pier foundations shall conform to the requirements of Section 31 63 29, Drilled Concrete Piers and Shafts.
- D. Materials used for constructing leaning rail foundation foundation shall conform to the requirements of Section 03 05 15 Portland Cement Concrete, and Section 31 23 43, Structure Excavation and Backfill.
- E. Materials used for constructing shelter structural steel shall conform to the requirements of Section 05 12 35, Structural Steel and Section 05 05 60, Metal Welding.

PART 3 – EXECUTION

3.01 STRUCTURE DEMOLITION

- A. Perform relocation in accordance with the approved Relocation Plan. Perform demolition work in accordance with ANSI A10.6 and the California Code of Regulations, Title 8 and Title 24, as applicable.
- B. Backfill and compact depressions caused by excavations, demolition, and removal in accordance with applicable requirements of Section 31 00 00, Earthwork.
- C. Demolish at-grade elements in accordance with applicable requirements of Section 02 41 00, Demolition. Removals shall be conducted to minimize interference with public or private thoroughfares. Removal operations shall result in no visible dust.
- D. The structure and appurtenances to be relocated shall be protected in an orderly and careful manner. Demolished material shall be immediately removed from the site and disposed of. The Contractor shall use its predetermined local dumpsite(s) for disposal of the demolished improvements. The Contractor responsible for disposal site charges. Existing building material shall not be burned or buried on site. The foundation and slab shall be completely removed.
- E. Footings, foundation walls, below-grade construction and concrete slabs on grade including utility lines shall be demolished and removed to a depth of not be less than three feet below existing ground surface.

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3.02 DRILLED PIER FOUNDATIONS

- A. Provide structural foundations in accordance with applicable requirements of Section 31 63 29, Drilled Concrete Piers and Shafts

3.03 STRUCTURAL STEEL

- A. Relocate and place structural steel in accordance with applicable requirements of Section 05 05 60, Metal Welding and Section 05 12 35, Structural Steel.

3.04 DISPOSAL OF REMOVED MATERIALS AND DEBRIS

- A. Dispose of removed materials, waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction.
- B. Burying of trash and debris on the site will not be permitted. Burning of trash and debris at the site will not be permitted.
- C. Remove trash and debris from the site at frequent intervals so that their presence will not delay the progress of the work or cause hazardous conditions for workers and the public.
- D. Removed materials, trash, and debris shall become the property of the Contractor and shall be removed from the public right of way and disposed of in a legal manner. Location of disposal site and length of haul shall be the Contractor's responsibility.

3.06 CLEANUP

- A. Provide a clean and orderly site at all times in accordance with Section 01 74 00, Cleaning.

END OF SECTION 02 43 13

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ATTACHMENT A – BRT SHOP DRAWINGS

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SECTION 02 61 00

CONTAMINATED SOIL MANAGEMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing all labor, facilities, equipment, services, employee training, permits and agreements necessary to perform the work required for properly removing, reusing and disposing of contaminated soils.

1.02 RELATED SECTIONS

- A. Section 6.6, Contract Data Requirements, of the Special Conditions
- B. Section 6.27, Environmental Coordination and Cooperation, of the Special Conditions.
- C. Section 7.9, Hazardous Materials or Unusual Conditions, of the General Conditions.
- D. Section 01 74 15, Dust Control
- E. Section 01 78 39, Project Record Documents.
- F. Section 31 00 00, Earthwork.
- G. Section 31 23 43, Structure Excavation and Backfill.
- H. Section 33 05 28, Trenching and Backfilling for Utilities

1.03 REFERENCED STANDARDS

- A. The report titled "Preliminary Site Investigation and Hazardous Materials Evaluation", dated January 2020, by Geocon Consultants Inc.
- B. The report titled "Limited Phase II Environmental Investigation Parcel 1214 (Tran & Zhong)", dated December 2019, by Haley & Aldrich, Inc.
- C. The report titled "Limited Phase II Environmental Investigation Parcel 1215 (World Oil)", dated January 2019, by Haley & Aldrich, Inc.
- D. The report titled "Phase II Site Characterization Report: Parcel 1216 AutoZone," dated January 22nd 2020, by Burns & McDonnell.
- E. The report titled "Phase II Site Characterization Report: Bohannon 1217 Parcel", dated December 13th 2019, by Burns & McDonnell.
- F. The report titled "Phase II Site Characterization Report: Parcel 1218 Abdulkariem," dated January 20th 2020, by Burns & McDonnell.

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- G. The report titled “Phase II Environmental Site Assessment Report – Parcel 1236 and Parcel 1240”, dated December 23rd 2019, by Kennedy Jenks.
- H. The report titled “Phase II Environmental Site Assessment Report – Parcel 1241”, dated January 3rd 2020, by Kennedy Jenks.
- I. State of California, Code of Regulations (CCR)
 - 1. Title 8, Part 5192
 - 2. Title 22, Part 66261.24
- J. State of California, Health and Safety Code
 - 1. Section 44300
- K. Code of Federal Regulations
 - 1. Title 29, Part 1910.120
 - 2. Title 40, Part 261
- L. U.S. Environmental Protection Agency (EPA)
 - 1. Guidance Document “Test Methods for Evaluating Solid Waste, Volume II: Field Manual Physical/Chemical Methods”, (SW 846)
 - 2. EPA Method 9095 as modified by Section 66264.314 of Title 22 of the California Code of Regulations (CCR)
- M. San Francisco Bay Regional Water Quality Control Board
 - 1. Environmental Screening Levels (ESLs)
- N. California Environmental Protection Agency
 - 1. California Human Health Screening Levels (CHHSLs)
- O. USEPA, Region 9:
 - 1. Preliminary Remediation Goals (PRGs)

1.04 SUBMITTALS

- A. General: For submittal requirements and procedures, refer to Section 6.6, Contract Data Requirements, of the Special Conditions.
- B. Health and Safety Plan: Within thirty (30) Days after the Notice to Proceed, the Contractor shall submit for review and approval a Health and Safety Plan (HSP). The HSP may be revised with site-

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specific details up to a minimum of thirty (30) Days prior to commencement of excavation. This plan shall include, but not be limited to, the following:

1. Sampling and Analysis Plan describing the scope of soil investigation.
 2. Methods, procedures, and equipment to be used for stockpiling, handling, transporting, and disposing of excavated material, including meeting all Lead Compliance requirements.
 3. Haul routes for transporting excavated and contaminated soils to licensed disposal facilities. The haul routes shall include area site maps showing truck routes in and out of the disposal facilities with appropriate traffic controls.
 4. Identification of and resume of a certified Industrial Hygienist, licensed in the State of California and experienced in soils characterization, who will be responsible for and sign the prepared HSP, and will provide the Contractor's Quality Control oversight of the soils testing and the performance of work associated with contaminated soil.
 5. Name, address, and current certification of the testing laboratory approved by the State of California, Department of Public Health for any sampling or analysis for disposal facility requirements, reclassification of material, or characterization of material both inside and outside of the excavation Contract pay limits. Include the testing laboratory's documented Quality Assurance and Quality Control program.
 6. Name, address, and license number of the licensed specialty Subcontractor approved by the State of California, Department of Public Health, to perform contaminated soil work for any work associated with contaminated soil both inside and outside of the excavation Contract pay limits. Include the licensed specialty Subcontractor's documented Quality Assurance and Quality Control program.
 7. Name, address, and license number(s) of the transporter(s) for hauling any soil off of the project site, both inside and outside of the excavation Contract pay limits, to a disposal facility.
 8. Name and address, with the applicable State and Federal identification numbers, of the off-site disposal facility or facilities the Contractor intends to use for disposing any contaminated soil to a disposal facility. The Contractor shall submit either the facility's acceptance criteria or a letter of commitment from each transfer facility or landfill facility or facilities at which they are proposing disposal.
 9. Hazardous Materials Training Plan meeting the required OSHA HAZWOPER 29 CFR 1910.120 and 8 CCR 5192 with certifications for Contractor's employees involved in the work including the licensed specialty Subcontractor, as described herein.
 10. The Contractor's and Subcontractor's EPA number with manifests for contaminated soil shipments to disposal sites.
- C. Record Documents: Provide copies of all approved submittals, specified herein, for record purposes in accordance with the requirements of Section 01 78 39, Project Record Documents.

1.05 MEASUREMENT AND PAYMENT

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- A. Measurement:
1. Handling and Disposal of Contaminated Soil (Class II Landfill) shall be measured by the cubic yard.
 2. The quantity measured shall be the basis for volume of excavated contaminated material that cannot be reused for backfill and therefore requires removal from site. Locations were determined, through preliminary site investigation, to have contaminated soil. Excavated contaminated soil shall be reused as backfill to the extent possible and shall be placed from where it was excavated.
 3. The upper limit for computing quantities of contaminated soil excavation shall be the ground surface as it existed prior to start of construction operations.
 4. The lower limits for computing quantities of contaminated soil excavation shall be a plane at the bottom of the excavation or over excavation required for construction of the project improvements and any other construction activity requiring excavation within the project limits.
 5. Pay quantities of contaminated soil shall be calculated based on the volume of excavated contaminated material that cannot be reused for backfill and therefore requires removal from site.
 6. Excavated material shall be used for backfilling and to raise the grades as necessary within the site to the extent possible. If the contractor elects to remove and dispose of excavated material as contaminated soil when it could have been reused for backfill on site it shall be at no additional cost to VTA
- B. Payment: The contract price paid per cubic yard for Handling and Disposal of Contaminated Soil (Class II Landfill) shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in handling and disposing of contaminated soil, including preparing the HSP, testing, sampling, analysis, contaminated soil stockpiling and handling, soil profiling for re-use or offsite disposal, off-site disposal including registered transport vehicles, personal hazardous material training as approved by the Engineer where required, personal protective equipment, Contractor procured permits, charges, fees, safety training for up to four VTA personnel as required, Industrial Hygienist, and all other work incidental to contaminated soil management, complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.
- C. All other items related to contaminated soil management is covered by other items of work.

1.06 RULES AND REGULATIONS

- A. Excavation, transport and disposal of contaminated soil, and non-hazardous material shall be in accordance with the rules and regulations of the following agencies and codes:
1. United States Department of Transportation (USDOT)
 2. United States Environmental Protection Agency (USEPA)

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3. California Environmental Protection Agency (CAL-EPA)
4. California Code of Regulations (CCR)
5. California Department of Toxic Substance Control (DTSC)
6. Integrated Waste Management Board
7. Regional Water Quality Control Board, Region 2 (RWQCB)
8. California Air Resources Board
9. Bay Area Air Quality Management District (BAAQMD)
10. California Division of Occupational Safety and Health Administration (CAL-OSHA)
11. United States Occupational Safety and Health Administration (OSHA)
12. Local regulatory agencies and California Unified Program Agencies

1.07 DEFINITIONS

- A. Contaminated Soil: Soil that does not meet screening levels (e.g., CHHSLs, ESLs, PRGs) or acceptance standards established by a regulatory agency for use as backfill (either in-situ or offsite), or may be reused as backfill only in the excavation from which it came. In both cases, disposal acceptance may not be granted at a Class III municipal landfill.
- B. California Hazardous Soil: Soil that contains contaminants at concentrations equal to or greater than the total threshold limit concentrations (TTLCs) or soluble threshold limit concentrations (STLCs) listed in Section 66261.24 of Title 22 of the California Code of Regulations, excluding Section 66261.24(a)(1).
- C. Non-Hazardous Soil: Soil that does not contain contaminants at concentrations equal to or greater than the TTLCs or STLCs listed in Section 66261.24 of Title 22 of the California Code of Regulations.
- D. HSP: Health and Safety Plan.
- E. Licensed Hauler: A transporter certified by the State of California to carry certain levels of contaminated wastes in registered transport vehicles.
- F. Class I Landfill: A permitted hazardous waste disposal facility.
- G. Class II Landfill: An industrial landfill accepting California regulated waste.
- H. Class III Landfill: A municipal or sanitary landfill accepting non-hazardous and household waste.
- I. Surplus Excavated Material: Excavated soil from within the Contract excavation pay limits that is displaced by the new concrete or by trackway ballast or subballast or by new roadway section materials.

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- J. Additional Excavated Material: Excavated soil that is from outside the Contract excavation pay limits.

1.08 AUTHORITY TO STOP WORK

- A. The Engineer will stop work at any time the Engineer determines that conditions are not within these Contract Specifications or applicable regulations. The stoppage of work shall continue until conditions have been corrected and corrective steps have been taken to the satisfaction of the Engineer. Standby time required to resolve violations shall be at the Contractor's cost, and shall not be cause for extending the Contract completion date.

PART 2 – PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FACILITIES

- A. The Contractor shall furnish all materials, tools, equipment, facilities, and services as required for providing the necessary excavation, soil stockpiling, soil testing and analysis, and soil disposition for contaminated soil. Provide back-up equipment as necessary for replacement and for unanticipated emergencies.
- B. Materials used for backfill shall conform to the requirements for backfill of Section 31 00 00, Earthwork.

PART 3 – EXECUTION

3.01 EARTHWORK GENERAL REQUIREMENTS

- A. Perform excavation and backfill as indicated and in conformance with Contract Specifications Section 31 00 00, Earthwork; Section 31 23 43, Structure Excavation and Backfill; and Section 33 05 28, Trenching and Backfilling for Utilities.
- B. The Contractor shall comply with all Federal and State of California EPA regulations for excavation and handling of contaminated soils and stockpiles at the designated excavation and storage areas. Where there is a conflict between these Contract Specifications and the cited State or Federal regulations, the more restrictive or stringent requirements shall prevail.
- C. The Contractor's attention is directed to Section 6.27, Environmental Coordination and Cooperation, of the Special Conditions for requirements related to environmental regulations.
- D. The Contractor shall verify that all personnel assigned to or regularly entering the work zones with contaminated soils present for the purpose of performing or supervising work, for health, safety, security, or administrative purposes, for maintenance, or for any other site-related function, shall have received appropriate hazardous materials safety training as described herein.
- E. The licensed specialty Subcontractor's employees shall have completed a safety training program which meets the 40 hour Cal-OSHA training as defined in 8 CCR 5192 or the 40 hour HAZWOPER training that meets 29 CFR 1910.120. The Contractor shall provide identification of the level of training conducted and furnish current certifications, including the 8-hour annual refresher training, for the employees trained and assigned to work on this Contract. The trained employees shall be medically certified to wear a respirator.

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- F. A site-specific hazardous material health and safety briefing, as part of the daily “tool box” meeting, shall be given to all personnel working in or near the work zones containing contaminated soils to familiarize them with the site safety procedures. A signature list for attending employees shall be required for the meeting and be submitted to the Engineer by the end of each shift of work.

- G. For work occurring with contaminated soils, the licensed specialty Subcontractor shall have available adequate CAL/OSHA Level D Personal Protective Equipment (PPE) to protect the workers such as:
 - 1. Gloves
 - 2. Coveralls
 - 3. Safety glasses
 - 4. Face shield
 - 5. Chemically resistive steel toed boots
 - 6. Appropriate chemical protective clothing
 - 7. Wash down facilities at the work zones

3.02 SOIL TESTING AND ANALYSIS

- A. Soil sampling and testing shall be performed on excavated material for this Contract as needed to profile excavated soil for reuse or disposal.

- B. The sampling frequency on excavated material for testing and analysis shall comply with requirements described by the Department of Toxic Substance Control and, at a minimum, shall be performed as one discrete sample per 250 cubic yards. All sampling, testing and analyses will not be measured for payment or paid for separately, but will be considered incidental to the Work

- C. The approved soils testing laboratory shall test the soil excavated for disposal acceptance requirements put forth by the licensed disposal facility. Soil to be disposed of at a licensed disposal facility must be characterized for receiving facility acceptance prior to disposal. The disposal facility shall also be contacted to determine the acceptable sampling frequency required. The sampling frequency shall be indicated in the HSP. Sampling and analysis shall be performed using the sampling and analysis procedure required by the disposal facility. The Engineer or the disposal facility may request additional analyses.

- D. Soil sampling and analysis for waste characterization purposes must be performed in accordance with applicable Federal and State of California EPA regulations. The sampling may be performed either in-place (in-situ) or from stockpiled material. The sampling scheme may be systematic, systematic random, or random, but must be representative of each type of material.

- E. The Contractor may perform additional tests on the material to be excavated at its option and cost for confirmation of the classification as Federal and California hazardous waste, or non-hazardous material.

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- F. The Engineer will make the final decision on reclassification of material after review of the test data. Five Working Days shall be allowed for review of the test data, and, if accepted, the testing and disposal for reclassified material that had previously been determined as non-contaminated or non-hazardous material will be considered a Differing Site Condition.

3.03 EXCAVATION OF CONTAMINATED SOILS

- A. Earthwork associated with areas below and for any other location identified through the Contractor's soil testing and analysis as being contaminated, including work for excavation, stockpiling, soil testing, and disposal of the contaminated soil shall only be performed by the Contractor's currently licensed specialty Subcontractor. Areas include, but are not limited to:
1. EBRC 1214 (Tran): Excavated soil at this location must be considered contaminated Class 2 soil for disposal to Class 2 landfill.
 2. EBRC 1217 (Bohannon): Excavated soil at this location must be considered contaminated Class 2 soil for disposal to Class 2 landfill.
 3. Project Limits: Excavated soil to a depth of 3 feet must be considered contaminated Class 2 soil for disposal to Class 2 landfill.
- B. Work zones shall be established at each location identified as having contaminated soil prior to starting excavation work. Excavated materials shall not be deposited across multiple excavation sites or on non-VTA property, unless approved by the Engineer. The Contractor shall not deposit excavated material on public roads. These work zones shall be described in the Work Plan within the Contractor's Contaminated Soils Management and Disposal Plan. There shall be procedures established, identified in the Contaminated Soils Management and Disposal Plan, for the work zones relative to soil segregation as to type and level of contamination and control of stockpiles. The Contractor shall prevent cross-contamination between segregated stockpiles, contaminated excavation material cleared and ready for disposal transport, and imported backfill material.
- C. In all cases, if the soil is determined to be contaminated, and/or is reclassified by the Engineer as contaminated, the continuing excavation, stockpiling, soil testing, and disposal of the contaminated soil shall be performed only by the Contractor's currently licensed specialty Subcontractor.
- D. Surplus excavated material, as well as additional excavated material from outside the Contract pay limits shown on the Contract Drawings that is not contaminated, shall become the property of the Contractor and shall be disposed of outside VTA property, at the Contractor's cost, in conformance with the provisions herein and in Contract Specifications Section 31 00 00, Earthwork.
- E. The Contractor's operations shall be conducted in a manner that prevents increases in the quantities of contaminated soil resulting from mixing with material containing lower contaminant concentrations. No additional compensation will be made for material requiring reclassification due to failure to segregate the material following excavation.
- F. The Contractor shall prevent the flow of surface water and groundwater from entering any excavation, and shall treat all water removed from the excavations in accordance with the requirements of Contract Specifications Section 01 57 00, Temporary Controls.

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- G. The Contractor shall provide dust control measures during the excavation and stockpiling operations to contain the contaminated aerial particulates in accordance with the requirements of Contract Specifications Section 01 74 15, Dust Control.

3.04 STOCKPILING EXCAVATED SOIL

- A. The stockpiles of the excavated soil shall not contain free liquids that separate readily from the material. The presence or absence of free liquids shall be demonstrated by methods prescribed in Federal and State of California EPA regulations. If the excavated soil contains a free liquid content that is greater than the content that the disposal facility will accept, the soil shall be stabilized at the stockpile using moisture absorbent material such as lime, cement or fly-ash as approved by the Engineer. This liquid stabilizing work is considered part of the excavation activities covered within Contract Specifications Section 31 00 00, Earthwork.
- B. Stockpiled soil shall have a temporary berm placed around the stockpile to prevent runoff from leaving the area and shall not be near storm drains or watercourses.
- C. All contaminated soil stockpiles shall be handled in compliance with the requirements in Federal and State of California regulations.
- D. Excavated soil not placed directly into a registered transport vehicle shall be stockpiled at a location approved by the Engineer, on undamaged 40-mil high-density polyethylene or equivalent impermeable barrier, unless testing data indicates the soil is acceptable for reuse. If the stockpile location is on a paved surface, the thickness of the barrier may be reduced to 20 mils or its equivalent. All seams in the barrier shall be sealed to prevent leakage and the dimensions of the impermeable barrier shall be greater than the dimensions of the stockpile by a minimum of one foot in all dimensions at all times.
- E. At the end of each work shift and during storm events, stockpiles shall be covered with undamaged 12-mil polyethylene or an equivalent barrier to prevent windblown dispersion and precipitation run-on or run-off. When more than one sheet is required to cover a stockpile, the sheets shall overlap a minimum of 1.5 feet to prevent water from flowing onto the stockpiled material. The cover shall be secured to keep it in place at all times. The cover shall be inspected by the VTA, and maintained in accordance with the requirements of Section 6.27, Environmental Coordination and Cooperation..
- F. Non-hazardous material shall be transferred directly from the excavation to a transport vehicle, a storage container, or a stockpile location approved by the Engineer.
- G. A written log shall be kept to track the source of all material in each stockpile and where the stockpiled material gets distributed to when the stockpile is removed. This log shall be maintained by the Contractor and updates of the log shall be submitted to the Engineer on a daily basis.
- H. Stockpile areas shall be returned to their original or better condition after completion of construction, and the cleanup shall be approved by the Engineer.

3.05 SOIL PROFILING FOR REUSE OR OFF-SITE DISPOSAL

- A. The determination as to whether the excavated soil is suitable for reuse will be based on the results of the soil testing required herein.

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- B. Excavated California Hazardous Waste and Contaminated Soil material acceptable for reuse may be reused as backfill at its original excavation location as long as the excavated material has not been removed from VTA property before being returned for reuse.
- C. Surplus Excavated California Hazardous Waste shall be transported to a Class I disposal facility permitted to accept the materials.
- D. Surplus Excavated Contaminated Soil shall be transported to a Class II disposal facility permitted to accept the materials.
- E. Surplus non-hazardous and non-contaminated material shall be disposed of in conformance with the provisions in Contract Specifications Section 31 00 00, Earthwork.

3.06 SOIL DISPOSITION

- A. All registered transport vehicles shall be operated only by licensed haulers in the possession of a current State of California Class C hazardous material transporting license.
- B. Submit copies of top tickets and certificates of disposal signed by the receiving disposal facility for any contaminated soil transported from the Jobsite. The Contractor shall also submit all manifests and shipping documents. All copies described herein shall be submitted to the Engineer, following the signature by the Contractor's Industrial Hygienist, by the day following the disposal of the material.
- C. The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary for the execution of the Work, including registration for transport vehicles carrying the contaminated soil.
- D. Thirty (30) Days prior to the Contractor's needs for disposal of contaminated soil, the Contractor shall notify the Engineer to obtain the Environmental Protection Agency Generator Identification Number and to sign all manifests as the Generator for the contaminated soil material from VTA property.
- E. The removal of stockpiles shall begin within Thirty (30) Days of accumulating contaminated soil at each work zone. After final removal has occurred the Contractor shall be responsible for any cleanup deemed necessary by the Engineer to restore each work zone to its original condition or better.
- F. Before leaving the Jobsite, all hazardous material, contaminated soil, and non-hazardous material on exteriors of transport vehicles shall be removed by brushing and washing. Collected material shall be collected in lined containment pits. Approved covers for the transport vehicles shall be secured so that hazardous material, contaminated soil, or non-hazardous material will not become airborne or be deposited on public roads or property.
- G. The Contractor shall not spill, overflow, or release excavated material during transport to the disposal site. The Contractor shall indemnify VTA from any costs due to spillage during the transport of the hazardous material, or non-hazardous material to the disposal facility.

3.07 FIELD QUALITY CONTROL

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- A. The Contractor shall employ a Certified Industrial Hygienist, currently licensed in the State of California and experienced in soil characterization.
- B. The Contractor shall be responsible for Quality Control of the operations associated with soil excavation, segregation, stockpiling, soil sampling and analysis, and soil disposition as well as Quality Control oversight of the testing laboratory performing soils analyses. The certified Industrial Hygienist shall approve and sign all soils reports from the testing laboratory.
- C. The Contractor shall submit daily field reports that document quality conditions and remedies used to address potential non-compliances with regulatory and/or Contract requirements.

3.08 CLOSEOUT

- A. Upon completion of Work, or prior thereto when required by the Engineer, remove all materials, tools, equipment, facilities, and services as required for providing the necessary soil stockpiling, soil testing and analysis, and soil disposition.

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SECTION 02 80 00

HAZARDOUS MATERIAL ABATEMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing all labor, facilities, equipment, services, employee training, permits and agreements necessary to perform the work required for hazardous materials removal, clean-up, decontamination, and disposal of the following:
1. Asbestos Containing Material (ACM)
 2. Lead Based Material (LBM)
 3. Polychlorinated Biphenyls (PCB) containing material and ballast
 4. Fluorescent lamps, bulbs and thermostat containing mercury

1.02 RELATED SECTIONS

- A. Section 6.6, Contract Data Requirements, of the Special Conditions
- B. Section 6.14, Safety Precautions, Programs and First Aid Requirements, of the Special Conditions
- C. Section 6.27, Environmental Coordination and Cooperation, of the Special Conditions
- D. Section 02 41 00, Demolition.
- E. Section 02 41 16, Structure Demolition.

1.03 REFERENCED STANDARDS

- A. Non-destruction Hazardous Material Building Survey Report by Haley & Aldrich dated Jan. 8, 2020 (EC202001-0143).
- B. State of California, Code of Regulations (CCR)
1. Title 8, Part 5192
 2. Title 22, Articles 5,6, 6.5 and 15
- C. Code of Federal Regulations (CFR)
1. Title 29, Part 1910.120
 2. Title 29, Part 1926

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1.04 SUBMITTALS

- A. General: For submittal requirements and procedures, refer to Section 6.6, Contract Data Requirements, of the Special Conditions. Do not proceed with hazardous material abatement until the Engineer has given written approval of the demolition plan.

- B. Hazardous Material Management Plan: Submit a comprehensive Hazardous Material Management Plan, describing the proposed sequence, methods, and equipment for hazardous material abatement. Plan shall include:
 - 1. Work Plan
 - 2. Organization Structure
 - 3. Medical Surveillance Program
 - 4. Contractor's Standard Operating Procedures for Safety and Health
 - 5. Evidence of supervisor and foreman training in accordance with 29 CFR 1910.120 and Section 5192 of Title 8, of the California Code of Regulations.
 - 6. Description of the necessary interface between general program and site specific activities.
 - 7. Emergency Response Work Plan to be adhered to when response is needed in a situation immediately dangerous to human life and the environment.
 - 8. Site Specific Health and Safety Plan prepared and signed by a certified industrial hygienist.
 - 9. A detailed equipment list to be used.
 - 10. Material Safety Data Sheet (MSDS) for all chemicals to be used.
 - 11. Evidence of employee respirator training.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Removal of ACM and LBM shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.

- B. Measurement: Removal of PCB shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.

- C. Payment: The lump sum payment for Removal of ACM and LBM shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removal and disposal, monitoring and testing, complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

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- D. Payment: The lump sum payment for Removal of PCB shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in removal and disposal, monitoring and testing, complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.
- E. All other items of work to be removed and disposed of from the site shall be considered paid for under the various items of work and no additional compensation shall be allowed.

1.06 REGULATORY REQUIREMENTS

- A. All work shall be in accordance with Section 6.14, Safety Precautions, Programs and First Aid Requirements, this specification, and the latest regulations from the U.S. Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the State of California Division of Occupational Safety and Health (DOSH), the State of California Department of Industrial Relations (Cal/OSHA), the recommendation of National Institute of Occupational Safety and Health (NIOSH), and any other applicable federal, state and local government regulations. Whenever there is a conflict or overlap of the above references, the most stringent provision is applicable.

1.07 PERMITS

- A. Contractor shall obtain permits from Bay Area Air Quality Management District (BAAQMD) prior to start of any Contract work.
- B. Contractor shall maintain current and unexpired license and certification for asbestos or hazardous substance removal, as required by applicable state or local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the work of this Contract.

1.08 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. Contractor shall include a list of assigned workmen with the Contractor Quality Management Plan along with their training certificates necessary for the performance of their work.
- B. In addition to complying with pertinent regulations of governmental agencies having jurisdiction, comply with pertinent provisions of the federal Resource Conservation and Recovery Act (RCRA); OSHA Chapter 30, Title 22, Articles 5,6, 6.5 and 15 of the California Code of Regulations; and Chapter 6.5, Division 20 and Chapter 7 of the California Health and Safety Code, and 29 CFR 1910.120 and 29 CFR 1926.650 through 1926.653, and Uniform Fire Code: Title 23, Division 3, Chapter 16 CCR.
- C. Contractor shall ensure all workers have current and unexpired 40-Hour Hazardous Waste Operations and Emergency Response Training (HAZWOPER) certificate during the duration of the contract work.

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1.09 TESTING

- A. The Contractor shall monitor airborne fiber counts outside the work area. The purpose of this air monitoring will be to detect airborne fiber counts which may significantly challenge the ability of the work area isolation procedures to protect the balance of the building or outside of the building from contamination by airborne fibers.
- B. Should asbestos fiber be detected outside the work area or building, the Contractor shall immediately cease asbestos abatement activities until the fault is corrected. Work shall not begin until authorized by VTA.

1.10 HANDLING

- A. Contractor shall secure permits and inspections from all necessary local, regional, state, and federal agencies. These agencies include, but are not limited to the Bay Area Air Quality Management District, County Health Department, Santa Clara Valley Water District, County Fire Marshal, and local fire department.
- B. Workmen removing Hazardous Waste shall be certified in Hazardous Materials Handling as specified by SARA, Title III, and in accordance with 29 CFR 1910.120 and any other applicable local, regional, state or federal regulations. Protective clothing and equipment shall be provided by Contractor.
- C. All vehicles used to haul hazardous material from this site shall display evidence of proper Department of Health Services (DOHS) and Department of Transportation (DOT) registration as a hazardous waste hauling vehicle.

PART 2 – PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FACILITIES

- A. The Contractor shall furnish all materials, tools, equipment, devices, appurtenances, facilities, and services as required for performing the demolition and removal work.

PART 3 – EXECUTION

3.01 SITE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Contractor shall sequence work accordingly. Demolition of above grade structures shall occur after the removal and disposal of asbestos and lead containing material in accordance with Section 6.14, Safety Precautions, Programs and First Aid Requirements, and these Technical Specifications.
- C. The Contractor's attention is directed to Section 6.27, Environmental Coordination and Cooperation, of the Special Conditions for requirements related to environmental regulations.

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3.02 TEMPORARY FACILITIES

- A. Contractor shall provide additional lighting as required to ensure safe and satisfactory illumination during the abatement activities.
- B. If building water service is unavailable, Contractor shall provide water on site for abatement activities including but not limited to decontamination area.

3.03 PRESSURE DIFFERENTIAL SYSTEM

- A. As part of Contractor's Work Plan, approval of pressure differential system must first be approved by VTA. The pressure differential system design shall include:
 - 1. Number of pressure differential machines required.
 - 2. Description of projected air flow within work area and methods required to provide adequate air flow in all portions of the work area.
- B. Contractor shall supply the required number of air filtration units to the site in accordance with these specifications.
- C. Continuously monitor and record the pressure differential between the work area and the building outside of the work area.
- D. Contractor shall provide one (1) additional air filtration unit as backup in case of equipment failure or machine shutdown for filter changing.
- E. Demonstrate operation of pressure differential system to VTA. The following conditions are to be observed:
 - 1. Plastic barriers and sheeting move lightly in toward work area.
 - 2. Curtain of decontamination units move lightly in toward work area.
 - 3. There is a noticeable movement of air through the decontamination unit. Use smoke tube to demonstrate air movement from Clean Room, and from Equipment Room to work area.
 - 4. Use smoke tubes to demonstrate a positive motion of air across all area in which work is to be performed.
 - 5. When a final inspection and the results of final air test indicate that the area had been decontaminated, exhaust units may be removed from the work area. Before removal from the work area, remove and properly dispose of pre-filter, and seal intake to the machine with 6 mil polyethylene to prevent environmental contamination from the filters.
- F. When a final inspection and the results of final air tests indicate that the area has been decontaminated, exhaust units may be removed from the work area. Contractor to secure Final Clearance inspection before equipment can be demobilized.

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3.04 WORK AREA PREPARATION

- A. Seal all openings, supply and exhaust vents, and convectors within ten (10) feet of work area with 6 mil polyethylene sheeting secured and completely sealed with plastic adhesion tape.
- B. Completely isolate work area from other parts of the building so as to prevent hazardous materials containing dust or debris from passing beyond the isolated area. Should the area beyond the work areas become contaminated with hazardous materials containing dust or debris as a consequence of the work, clean those areas in accordance with the procedures indicated in Article 3.08 Decontamination Procedures.
- C. Provide Warning Signs at each visual and physical barrier.

3.05 WORKER PROTECTION

- A. Workers shall have the appropriate training in accordance with 29 CFR 1926.
- B. Provide medical examinations for all workers who may encounter an airborne fiber level of 0.1 f/cc of asbestos or 50 ug/m³ of lead of greater for an 8 hour time weighted average.
- C. Contractor shall provide workers with appropriate personal protective equipment (PPE), including but not limited to, disposable full-body coveralls and disposable head covers, work boots, hard hats, goggles, and work gloves that meets OSHA and EPA standards. PPE must be worn by all workers in the work area.

3.06 RESPIRATORY PROTECTION

- A. All workers involved in hazardous materials abatement must be trained in proper respiratory use and require that each worker always wear a respirator, properly fitted on the face in the work area from the start of any operation which may disturb hazardous materials until the work area is completely decontaminated. Use respiratory protection appropriate for the fiber level encountered in the work area or as required for other toxic or oxygen deficient situation encountered.
- B. Contractor shall submit a signed Respiratory Protection Program Certificate as part of the submittals, for VTA review. Do not start work until approval is received.

3.07 DECONTAMINATION UNITS

- A. Contractor shall provide a decontamination unit for workers involved in hazardous material abatement. The decontamination unit must consist of Changing room, Shower room, and Equipment room.
- B. Changing (Clean) Room: Shall be physically and visually separated from the rest of the building for the purpose of changing into protective clothing.
- C. Shower Room: Provide a completely water tight operational shower for transit by cleanly dressed workers heading for the work area from the Changing Room, or for showering workers headed out of the work area after undressing in the Equipment Room.

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- D. Equipment Room: All work equipment, footwear and additional contaminated work clothing to be left here. This is a change and transit area for workers. Equipment Room shall be separated from the work area by a 6 mil polyethylene flap doorway.

3.08 DECONTAMINATION PROCEDURE

- A. Contractors shall require all workers and visitors to adhere to the following decontamination procedures whenever exiting the work area:
1. When exiting work area, remove disposable coveralls, disposable head covers, and disposable footwear covers or boots in the Equipment Room
 2. Still wearing respirators, proceed to Shower Room. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. Shower completely with soap and water, then rinse thoroughly.
 3. Proceed from shower to Changing Room and change into street clothes or into new disposable work clothing.

3.09 PROJECT DECONTAMINATION

- A. Work in this section includes cleaning, decontamination, and removal of temporary facilities installed prior to abatement work and decontamination of all surfaces of the work area.
- B. Clean all surfaces of the work area including but not limited to, sheeting, tools, and scaffolding by use of damp-cleaning and mopping. Continue cleaning until there is no visible debris from removed materials on plastic sheeting or other surfaces.
- C. Maintain pressure differential system in operation during the cleaning.
- D. Visual Inspection: Contractor to perform a visual inspection of the entire work area including decontamination unit, all plastic sheeting, seals over ventilation openings, doorways, windows and other openings, look for debris from any sources, residue on surfaces, dust or other matter. If any such debris, residue, dust or other matter is found, repeat cleaning and continue decontamination procedure from that point.
- E. Final Air Sampling: After work area is found to be visually clean, Contractor shall perform a final air sampling and analyze in accordance with Section 3.10 Work Area Clearance. If Release Criteria are not met, repeat cleaning and continue decontamination procedure from that point.
- F. If Release Criteria is met, remove the interior of the decontamination unit leaving in place only the critical barriers separating the work area from the rest of the building.

3.10 WORK AREA CLEARANCE

- A. Contractor and VTA Senior Environmental Engineer shall jointly perform final visual and tactile inspection as prerequisite for air sampling and analysis.
- B. To determine if elevated airborne asbestos concentration during the abatement operations have been reduced to the recommended EPA post-abatement asbestos re-occupancy criteria of < 0.01 fibers per cubic centimeter (f/cc), Contractor shall perform air sampling and analysis inside the work area.

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- C. Release Criteria: Decontamination of the work site is complete when all sample results are below the 0.01 fibers per cubic centimeter (f/cc) of air.
- D. Contractor shall submit a Final Clearance Inspection letter to VTA certifying that all abatement activity had been completed.

3.11 HANDLING AND DISPOSAL OF HAZARDOUS WASTE MATERIAL

- A. Asbestos containing vapor barrier within concrete slab shall be placed into roll-off bins and covered and disposed as asbestos waste.
- B. All other asbestos and lead containing waste and contaminated waste shall be double bagged in pre-labeled 6 mil airtight puncture resistance bags with labeling in accordance to OSHA and EPA guidelines.
- C. Bags shall be sealed with tape in the work area and not be allowed to dry out prior to sealing bags. Bags shall be decontaminated of any bulk debris by wet wiping.
- D. Seal lead waste in leak-proof impermeable containers labeled in accordance with EPA guidelines.
- E. Florescent lamps and tubes must be placed inside cardboard boxes and properly sealed and labeled prior to disposal.
- F. All hazardous waste materials are to be hauled by a waste hauler with all required licenses from State and local authority with jurisdiction.

3.12 SITE AND BUILDING DEMOLITION

- A. After hazardous abatement is complete, perform site demolition and building demolition in accordance with the requirements of Section 02 41 00, Demolition, and Section 02 41 16, Structure Demolition.

END OF SECTION 02 80 00

SECTION 03 05 15

PORTLAND CEMENT CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Cementitious materials
 2. Aggregates
 3. Concrete admixtures
 4. Mix designs
 5. Minor concrete
 6. Drying shrinkage of concrete
 7. Tests and analysis of materials
 8. Batching, mixing, and transporting
 9. Inspection and testing

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 02 43 13, BRT Ocala Station Relocation
- D. Section 03 11 00, Concrete Formwork
- E. Section 03 11 16, Architectural Cast-in-Place Concrete Forming
- F. Section 03 20 00, Concrete Reinforcing
- G. Section 03 30 00, Cast-in-Place Concrete
- H. Section 03 35 00, Concrete Finishing
- I. Section 03 41 00, Structural Precast Concrete
- J. Section 03 53 00, Concrete Topping
- K. Section 03 62 00, Non-Shrink Grouting
- L. Section 31 62 00, Driven Piles
- M. Section 31 63 23, Drilled Concrete Piers and Shafts
- N. Section 31 66 17, Mechanically Stabilized Earth Walls

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O. Section 32 35 20, Sound Barrier on Structures

1.03 REFERENCED STANDARDS

A. American Concrete Institute (ACI):

1. ACI CT Concrete Terminology
2. ACI Specification for Tolerances for Concrete Construction and Materials
3. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
4. ACI 211.2 Standard Practice for Selecting Proportions for Structural Lightweight Concrete
5. ACI 301 Standard Specifications for Structural Concrete
6. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
7. ACI 304.2R Placing Concrete by Pumping Methods
8. ACI 305R Guide to Hot Weather Concreting
9. ACI 306.1 Standard Specification for Cold Weather Concreting
10. ACI 318 Building Code Requirements for Structural Concrete and Commentary

B. ASTM International (ASTM):

1. ASTM C31/C31M Standard Practice for Making and Curing Concrete Test Specimens in the Field
2. ASTM C33/C33M Standard Specification for Concrete Aggregates
3. ASTM C42/C42M Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
4. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete
5. ASTM C114 Standard Test Methods for Chemical Analysis of Hydraulic Cement
6. ASTM C117 Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
7. ASTM C123/C123M Standard Test Method for Lightweight Particles in Aggregate
8. ASTM C127 Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
9. ASTM C131/C131M Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
10. ASTM C136/C136M Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
11. ASTM C138/C138M Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
12. ASTM C142/C142M Standard Test Method for Clay Lumps and Friable Particles in Aggregates
13. ASTM C143/C143M Standard Test Method for Slump of Hydraulic Cement Concrete
14. ASTM C150/C150M Standard Specification for Portland Cement
15. ASTM C157/C157M Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
16. ASTM C172/C172M Standard Practice for Sampling Freshly Mixed Concrete
17. ASTM C173/C173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

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18.	ASTM C231/C231M	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
19.	ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
20.	ASTM C330/C330M	Standard Specification for Lightweight Aggregates for Structural Concrete
21.	ASTM C470/C470M	Standard Specification for Molds for Forming Concrete Test Cylinders Vertically
22.	ASTM C490/C490M	Standard Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete
23.	ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
24.	ASTM C535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
25.	ASTM C567/C567M	Test Method for Determining Density of Structural Lightweight Concrete
26.	ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan in Portland Cement Concrete
27.	ASTM C979/C979M	Standard Specification for Pigments for Integrally Colored Concrete
28.	ASTM C1017/C1017M	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
29.	ASTM D2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
30.	ASTM D7508/D7508M	Standard Specification for Polyolefin Chopped Strands for Use in Concrete
31.	ASTM E329	Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

C. State of California, Department of Transportation (Caltrans):

1.	California Test 125	Sampling Highway Materials and Products Used in the Roadway Structural Sections (Equivalent to ASTM D75/D75M and ASTM D979)
2.	California Test 202	Method of Test for Sieve Analysis of Fine and Coarse Aggregates
3.	California Test 206	Method of Test for Specific Gravity and Absorption of Coarse Aggregate
4.	California Test 207	Method of Test for Specific Gravity and Absorption of Fine Aggregate
5.	California Test 211	Abrasion of Coarse Aggregate by Use of the Los Angeles Rattler Machine (Equivalent to ASTM C131)
6.	California Test 213	Organic Impurities in Concrete Sand (Equivalent to ASTM C40)
7.	California Test 214	Soundness of Aggregates by Use of Sodium Sulfate (Equivalent to ASTM C88)
8.	California Test 217	Sand Equivalent (No ASTM Equivalent)
9.	California Test 227	Evaluating Cleanness of Coarse Aggregate (No ASTM Equivalent)
10.	California Test 229	Durability Index (Equivalent to ASTM D3744)
11.	California Test 415	Determining the Chloride Content in Organic Additives for Portland Cement Concrete (No ASTM Equivalent)

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12.	California Test 417	Soils and Waters for Sulfate Content (No ASTM Equivalent)
13.	California Test 422	Testing Soils and Waters for Chloride Content (No ASTM Equivalent)
14.	California Test 504	Determining Air Content of Freshly Mixed Concrete by the Pressure Method (Equivalent to ASTM C231)
15.	California Test 515	Relative Mortar Strength of Portland Cement Concrete Sand (No ASTM Equivalent)
16.	California Test 518	Unit Weight of Fresh Concrete (Equivalent to ASTM C138/C138M)
17.	California Test 521	Compressive Strength of Molded Concrete Cylinders (Equivalent to ASTM C39/C39M)
18.	California Test 529	Proportions of Coarse Aggregate in Fresh Concrete (No ASTM Equivalent)
19.	California Test 533	Test for Ball Penetration in Fresh Portland Cement Concrete (Equivalent to ASTM C143/C143M)
20.	California Test 539	Sampling Fresh Concrete (Equivalent to ASTM C172)
21.	California Test 540	Making, Handling and Storing Concrete Compressive Test Specimens in The Field (Equivalent to ASTM C31/C31M)
22.	California Test 549	Prequalification of Concrete Aggregate (No ASTM Equivalent)

D. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:

1. Section 90 Concrete

1.04 DEFINITIONS

- A. The word "concrete" indicates normal weight aggregate concrete, having a minimum unit weight of 145 pounds per cubic foot (without reinforcement) at 28 days.
- B. The terms "lightweight concrete" and "LWC" indicates lightweight structural concrete which has a maximum air-dry unit weight of 115 pounds per cubic foot at 28 days for prestressed concrete and 110 pounds per cubic foot at 28 days for nonprestressed concrete.
- C. The term "free water" indicates the total water in the concrete mixture minus the water absorbed by the aggregates in reaching a saturated surface-dry condition.
- D. The term "SCM" indicates supplementary cementitious material, as specified herein.
- E. The term "mass concrete" indicates any structural element having a least dimension of more than seven feet or any volume of concrete with dimensions large enough to require that measures be taken to cope with the generation of heat from hydration of the cement and attendant volume change in order to minimize shrinkage and cracking. Attention is directed to Section 03 30 00, Cast-in-Place Concrete, for additional requirements.
- F. The term "tiers" refers to precast concrete member categories, as defined in Section 03 41 00, Structural Precast Concrete.
- G. The term "cast-in-place structural concrete" includes cast-in-place components of bridge structures, building structures, access structures, stairs, piling, foundations, retaining walls, approach slabs, bridge railing, and bridge barriers.

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- H. The term "returned plastic concrete" indicates excess concrete that is returned to a concrete plant in a plastic state and that has not attained initial set.
- I. Except for the foregoing definitions, the words and terms used in these Technical Specifications conform to the definitions given in ACI CT.

1.05 SUBMITTALS

- A. General: Submittals for Portland cement concrete must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Concrete Mix Designs:
 - 1. Submit mix designs as herein specified in Article 2.03 before using the concrete in the work and before changing the mix proportions or an aggregate source.
 - a. Hire a professional testing laboratory to provide concrete mix designs for each type of concrete on the job. The laboratory must meet applicable requirements of ASTM E329 and must be approved by the VTA.
 - b. Submit mix designs for each class of concrete on the Project and show names and brands of all materials, proportions, weights, absolute volume of all materials, slump, strength, gradation of coarse and fine aggregates, admixtures, amount of water and the like. The proposed location where the mix will be used on the Project, (e.g., bridge footings, bridge columns, and the like) must be clearly indicated at the top of all proposed mix design sheets.
 - c. Each mix design must be qualified by trial batch tests or laboratory test reports and certified by a principal of the laboratory who is currently registered as a civil engineer in the State of California. Qualifications of the laboratory and registered civil engineer must be submitted with the mix designs.
 - d. Each mix design submittal for concrete designated by strength must be accompanied by certified laboratory test reports or trial batch test reports in accordance with the requirements specified herein.
 - e. Submit the prequalification data or reports and the proposed mix design at least 45 days before placing lightweight concrete.
 - 2. Aggregate Gradation:
 - a. Except for minor concrete, submittals of aggregate gradation must conform to the following requirements:
 - 1) Before starting concrete work, submit the gradation of the primary aggregate nominal sizes. If the aggregate source changes, submit the new gradation before using the aggregate.
 - 2) If a primary coarse aggregate or the fine aggregate is separated into two or more sizes, submit the gradation and proposed proportions of each size combined mathematically to show one proposed gradation. Show the percentage passing for each applicable sieve size.
 - b. Submittals of aggregate gradation for minor concrete must conform to the following requirements:

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- 1) Submit a proposed combined aggregate gradation. After authorization of the gradation, the aggregate furnished for minor concrete must comply with that gradation.
 - 2) If requested by VTA, submit periodic test reports of the aggregate gradation furnished.
 - 3) VTA may waive the specifications for gradation if VTA determines that furnishing a gradation is not necessary for the type or quantity of concrete work to be constructed.
3. Certified Test Data and Trial Batch Test Reports:
- a. If the concrete has a described 28-day compressive strength greater than 3,600 pounds per square inch, or if prequalification is specified, submit certified test data or trial batch reports to prequalify the materials, mix proportions, mixing equipment, and procedures proposed for use in the work before placing the concrete.
 - b. If 56 days are allowed for the concrete to attain the compressive strength described, submit test results as specified herein.
 - c. Submit certified test data or trial batch test reports based on the same materials, mix proportions, mixing equipment, procedures, and batch size proposed for use in the work.
 - 1) Certified test data and trial batch reports must include date of mixing, mixing equipment and procedures, batch size in cubic yards, weight, type, and source for each ingredient, slump, air content if an air-entraining admixture is used, concrete age at the time of testing, compressive strength for each cylinder tested, and the signature of an official of the testing firm.
 - d. Certified test data must show the following:
 - 1) Results of 90 percent or more of at least 20 consecutive tests exceed the compressive strength described at the maximum number of days specified or allowed and none of the test results are less than 95 percent of the strength described.
 - 2) All tests are the most recent tests made on concrete of the proposed mix design and were made within one year of the proposed use of the concrete.
 - e. Trial batch test reports must show the following:
 - 1) Average compressive strength for five consecutive concrete cylinders taken from a single batch and tested at not more than the maximum age specified or allowed is at least 600 pounds per square inch greater than the 28 day compressive strength described.
 - 2) No individual cylinder has a strength less than the strength described at the maximum age specified or allowed.
 - 3) Data contained in the report is from trial batches produced within one year of the proposed use of the concrete.
 - 4) If air entrainment is specified, the air content of the trial batches must be greater than or equal to the air content specified for the concrete without reduction due to tolerances.
 - f. If the concrete is tested for shrinkage, submit the test data with the mix design.
 - g. Minor Concrete:

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- 1) If required by the following table, submit compressive strength test results with the mix design that verify the minimum required compressive strength:

SCM	Test submittal required
Fly ash used alone	If portland cement content is less than 350 pounds per cubic yard
GGBFS used alone	If portland cement content is less than 250 pounds per cubic yard
Natural pozzolan used alone	If portland cement content is less than 350 pounds per cubic yard
More than one SCM	Always

NOTE: Compressive strength tests must be performed by an ACI-certified technician.

- h. If precast concrete is manufactured at an established precast concrete plant, a trial batch and prequalification of the materials, mix proportions, mixing equipment, and procedures are not required.
- i. Any change to the prequalified materials, mix proportions, mixing equipment, or procedures that could result in a concrete strength below that described requires additional prequalification by trial batch testing.

4. Lightweight Concrete:

- a. Mix designs for lightweight concrete must include the type, brand, weight, and absolute volume of each ingredient for each concrete type and strength.
- b. Mix designs for lightweight concrete must report the weight for each aggregate for a surface-dry condition, for an oven-dry condition, or for the condition proposed for use. The reported weight for each aggregate for a surface-dry condition must include moisture absorbed in the aggregate.
- c. Prequalify the lightweight concrete by submitting certified test data or trial batch test reports, in accordance with the requirements of Article 1.05B.3, herein.
- d. Submit certified copies of the lightweight concrete manufacturer's test reports showing the estimated fresh concrete unit weight that results in the selected air-dry unit weight. The air-dry unit weight must be determined in accordance with Article 2.03O, herein.
- e. Include with the mix design written verification that arrangements have been made for the Engineer to obtain test samples. The test samples of lightweight aggregates will not exceed 500 pounds for each separate gradation.

5. Concrete mix designs must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by VTA.

C. Submit for the VTA's approval the name and qualifications of the proposed laboratory, agency, mill, or ready-mix plant to be used for the design of concrete mixes.

D. Product Data:

- 1. Submit manufacturer's product data for proposed concrete admixtures, including manufacturer's instruction for use and description of application. Instructions for chemical

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- admixtures must include a statement that the admixture is compatible with the types and quantities of any supplementary cementitious materials used.
2. Submit reinforcement fiber manufacturer's product data and instructions for use.
 3. Submit crystalline waterproofing admixture manufacturer's product data and instructions for use.
 4. Submit colored concrete technical data and manufacturer's specifications and instructions for use.
 5. Product data must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by VTA.
- E. Samples: Furnish and deliver samples of cement and aggregates as selected by the Independent Testing Agency for testing and analysis, and additional samples to the Independent Testing Agency for information. This requirement may be waived if certificates of compliance are furnished as specified in Article 1.08E and Article 2.02 herein.
- F. Affidavits/Certificates: For each shipment of materials, submit evidence of compliance with Specification requirements for cement, aggregate, admixtures, and other materials specified herein. Mill tests and manufacturers' certificates of compliance with ASTM Specifications will be accepted in lieu of testing of cement and analysis of aggregates. Certificates of compliance must be signed by the materials manufacturer and the Contractor.
1. Certificates of compliance for cementitious materials:
 - a. Submit a certificate of compliance for cementitious materials. Include the type, source name, manufacturing location, and shipping location.
 - b. If the cementitious material is delivered directly to the Worksite, the certificate of compliance must be signed by the cementitious material supplier.
 - c. If the cementitious material is used in ready-mixed concrete, the certificate of compliance must be signed by the concrete manufacturer.
 - d. If blended cement is used, the certificate of compliance must include a statement signed by the blended cement supplier that shows the actual percentage of SCM, by weight, in the blend. Determine the weight of SCM by using a weighing device or by chemical analysis.
 2. Certificates of compliance for aggregates must include type, pit or quarry location, producers' name, grading, specific gravities and certification evidence not more than 90 days old.
 3. Certificates of compliance for admixtures must include type, brand name, producer, manufacturer's technical data sheet, and certification data.
 - a. If you propose to use an admixture from the Caltrans Authorized Material List for chemical admixture for use in concrete, submit a certificate of compliance from the manufacturer certifying that the admixture furnished is the same as that previously authorized.
 4. Certificates of compliance for water must include source of supply that is used in each class of concrete.
 5. Submit a certificate of compliance for each shipment and type of reinforcement fibers.
 6. Certificates of compliance must be furnished 60 days in advance of any concrete pours.

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7. When certificates of compliance cannot be provided, the Contractor must hire a professional testing laboratory to verify compliance of each type of material to be used in each class of concrete. The cost of testing must be paid for by the Contractor.
 8. Before placing minor concrete from a source not previously used on the Contract, submit a certificate of compliance stating that the minor concrete to be furnished complies with the Contract requirements, including the specified minimum cementitious material content.
- G. Batch Tickets: Submit a delivery ticket with each batch of concrete delivered to the Worksite in accordance with the requirements of ASTM C94/C94M.
1. Batch ticket must include the reading of revolution counter at the first addition of water, the source and amount of each metered or weight water, information necessary to calculate the total mixing water, and the actual scale weights, in pounds, for of all the materials batched. Do not substitute theoretical or target batch weights for actual scale weights.
- H. Concrete Quality Control Plan:
1. Provide a Concrete Quality Control Plan to assure control and uniformity of materials, conformance with accepted mix designs, and prompt and proper delivery of concrete to the Worksite in accordance with applicable requirements of ASTM C94/C94M.
 2. Include in the plan all tests the Independent Testing Agency will perform to verify compliance with Specification requirements, and the laboratory that the Independent Testing Agency intends to engage to perform the tests.
 3. The Concrete Quality Control Plan must include the following items:
 - a. Names, addresses, telephone numbers, and documentation of certification or accreditation of the concrete plants and testing laboratories to be used
 - b. Names, qualifications, and copies of certifications for the Quality Control Manager and all quality control testing and inspection personnel to be used
 - c. Organization chart showing quality control personnel and their assigned quality control responsibilities
 - d. Example forms, including forms for certificates of compliance, hard copy test result submittals, and inspection reports
 - e. Methods and frequencies for performing all required quality control procedures, including all inspections and material testing
 - f. Procedures to control quality characteristics, including standard procedures to address properties outside of the specified operating range or limits, and example reports to document non-conformances and corrective actions taken
 - g. Procedures for verifying the following:
 - 1) Materials are properly stored during concrete batching operations
 - 2) Batch plants have the ability to maintain the concrete consistency during periods of extreme heat and cold
 - 3) Admixture dispensers deliver the correct dosage within the accuracy requirements specified
 - 4) Delivery trucks have a valid National Ready Mixed Concrete Association certification card
 - 5) Procedures for verifying that the weighmaster certificate for each load of concrete shows:
 - a) Concrete as batched complies with the authorized concrete mix design weights
 - b) Moisture corrections are being accurately applied to the aggregates

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- c) Cementitious materials are from authorized sources
 - d) Any water that is added after batching at the plant
 - 6) Procedures for visually inspecting the concrete during discharge operations
- 4. Before submitting a Concrete Quality Control Plan, hold meeting to discuss the requirements for cast-in-place structural concrete quality control. The meeting attendees must include VTA, the Quality Control Manager, and at least one representative from each concrete plant performing cast-in-place structural concrete activities for the Work.
- 5. Submit an amended Concrete Quality Control Plan or an addendum to the Concrete Quality Control Plan when there are any changes to any of the following:
 - a. Concrete plants
 - b. Testing laboratories
 - c. Plant certification or laboratory accreditation status
 - d. Tester or inspector qualification status
 - e. Quality control personnel
 - f. Procedures and equipment
 - g. Material sources
 - h. Material testing
- 6. The Concrete Quality Control Plan must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.
- 7. It is expressly understood that the VTA's review of the Concrete Quality Control Plan must not relieve the Contractor of any responsibility under the Contract for the successful completion of the work in conformance with the requirements of the plans and Technical Specifications. The VTA's review must neither constitute a waiver of any of the requirements of the plans and Technical Specifications nor relieve the Contractor of any obligation thereunder; and defective work, materials, and equipment may be rejected notwithstanding approval of the Concrete Quality Control Plan.
- I. Precast Concrete Quality Control Plan: Refer to Section 03 41 00, Structural Precast Concrete, for requirements.
- J. Laboratory Test Reports:
 - 1. Laboratory test reports must show the name of the independent testing laboratory, date of testing, types of tests performed and must be signed by a principal of the testing laboratory who is currently registered as a civil engineer in the State of California. Laboratory tests must not be older than eight months and must certify that the tested materials meet the specified standards.
 - 2. Laboratory test reports for concrete mix designs must clearly identify each material or mix number of each mix tested to verify the correlation between the tested mix designs and the proposed mix designs.
 - 3. When required by other portions of these Technical Specifications, laboratory test reports must be submitted for each material to be used in each class of concrete, or for each mix design and must show compliance with appropriate ASTM Standards and these Technical Specifications.
- K. Submit a work plan for mixing, delivery, placement, finishing, and curing of colored concrete.

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L. Weighmaster Certificates:

1. Submit a weighmaster certificate as an informational submittal with each load of concrete delivered to the Worksite.
2. The weighmaster certificate must show the following information:
 - a. Mix identification number.
 - b. Nonrepeating load number.
 - c. Date and time the materials were batched.
 - d. Total quantity of water added to the load.
 - e. For transit-mixed concrete, the revolution counter reading at the time the truck mixer is charged with cement.
 - f. Actual scale weights in pounds for the ingredients batched. Do not substitute theoretical or target batch weights for actual scale weights.
3. Submit weighmaster certificates in printed form or, if authorized, in electronic media. Present electronic media in a tab-delimited format on a CD or DVD. Captured data for the ingredients represented by each batch must be a line-feed, carriage-return, and one line separated record with sufficient fields for the specified data.
4. You may submit a weighmaster certificate with a separate certificate that lists the actual batch weights or measurements for a load of concrete if both certificates are delivered to the Worksite and are imprinted with the same nonrepeating load number that is unique to the Contract.
5. For minor concrete, submit a weighmaster certificate as an informational submittal with each load of ready-mixed concrete at the concrete discharge location. The weighmaster certificate must show the date and time the load left the batching plant and, if hauled in a truck mixer or agitator, the time the mixing cycle started.

M. Concrete Materials Quality Control Summary Reports:

1. During concrete production for cast-in-place structural concrete members, submit a concrete materials quality control summary report at least once a month. The report must include the following items:
 - a. Inspection reports.
 - b. Test results.
 - c. Documentation of the following items:
 - 1) Test result evaluation by the Concrete Quality Control Manager
 - 2) Any discovered problems or deficiencies and the corrective actions taken
 - 3) Any testing of repair work performed
 - 4) Any deviations from the specifications or regular practices with explanation
 - d. Certificate of compliance for the structural concrete material signed by the Concrete Quality Control Manager. The certificate must state that the information contained in the report is accurate, the minimum testing frequencies specified herein are met, and the materials comply with the Contract.

1.06 CONCRETE STRENGTH

- A. The structural concrete strength shown on the plans indicates the minimum 28-day compressive strength, in pounds per square inch, as determined by California Test 521.

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- B. Except for minor structures, the minimum required 28-day compressive strength for concrete in structures or portions of structures is the compressive strength described or 3,600 pounds per square inch, whichever is greater.
- C. If the 28-day compressive strength described is 3,600 pounds per square inch or greater, the concrete is designated by compressive strength.
- D. Concrete designated by compressive strength must be proportioned such that the concrete will attain the strength shown on the plans or specified in these Technical Specifications.

1.07 QUALITY ASSURANCE AND CONTROL

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
 - 1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 - e. Select samples that fairly represent average quality and grading of aggregates proposed for the work. When aggregates have been approved, no change will be allowed without written permission of the VTA. Maintain stocks of accepted aggregates so no pour need be interrupted
 - f. Perform tests under the appropriate California Test methods or ASTM test methods, as specified herein. Use testing equipment that is in good condition and properly calibrated. If tests are performed during the Contract, notify VTA in advance so that VTA can witness the test procedures.
 - 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - a. Laboratory tests must be carried out in facilities that have current accreditation from the AASHTO Accreditation Program for the tests performed.
 - b. Independent Testing Agency personnel performing quality control laboratory testing must have an ACI Concrete Laboratory Testing Technician, Level 1 certification or

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- an ACI Aggregate Testing Technician, Level 2 certification, whichever certification includes the test being performed.
- c. Independent Testing Agency personnel performing quality control field testing and field and plant inspection must have an ACI Concrete Field Testing Technician, Grade I certification.
3. Concrete Quality Control Manager (CQCM):
- a. The Contractor must designate in writing a Concrete Quality Control Manager (CQCM). The CQCM must be responsible directly to the Contractor's Structural Quality Control Manager (SQCM) for the quality of all cast-in-place structural concrete operations, including materials and workmanship performed by the Contractor and all subcontractors.
- b. The CQCM must cooperate with the Independent Testing Agency and notify the Independent Testing Agency 48 hours in advance of all cast-in-place structural concrete placement.
- c. The CQCM must be the sole individual responsible to the Contractor's Structural Quality Control Manager (SQCM) for receiving, reviewing, and approving all correspondence, submittals, and reports related to quality control and quality assurance of cast-in-place structural concrete operations.
- d. The CQCM must have at least one of the following qualifications:
- 1) Currently registered as a civil engineer in the State of California
 - 2) ACI Concrete Laboratory Testing Technician, Level 1 certification
 - 3) NICET Level II concrete certification
 - 4) ICC Reinforced Concrete Special Inspector certification
 - 5) ASQ Certified Manager of Quality/Organizational Excellence with the qualifying 10 years of experience and body of knowledge in the field of concrete
- e. During concrete placement, the CQCM must be at the plant or Worksite within three hours of receiving notification from the Engineer.
- f. The CQCM must be fully authorized by the Contractor to reject material.
- g. The CQCM must be your employee or must be hired by a subcontractor providing only quality control services. The CQCM must not be employed or compensated by a subcontractor or by other persons or entities hired by subcontractors who will provide other services or materials for the project.
- h. The responsibilities of the CQCM may be fulfilled by the Contractor's Structural Quality Control Manager (SQCM).
4. Qualifications of the Concrete Supplier:
- a. The Contractor must select a qualified concrete supplier capable of meeting project requirements and the requirements of these Technical Specifications.
- b. The concrete supplier must have a current certification for ready mixed concrete production facilities from the National Ready Mix Concrete Association.
5. Provide a Concrete Quality Control Plan in accordance with Article 1.05G, "Concrete Quality Control Plan," herein.
6. Provide a Precast Concrete Quality Control Plan (PCQCP) in accordance with Section 03 41 00, Structural Precast Concrete.

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7. Inspection Reports: The Independent Testing Agency must document each inspection performed by a quality control inspector in an inspection report that includes the following items:
 - a. Contract number
 - b. Mix design number
 - c. Date and time of inspection
 - d. Plant location
 - e. Concrete placement location
 - f. Batch number
 - g. Reviewed copies of weighmaster certificates
 - h. Description of the inspection performed
 - i. Name, certification number, and signature of the quality control inspector

D. VTA Quality Assurance:

1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Hot Weather Concreting:

1. Batching, mixing, and delivering of concrete in hot weather must conform to the applicable requirements of ACI 305R.
2. Maximum ambient temperature for placing concrete must be 90 degrees Fahrenheit. If the ambient temperature exceeds 90 degrees Fahrenheit, the mix must be cooled by an appropriate method approved by VTA, such as icing the mixing water. Maintain uniform concrete temperature of succeeding batches placed.

B. Cold Weather Concreting:

1. Batching, mixing, and delivering of concrete in cold weather must conform to the applicable requirements of ACI 306.1.
2. When the ambient temperature drops below 35 degrees Fahrenheit, or is expected to drop below 35 degrees Fahrenheit during placement, the temperature of the mix must be heated by adding hot water, not exceeding 120 degrees Fahrenheit, or by steam heating the aggregates, or both. Other methods of heating aggregates will not be permitted. Steam heating the aggregates may require an adjustment in the mixing water.
3. All concrete must be protected against freezing for at least 36 hours after placing.

1.09 MEASUREMENT AND PAYMENT

- A. Full compensation for all work under this Section must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

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PART 2 - PRODUCTS

2.01 MATERIALS

- A. Portland Cement Concrete: Portland cement concrete must be composed of cementitious material, fine aggregate, coarse aggregate, and water, with or without admixtures, as approved by VTA, proportioned and mixed as specified herein.
- B. Cementitious Materials:
1. The cementitious materials type and brand must be on the Caltrans Authorized Material List for cementitious material for use in concrete when the mix design is submitted.
 2. Unless otherwise specified, the cementitious material must be one of the following:
 - a. Combination of Type II or V portland cement and SCM
 - b. Blended cement
 3. Type III portland cement may be used in precast concrete.
 4. The cementitious materials used in cast-in-place concrete for exposed surfaces of similar elements of a structure must be from the same sources and of the same proportions.
 5. Portland Cement: ASTM C150/C150M.
 - a. Use portland cement that is of the same brand and type and from the same plant of manufacture as the cement used in the portland concrete represented by the submitted field test records or used in the trial mixtures.
 - b. The C₃S content of Type II cement must not exceed 65 percent.
 - c. Types II, III, and V portland cement must comply with the following requirements:
 - 1) Alkali content must not exceed 0.60 percent by mass of alkalis as Na₂O+0.658K₂O when determined under ASTM C114.
 - 2) Autoclave expansion must not exceed 0.50 percent.
 - d. Type III portland cement may be used only if specified or authorized.
 - e. Use cementitious materials that are of the same brand and type and from the same plant of manufacture as the cementitious materials used in the concrete represented by the submitted field test records or used in the trial mixtures.
 6. Blended Cement:
 - a. Portland cement must comply with ASTM C150, except the C₃S content of Type II cement must not exceed 65 percent.
 - b. Blended cement must comply with portland blast-furnace slag cement, Type IS (MS), or portland-pozzolan cement, Type IP (MS), specified in AASHTO M 240, except:
 - 1) Maximum limits on pozzolan content do not apply
 - 2) Blended cement must be composed of Type II or V cement and SCM produced by one of the following methods:
 - a) Intergrinding of portland cement clinker and granulated blast furnace slag, GGBFS, or pozzolan
 - b) Blending of portland cement and either GGBFS or finely divided pozzolan

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c) Combination of intergrinding and blending

7. Supplementary Cementitious Material (SCM):

a. The amount of portland cement and SCM used in portland cement concrete must conform to the minimum cementitious material content provisions in Article 2.03C, "Content of Cementitious Materials."

b. Each SCM must be one of the following:

1) Fly ash complying with AASHTO M 295, Class F, and either of the following:

a) Available alkali as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ must not exceed 1.5 percent when tested under ASTM C311.

b) Total alkali as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ must not exceed 5.0 percent when tested under AASHTO T 105.

2) UFFA complying with AASHTO M 295, Class F, and the chemical and physical requirements shown in the following tables:

Chemical quality characteristic	Requirement (percent)
Sulfur trioxide (SO_3) (max)	1.5
Loss on ignition (max)	1.2
Available alkalies as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ (max)	1.5

Physical quality characteristic	Requirement (percent)
Particle size distribution	
Less than 3.5 microns (min)	50
Less than 9.0 microns (min)	90
Strength activity index with portland cement	
7 days (percent of control, min)	95
28 days (percent of control, min)	110
Expansion at 16 days when testing project materials under ASTM C1567 (See Note A) (max)	0.10

Note A: In the test mix, at least 12 percent, by weight, of the Type II or V portland cement must be replaced with UFFA.

3) Raw or calcined natural pozzolans complying with AASHTO M 295, Class N, and either of the following:

a) Available alkali as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ must not exceed 1.5 percent when tested under ASTM C311.

b) Total alkali as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ must not exceed 5.0 percent when tested under AASHTO T 105.

4) Metakaolin complying with AASHTO M 295, Class N, and the chemical and physical requirements for the quality characteristics shown in the following tables:

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Chemical quality characteristic	Requirement (percent)
Silicon dioxide (SiO ₂) + aluminum oxide (Al ₂ O ₃) (min)	92.0
Calcium oxide (CaO) (max)	1.0
Sulfur trioxide (SO ₃) (max)	1.0
Loss on ignition (max)	1.2
Available alkalies as Na ₂ O + 0.658 K ₂ O (max)	1.0

Physical quality characteristic	Requirement (percent)
Particle size distribution less than 45 microns (min)	95
Strength activity index with portland cement 7 days (percent of control, min) 28 days (percent of control, min)	100 100

- 5) GGBFS complying with AASHTO M 302, Grade 100 or 120.
 - 6) Silica fume complying with AASHTO M 307, with a minimum reduction in mortar expansion of 80 percent when using the cement from the proposed mix design.
- c. Fly ash from different sources may be commingled at uncontrolled ratios if the following conditions are satisfied:
- 1) Each source produces fly ash complying with AASHTO M 295, Class F
 - 2) At the time of commingling, each fly ash has:
 - a) Running average of relative density that does not differ from any other fly ash by more than 0.25
 - b) Running average of loss on ignition that does not differ from any other fly ash by more than 1 percent
 - 3) Final commingled fly ash complies with AASHTO M 295, Class F
 - 4) Fly ash supplier is responsible for testing the commingled fly ash
- d. The quantity of portland cement and SCM in concrete must comply with the minimum cementitious material content specified.
- e. The SCM content in non-precast concrete must comply with one of the following:
- 1) Any combination of portland cement and at least one SCM, satisfying equations 1 and 2:
 - a) Equation 1:

$$[(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)]/MC \geq X$$
 where:
UF = silica fume, metakaolin, or UFFA, including the quantity in blended cement, pounds per cubic yard
FA = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, with a CaO content of up to 10 percent, including the quantity in blended cement, pounds per cubic yard

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FB = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, with a CaO content of greater than 10 percent and up to 15 percent, including the quantity in blended cement, pounds per cubic yard

SL = GGBFS, including the quantity in blended cement, pounds per cubic yard

MC = minimum quantity of cementitious material specified, pounds per cubic yard

X = 1.8 for innocuous aggregate, 3.0 for all other aggregate

b) Equation 2:

$$MC - MSCM - PC \geq 0$$

where:

MC = minimum quantity of cementitious material specified, pounds per cubic yard

MSCM = minimum sum of SCMs that satisfies equation 1, pounds per cubic yard

PC = quantity of portland cement, including the quantity in blended cement, pounds per cubic yard

- 2) 15 percent Class F fly ash with at least 48 ounces of LiNO₃ solution added per 100 pounds of portland cement. The CaO content of the fly ash must not exceed 15 percent.

f. The SCM content in precast concrete must comply with one of the following:

- 1) Any combination of portland cement and SCM satisfying the following equation:

$$[(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)]/TC \geq X$$

where:

UF = silica fume, metakaolin, or UFFA, including the quantity in blended cement, pounds per cubic yard

FA = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, with a CaO content of up to 10 percent, including the quantity in blended cement, pounds per cubic yard

FB = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, with a CaO content of greater than 10 percent and up to 15 percent, including the quantity in blended cement, pounds per cubic yard

SL = GGBFS, including the quantity in blended cement, pounds per cubic yard

TC = total quantity of cementitious material, pounds per cubic yard

X = 0.0 for innocuous aggregate, 3.0 for all other aggregate

- 2) 15 percent Class F fly ash with at least 48 oz of LiNO₃ solution added per 100 pounds of portland cement. The CaO content of the fly ash must not exceed 15 percent.
- 3) Any combination of SCM and portland cement for which the expansion of cementitious material and aggregate does not exceed 0.10 percent when tested under ASTM C1567. Submit test data with each mix design. Test data authorized by VTA no more than three years before the first day of the Contract is authorized for the entire Contract. The test data must be for the same concrete mix and must use the same materials and material sources to be used on the Contract.

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8. Minor Concrete:

- a. Minor concrete must contain at least 505 pounds of cementitious material per cubic yard.
- b. You may use rice hull ash as an SCM. Rice hull ash must comply with AASHTO M 321 and the requirements for the quality characteristics shown in the following tables:

Chemical quality characteristic	Requirement (percent)
Silicon dioxide (SiO ₂) ^a (min)	90
Loss on ignition (max)	5.0
Total alkalis as Na ₂ O equivalent (max)	3.0

^aSiO₂ in crystalline form must not exceed 1.0 percent.

Physical quality characteristic	Requirement
Particle size distribution	
Less than 45 microns (min, percent)	95
Less than 10 microns (min, percent)	50
Strength activity index with portland cement (See Note A)	
7 days (min, percent of control)	95
28 days (min, percent of control)	110
Expansion at 16 days when testing project materials under ASTM C1567 (See Note B) (max, percent)	0.10
Surface area when testing by nitrogen adsorption under ASTM D5604 (min, m ² /g)	40.0

Note A: When tested under AASHTO M 307 for strength activity testing of silica fume.

Note B: In the test mix, Type II or V portland cement must be replaced with at least 12 percent rice hull ash by weight.

- c. For the purpose of calculating the equations for the cementitious material specifications, consider rice hull ash to be represented by the variable UF.

C. Aggregates:

- 1. Except for aggregates for use in minor concrete, aggregates must conform to the following requirements:
 - a. Both the coarse and fine aggregate must be on the Caltrans Authorized Material List for the aggregate used in concrete to be considered innocuous.
 - b. Aggregates must be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.
 - c. Provide safe and suitable facilities, including splitting devices, for obtaining aggregate test samples under California Test 125.
 - d. Aggregates must have characteristics that enable the production of workable concrete within the limits of water content specified herein.
 - e. Aggregates must have no more than 10 percent loss when tested for soundness under California Test 214. The soundness requirement does not apply to fine aggregate if

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the durability index of the fine aggregate is 60 or greater when tested under California Test 229.

- f. Each cleanness value, sand equivalent, or aggregate gradation test represents no more than 300 cubic yards of concrete or one day's pour, whichever is smaller.
- g. If the results of any one or more of the cleanness value, sand equivalent, or aggregate gradation tests do not comply with the requirements for operating range, but all comply with the requirements for contract compliance:
 - 1) Suspend the concrete placement at the completion of the current pour
 - 2) Do not restart the concrete placement until test results or other information show that the next material to be used in the work complies with the requirements for operating range
- h. If the results of either or both of the cleanness value and coarse aggregate gradation tests do not comply with the requirements for contract compliance, you must remove the concrete represented by the tests.
- i. If the results of either or both of the sand equivalent and fine aggregate gradation tests do not comply with the requirements for contract compliance, you must remove the concrete represented by the tests.
- j. Coarse Aggregate: ASTM C33/C33M, clean and uniformly graded from 3/8 inch to maximum size indicated or specified. When not specified, provide 1 inch maximum size (ASTM C33, Size No. 57). Deleterious materials in aggregates must not exceed the limits specified in ASTM C33/C33M, Class Designation 1N.
 - 1) Nominal maximum size of coarse aggregate must not exceed three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.
 - 2) Do not use crushed air-cooled iron blast furnace slag or crushed hydraulic-cement concrete in reinforced concrete.
 - 3) Coarse aggregate must consist of gravel, crushed gravel, crushed rock, reclaimed aggregate, crushed air-cooled iron blast furnace slag, or a combination of these.
 - 4) Do not use crushed air-cooled iron blast furnace slag in reinforced or PS concrete.
 - 5) Reclaimed aggregate must comply with the specifications for aggregate.
 - 6) Coarse aggregate must have the requirements for the quality characteristics shown in the following table:

Quality characteristic	Test method	Requirement
Loss in Los Angeles rattler after 500 revolutions (percent, max)	California Test 211	45
Cleanness value		
Operating range (min)	California Test 227	75
Contract compliance (min)	California Test 227	71

- 7) For cleanness value, an operating range limit of 71 minimum and a contract compliance limit of 68 minimum apply if you submit a certificate of compliance certifying that:

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- a) Coarse aggregate sampled at the completion of processing at the aggregate production plant had a cleanness value of at least 82 when tested under California Test 227
 - b) Prequalification tests performed under California Test 549 showed that the aggregate would develop a relative strength of at least 95 percent and have a relative shrinkage of no more than 105 percent based on concrete
- k. Fine Aggregate: ASTM C33/C33M, uniformly graded from 3/8-inch to fines, washed clean. Deleterious materials in fine aggregates must not exceed the limits specified in ASTM C33/C33M.

- 1) Fine aggregate must consist of natural sand, manufactured sand produced from larger aggregate, or a combination of these. Manufactured sand must be well graded.
- 2) Fine aggregate must have the requirements for the quality characteristics shown in the following table:

Quality characteristic	Test method	Requirement
Organic impurities	California Test 213	Satisfactory (See Note A)
Sand equivalent:		
Operating range (min)	California Test 217	75
Contract compliance (min)	California Test 217	71

Note A: Fine aggregate that develops a color darker than the reference standard color may be authorized if 95 percent relative mortar strength is achieved when tested under ASTM C87.

- 3) For sand equivalent, an operating range limit of 71 minimum and a contract compliance limit of 68 minimum apply if you submit a certificate of compliance certifying that:
 - a) Fine aggregate sampled at the completion of processing at the aggregate production plant had a sand equivalent value of at least 82 when tested under California Test 217
 - b) Prequalification tests performed under California Test 549 showed that the aggregate would develop a relative strength of at least 95 percent and have a relative shrinkage of no more than 105 percent based on concrete
- l. Aggregates for Lightweight Concrete:

- 1) The fine aggregate must consist of lightweight fine aggregate, natural sand or manufactured sand fine aggregate, or a combination of these, as required to comply with the air-dry unit weight requirements.
- 2) Lightweight aggregates must comply with ASTM C330/C330M, except the splitting tensile strength and drying shrinkage requirements do not apply.
- 3) Lightweight aggregates must be rotary kiln expanded shale or clay having a surface sealed by firing. Do not crush the coarse aggregate after firing, except aggregate that is 3/4 inch and smaller may be crushed as necessary to produce the required coarse aggregate gradation. The final coarse aggregate size must not exceed 3/4 inch.

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- 4) The shrinkage characteristics of lightweight aggregates must be such that the drying shrinkage of the lightweight concrete produced does not exceed 0.040 percent after 14 days of drying when tested under California Test 537.
 - 5) Lightweight aggregates must have no more than 5 percent loss when tested for soundness under California Test 214.
 - 6) Lightweight aggregate must be presoaked per ACI 304.2.
- m. Aggregate for Exposed Concrete: Aggregate for concrete which will be exposed to the public must be obtained from one source for each type of aggregate required in order to produce a uniform color.
 - n. Aggregates used for entire project must be obtained from the same sources and have the same size ranges as the aggregates used in the concrete represented by submitted historical data or used in trial mixtures.
2. Aggregates for Minor Concrete:
- a. The aggregate must be clean and free from deleterious coatings, clay balls, roots, and other extraneous material.
 - b. The maximum aggregate size must not be larger than 1-1/2 inches or smaller than 3/4 inch.
 - c. You may use crushed concrete and reclaimed aggregate if they comply with the specifications for aggregate.
- D. Water: Water for concrete mixes, curing, and cleaning must be clean and must not contain impurities at concentrations that cause discoloration or surface etching.
- 1. Except for minor concrete, water for washing aggregates, mixing concrete, and curing must comply with the following requirements:
 - a. Water must not contain oil.
 - b. Water must not contain impurities at concentrations that cause either of the following results when compared to the same test using distilled or deionized water:
 - 1) Change of more than 25 percent in the setting time of cement when tested under ASTM C191 or ASTM C266
 - 2) Reduction by more than 5 percent in the mortar compressive strength at 14 days when tested under ASTM C109
 - c. Water must not contain chlorides as Cl or sulfates as SO₄ in excess of the values shown in the following table:

Quality characteristic	Type of concrete work		
	Nonreinforced	Reinforced	PS
Chloride as Cl (See Note A) (ppm, max)	2,000	1,000	650
Sulfate as SO ₄ (See Note B) (ppm, max)	1,500	1,300	1,300

Note A: When tested under California Test 422

Note B: When tested under California Test 417

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- d. Water reclaimed from washing out the mixer may be used in mixing concrete. The water must not contain coloring agents or more than 300 ppm of alkalis as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ as determined on the filtrate. The specific gravity of the water must not exceed 1.03 and must not vary more than plus or minus 0.010 during a day's activities.
 2. Water used for washing, mixing, and curing minor concrete must be free from oil, salts, and other impurities that would discolor or etch the surface or have an adverse affect on the concrete quality.
- E. Concrete Admixtures:
1. The Contractor may include accepted concrete admixtures in the mix to improve the water-cement ratio or water-cementitious ratio or workability of the concrete, providing the strengths specified and other desirable characteristics of the concrete can be achieved and maintained. Admixtures require acceptance of the VTA before they may be used, and must be included in the design mix and introduced in solution form. Admixtures must be added at the batch plant, except as otherwise noted herein.
 2. The admixture type and brand must be on the Authorized Material List at the time of mix design submittal.
 3. Admixtures must comply with the following requirements:
 - a. Chemical admixtures must comply with ASTM C494.
 - b. Air-entraining admixtures must comply with ASTM C260.
 - c. Lithium nitrate must be in an aqueous solution that complies with the following:
 - 1) Lithium nitrate as LiNO_3 must be 30 plus or minus 0.5 percent by weight
 - 2) Sulfate as SO_4 must be less than 1,000 parts per million
 - 3) Chloride as Cl must be less than 1,000 parts per million
 - 4) Alkalis as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ must be less than 1,000 parts per million
 - d. Pigments for integrally colored concrete: ASTM C979/C979M, for synthetic or natural iron oxides.
 4. Store and dispense the admixtures in liquid form.
 5. Admixture properties must be uniform throughout their use in the work.
 6. If more than one admixture is used, the admixtures must be compatible with each other such that the desirable effects of all the admixtures used are realized.
 7. Use chemical admixtures in compliance with the manufacturer's written instructions. The instructions must include a statement that the admixture is compatible with the types and quantities of SCM used.
 8. If you are ordered to use admixtures in the concrete that are not specified, furnishing the admixtures and adding them to the concrete is change order work.
 9. Admixtures used in the concrete must be the same as those used in the concrete represented by the submitted field test records or used in the trial mixtures.
 10. Chemical Admixtures:
 - a. If the use of chemical admixtures is specified, use the dosage specified. If the dosage is not specified, use the dosage recommended by the admixture manufacturer.
 - b. You may use any of the following admixture types to conserve cementitious material or to facilitate construction:
 - 1) Type A or F, water-reducing

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- 2) Type B, retarding
 - 3) Type D or G, water-reducing and retarding

 - c. If you use a water-reducing admixture or a water-reducing and retarding admixture, you may reduce the specified cementitious material content by up to 5 percent by weight. The resulting concrete must contain at least 505 pounds of cementitious material per cubic yard. If you reduce the cementitious material content, use at least the admixture dosage used in authorizing the admixture as shown on the Authorized Material List for chemical admixture for use in concrete.
 - d. You may use a Type S admixture.
 - e. You may use a Type C accelerating admixture. Inclusion of the Type C admixture in the mix design is not required if it is added to counteract changing conditions that contribute to delayed setting of the concrete and if the use or change in dosage of the admixture is authorized.
 - f. Chemical admixtures must not contain more than one percent chlorides as Cl by weight of admixture when tested under California Test 415.
11. Air-Entraining Admixtures:
- a. If air entrainment is specified or ordered, use the quantity of air-entraining admixture that produces concrete having the specified air content when tested under California Test 504.
 - b. If air entrainment is not specified or ordered, you may use an air-entraining admixture to facilitate the use of a construction procedure or equipment. The average air content of three successive tests must not exceed four percent and each test value must be no more than 5.5 percent when tested under California Test 504.
 - c. Air-entraining admixtures must not contain more than one percent chlorides as Cl by weight of admixture when tested under California Test 415.
12. Crystalline Waterproofing Admixture: Crystalline waterproofing admixture must consist of Xypex Admix C-Series as manufactured by Xypex Chemical Corporation (Richmond, BC, Canada) or approved equal, in the amounts recommended by the manufacturer.
- F. Reinforcement Fibers: Chopped strands of alkali-resistant polypropylene fibers must be added to the concrete mix for stairs and bridge deck concrete, including bridge decks over metal decking, for protection against shrinkage cracks.
- 1. Reinforcement fibers must be designed for use in concrete and comply with ASTM D7508/D7508M. Microfibers must be from 1/2 inch to 2 inches long. Macrofibers must be from 1 inch to 2-1/2 inches long.

2.02 TESTS AND ANALYSES OF MATERIALS

- A. Tests and Sample Analyses: Testing of cement and analysis of aggregates must be performed by the Independent Testing Agency as specified herein. Mill tests and supplier's certificates of compliance with ASTM Specifications will be accepted in lieu of testing of cement. Mill tests and supplier's certificates of compliance with Section 90-1.02C, Aggregates, of the Caltrans Standard Specifications will be accepted in lieu of analysis of aggregates. Tests and services must consist of the following:
- 1. Testing of portland cement in accordance with ASTM C150/C150M and ASTM C114.
 - 2. Analysis of aggregates in accordance with ASTM C33/C33M, and sieve analysis of fine and coarse aggregates in accordance with California Test 202 or ASTM C136/C136M, as specified herein.

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- a. The Independent Testing Agency must perform sampling and testing for conformance with the requirements specified herein at the minimum frequencies shown in the following tables:

1) Non-precast Concrete:

Test	Test Method	Minimum Test Frequency
Coarse Aggregate		
Cleanness Value	California Test 227	Prior to production and minimum one for every 300 cubic yards and minimum one per day
Resistance to abrasion	California Test 211	Prior to production and minimum one random for every 25,000 cubic yards or less of concrete. If initial test shows abrasion loss greater than 40 percent, increase to minimum one random for every 4,000 cubic yards or less of concrete.
Soundness	California Test 214	Prior to production
Specific gravity and absorption	California Test 206	Prior to production and when aggregate source changes
Sieve analysis	California Test 202	Prior to production and minimum one for every 300 cubic yards and minimum one per day
Fine Aggregate		
Specific gravity and absorption	California Test 207	Prior to production and when aggregate source changes
Organic impurities	California Test 213	Prior to production and when contamination is suspected
Soundness	California Test 214	Prior to production
Durability	California Test 229	Prior to production
Sand Equivalent	California Test 217	Minimum one for every 300 cubic yards and minimum one per day
Sieve analysis	California Test 202	Prior to production and minimum one for every 300 cubic yards and minimum one per day
Moisture content	California Test 226	1 to 2 times per each day of pour, depending on conditions

2) Tier 1 and Tier 2 Precast Concrete:

Quality Characteristic	Test Method	Minimum Test Frequency
Aggregate gradation	ASTM C136/C136M	Once per 400 cubic yards of concrete cast or every seven days, whichever is more frequent

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Quality Characteristic	Test Method	Minimum Test Frequency
Sand equivalent	ASTM D2419	Once per 400 cubic yards of concrete cast or every seven days, whichever is more frequent
Percent fines under 75 microns	ASTM C117	Once per 400 cubic yards of concrete cast or every seven days, whichever is more frequent
Moisture content of fine aggregate	ASTM C566, or electronically actuated moisture meter. Electronically actuated moisture meter must be calibrated every 7 days per ASTM C566	1 to 2 times per each day of pour, depending on conditions

3. Testing of water: The Independent Testing Agency must perform sampling and testing of water for conformance with the requirements specified herein if the water is suspected of containing impurities detrimental to concrete.
 - a. If municipally supplied potable water is used for precast concrete, sampling and testing is waived unless requested by VTA.

B. Samples: Samples must be selected at random and collected by the Independent Testing Agency, as specified herein and as directed by VTA.

1. Samples of cementitious materials and aggregates must be taken at least 30 days prior to use on the project.
2. Sample cementitious materials in accordance with California Test 125.

C. Compressive Strength:

1. If the 28-day compressive strength described is 3,600 pounds per square inch or greater, the concrete is designated by compressive strength.
2. If the concrete is designated by compressive strength, the strength of concrete that is not steam cured is determined from cylinders cured under Method 1 of California Test 540.
3. If attaining a minimum concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member, cylinders for concrete that is not steam cured are cured under Method 2 of California Test 540 and the concrete compressive strength is evaluated based on individual tests.
4. For concrete with a described 28-day compressive strength greater than 3,600 pounds per square inch, 42 days are allowed to attain the strength described.
5. 56 days are allowed to attain the strength described if the cementitious material satisfies the following equation:

$$[(41 \times UF) + (19 \times F) + (11 \times SL)]/TC \geq 7.0$$
 where:
F = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, including the quantity in blended cement, pounds per cubic yard. *F* is equivalent to the sum of *FA* and *FB*, which are defined as follows:

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FA = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, with a CaO content of up to 10 percent, including the quantity in blended cement, pounds per cubic yard.

FB = natural pozzolan or fly ash complying with AASHTO M 295, Class F or N, with a CaO content of greater than 10 percent and up to 15 percent, including the quantity in blended cement, pounds per cubic yard.

SL = GGBFS, including the quantity in blended cement, pounds per cubic yard

UF = silica fume, metakaolin, or UFFA, including the quantity in blended cement, pounds per cubic yard

TC = total quantity of cementitious material used, pounds per cubic yard

- a. For concrete satisfying the equation above, test for the compressive strength at least once every 500 cubic yards at 28, 42, and 56 days. Submit the test results to VTA.
6. The Independent Testing Agency must determine the concrete compressive strength from test cylinders made from concrete sampled under California Test 539, molded and initially field cured under California Test 540, and cured and tested under California Test 521.
7. A compressive strength test represents no more than 300 cubic yards of concrete and consists of the average compressive strength of 2 cylinders made from material taken from a single load of concrete. If a cylinder shows evidence of improper sampling, molding, or testing, the cylinder is discarded and the test consists of the compressive strength of the remaining cylinder.
8. If a single compressive strength test result is below the strength described at the maximum age specified or allowed, or if the compressive strength of concrete tested at seven days indicates to VTA that the concrete will not attain the strength described at the maximum age specified or allowed, correct the mix design or concrete fabrication procedures and obtain authorization before you place additional concrete.
9. If a single compressive strength test result is below the strength described at the maximum age specified or allowed, the concrete represented by the test is subject to one of the following actions:
 - a. If the compressive strength is at least 95 percent of the strength described, \$10 per cubic yard of concrete is deducted.
 - b. If the compressive strength is below 95 percent of the strength described but is at least 85 percent of the strength described, \$15 per cubic yard of concrete is deducted.
 - c. If the compressive strength is below 85 percent of the strength described, you must remove the concrete.
10. If a strength test result at the maximum age specified or allowed is below the strength described but is at least 85 percent of the strength described, the deductions specified above apply unless you obtain and submit evidence that the strength of the concrete placed in the work is greater than or equal to the strength described and this evidence is accepted by VTA.
11. If a strength test result at the maximum age specified or allowed is below 85 percent of the strength described, you must remove the concrete represented by the test unless you obtain and submit evidence that the strength of the concrete placed in the work is at least 85 percent of the strength described and this evidence is accepted by VTA.
12. If the evidence consists of tests made on cores taken from the work, obtain and test the cores under ASTM C42.
13. For precast concrete that is steam cured, concrete designated by compressive strength is acceptable if its compressive strength reaches the described 28-day compressive strength in no more than the maximum number of days specified or allowed after the concrete is cast.

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D. Shrinkage:

1. The following shrinkage limitations apply:
 - a. Length change of laboratory cast specimens at 28 days drying (average of 3) for paving and approach slab concrete must not exceed 0.050 percent.
 - b. Length change of laboratory cast specimens at 28 days drying (average of 3) for bridge deck concrete must not exceed 0.032 percent. This shrinkage limitation does not apply to concrete used to fill blocked-out recesses for joint seal assemblies.
2. If shrinkage limitations are specified, test the concrete under AASHTO T 160, modified as follows:
 - a. Prepare specimens that have a 4 by 4-inch cross section.
 - b. Remove each specimen from the mold 23 plus or minus 1 hours after mixing the concrete and place the specimen in lime water at 73 plus or minus 3 degrees Fahrenheit until 7 days age.
 - c. Take a comparator reading at 7 days age and record it as the initial reading.
 - d. Store the specimens in a humidity-controlled room maintained at 73 plus or minus 3 degrees Fahrenheit and 50 plus or minus 4 percent relative humidity for the remainder of the test.
 - e. Take subsequent readings at 7, 14, 21, and 28 days drying.
3. Perform AASHTO T 160 testing at a laboratory that is accredited to perform AASHTO T 160 or that maintains a current rating of 3 or better for the Cement and Concrete Reference Laboratory concrete proficiency sample program.
4. Shrinkage test data authorized by VTA no more than three years before the first day of the Contract is authorized for the entire Contract. The test data must be for concrete with similar proportions and using the same materials and material sources to be used on the Contract. Concrete is considered to have similar proportions if no more than two mix design elements are varied and the variation is within the tolerances shown in the following table:

Mix design element	Tolerance (Plus or Minus)
Water to cementitious material ratio	0.03
Total water content (percent)	5
Coarse aggregate content (percent)	10
Fine aggregate content (percent)	10
SCM content (percent)	5
Admixture as originally dosed (percent) (Admixtures must be the same brand)	25

E. Precast Concrete Temperature Monitoring:

1. Temperature monitoring devices must provide an accurate, continuous, permanent record of the temperature during curing activities.
2. At a minimum, provide temperature monitoring devices as shown in the following table:

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Temperature Monitoring Requirements		
Component	Steam curing	Other curing methods
Tier 1 precast bridge components except piling and deck panels	One internal temperature sensor for each individually cast member; One internal temperature sensor for every 100 feet of bed length for continuously cast elements (See Note A)	One internal temperature sensor for each individually cast member; One internal temperature sensor for every 100 feet of bed length for continuously cast elements (See Note A)
Precast piling, deck panels, and PS pavement	One enclosure temperature sensor for every 200 feet of bed length for continuously cast elements	Not required
Other precast components	One enclosure temperature sensor for every 200 feet of bed length for continuously cast elements	Not required

Note A: Members not instrumented are represented by the nearest internal temperature probe.

3. Tier 1 Precast Concrete Members:
 - a. Maximum internal concrete temperature must not exceed 165 degrees Fahrenheit at any temperature sensor.
 - b. Maximum temperature gain must not exceed 40 degrees Fahrenheit per hour at any temperature sensor.
 - c. For precast concrete that is steam cured, VTA evaluates the compressive strength based on individual tests representing specific portions of production.
 - d. Bridge Components:
 - 1) Except for piling and deck panels, provide a temperature monitoring and recording system during concrete placement and curing for tier 1 precast bridge components. The system must consist of temperature sensors connected to a data acquisition system. The system must be capable of recording, printing, and downloading temperature data to a computer. Temperature sensors must be accurate to within plus or minus two degrees Fahrenheit.
 - 2) Position each internal concrete temperature sensor as shown in the following table:

Internal Concrete Sensor Locations	
Precast component	Sensor location
Wide flange girders	6 to 8 inches below top surface along center line at midpoint
Deck slabs	Center of element at mid-depth
Other elements	Position sensor to provide maximum concrete cover

- 3) Record temperature readings automatically at least every 15 minutes. You may discontinue temperature recording when the maximum internal concrete temperature is falling for a minimum of one hour, or immediately before stress transfer to the concrete.
- 4) Do not allow the ends of temperature sensors to come into contact with concrete supports, forms, or reinforcement.

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- 5) Correct equipment failures in temperature control and monitoring and recording systems immediately.
- 6) For precast bridge components that are monitored for internal temperature, VTA rejects components if at any temperature sensor the maximum internal concrete temperature exceeds 165 degrees Fahrenheit, or the internal temperature gain exceeds 40 degrees Fahrenheit per hour. If the maximum internal concrete temperature is from 161 to 165 degrees Fahrenheit, VTA reduces payment for furnish precast concrete member by a percentage equal to two times the difference of the maximum measured temperature in degrees Fahrenheit minus 160.

2.03 MIX DESIGNS

- A. Design of concrete mixes, including recommended amounts of admixture and water to be used in the mixes, must be obtained by the Contractor from a qualified independent testing laboratory or agency, or from a mill or ready-mix plant, properly equipped to design concrete mixes. The design must be performed and certified by an engineer who is currently registered as a civil engineer in the State of California. The laboratory, agency, mill, or ready-mix plant must meet applicable requirements of ASTM E329, and must be approved by VTA. Costs of obtaining the mix designs must be paid by the Contractor.
- B. Selection of mix proportions must conform to the applicable requirements of ACI 211.1 and ACI 211.2. Concrete must comply with ACI 301 and ACI 318, as applicable. Ensure that mix designs will produce concrete suited for proper placement and finishing.
- C. Content of Cementitious Materials:
 1. Except for minor structures, the cementitious material content per cubic yard of concrete in structures or portions of structures must comply with the content shown in the following table, unless otherwise specified in these Technical Specifications:

Use	Cementitious Material Content
	(pounds per cubic yard)
Deck slabs and slab spans of bridges	675 min., 800 max.
Roof sections of exposed top box culverts	675 min., 800 max.
Pier columns	675 min., 800 max.
Approach slabs	675 min.
Prestressed members	675 min.
Seal courses	675 min.
Cast-in-place concrete for use in piles, placed under slurry	675 min.
Concrete in corrosive environments	675 min.
Other portions of structures	590 min., 800 max.
Concrete for precast members	590 min., 925 max.

2. Minor concrete must contain at least 505 pounds of cementitious material per cubic yard unless otherwise specified in these Technical Specifications.

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- D. Mix designs must indicate brands, types, and quantities of admixtures included. If fly ash is proposed, it must be identified as such (for example, "fly ash"), and the mix design must identify the percentage of cement replacement and the locations in the structures where such mixes are proposed for use.
1. Use chemical admixtures in compliance with the manufacturer's written instructions.
- E. Mix designs for integrally colored concrete must indicate brand type of natural or synthetic metallic oxide or pigment, and quantity used, all prepared as specified in ASTM C979/C979M. Compensate for fly ash with additional pigment as applicable. The dosage of metallic oxide or pigment must not exceed 10 percent by weight of cementitious material in the concrete mix design. When a combination of pigments is used to produce the desired color and color intensity, the total dosage rate of all pigments combined must not exceed any of the individual maximum dosage rates of the component pigments.
- F. Mix design for mass concrete must have a percentage of fly ash replacement of cement by weight to reduce the amount of heat generated during heat of hydration. Amount of fly ash to be introduced into the mix must be approved by VTA. ASTM C494/C494M Type F or Type G high-range water-reducing admixture may also be used to reduce heat of hydration.
- G. If concrete is to be placed by pumping, concrete mixes must be designed in accordance with the applicable requirements of ACI 304R and ACI 304.2R, and must include strengths and slumps.
- H. Mix designs must indicate location of each mix within the structure. Mix designs must specify both coarse and fine aggregate sources.
- I. Upon receipt of acceptable mix designs from the prequalified testing laboratory or agency or concrete supplier, conforming to specified requirements, the Contractor must submit these accepted mix designs to VTA for review, 14 calendar days prior to batching or delivering any concrete.
- J. The water-to-cement ratio must not exceed 0.40 for concrete which may be exposed to underground water, included but not limited to subway and station structures, footings, and retaining walls, or for concrete in structures critical to continued main line track operations. Conversion to equivalent water-to-cementitious ratio must be performed in accordance with applicable requirements of ACI 211.1.
- K. Concrete for concrete stairs and concrete bridge decks, including bridge decks over metal decking, must contain reinforcement fibers. Each cubic yard of concrete must contain at least one pound of microfibers and at least three pounds of macrofibers.
1. Concrete used for filling blocked-out recesses for joint seal assemblies does not require microfibers or macrofibers.
- L. Concrete for concrete bridge decks, including bridge decks over metal decking, must contain a shrinkage reducing admixture. Each cubic yard of concrete must contain at least 3/4 gallon of a shrinkage reducing admixture. If you use the maximum dosage rate shown on the Caltrans Authorized Material List for the shrinkage reducing admixture, your submitted shrinkage test data does not need to meet the shrinkage limitation specified in Article 2.02D.1, herein.
1. Concrete used for filling blocked-out recesses for joint seal assemblies does not require a shrinkage reducing admixture.
- M. Concrete for concrete bridge decks over metal decking, including at Story Station Pedestrian Overcrossing, must contain crystalline waterproofing admixture, as specified in Article 2.01, "Materials," herein.

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N. The air-dry unit weight of lightweight concrete furnished for each mix design must be a single weight from 109 to 115 pounds per cubic foot for prestressed concrete and from 104 to 110 pounds per cubic foot for nonprestressed concrete.

1. Determine the air-dry unit weight as follows:

- a. Test three 6-inch-diameter by 12-inch-tall cylinders.
- b. Prepare the cylinders under ASTM C192/C192M or ASTM C31/C31M, whichever is applicable.
- c. Cure the cylinders for 6 days.
- d. On the 6th day, remove the cylinders from the molds or curing media and immerse them in water at 73.4 plus or minus 3 degrees Fahrenheit for 24 hours.
- e. Determine the suspended-immersed weights of the cylinders.
- f. Remove the cylinders from the water and determine the saturated surface-dry weights.
- g. Dry the cylinders for 90 days at 73.4 plus or minus 3 degrees Fahrenheit and a relative humidity of 50 plus or minus 5 percent.
- h. Weigh the dried cylinders.
- i. Use the following equation to calculate the air-dry unit weight:

$$W = (A \times 62.3) / (B - C)$$
 where:
 W = air-dry unit weight, pounds per cubic foot;
 A = 90-day dried weight of the cylinder, pounds;
 B = saturated surface-dry weight of the cylinder, pounds;
 C = suspended-immersed weight of the cylinder, pounds

O. Lightweight concrete must be composed of portland cement, fine aggregate, lightweight aggregate, and water, with or without admixtures as approved by the Independent Testing Agency, proportioned and mixed as specified herein.

1. Mix designs for lightweight concrete must contain an air-entraining admixture to provide five percent entrained air, plus or minus one percent. The total air content of freshly mixed lightweight concrete must not exceed six percent.

P. Quantity of Water and Slump:

1. Regulate the quantity of water used in the concrete mix such that the penetration as tested under California Test 533, or the slump as tested under ASTM C143/C143M, complies with the nominal range shown in the following table:

Type of Work	Nominal Penetration	Maximum Penetration	Nominal Slump	Maximum Slump
	(inches)	(inches)	(inches)	(inches)
Concrete pavement	0-1	1.5	0-2	3
Non-reinforced concrete members	0-1.5	2	0-3	4
Reinforced concrete structures with:				
Sections over 12 inches thick	0-1.5	2.5	0-3	5
Sections 12 inches thick or less	0-2	3	0-4	6

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Concrete placed under water	--	--	6-8	9
Cast-in-place concrete for use in piles, except concrete placed under slurry	2.5-3.5	4	5-7	8
Cast-in-place concrete for use in piles, placed under slurry			7-9	10
Lightweight concrete			3-5	6

2. If the penetration or slump exceeds the nominal range, adjust the mixture for subsequent batches to reduce the slump to a value within the nominal range.
3. Do not use a batch of concrete with a penetration or slump that exceeds the maximum value shown in the table above.
4. If Type F or G chemical admixtures are used, slump measurements must be taken prior to the addition of those admixtures, except slump measurements for cast-in-place piles will be taken after the addition of those chemical admixtures. The slump must not exceed nine inches after adding the chemical admixtures for all types of work. The penetration requirements do not apply
5. The quantity of free water must not exceed 310 pounds per cubic yard of concrete plus 20 pounds of free water for each required 100 pounds of cementitious material in excess of 550 pounds of cementitious material per cubic yard of concrete.
6. When determining the total quantity of free water, consider liquid admixtures to be water if the dosage is more than 1/2 gallon of admixture per cubic yard of concrete.
7. If there are adverse or difficult conditions that affect concrete placement, the specified free water content limitations may be exceeded if the following conditions are met:
 - a. The Contractor receives authorization from VTA to increase the cementitious material content per cubic yard of concrete.
 - b. The Contractor must increase the water and cementitious material at a ratio that does not exceed 30 pounds of water per added 100 pounds of cementitious material per cubic yard of concrete.

Q. Concrete in Corrosive Environments:

1. Concrete at precast prestressed concrete piles, concrete footings, and columns at Capitol Aerial Guideway Bent 40 through Bent 55 is in a corrosive environment.
2. The cementitious material to be used in the concrete must be a combination of Type II or V portland cement and SCM.
3. The concrete must contain at least 675 pounds of cementitious material per cubic yard.
4. The reduction of cementitious material content as specified in Article 2.01C.13, "Chemical Admixtures," herein, is not allowed.
5. The specifications for SCM content in Article 2.01A.7, "Supplementary Cementitious Material (SCM)," herein, do not apply.
6. Unless otherwise specified, the cementitious material must be composed of one of the following, by weight:
 - a. 25 percent natural pozzolan or fly ash with a CaO content of up to 10 percent and 75 percent portland cement
 - b. 20 percent natural pozzolan or fly ash with a CaO content of up to 10 percent, 5 percent silica fume, and 75 percent portland cement
 - c. 12 percent silica fume, metakaolin, or UFFA, and 88 percent portland cement
 - d. 50 percent GGBFS and 50 percent portland cement

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7. For structures, the total cementitious material must be composed of one of the following options, by weight, unless otherwise specified:
 - a. 25 percent natural pozzolan or fly ash with a CaO content of up to 10 percent and 75 percent portland cement.
 - b. 20 percent natural pozzolan or fly ash with a CaO content of up to 10 percent, 5 percent silica fume, and 75 percent portland cement.
 - c. 12 percent silica fume, metakaolin, or UFFA, and 88 percent portland cement.
 - d. 50 percent GGBFS and 50 percent portland cement.
 - e. 25 to 50 percent fly ash with a CaO content of up to 10 percent, and no natural pozzolan. The remaining portion of the cementitious material must be portland cement or a combination of portland cement and UFFA, metakaolin, GGBFS, or silica fume.

8. For concrete at precast prestressed concrete piles at Capitol Aerial Guideway Bent 40 through Bent 55, the cementitious material must be composed of one of the following, by weight:
 - a. 20 percent natural pozzolan or fly ash with a CaO content of up to 10 percent, 5 percent silica fume, and 75 percent portland cement
 - b. 12 percent silica fume, metakaolin, or UFFA, and 88 percent portland cement
 - c. 50 percent GGBFS and 50 percent portland cement

9. For concrete at precast prestressed concrete piles, concrete footings, and columns at Capitol Aerial Guideway Bent 40 through Bent 55, the ratio of the quantity of free water to the quantity of cementitious material must not exceed 0.40.

R. Returned plastic concrete must not be used.

2.04 AGGREGATE GRADATION

A. Proposed aggregate gradations must be within the percentage passing limits shown in the following table:

Primary aggregate nominal size	Sieve size	Limits of gradation (percent passing)
1-1/2 x 3/4 inch	1 in	19–41
1 inch x No. 4	3/4 in	52–85
1 inch x No. 4	3/8 in	15–38
1/2 inch x No. 4	3/8 in	40–78
3/8 inch x No. 8	3/8 in	50–85
Fine aggregate	No. 16	55–75
Fine aggregate	No. 30	34–46
Fine aggregate	No. 50	16–29

B. VTA may waive, in writing, the specifications for gradation if in VTA's opinion furnishing the gradation is not necessary for the work.

C. Coarse Aggregate Gradation:

1. Coarse aggregate must be graded within the limits shown in the following table for each size of coarse aggregate:

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Sieve size	Primary aggregate nominal sizes							
	1-1/2 x 3/4 inch		1 inch x No. 4		1/2 inch x No. 4		3/8 inch x No. 8	
	Operating Range (% passing)	Contract Compliance (% passing)	Operating Range (% passing)	Contract Compliance (% passing)	Operating Range (% passing)	Contract Compliance (% passing)	Operating Range (% passing)	Contract Compliance (% passing)
2 inch	100	100	--	--	--	--	--	--
1-1/2 inch	88–100	85–100	100	100	--	--	--	--
1 inch	X ± 18	X ± 25	88–100	86–100	--	--	--	--
3/4 inch	0–17	0–20	X ± 15	X ± 22	100	100	--	--
1/2 inch	--	--	--	--	82–100	80–100	100	100
3/8 inch	0–7	0–9	X ± 15	X ± 22	X ± 15	X ± 22	X ± 15	X ± 20
No. 4	--	--	0–16	0–18	0–15	0–18	0–25	0–28
No. 8	--	--	0–6	0–7	0–6	0–7	0–6	0–7

NOTE: "X" is the percent passing of the gradation that you propose to furnish for the specific sieve size under Article 2.04 herein.

2. Furnish coarse aggregate for the 1-1/2-inch maximum combined aggregate gradation under Article 2.04E, "Combined Aggregate Gradation," herein in two or more primary aggregate nominal sizes. You may separate each primary aggregate nominal size into two sizes and store them separately, provided that the combined material complies with the gradation specifications for the primary aggregate nominal size.
3. You may separate the coarse aggregate for the 1-inch maximum combined aggregate gradation under Article 2.04E, "Combined Aggregate Gradation," herein into two sizes and store them separately, provided that the combined material complies with the gradation specifications for the 1 inch x No. 4 primary aggregate nominal size.

D. Fine Aggregation Gradation:

1. Fine aggregate must be graded within the limits shown in the following table:

Sieve size	Operating range (percent passing)	Contract compliance (percent passing)
3/8 inch	100	100
No. 4	95–100	93–100
No. 8	65–95	61–99
No. 16	X ± 10	X ± 13
No. 30	X ± 9	X ± 12
No. 50	X ± 6	X ± 9
No. 100	2–12	1–15
No. 200	0–8	0–10

NOTE: "X" is the percent passing of the gradation that you propose to furnish for the specific sieve size under Article 2.04 herein.

2. Fine aggregate sizes must be distributed such that the difference between the total percentage passing the No. 16 and No. 30 sieves is from 10 to 40, and the difference between the percentage passing the No. 30 and No. 50 sieves is from 10 to 40.
3. You may separate fine aggregate into 2 or more sizes and store them separately, provided that the combined material complies with the gradation specifications.

E. Combined Aggregate Gradation:

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1. Use combined aggregate gradation limits only for the design of concrete mixes. Design concrete mixes such that aggregates are combined in proportions that produce a mixture within the gradation limits for combined aggregate.
2. Use either the 1-1/2-inch maximum gradation or the 1-inch maximum gradation, unless otherwise specified.
3. Combined aggregate must be graded within the limits shown in the following table:

Sieve size	1-1/2 inch max (% passing)	1 inch max (% passing)	1/2 inch max (% passing)	3/8 inch max (% passing)
2 inch	100	--	--	--
1-1/2 inch	90–100	100	--	--
1 inch	50–86	90–100	--	--
3/4 inch	45–75	55–100	100	--
1/2 inch	--	--	90–100	100
3/8 inch	38–55	45–75	55–86	50–100
No. 4	30–45	35–60	45–63	45–63
No. 8	23–38	27–45	35–49	35–49
No. 16	17–33	20–35	25–37	25–37
No. 30	10–22	12–25	15–25	15–25
No. 50	4–10	5–15	5–15	5–15
No. 100	1–6	1–8	1–8	1–8
No. 200	0–3	0–4	0–4	0–4

4. Do not change from one aggregate gradation to another during the progress of the work.

2.05 STORAGE, STOCKPILING, AND HANDLING

A. Aggregates:

1. Store or stockpile aggregates such that the coarse and fine particles of each size do not separate and various sizes do not intermix before proportioning.
2. Prevent contamination by foreign materials while storing, stockpiling, and handling aggregates.
3. If you store the aggregates at a batching or mixing plant that is erected after the Contract is awarded and is used for furnishing concrete for the work:
 - a. Prevent intermingling of different aggregate sizes by using measures such as the physical separation of stockpiles or the construction of bulkheads of adequate length and height
 - b. Prevent contamination of the aggregates by contact with the ground through measures such as placing the aggregates on wooden platforms or on hardened surfaces made of concrete, asphalt concrete, or cement-treated material
4. When placing the aggregates in storage or moving the aggregates from storage to the weigh hopper of the batching plant, do not use methods that cause either of the following:
 - a. Segregation, degradation, or the combining of materials of different gradations and result in an aggregate size failing to comply with the gradation specifications at the weigh hopper
 - b. Excessive particle breakage
5. You may be required to use devices that reduce the impact of falling aggregates.

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B. Cementitious Materials:

1. Protect cementitious materials from moisture until used.
2. Place sacked cementitious materials in a pile to allow access for tallying, inspecting, and identifying each shipment.
3. Provide facilities that ensure the cementitious materials to be used in the work are kept separate from each other and from other cementitious materials.
4. A storage silo containing a cementitious material must be emptied before using the silo for a different cementitious material. Blended cements with a percentage of SCM differing by more than two percent are considered different cementitious materials.

2.06 PROPORTIONING CONCRETE

A. Proportioning Devices:

1. Automatic weighing systems must comply with the requirements specified for automatic proportioning herein. For an automatic device, the single operation of a switch or starter must be the only manual operation required to proportion the aggregates, cement, and SCM for 1 batch of concrete.
2. Insulate the weighing equipment against the vibration or movement of other plant equipment.
3. The weight of each batch of material must not vary from the weight designated by VTA by more than the specified tolerances.
4. The weighing and measuring equipment must have the following zero tolerances:
 - a. For cumulative weighing of aggregates, plus or minus 0.5 percent of the designated total aggregate batch weight
 - b. For weighing each aggregate size separately, plus or minus 0.5 percent of the designated batch weight for each aggregate size
 - c. For cumulative weighing of cement and SCM, plus or minus 0.5 percent of the designated total batch weight of the cement and SCM
 - d. For weighing cement and SCM separately, plus or minus 0.5 percent of their designated individual batch weights
 - e. For measuring water, plus or minus 0.5 percent of its designated weight or volume
5. The weight indicated for a batch of material must not vary from the preselected scale setting by more than the following:
 - a. Aggregates weighed cumulatively must be within plus or minus 1.0 percent of the designated total aggregate batch weight.
 - b. Aggregates weighed separately must be within plus or minus 1.5 percent of the designated batch weight of each aggregate.
 - c. Cement weighed separately must be within plus 2 to minus 1 percent of the designated cement batch weight.
 - d. SCM weighed separately must be within plus 2 to minus 1 percent of the designated SCM batch weight.
 - e. For cement and SCM weighed cumulatively, the cement must be within plus 2 to minus 1 percent of the designated cement batch weight and the total for cement and SCM must be within +2 to -1 percent of the sum of the designated cement and SCM batch weights.
 - f. Water must be within plus or minus 1.5 percent of the designated weight or volume of water.

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6. Each scale graduation must be no more than 0.001 of the total scale capacity. For each material being weighed, use a scale with single graduations that indicate a weight not exceeding the maximum permissible weight variation above, except that graduations less than one pound are not required.

B. Proportioning:

1. Proportioning consists of dividing the aggregates into the specified sizes, each stored in a separate bin, and combining the aggregates with cementitious material, admixtures if used, and water.
2. Proportion the aggregates by weight.
3. At the time of batching:
 - a. Aggregates must be dried and drained to a stable moisture content such that no visible separation of water from the aggregate occurs during transportation from the proportioning plant to the point of mixing
 - b. Free moisture content of the fine aggregate must not exceed 8 percent of its saturated surface-dry weight
4. If the proportioning plant has separate supplies of the same size group of aggregate with different moisture content, specific gravity, or surface characteristics affecting workability, exhaust one supply before using another supply.
5. Weigh bulk Type IP (MS) or Type IS (MS) cement in an individual hopper and keep it separate from the aggregates until the ingredients are released for discharge into the mixer.
6. Bulk cement and SCM may be weighed in separate weigh hoppers or in the same weigh hopper. Keep the cement and SCM separate from the aggregates until the ingredients are released for discharge into the mixer.
7. If the cement and SCM are weighed in the same weigh hopper, weigh the cement first. If the cement and SCM are weighed in separate weigh hoppers, the weigh systems for the proportioning of the aggregate, the cement, and the SCM must be individual and distinct from all other weigh systems. To constitute an individual and distinct material-weighing device, each weigh system must have a hopper, a lever system, and an indicator.
8. Discharge the cement and the SCM into the mixer simultaneously with the aggregate.
9. The scales and weigh hoppers for bulk weighing cement, SCM, or cement plus SCM must be separate and distinct from the aggregate weighing equipment.
10. For batches of one cubic yard or more, the batching equipment must comply with one of the following combinations:
 - a. Separate boxes and separate scale and indicator for weighing each aggregate size
 - b. Single box and scale indicator for all aggregates
 - c. Single box or separate boxes and automatic weighing mechanism for all aggregates
11. If you are requested to check the accuracy of batch weights, determine the gross weight and tare weight of batch trucks, truck mixers, truck agitators, and nonagitating hauling equipment. Weigh the equipment using scales designated by VTA.
12. For proportioning pavement concrete, install and maintain in good operating condition an electronically actuated moisture meter that indicates, on a readily visible scale, changes in the moisture content of the fine aggregate as it is batched within a sensitivity of 0.5 percent by weight of the fine aggregate.
13. Lightweight Concrete:
 - a. At the time of batching, adjust the authorized aggregate weight to compensate for surface moisture and absorbed moisture.

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- b. After authorization of the mix design, do not alter the materials and batch proportions during the work, except as required to maintain the authorized cementitious material content and unit weight. The cementitious material content of individual batches must not vary from the authorized cementitious material content by more than from minus 15 to plus 25 pounds of cementitious material per cubic yard of concrete.
- c. Batch the lightweight fine aggregate and natural sand by weight. Batch the lightweight coarse aggregate by weight or volumetric methods. If volumetric methods are used, the batching equipment must allow the Engineer to check the weight of each aggregate size in the batch.
- d. Limit the absolute volume of coarse aggregate such that no concrete segregation occurs during mixing, transporting, placing, consolidating, or finishing. For site-cast concrete, the absolute volume of coarse aggregate must not exceed 10 cubic feet per cubic yard of concrete.
- e. Uniformly pre-wet or pre-saturate the aggregates such that uniform penetration of the concrete is maintained. For lightweight concrete that is to be pumped, pre-saturate the aggregates using thermal, vacuum, or equivalent methods.
- f. Lightweight concrete must have adequate workability such that proper placement, consolidation, and finishing are attained.

C. Proportioning and Dispensing Liquid Admixtures:

- 1. Liquid admixture dispensers must:
 - a. Have enough capacity to measure at one time the total quantity of admixture required for each batch of concrete
 - b. Include a graduated measuring unit that is accurate to within plus or minus 5 percent of the required quantity for each batch of concrete
 - c. Be located and maintained such that the graduations can be read accurately from the point at which proportioning is controlled to allow a visual check of batching accuracy before discharge
 - d. Have measuring units that are clearly marked for the type and quantity of admixture
- 2. Each liquid admixture dispensing system must be equipped with a sampling device that consists of a valve located in a safe and readily accessible position such that VTA can slowly withdraw a test sample.
- 3. If more than one liquid admixture is used in the concrete mix, each admixture must have a separate measuring unit and must be dispensed by injecting equipment located such that the admixtures are not mixed at high concentrations and do not interfere with the effectiveness of each other.
- 4. If an air-entraining admixture is used with other liquid admixtures, incorporate the air-entraining admixture into the mix first, unless you demonstrate that a different sequence improves performance.
- 5. If automatic proportioning devices are used, the liquid admixture dispensers must operate automatically with the batching control equipment. The dispensers must have an automatic warning system in good operating condition that provides a visible or audible signal at the point at which proportioning is controlled. The signal must activate if the quantity of admixture measured varies from the preselected dosage by more than 5 percent or if the entire contents of the measuring unit are not emptied from the dispenser.
- 6. Add liquid admixtures to the premeasured batch water or discharge the admixtures into the stream of water such that they are well-dispersed throughout the batch.
- 7. You may dispense air-entraining admixtures directly into moist sand in the batching bins if you maintain adequate control of the concrete air content.

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D. Automatic Proportioning:

1. Automatic proportioning devices must be authorized by the VTA.
2. The batching of the aggregate and the cement, SCM, or cement plus SCM must be interlocked such that a new batch cannot start until all weigh hoppers are empty, the proportioning devices are within zero tolerance, and the discharge gates are closed.
3. The interlock must not allow any part of the batch to be discharged until all aggregate hoppers and the cement and SCM hoppers or the cement plus SCM hopper are charged with weights that are within the tolerances specified in Article 2.05B, "Proportioning Devices," herein.
4. If interlocks are required for the cement and SCM charging mechanisms and the cement and SCM are weighed cumulatively, their charging mechanisms must be interlocked to prevent the introduction of SCM until the weight of cement in the cement weigh hopper is within the tolerances specified in Article 2.05B, "Proportioning Devices," herein.
5. If the concrete is mixed completely in a stationary mixer, weigh the SCM in a separate weigh hopper and introduce the SCM and cement simultaneously into the mixer proportionately with the aggregate. If you submit certification that the stationary mixer is capable of mixing the cement, SCM, aggregates, and water uniformly before discharge, you may weigh the SCM cumulatively with the cement. Certification must include:
 - a. Test results for two compressive strength test cylinders taken within the first 1/3, and 2 compressive strength test cylinders taken within the last 1/3, of a single batch of concrete discharged from the stationary mixer. Strength tests and cylinder preparation must comply with the requirements specified herein.
 - b. Calculations demonstrating that the average of the two compressive strengths taken within the first 1/3 of the batch do not differ by more than 7.5 percent from the average of the 2 compressive strengths taken within the last 1/3 of the batch.
 - c. Mixer rotation speed and time of mixing before discharge that are required to produce a mix that complies with the above requirements.
6. The discharge gate on the cement and SCM hoppers or the cement plus SCM hopper must be designed to allow the regulation of the flow of cement, SCM, or cement plus SCM into the aggregate.
7. If separate weigh boxes are used for each aggregate size, the discharge gates must allow the regulation of the flow of each aggregate size.
8. Material discharged from each bin must be controlled by gates or by mechanical conveyors.
9. The means of withdrawal from the bins and of discharge from the weigh box must be interlocked such that not more than 1 bin can discharge at a time and the weigh box cannot be tripped until the required quantity from each bin has been deposited into it.
10. If a separate weigh box is used for each aggregate size, all the weigh boxes may be operated and discharged simultaneously.
11. If the discharge from the bins is controlled by gates, each gate must be actuated automatically such that the required weight is discharged into the weigh box, after which the gate must automatically close and lock.
12. The automatic weighing system must be designed to allow all required proportions to be set on the weighing controller at the same time.

2.07 MIXING AND TRANSPORTING CONCRETE

- A. Mix the concrete in a mechanically operated mixer, except, if authorized, you may mix batches not exceeding 1/3 cubic yard by hand mixing methods, as specified herein.
- B. Do not use equipment with components made of aluminum or magnesium alloys that could have contact with plastic concrete during mixing, transporting, or pumping.

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- C. Concrete must be thoroughly mixed, homogeneous, and free of lumps or evidence of undispersed cementitious material.
- D. Equipment used in the manufacture of concrete shall be kept clean at all times.
- E. Hand Mixing:
1. Hand-mixed concrete must be made in batches of 1/3 cubic yard or less.
 2. Use the following procedure to make hand-mixed concrete:
 - a. Measure the quantity of coarse aggregate in measuring boxes.
 - b. Spread the coarse aggregate on a watertight, level platform.
 - c. Spread the fine aggregate on the layer of coarse aggregate. The total depth of the two layers must be one foot or less.
 - d. Spread the dry cementitious materials on the aggregates.
 - e. Turn the whole dry mass at least two times.
 - f. Add and evenly distribute the water.
 - g. Turn the whole mass at least three more times, not including placement in the carriers or forms.
- F. Machine Mixing:
1. Concrete mixers must be the revolving drum or revolving blade type. Operate the mixing drum or blades uniformly at the mixing speed recommended by the manufacturer. Do not use a mixer or agitator that has an accumulation of hard concrete or mortar.
 2. Mixers must be equipped with automatic device for recording number of revolutions of drum or blades prior to completion of mixing operation.
 3. Immediately before placing the concrete, the temperature of the mixed concrete must be from 50 to 90 degrees Fahrenheit. Cool or heat the aggregates and mixing water as necessary to produce concrete within these temperature limits. Do not heat the aggregates or water above 150 degrees Fahrenheit. Any ice used to cool the concrete must be melted before the concrete is discharged from the mixer.
 4. Charge the batch into the mixer such that some water enters before the cementitious materials and aggregates. Add all the water to the drum by the end of the first 1/4 of the specified mixing time. If the concrete is delivered in a truck mixer, you may withhold a portion of the mixing water and, if authorized, add it at the delivery point as specified in Article 2.06F, "Transporting Mixed Concrete," herein.
 5. Batch and charge the cementitious materials into the mixer by means that will not cause:
 - a. Loss of cementitious materials due to the effect of wind
 - b. Accumulation of cementitious materials on the surfaces of conveyors or hoppers
 - c. Other conditions that reduce or vary the required quantity of cementitious material in the concrete mixture
 6. Operate stationary mixers with an automatic timing device. The timing device and discharge mechanism must be interlocked such that during normal operation no part of the batch is discharged before the specified mixing time has elapsed.
 7. The total time from the intermingling of damp aggregates and all cementitious materials to the start of mixing must not exceed 30 minutes.
 8. The batch size must not exceed the manufacturer's guaranteed capacity.
 9. For pavement or base concrete, install and maintain suitable batch counters in good operating condition at Worksite batching plants and stationary mixers. The batch counters must indicate the exact number of batches proportioned and mixed.

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10. Mix and deliver the concrete to the Worksite by one of the following methods:
 - a. Central-mixed concrete, in which the concrete is mixed completely in a stationary mixer and transported to the delivery point in a truck agitator or nonagitating hauling equipment.
 - b. Shrink-mixed concrete, in which the concrete is mixed partially in a stationary mixer and the mixing is completed in a truck mixer.
 - c. Transit-mixed concrete, in which the concrete is mixed completely in a truck mixer.
11. Agitators must be truck mixers operating at agitation speed or truck agitators. Each mixer and agitator must have a metal plate attached in a prominent place that clearly shows:
 - a. Various uses for which the equipment is designed
 - b. Manufacturer's guaranteed drum or container capacity in terms of the volume of mixed concrete
 - c. Rotation speed of the mixing drum or blades
12. Truck mixers must have an electrically or mechanically actuated revolution counter that readily allows verification of the number of revolutions of the drum or blades.
13. For shrink-mixed concrete, transfer concrete that has been partially mixed at a central plant into a truck mixer and comply with the specifications for transit-mixed concrete. Partial mixing in a central plant does not count toward the number of revolutions at mixing speed.
14. The equipment for supplying water to the mixer must accurately measure to within 1.5 percent of the quantity of water required to be added to the mix for any position of the mixer.
15. The tanks used to measure the water must be designed such that water cannot enter while water is being discharged into the mixer. The water must be discharged into the mixer rapidly in one operation without dribbling.
16. Arrange the equipment to allow checking of the quantity of water delivered by discharging into measured containers.

G. Transporting Mixed Concrete:

1. You must transport mixed concrete to the delivery point in one of the following:
 - a. Truck agitator operating at the manufacturer's designated agitating speed if it:
 - 1) Does not carry more than the manufacturer's guaranteed capacity
 - 2) Maintains the mixed concrete in a thoroughly mixed and uniform mass during hauling
 - b. Truck mixer operating at the manufacturer's designated agitating speed
 - c. Nonagitating hauling equipment with a body that does not allow leakage of any part of the concrete mix at any time
2. When discharged at the delivery point, the consistency and workability of the mixed concrete must be suitable for adequate placement and consolidation in place and the mixed concrete must comply with the requirements for uniformity specified herein.
3. Protect concrete hauled in open-top vehicles from rain or from exposure to the sun for more than 20 minutes if the ambient temperature exceeds 75 degrees Fahrenheit.
4. Do not add water to the concrete in excess of that in the authorized mix design. At the delivery point, you may add water withheld during batching if authorized. Add the water in one operation before the discharge of more than 1/4 cubic yard. The equipment for supplying the water must comply with the requirements specified in Article 2.06, "Machine Mixing."

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herein. After adding the water, revolve the drum at least 30 revolutions at mixing speed before discharging the concrete.

5. Control the rate of discharge of mixed concrete from a truck mixer or agitator by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.
6. If you use a truck mixer or agitator to transport the concrete to the delivery point, comply with the following limits:
 - a. Complete the discharge within 1.5 hours or before 250 revolutions of the drum or blades, whichever occurs first, after introducing the cementitious materials to the aggregates.
 - b. Under conditions contributing to quick stiffening of the concrete, or if the concrete temperature is 85 degrees Fahrenheit or above, the time allowed may be less than 1.5 hours.
 - c. If you use an admixture to retard the set time:
 - 1) Concrete temperature must not exceed 85 degrees Fahrenheit
 - 2) Time limit is two hours
 - 3) Revolution limit is 300
7. If you use non-agitating hauling equipment to transport the concrete to the delivery point:
 - a. Complete the discharge within one hour after introducing the cementitious materials to the aggregates
 - b. Under conditions contributing to quick stiffening of the concrete, or if the concrete temperature is 85 degrees Fahrenheit or above, complete the discharge within 45 minutes after introducing the cementitious materials to the aggregates
8. If you add a high-range water-reducing admixture to the concrete at the Worksite, the total number of revolutions must not exceed 300.

H. Time or Quantity of Mixing:

1. Mixing of the concrete in a stationary mixer must continue for the required mixing time after all ingredients, except water and admixture that is added with the water, are in the mixing compartment of the mixer before any part of the batch is released. The transfer time in multiple drum mixers must not be counted as part of the required mixing time.
2. For concrete used in concrete structures other than minor structures, the mixing time in a stationary mixer must be at least 90 seconds and no more than five minutes, except that if authorized the minimum mixing time may be reduced to 50 seconds. For all other concrete, the mixing time must be at least 50 seconds and no more than five minutes.
3. The minimum required revolutions at the mixing speed for transit-mixed concrete must be at least that recommended by the mixer manufacturer and must be enough to produce uniform concrete, as specified herein.

I. Minor Concrete:

1. Store, proportion, mix, transport, and discharge the cementitious material, water, aggregate, and admixtures in compliance with recognized standards of good practice that result in thoroughly and uniformly mixed concrete suitable for the intended use. Recognized standards of good practice are outlined in various industry publications, such as those issued by ACI, AASHTO, or Caltrans.

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2. Use a quantity of water that produces concrete with a consistency that complies with Article 2.03P, "Quantity of Water and Slump," herein. Do not add water during hauling or after arrival at the delivery point unless allowed by the Engineer.
3. Discharge ready-mixed concrete from the transport vehicle while the concrete is still plastic and before stiffening occurs. Take whatever action is necessary to eliminate quick stiffening, except do not add water.
4. Conditions contributing to quick stiffening are:
 - a. Elapsed time of 1.5 hours in agitating hauling equipment or one hour in non-agitating hauling equipment
 - b. More than 250 revolutions of the drum or blades after introduction of the cementitious material to the aggregates
 - c. Concrete temperature over 90 degrees Fahrenheit
5. The mixing time in a stationary mixer must be at least 50 seconds and no more than 5 minutes.
6. The minimum required revolutions at mixing speed for transit-mixed concrete must be at least that recommended by the mixer manufacturer and must be increased as needed to produce thoroughly and uniformly mixed concrete.
7. If you add a high-range water-reducing admixture to the concrete at the Worksite, the total revolutions must not exceed 300.
8. Maintain a concrete temperature of at least 40 degrees Fahrenheit for 72 hours after placing.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Inspection and Testing Services:

1. Acceptance of concrete mix designs will be by VTA.
2. The Independent Testing Agency will perform visual inspections and observe concrete batching, mixing, and placing operations, and the Contractor must keep records of all concrete placed. Copies of such records must be submitted to VTA for record purposes.
3. Testing services for the Contractor's quality control program, including concrete strength tests, must be provided by the Independent Testing Agency at an independent testing laboratory or agency, employed by the Contractor and approved by VTA, and must be performed in accordance with the applicable requirements of ACI 301. If, as a result of these tests, it is determined that the specified concrete properties are not being obtained, VTA will order such changes in proportions or materials, or both, as may be necessary to secure the specified properties.
 - a. Field tests must be performed by personnel having ACI Level 1 Field Technician Certification.
4. Failure of VTA or the Independent Testing Agency to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.
5. Additional inspection and testing services required by the Independent Testing Agency because of changes in materials, sources, or proportions; or occasioned by failure of inspections and tests to meet specification requirements, must be paid for by the Contractor.
6. Provide materials, labor, and services for sampling and testing of concrete, including the following facilities and services:

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- a. Preparation, handling, storage, and delivery of concrete test specimens.
 - b. Suitable containers for the storage, curing, and delivery of concrete test specimens in accordance with ASTM C31/C31M and ASTM C470/C470M.
 - c. Suitable storage for a supply of test cylinder molds, test specimens to be cured at the Worksite, and other items required for sampling and testing.
7. A minimum of 48 hours notice must be given to VTA by the Contractor prior to placing any concrete. Failure to provide at least 48 hours notice may result in VTA rejecting the placement. Said notice must include the date and time of the scheduled placement.

B. Methods of Sampling and Testing:

1. **Sampling:** Representative composite samples must be taken by the Independent Testing Agency in accordance with ASTM C172/C172M. Each sample must be obtained from a different batch of concrete on a random basis.
2. **Slump Tests:** The Independent Testing Agency must perform slump tests of concrete during placing of concrete at the point of truck discharge, as required, in accordance with ASTM C143/C143M. At least one test must be performed at the delivery trucks for each 50 cubic yards of concrete delivered. A minimum of two tests must be performed each day.
 - a. Consistency of fresh concrete must be tested in accordance with ASTM C143/C143M when test cylinders are taken and when consistency or uniformity is questionable, as determined by the Independent Testing Agency or VTA.
3. **Tests for Concrete Uniformity:**
 - a. The Independent Testing Agency must determine the uniformity of concrete mixtures based on differences in test results between two test samples of mixed concrete from the same batch for the following tests:
 - 1) California Test 533 if the mix design specifies a penetration value
 - 2) ASTM C143/C143M if the mix design specifies a slump value
 - 3) California Test 529
 - b. Each batch of concrete must be tested as specified herein.
 - c. When tested for uniformity, the differences in test results between the two concrete test samples must comply with the following:
 - 1) When tested under California Test 533, the difference in penetration values must not exceed 1/2 inch.
 - 2) When tested under ASTM C143/C143M, the difference in slump values must not exceed the values shown in the following table:

Average slump, S (in)	Maximum permissible difference (in)
$S < 4$	1
$4 \leq S \leq 6$	1-1/2
$6 < S \leq 9$	2

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- 3) When tested under California Test 529, the difference in the proportion of coarse aggregate must not exceed 170 pounds of aggregate per cubic yard of concrete.
4. Tests for Concrete Temperature: Freshly mixed concrete must be tested by the Independent Testing Agency in accordance with California Test 557 at the following minimum testing frequencies. Refer to Article 1.09 herein for hot and cold weather remedial requirements.
 - a. Hourly when the ambient temperature is below 40 degrees Fahrenheit or above 80 degrees Fahrenheit.
 - b. Each time compression test cylinders are made. The concrete temperature must be recorded on all compression test cylinders made.
 - c. At least one test must be performed for each 100 cubic yards of concrete delivered.
 - d. A minimum of one test must be performed each day of casting.
5. Strength Tests:
 - a. The Independent Testing Agency must prepare, cast, and deliver to the same independent testing laboratory, cylinders for laboratory-cured compression test samples. Cylinders must be made and cured in accordance with ASTM C31/C31M. Cylinders must be tested in accordance with California Test 521.
 - b. The minimum number of test cylinders to be made for each class of concrete and for each placement must be four cylinders for each 100 cubic yards or fraction thereof. When additional sets of test cylinders are required beyond the normal seven and 28-day tests, each set must consist of a minimum of two test cylinders.
 - c. All cylinders in a set must be marked with a unique number on one end. The Contractor must record this number on the record of concrete placed. All cylinders must be cured by the Independent Testing Agency.
 - d. From each set of cylinders cast, one cylinder must be tested at seven days and two cylinders at 28 days in accordance with California Test 521. If the 28-day tests are satisfactory, the fourth cylinder must be discarded.
 - 1) If a cylinder shows evidence of improper sampling, molding, or testing, the cylinder is discarded and the test must consist of the compressive strength of the remaining cylinder.
 - e. In the event the 28-day tests are below the specified strength requirements, the Independent Testing Agency must then test the fourth cylinder at 42 days.
 - f. For concrete with a compressive strength greater than or equal to 3,500 pounds per square inch, 42 days are allowed to attain the strength described, when approved by VTA.
 - g. Where 56 days are allowed to attain the strength of concrete, as specified herein, test for the compressive strength at least once every 500 cubic yards at 28, 42, and 56 days.
6. Test for Unit Weight, Volume, and Cementitious Material Content: The Independent Testing Agency must verify compliance with the specified cementitious material content by testing for unit weight and cement content in accordance with California Test 518. For testing purposes, supplementary cementitious material is considered to be cement. Adjust the batch proportions as necessary to produce concrete having the specified cementitious material content. At least one test must be performed at the delivery trucks for each 100 cubic yards of concrete delivered. A minimum of one test must be performed each day.

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7. Test for Air Content: If concrete is air entrained, the Independent Testing Agency must verify compliance with the specified air content by testing under California Test 504, except test in accordance with ASTM C173/C173M for lightweight concrete.
 - a. At least one test must be performed at the delivery trucks for each 100 cubic yards of concrete delivered.
 - b. A minimum of one test must be performed for every four hours of production and when test specimens are fabricated.
8. Tests for Contractor's Benefit: Tests required verifying early form removal, or other reasons for the Contractor's benefit, must be performed at Contractor's expense as part of the Contractor's quality control program.
9. In addition to the inspection and testing requirements specified above, the Independent Testing Agency must perform the following inspections and tests:
 - a. Weight and Batch Tickets:
 - 1) Weight and batch tickets must be taken at the Worksite for each load of ready-mixed concrete.
 - 2) Review weight and batch tickets at the time of delivery and compare the actual batched weights against the reviewed mix designs for conformance. The difference between actual and batched weights, including total water, must not exceed one percent.
 - b. Aggregates: Sample and test aggregates from the batch plant in accordance with the provisions of Article 2.02 herein.
 - c. Unit Weight of Lightweight Concrete: Unit weight of lightweight concrete must be tested in accordance with California Test 518 when test cylinders are taken and a minimum of once every four hours. The unit weight of the fresh concrete must not vary from the weight shown in the test report by more than 4 pounds per cubic foot.
 - d. Provide continuous inspection at the time fresh concrete is sampled to perform slump and air content tests and take cylinders.
 - e. Refer to Section 03 30 00, Cast-in-Place Concrete, for additional cast-in-place concrete quality control inspection and testing requirements.

C. Evaluation and Acceptance of Tests:

1. Acceptance of Concrete: The strength of the concrete must be considered satisfactory, provided the averages of all sets of three consecutive strength test results equal or exceed the specified 28-day compressive strength, and no individual strength test result falls below the specified 28-day compressive strength by more than 500 pounds per square inch.
2. Adjustments: The Independent Testing Agency must order adjustments to the mix proportions, increase in the minimum cement content, additional curing of the structure, or any combination of the above when strength tests acceptance criteria specified are not being met.
 - a. If a single compressive strength test result is below the strength described at the maximum age specified or allowed, or if the compressive strength of concrete tested at seven days indicates to the Independent Testing Agency that the concrete will not attain the strength described at the maximum age specified or allowed, correct the mix design or concrete fabrication procedures and obtain authorization from VTA before you place additional concrete.

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3. Test Cores:
- a. When laboratory test results indicate concrete to be more than 300 pounds per square inch below the specified strength, or if there is a likelihood of low strength concrete, a significant reduction in load-carrying capacity, or absence of desired durability in the concrete, VTA will require tests of cores to be drilled from the areas in question.
 - b. Test cores must be obtained from each member or area of suspect strength, from locations designated by VTA, and test specimens must be prepared by the Contractor in accordance with ASTM C42/C42M.
 - c. Three cores must be taken for each determination of in-place strength. Concrete in the area represented by the core tests will be considered structurally adequate if the average of the three cores is equal to at least 85 percent of the specified design strength and no single core is less than 75 percent of the design strength. Locations represented by erratic core strengths must be retested at the direction of VTA.
 - d. Fill core holes in accordance with the requirements of Section 03 35 00, Concrete Finishing, for repair of surface defects.
 - e. Preparation and testing of cores must be performed by the Independent Testing Agency as part of the Contractor's quality control program.
4. Rejection of Concrete; Repair and Replacement:
- a. VTA has authority to reject concrete work which does not meet specification requirements, and to require repair or replacement as necessary to complete the Work.
 - b. For all concrete except minor concrete, if the cementitious material, portland cement, or supplementary cementitious material content is less than the minimum required, you must remove the concrete.
 - c. If any of the quality control concrete test results fail to comply with the specified requirements, the batch of concrete must not be incorporated in the work. Notify the Engineer. Repeat the quality control concrete tests on each subsequent batch until the test results comply with the specified requirements.
 - d. If three consecutive batches fail to comply with the specified requirements, comply with all of the following:
 - 1) Revise concrete operations as necessary to bring the concrete into compliance.
 - 2) Increase the frequency of quality control testing.
 - 3) The revisions must be authorized before resuming production. After production resumes, you must receive authorization from the VTA before returning to the quality control testing frequency authorized in the Concrete Quality Control Plan.
- D. Acceptance of Structure: Acceptance of the completed concrete work requires conformance with the dimensional tolerances, appearance, and strengths specified in these Technical Specifications, in ACI 301, and in ACI 117.

END OF SECTION 03 05 15

SECTION 03 05 18

PRESTRESSED CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
 - 1. Prestressing tendons
 - 2. Prestressing anchors
 - 3. Prestressing coatings, sheathing, couplings, sleeves and gaskets

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 05 15, Portland Cement Concrete
- D. Section 03 11 00, Concrete Formwork
- E. Section 03 20 00, Concrete Reinforcing
- F. Section 03 30 00, Cast-in-Place Concrete
- G. Section 03 41 00, Structural Precast Concrete
- H. Section 03 62 00, Non-Shrink Grouting
- I. Section 09 96 23, Graffiti-Resistant Coatings
- J. Section 31 62 00, Driven Piles
- K. Section 31 63 29, Drilled Concrete Piers and Shafts

1.03 REFERENCED STANDARDS

- A. American Concrete Institute (ACI):
 - 1. ACI 315 Details and Detailing of Concrete Reinforcement
 - 2. ACI 318 Building Code Requirements for Structural Concrete and Commentary
- B. ASTM International (ASTM):

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1. ASTM A882/A882M Standard Specification for Seamless Cold-Drawn Carbon Steel Tubing for Hydraulic System Service
 2. ASTM C416/C416M Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
 3. ASTM C1107/C1107M Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- C. Post Tensioning Institute (PTI):
1. Post-Tensioning Manual
 2. Guide Specification for Post-Tensioning Materials
- D. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:
1. Section 50 Prestressing Concrete
- E. State of California, Department of Transportation (Caltrans):
1. California Test 541 Method for Flow of Grout Mixtures (Flow Cone Method)

1.04 SUBMITTALS

A. General:

1. Submittals for prestressed concrete must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.

B. Shop Drawings and Calculations:

1. Submit drawings and design calculations, prepared by an engineer licensed in the State of California in accordance with the requirements of Caltrans Standard Specifications, Section 50, Prestressing Concrete, and these Technical Specifications.
2. Shop Drawings and calculations must be designed, detailed, stamped, and signed by an engineer who is currently registered as a civil engineer in the State of California.
3. The Shop Drawings must show complete details and substantiating calculations of the method and materials proposed for use in the prestressing activities, including the addition or rearrangement of reinforcing steel.
 - a. The details must outline the method and sequence of stressing and must include the following:
 - 1) Complete specifications and details of the prestressing steel and anchorage system
 - 2) Working stresses
 - 3) Jacking stresses
 - 4) Type of ducts
 - 5) Proposed arrangement of the prestressing steel in the members
 - 6) Elongation calculations
 - 7) All other data pertaining to the prestressing operations
 - 8) The details must also include the exact location of anchorage system components, ducts, and other related elements. Show duct location data, including elevations, at least every 1/8th point of the span for each span.

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4. Each Shop Drawing submittal must consist of drawings for a single bridge frame. Each bridge frame must have a separate Shop Drawing submittal.
 5. Include a grouting plan with the Shop Drawing submittal.
 6. VTA must be allowed 6 weeks to review the complete shop drawings and calculations submittal.
 7. Shop Drawings and calculations must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.
- C. Product Data:
1. Manufacturer's catalog sheets including instructions for use and description of application must be provided on each of the following items intended for use on project:
 - a. Anchorage devices
 - b. Prestressing ducts
 - c. Mechanical couplers
 - d. Strand coating
 - e. Strand sheathing
 2. VTA must be allowed two weeks to review the complete product data submittal.
- D. Certifications: Submit the certifications specified in ASTM A416/A416M to VTA.
1. Include with each certification a representative load-elongation curve for each size and grade of strand.
 2. Include with each certification a copy of the quality control tests performed by the manufacturer.
 3. Include a certificate from the manufacturer stating the minimum guaranteed ultimate tensile strength of uncoated prestressing strand to be used in the work.
- E. Mill Certificates:
1. Contractor must provide Mill Certificates for each heat of prestressing steel to be used on project.
 2. Mill Certificates must include name of mill, date of rolling, date of shipping, minimum tensile strength and percent of elongation.
 3. Mill Certificates must be provided with each lot of material shipped to the Worksite and must be signed by Contractor which will serve to certify that all prestressing materials installed comply with specified requirements.
 4. When Mill Certificates cannot be provided, Contractor must hire an independent professional testing laboratory to verify compliance and provide laboratory test reports. The cost of testing must be paid for by Contractor.
- F. Laboratory Test Reports:
1. Laboratory test reports must show the name of the Independent Testing Agency, date of testing, types of tests performed and must be signed by a principal of the testing agency who is currently registered as a civil engineer in the State of California.

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2. When required by other portions of these Technical Specifications, laboratory test reports must be submitted for each heat of prestressing strand or anchorage devices tested to show compliance with appropriate ASTM Standards and these Technical Specifications.
 3. VTA must be allowed 2 weeks to review the complete product data submittal.
- G. Grout Mix Design:
1. Grout mix design submittal must include the following:
 - a. Mix design, including water to cement ratio, mix proportions, and admixture proportions.
 - b. Mix design strength test data, and shrinkage test data and alkali reactivity test data.
 - c. Cement source and certificate of compliance.
 - d. Product data and certificates of compliance for proposed admixtures.
 - e. Water quality certificate of compliance
 - f. Mix designs must indicate location of each mix within the structure.
 2. VTA must be allowed two weeks to review the grout mix design.
- H. Grouting Plan:
1. The grouting plan must include the following items:
 - a. Detailed grouting procedures
 - b. Type, quantity, and brand of materials to be used
 - c. Type of equipment to be used and provisions for backup equipment
 - d. Types and locations of grout inlets, outlets, and vents
 - e. Methods to clean ducts before grouting
 - f. Methods to control the rate of flow within ducts
 - g. Theoretical grout volume calculations for each duct
 - h. Duct repair procedures for an air pressure test failure
 - i. Mixing and pumping procedures
 - j. Direction of grouting
 - k. Sequence of use of inlets and outlets
 - l. Procedure for handling blockages
 - m. Forms for recording grouting information
 - n. Procedure for secondary grouting
 - o. Names of people who will perform grouting activities and their relevant experience and certifications
- I. Prestressing Contractor Qualifications:
1. Contractor must provide qualifications of all personnel placing and tensioning the prestressing steel.
- J. Daily Grouting Report:
1. Submit a daily grouting report for each day grouting is performed. Submit the report within 3 business days after grouting. The report must be signed by the technician supervising the grouting activity. The report must include the following items:
 - a. Identification of each tendon
 - b. Date the grouting occurred

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- c. Time the grouting started and ended
- d. Date of placing the prestressing steel in each duct
- e. Date of stressing
- f. Type of grout used
- g. Injection end and applied grouting pressure
- h. Actual and theoretical quantities of grout used to fill each duct
- i. Ratio of actual to theoretical grout quantity
- j. Records of air, grout, and structure surface temperatures during grouting
- k. Summary of tests performed and the results
- l. Names of personnel performing the grouting activity
- m. Summary of problems encountered and corrective actions taken
- n. Summary of void investigation and repairs made

K. Jack Calibration Charts:

- 1. Submit the post-tensioning jack calibration plot.
- 2. For any pretensioning jack calibrated by an authorized laboratory, submit a certified calibration plot.

1.05 QUALITY CONTROL

A. Codes and Standards: Comply with all applicable Federal, State and local code and safety regulations. In addition, comply with the provisions of ACI 315, ACI 318, and PTI Post-Tensioning Manual, except where more stringent requirements are shown or specified.

B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.

C. Contractor Quality Control:

- 1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
- 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
- 3. For accurate identification, assign an individual lot number and tag each lot of the following items to be shipped to the Worksite or casting site:

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- a. Strand from each reel or pack
 - b. Anchorage assemblies
4. Remove all unidentified prestressing steel and anchorage assemblies received at the Worksite or casting site.
- D. Engineer Quality Assurance:
1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.
 3. All materials and work must be subject to inspection at the mill, the fabricating shop, and at the Worksite. Material or workmanship not complying fully with the plans or these Technical Specifications will be rejected.
- E. Personnel Qualifications:
1. Placing and tensioning of prestressing steel must be done under the immediate control of a person with a minimum of three years of experience in this type of work.
 2. Perform post-tensioning field activities, including grouting, under the direct supervision of a technician certified as a Level 2 Bonded PT Field Specialist through the Post-Tensioning Institute. Grouting activities may be performed under the direct supervision of a technician certified as a Grouting Technician through the American Segmental Bridge Institute.
 3. Perform vacuum grouting under the direct supervision of a person who has been trained and has experience in the use of vacuum grouting equipment and procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. All prestressing steel must be protected against physical damage and rust or other results of corrosion at all times from manufacturer to encasing in concrete. Prestressing steel that has sustained physical damage at any time must be rejected.
- B. Prestressing steel must be packaged in containers or shipping forms for the protection of the steel against physical damage during shipping and storage.

1.07 MEASUREMENT AND PAYMENT

- A. Measurement:
1. Prestressing Cast-In-Place Concrete must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment:
1. The lump sum payment for Prestressing Cast-In-Place Concrete must include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all Work involved in constructing Prestressing Cast-In-Place Concrete complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.

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- C. Full compensation for prestressing precast concrete girders must be considered as included in the bid item for Furnish Precast Prestressed Concrete Girder (CA WF72PT) and no additional compensation will be allowed therefor.
- D. Full compensation for prestressing precast concrete piles must be considered as included in the bid item for Furnish Precast Prestressed Concrete Piling of the various sizes listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Post-tensioning prestressing systems must be on the Caltrans Authorized Material List for post-tensioning systems.
- B. Prestressing Steel:
 - 1. Uncoated strand must comply with ASTM A416/A416M, Grade 270.
 - 2. Protect the prestressing steel against physical damage and rust or other results of corrosion at all times, from manufacture to grouting or encasing in concrete.
 - 3. Package the prestressing steel in containers or shipping forms that protect the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor that prevents rust or other results of corrosion must be placed in the container or shipping form, must be incorporated in a corrosion-inhibitor-carrier-type packaging material, or must be applied directly to the steel if authorized by the VTA.
 - 4. Corrosion inhibitors must not have a deleterious effect on the steel, concrete, or bond strength of the steel to concrete.
 - 5. Clearly mark each shipping container or form with the following:
 - a. Statement that the package contains prestressing steel
 - b. Type of corrosion inhibitor used
 - c. Date packaged
 - 6. Immediately replace or restore any damaged container or shipping form to its original condition.
 - 7. Broken or damaged strands, and strands showing fabrication defects must be removed and replaced.
- C. Anchorage:
 - 1. All anchorages, couplings, and other appurtenances must meet the minimum requirements as set forth in the "Guide Specifications for Post-tensioning Materials," as prepared by the Post-tensioning Institute, and their size must be such that the bearing stress requirements of these same "Guide Specifications for Post-tensioning Materials" are satisfied.
 - 2. The anchorage system for post-tensioning must be capable of holding the prestressing steel at a force producing a stress of at least 95 percent of the specified ultimate tensile strength of the steel.
 - 3. The anchorage system for post-tensioning must permanently secure the ends of the prestressing steel.
 - 4. The anchorage system for post-tensioning must be equipped with permanent grout caps.
- D. Permanent Grout Caps:

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1. Permanent grout caps for anchorage systems of post-tensioned tendons must be glass-fiber-reinforced plastic with antioxidant additives. The environmental stress-cracking failure time must be at least 192 hours under ASTM D1693, condition C.
2. Permanent grout caps for anchorage systems of post-tensioned tendons must completely cover and seal the wedge plate or anchorage head and all exposed metal parts of the anchorage against the bearing plate using neoprene O-ring seals.
3. Permanent grout caps for anchorage systems of post-tensioned tendons must have a grout vent at the top of the cap.
4. Permanent grout caps for anchorage systems of post-tensioned tendons must be bolted to the anchorage with stainless steel fasteners complying with ASTM F593. All fastener components must be alloy 316.
5. Permanent grout caps for anchorage systems of post-tensioned tendons must be pressure rated at or above 150 pounds per square inch.

E. Strand Coating:

1. Strands must be coated with a rust preventative, lubricating grease and enclosed in a sheath that will permit the stressing of the tendons after the concrete has attained the proper strength.

F. Debonding Sheathing:

1. Sheathing for debonding prestressing strand must be split or un-split flexible polymer plastic tubing, must have a minimum wall thickness of 0.025 inch, and must have an inside diameter exceeding the maximum outside diameter of the strand by 0.025 to 0.14 inch.
2. Split sheathing must overlap at least 3/8 inch.
3. Waterproofing tape used to seal the ends of the sheathing must be flexible adhesive tape.
4. The sheathing and waterproof tape must not react with the concrete, coating, or steel.

G. Prestressing Ducts:

1. Duct enclosures for prestressing steel must be accurately placed at the locations on the plans or as approved by VTA.
2. Ducts for prestressing steel must be galvanized rigid ferrous metal.
3. Ducts for prestressing steel must be fabricated with either welded or interlocked seams except galvanizing of the welded seams is not required.
4. Ducts for prestressing steel must be mortar tight.
5. Ducts for prestressing steel must have sufficient strength to maintain their correct alignment during placing of concrete.
6. Ducts for prestressing steel must have positive metallic connections at joints between sections that do not result in angle changes at the joints.
7. Ducts for prestressing steel must have waterproof tape at the connections.
8. Ducts for prestressing steel must have bends that are not crimped or flattened.
9. Ducts for prestressing steel must have ferrous metal or polyolefin transition couplings connecting the ducts to anchorage system components. Ferrous metal transition couplings need not be galvanized.
10. Ducts for prestressing steel must have an inside cross-sectional area of at least 2.5 times the net area of the prestressing steel for multistrand tendons.
11. Ducts for prestressing steel must have an outside diameter not exceeding 50 percent of the girder web width.
12. Furnish all ducts or anchorage assemblies with pipes or other suitable connections for the injection of grout after prestressing.

H. Vents:

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1. Vent all ducts having a vertical duct profile change of six inches or more.
2. Vents must be at least 1/2-inch-diameter standard pipe or suitable plastic pipe.
3. Vents must be connected to ducts using metallic or plastic structural fasteners. Plastic components must not react with the concrete or enhance corrosion of the prestressing steel and be free from water soluble chlorides.
4. Vents must be mortar tight and taped as necessary.
5. Vents must provide a means for injection of grout through the vents and for sealing the vents.

I. Grout:

1. Grout must consist of portland cement and water and may contain an admixture if approved by VTA.
2. Portland cement must conform to the provisions in Section 03 05 15, Portland Cement Concrete.
3. Water must conform to the provisions in Section 03 05 15, Portland Cement Concrete.
4. The use of admixtures must conform to the provisions in Section 03 05 15, Portland Cement Concrete, except that the admixtures must not contain chloride ions in excess of 0.25 percent by weight.
5. The efflux time of grout immediately after mixing must be at least 11 seconds. Determine the efflux time under California Test 541.
6. Secondary grout must comply with ASTM C1107/C1107M and must not have a deleterious effect on the steel, concrete, or bond strength of the steel to the concrete.

- J. Organic Zinc-Rich Primer: Organic zinc-rich primer must be on the Caltrans Authorized Material List for organic zinc rich primer.

2.02 EQUIPMENT AND CALIBRATION

- A. Each jack body must be permanently marked with the ram area.
- B. Each pressure gauge must be fully functional and have an accurately reading, clearly visible dial or display. The dial must be at least six inches in diameter and graduated in 100 pounds per square inch increments or less.
- C. Each load cell must be calibrated and have an indicator that can be used to determine the force in the prestressing steel.
- D. The range of each load cell must be such that the lower ten percent of the manufacturer's rated capacity is not used in determining the jacking force.
- E. Each jack must be calibrated equipped with its gauges.
- F. Mechanically calibrate the gauges with a dead weight tester or other authorized means before calibration of the jacking equipment.
- G. Post-tensioning:
1. Equip each hydraulic jack used to tension prestressing steel with two pressure gauges or one pressure gauge and a load cell. Only one pressure gauge must be connected to the jack during stressing.
 2. Each jack used to tension prestressing steel permanently anchored at 25 percent or more of its specified minimum ultimate tensile strength must be calibrated by a testing laboratory approved by the Engineer within 180 days of use and after each repair. You must:

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- a. Schedule the calibration of the jacking equipment.
 - b. Verify that the jack and supporting systems are complete, with proper components, and are in good operating condition.
 - c. Provide labor, equipment, and material to install and support the jacking and calibration equipment, and to remove the equipment after the calibration is complete.
 - d. Plot the calibration results.
3. Each jack used to tension prestressing steel permanently anchored at less than 25 percent of its specified minimum ultimate tensile strength must be calibrated by a testing laboratory approved by the Engineer within 180 days of use and after each repair.
- H. Pretensioning:
1. Each jack used to pretension prestressing steel must be calibrated, equipped with its gauges, by a laboratory on the Caltrans Authorized Laboratories List to perform pretensioning calibrations within one year of use and after each repair.
 2. Pretensioning Jack Calibration:
 - a. Calibrate pretensioning jacks in accordance with ASTM E4 using an authorized laboratory. Certification that the calibration is performed to ASTM accuracy is not required.
 - b. Calibrate pretensioning jacks in the presence of the Engineer. Notify the Engineer at least two business days before calibrating the jack.
 - c. Calibrate pretensioning jacks using three test cycles. Average the forces from each test cycle at each increment.
 - d. Calibrate pretensioning jacks to cover the load range used in the work.
 3. Gauges for pretensioning jacks may have a dial less than six inches in diameter or be electronic pressure indicators that display either of the following:
 - a. Pressure in 100 pounds per square inch increments or less
 - b. Load to one percent of the maximum sensor/indicator capacity or two percent of the maximum load applied, whichever is smaller
 4. Gauges displaying pressure must have been calibrated within one year of the jack calibration.
 5. Each hydraulic jack used for pretensioning must be equipped with either two gauges or one gauge and a load cell or you must have a calibrated standby jack with its gauge present on site during stressing.
- I. Pressure Testing Ducts:
1. For post-tensioned concrete bridges, pressure test each duct with compressed air after stressing. Pressure test the ducts in accordance with the following procedure:
 - a. Seal all inlets, outlets, and grout caps.
 - b. Open all inlets and outlets on adjacent ducts.
 - c. Attach an air compressor to an inlet at one end of the duct. The attachment must include a valve that separates the duct from the air source.
 - d. Attach a pressure gauge to the inlet at the end of the duct.
 - e. Pressurize the duct to 50 pounds per square inch.
 - f. Lock-off the air source.
 - g. Record the pressure loss after one minute.

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- h. Repair the leaks with authorized methods and retest if a pressure loss exceeds 25 pounds per square inch.
 - 2. Compressed air used to clear and test the ducts must be clean, dry, and free from oil or contaminants.
- J. Duct Demonstrations for Post-Tensioned Members:
 - 1. Before placing forms for deck slabs of box girder bridges, demonstrate that any prestressing steel placed in the ducts is free and unbonded. If no prestressing steel is in the ducts, demonstrate that the ducts are unobstructed.
 - 2. If prestressing steel is installed after the concrete is placed, demonstrate that the ducts are free of water and debris immediately before installing the steel.
 - 3. Before post-tensioning any member, demonstrate that the prestressing steel is free and unbonded in the duct.
 - 4. Demonstrations must be performed in the presence of the Engineer.

2.03 SOURCE QUALITY CONTROL

- A. The Independent Testing Agency must randomly sample the following materials to be used in the work in the presence of the Engineer. Sampling must conform to the requirements of ASTM A416/A416M.
 - 1. One four-foot-long sample from each reel or pack of uncoated strand
 - 2. One anchorage assembly from each lot of anchorage assemblies
- B. The Independent Testing Agency must test the samples for conformance with ASTM A416/A416M, Grade 270.
 - 1. Prestressing steel that sustains physical damage must be rejected.
- C. Obtain VTA's authorization of the uncoated strand before incorporating it into the work.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation and execution of prestressing concrete must conform to Section 50, Prestressing Concrete, of the Caltrans Standard Specifications and these Technical Specifications.
 - 1. Refer to Section 50-1.03B(2), Post-Tensioned Members, of the Caltrans Standard Specifications for post-tensioning concrete members.
 - 2. Refer to Section 50-1.03B(3), Pretensioned Members, of the Caltrans Standard Specifications for pretensioning concrete members.
- B. Coordinate work with all trades so as not to interfere with the work of other trades. Bring interferences between trades to the attention of the Engineer of Record and resolve before any concrete is placed.

3.02 FIELD QUALITY CONTROL

- A. The Independent Testing Agency must sample and test grout in accordance with California Test 541. The efflux time of a grout sample immediately after mixing must not be less than 11 seconds.

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- B. The Independent Testing Agency must continuously inspect all prestressing strand placement and stressing operations, and provide prestressing inspection reports.
- C. The Independent Testing Agency must continuously inspect all grout placement operations and provide grouting inspection reports.
- D. Prestressing steel is rejected if surface rust either cannot be removed by hand-cleaning with a fine steel wool pad or leaves pits visible to the unaided eye after hand-cleaning.
 - 1. If prestressing steel is installed in the ducts of post-tensioned members after completion of concrete curing and if tensioning and grouting are completed within 10 days after the installation, then rust that may form during this period is not cause for rejection of the steel and the use of a corrosion inhibitor in the duct is not required after installation.
- E. Void Investigation: In the presence of the Engineer, investigate the ducts for voids between 24 and 72 hours after grouting. As a minimum, inspect the inlet and outlet ports at the anchorages and at high points in the tendons for voids after removal of the inlet and outlet pipes. Completely fill any voids found with secondary grout.

END OF SECTION 03 05 18

SECTION 03 11 00
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Layout of formwork.
 2. Formwork construction.
 3. Embedded items and openings in concrete.
 4. Form release materials.
 5. Removal of forms.
 6. Field quality control.
 7. Detection of movement.
 8. Re-use of forms.

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 11 14, Falsework
- D. Section 03 11 16, Architectural Cast-in-Place Concrete Forming
- E. Section 03 15 13, Waterstops
- F. Section 03 35 00, Concrete Finishing
- G. Section 03 30 00, Cast-in-Place Concrete
- H. Section 03 53 00, Concrete Topping

1.03 REFERENCED STANDARDS

- A. American Concrete Institute (ACI):

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1. ACI 117 Standard Specifications for Tolerances for Concrete Construction and Materials
 2. ACI 301 Standard Specifications for Structural Concrete
 3. ACI 318 Building Code Requirements for Structural Concrete
 4. ACI 347 Formwork for Concrete
- B. American Plywood Association (APA):
1. U.S. Product Standard PS 1 for Construction and Industrial Plywood
- C. West Coast Lumber Inspection Bureau (WCLIB):
1. WCLIB No. 17 Standard Grading Rules
- D. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:
1. Section 51 Concrete Structures.
- E. State of California, Department of Transportation (Caltrans) Office of Structure Construction:
1. Falsework Manual

1.04 SUBMITTALS

- A. General: Submittals for concrete formwork must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications. For formwork submittals involving shoring or falsework, comply with requirements specified in Section 03 11 14, Falsework.
- B. Shop Drawings: Submit Shop Drawings that indicate and include the following details and requirements:
1. Forming system and method of erection with associated details, including size of members, bracing, jointing, special form joint or reveals, locations and pattern of form tie placement, and other items that affect the structural integrity of formwork or exposed concrete visually. Formwork over 12 feet in height or more than 12 feet above ground must be designed, detailed, and stamped by an engineer who is currently registered as a civil engineer in the State of California.
 2. Shoring, formwork over 12 feet in height, and formwork more than 12 feet above ground must be accompanied by design calculations. Include reshoring procedures. Both drawings and calculations must be signed by an engineer who is currently registered as a civil engineer in the State of California. Coordinate with Section 03 11 14, Falsework.
 3. Locations of construction joints in plan and elevation views. Means of leakage prevention for concrete exposed to view in finished construction.
 4. Locations and sizes of conduits, openings, recesses, pipes, ducts, and other attached or embedded products.
 5. Beam intersections and other conditions where concrete casting by vertical drop may be restricted.
 6. Chamfer strips for corner treatment.
 7. Method and schedule for removing forms and shoring.
 8. Method for detecting formwork movement during concrete placement.
 9. Permanent Steel Deck Forms:

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- a. Submit three copies of Shop Drawings for permanent steel deck forms. Include in the submittal the following items:
 - 1) Layout plan
 - 2) Grade of steel
 - 3) Physical and section properties of members
 - 4) Method of support and grade adjustment
 - 5) Method for accommodating skew
 - 6) Methods of sealing against grout leaks

- C. Product Data: Submit manufacturers' product data for manufactured products. Include products proposed for leakage control.

- D. Samples: Submit form material, 12 inches by 12 inches or larger in size, for formed concrete which will be exposed in the finished work to public view. Such samples require approval of VTA before they may be used in the work.

1.05 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.

- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow the Engineer and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.

- C. Formwork Standards: Unless otherwise indicated, design, construct, erect, maintain, and remove forms and related structures for concrete work in accordance with applicable requirements of ACI 301, ACI 318, and ACI 347.
 - 1. Formliners: Formliners must be designed and constructed in accordance with requirements for architectural concrete in ACI 301 and as specified in Section 03 11 16, Architectural Cast-in-Place Concrete Forming.
 - 2. Deflection: Where dead and live loads on forms will be more than 20 percent greater than the weight of the concrete, provide framing lumber of required strength, and comply with ACI 301 and ACI 347 for design of framing members. Deflection must be kept within the herein specified tolerances.
 - 3. Concrete Mix Design: Design of formwork must be coordinated with the concrete mix design, as specified in Section 03 05 15, Portland Cement Concrete, so that form materials, form surfaces, and formwork strength will produce the desired concrete tolerances and finishes.

- D. Formwork Surface Materials: Provide material and work quality which will produce clean and uniform finished surfaces within the allowable tolerances specified and which will conform with the following requirements:
 - 1. Concrete Exposed to View: Provide material and work quality that will produce clean, smooth, and uniform concrete surfaces. Refer to Section 03 35 00, Concrete Finishing, and ACI 301 for requirements.
 - 2. Concrete Concealed from View: Provide material and work quality that will produce aligned concrete surfaces free of fins, honeycomb, and stains.

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- E. Special Formwork Sections: Provide openings, offsets, sinkages, keyways, recesses, moldings, rustication strips, chamfers, blocking, screeds, bulkheads, anchorages, embedded items, and other features. Select materials and provide workmanship that will ensure indicated finishes.
- F. Chamfered Corners: All external corners must be chamfered, unless otherwise indicated.
- G. Removal Features: Design formwork to be readily removable without impact, shock, and damage to concrete surfaces and adjacent materials.
- H. Tolerances for Formed Surfaces: For buildings and similar structures, comply with the requirements of ACI 301, as applicable. For those items of work or parts of the structure not covered by ACI 301, comply with the requirements of ACI 117, as applicable. Coordinate with the requirements specified in Section 03 30 00, Cast-In-Place Concrete.
1. The class of surface for offset between adjacent pieces of formwork facing material must be Class A for surfaces permanently exposed to public view and Class C for surfaces that will be permanently concealed, unless otherwise specified.
- I. Abrupt and Gradual Irregularities Tolerances for Formed Surfaces: In addition to the tolerance requirements of ACI 301, surfaces of buildings and similar structures permanently exposed to view must conform to the abrupt and gradual irregularities tolerances specified herein. Abrupt irregularities must be understood to mean offsets and fins resulting from displaced, mismatched, or misplaced forms, sheathing, or liners or from defects in forming materials are considered abrupt irregularities. Gradual irregularities must be understood to mean those resulting from warping and similar uniform variations from planeness or true curvature. Gradual irregularities must be checked with a straightedge for plane surfaces or a shaped template for curved or warped surfaces.
1. In measuring irregularities, the straightedge or template must be placed in various places on the surface in various directions. Permitted abrupt or gradual irregularities in formed surfaces as measured within a 5 foot length with a straightedge must be as follows:

Class of Surface	Maximum Abrupt or Gradual Irregularity
A	1/8 inch
B	1/4 inch
C	1/2 inch
D	1 inch

- J. VTA Quality Assurance:
1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.06 MEASUREMENT AND PAYMENT

- A. Full compensation for all work under this Section must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

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PART 2 - PRODUCTS

2.01 MATERIALS

- A. Lumber: Boards and framing lumber must be graded and grade-marked in accordance with WCLIB No. 17. Provide framing lumber of required strength, conforming with the above- specified WCLIB No. 17.
1. Boards: Provide all West Coast Species, "Construction" or "Standard" Boards. Use dressed side of lumber for surface in contact with the concrete, and provide boards with dressed or tongue-and-groove edges to provide tight joints to prevent mortar leakage.
 2. Deflection: Where dead and live loads on forms will be more than 20 percent greater than the weight of the concrete, provide framing lumber of required strength, and comply with ACI 301 and ACI 347 for design of framing members. Deflection must be kept within the herein specified tolerances.
 3. Framing Lumber:
 - a. Light Framing: Provide all West Coast Species, "Construction" or "Standard" Light Framing, dressed or rough. Where loads are not a factor, "Utility" Light Framing will be acceptable.
 - b. Joists and Planks: Provide all West Coast Species, "No. 2" Structural Joists and Planks, dressed or rough.
 - c. Beams and Stringers: Provide all West Coast Species, "Standard" Beams and Stringers or "No. 2 Structural" Beams and Stringers, dressed or rough.
- B. Plywood (Plyform): Plywood must be graded and grade-marked in accordance with U.S. Product Standard PS-1.
1. B-B Plyform: Provide Class I, EXT-APA, sanded, APA trademarked.
 2. B-C Plyform: Provide Class I, EXT-APA, APA trademarked.
 3. High Density Overlay (HDO) Plyform: Provide A-A, 60-60, Class I, EXT-APA, APA trademarked.
 4. Thickness: As required to maintain surface smoothness without deflection, but not thinner than 5/8 inch.
- C. Steel Forms:
1. Proprietary, patented, or fabricated steel forms, using standard or commercial quality, uncoated steel sheet or plate, 3/16-inch minimum thickness, for panel facings. Provide surfaces that will not impart corrosion residue to concrete. Include panel framing, reinforcement, and erection accessories.
 2. Permanent Steel Deck Forms: Permanent steel deck forms are only allowed where shown or for the deck slabs between precast prestressed concrete girders of Capitol Aerial Guideway.
 - a. Permanent steel deck forms and supports must comply with ASTM A653/A653M, Designation SS, Grades 33 through 80, coating designation G165.
 - b. Refer to Section 05 30 00, Metal Decking, for metal decking at Story Station Pedestrian Overcrossing, including the south median pedestrian overcrossing landing.
- D. Waffle Slab Forms: Steel or reinforced plastic dome forms for two-way joist construction, smooth surface, of sizes indicated.

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- E. Round Column Forms: Pressed or molded fiber-reinforced plastic or steel, manufactured round column forms, seamless or one-piece (one vertical seam), smooth surface, of sizes indicated.
 - 1. Provide forms with will not deflect under pressure of concrete placement, and which will not deflect or blow off under added pressure of placement of fly-ash-modified concrete.
- F. Formliners: Formliners must conform to the requirements in Section 03 11 16, Architectural Cast-in-Place Concrete Forming.
- G. Leakage Control Materials: Provide materials capable of producing flush, watertight, and nonabsorbent surfaces and joints, and compatible with forming material and concrete ingredients. Seal form edges with gasketing material or sealant placed in the joint in such a way that neither a fin nor groove is made in the face of the cast concrete.
- H. Form Release Agent: Commercial formulation, silicone-free form-release agent, designed for use on all types of forms, which will not bond with, stain, nor adversely affect concrete surfaces, and which will not impair subsequent treatment of concrete surfaces requiring bond or adhesion nor impede wetting of surfaces which will be cured with water, steam, or curing compounds.
- I. Plugged Cone Form Ties: Rod type, with ends or end fasteners which can be removed without spalling the concrete and which leave a hole equal in depth to the required reinforcement clearance. Form ties must be of a design in which the hole left by the removed end or end fastener is easily filled to match the surface of the hardened concrete. Provide removable cones 1-1/4 inches in diameter by 1-1/2 inches deep. Provide preformed mortar plugs to match the color of the concrete, recessed 1/4 inch, adhered with an approved epoxy adhesive.
- J. Inserts: Cast stainless steel or welded stainless steel, Type 316 or similar 300 Series, complete with anchors to concrete and fittings such as bolts, wedges, and straps. Provide hanger inserts spaced to match grid of suspended ceiling.
- K. Dovetail Anchor Slots: 22 gage or heavier galvanized steel dovetail anchor slots, for anchoring of masonry veneer with galvanized steel dovetail anchors provided under Division 4, Masonry.
- L. Chamfer Strips: 3/4 inch by 3/4 inch triangular fillets milled from clear, straight-grain pine, surfaced each side, or extruded vinyl type with or without nailing flange.
- M. Miscellaneous Joint Strips: Preformed strips for reveals, rustications, and similar joints fabricated of wood, metal, or plastic.
- N. Waterstops: Refer to Section 03 15 13, Waterstops, for requirements.

2.02 FABRICATION

- A. Formwork - General: Fabricate forms in accordance with approved Shop Drawings. Maintain forms clean, smooth, and free from imperfections and distortion. Formliners must be fabricated in accordance with Section 03 11 16, Architectural Cast-in-Place Forming, and applicable requirements of ACI 301.
- B. Joints:
 - 1. Arrange form panels in symmetrical patterns conforming to general lines of the structure.
 - 2. Unless otherwise indicated, orient panels on vertical surfaces with long dimension horizontal, and make horizontal joints level and continuous.

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3. Align form panels on each side of the panel joint with fasteners common to both panels, and in a manner which will result in a continuous, unbroken concrete plane surface.

C. Steel Forms:

1. Use material which is clean, smooth, and free from warps, bends, kinks, rust, cracks, and matter which may stain concrete. Fabricate panels in accordance with approved Shop Drawings. Unless otherwise specified, deflection between form supports from concrete placement must not exceed 1/240 of the span length.

D. Permanent Steel Deck Forms Design Requirements:

1. Design permanent steel deck forms based on the combined dead load of forms, reinforcement, and plastic concrete with an allowance for construction loads of at least 50 pounds per square foot. The combined dead load must be assumed to be at least 160 pounds per cubic foot for normal concrete and 130 pounds per cubic foot for lightweight concrete.
2. Configure forms such that the weight of deck slab and forms is at most 110 percent of the weight of the deck slab as shown.
3. Compute the physical design properties under AISI's North American Specification for the Design of Cold-Formed Steel Structural Members.
4. The design span for form sheets is the clear span of the form plus two inches, measured parallel to the form flutes.
5. Maximum allowable stresses and deflections are as follows:
 - a. Tensile stress must not exceed the lesser of 0.725 times the specified yield strength or 36,000 pounds per square inch.
 - b. Dead load deflection must not exceed the lesser of 0.0056 times the form span or 1/2 inch. The dead load for deflection calculations must be at least 120 pounds per square foot total.
 - c. You may use form camber based on the actual dead load condition. Do not use camber to compensate for deflection exceeding the allowable limits.

PART 3 - EXECUTION

3.01 LAYOUT OF FORMWORK

- A. Locate and stake out all forms and establish all lines, levels, and elevations.

3.02 CONSTRUCTION

A. Formwork:

1. Construct formwork in accordance with the approved Shop Drawings, and in a manner that will produce finished concrete surfaces conforming to indicated design and within specified tolerances. Formwork for concrete not exposed to view in the finished work may be constructed of any material that will adequately support the weight of the concrete.
2. Make joints and seams mortar-tight. Install leakage control materials in accordance with the manufacturer's installation instructions, and in a manner that will maintain a smooth continuity of plane between abutting form panels and which will resist displacement by concreting operations.
3. Kerf wood inserts for forming keyways, reglets, and recesses in a manner that will prevent swelling and ensure ease of removal.

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4. Maintain forms clean and free from indentations and warpage. Do not use rust-stained steel surfaces for forms in contact with concrete. Do not sandblast steel form surfaces to remove rust or mill scale; remove these imperfections by grinding.
 5. Brace temporary closures to prevent warpage or displacement and set tightly against forms in a manner that will prevent loss of concrete mortar.
 6. Support joints with extra studs or girts, and in a manner that will ensure true, square intersections.
 7. Assemble forms in a manner that will facilitate their removal without damage to the concrete.
 8. Construct molding shapes, recesses, and projections with smooth finish materials and install in forms with sealed joints.
 9. Provide camber in formwork as required to compensate for deflections caused by weight and pressures of fresh concrete and construction loads and as otherwise indicated. Provide camber strips to compensate for deflections due to permanent loads and long-term deflections due to shrinkage and creep as required.
 10. Provide construction openings in forms where required for concrete pour pockets, vibrator access holes, and inspection openings to aid in proper placement and consolidation of concrete, and close up openings during placement of concrete as applicable.
 11. Provide inspection and cleanout openings in forms at bottom of walls and columns and elsewhere as required. Do not close cleanouts until inspected and accepted by VTA just before placing concrete.
 12. Drill air escape holes in bottom members of blockouts.
 13. Ensure that formed stair risers within a stair run are equal.
 14. Clean inside form surfaces of dirt, mortar, and foreign material before beginning concrete placement.
 15. Form exposed surfaces of each element of a concrete structure with the same forming material or with materials that produce similar surface textures, color, and appearance.
 16. Use form panels in uniform widths of at least three feet and uniform lengths of at least six feet except at the ends of continuously formed surfaces where the final panel length is less than six feet. For members less than three feet wide, form panels must be the width of the entire member.
 17. Arrange form panels in symmetrical patterns conforming to the general lines of the structure. Place panels for vertical surfaces with the long dimension horizontal and horizontal joints level and continuous.
 18. Form panels for curved column surfaces must be continuous for at least 1/4 of the circumference or six feet. For walls with sloping footings that do not abut other walls, you may place panels with the long dimension parallel to the footing.
 19. Forms for concrete surfaces that will not be completely enclosed or hidden below the permanent ground surface must comply with the specifications for forms for concrete exposed to view. Interior surfaces of underground drainage structures are considered completely enclosed surfaces.
 20. Bolts, rods, or other devices approved by VTA must be used for internal form fasteners and must be of sufficient quantities to prevent spreading of the forms. The form fasteners must be placed at least one inch away from the finished surface of the concrete. Do not use twisted wire ties to hold forms in position. Form fasteners and anchors must be of those types that can be removed to at least one inch below the concrete surface without chipping, spalling, heating or otherwise damaging the concrete surface.
 21. You may cast anchor devices into the concrete for supporting forms or lifting PC members. Do not use driven types of anchorages for fastening forms or form supports to concrete.
- B. Edge Forms and Screeds for Slabs: Set edge forms or bulkheads and intermediate screeds for slabs to obtain required elevations and contours in the finished slab surface. Support screeds substantially without penetrating waterproof membranes and vapor barriers.

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- C. Corner Treatment: Form chamfers with 3/4 inch on each leg, unless otherwise indicated, and accurately shape and surface in a manner which will produce uniformly straight lines and edge joints and which will prevent mortar runs. Extend terminal edges to limits, and miter chamfer strips at changes in direction.
- D. Construction Joints:
1. Locate joints as indicated. Support forms for joints in concrete so as to rigidly maintain their positions during placement, vibration, and curing of concrete. Install keys in all joints.
 2. Locate and install construction joints, for which locations are not indicated, so as not to impair strength and appearance of the structure, and indicate such joints on Shop Drawings. Locations of construction joints require approval of VTA.
 3. Position joints perpendicular to longitudinal axis of pier, beam, or slab as the case may be.
 4. Locate joints in walls, vertically as indicated; at top of footing; at top of slabs on grade; at bottom of door openings; and at underside of the deepest beam or girder framing into wall; or as required to conform to indicated details.
 5. Provide keyways as indicated in construction joints in walls and slabs, and between walls and footings unless otherwise indicated. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
 6. Retighten forms and dampen concrete surfaces before concrete placing is continued.
- E. Load Supports: Loads for construction of roof slab and suspended floor slabs must be carried down to on-grade base slabs. These loads must not be carried by intermediate slabs at any time. Formwork loads must be carried only by structural elements that are supported directly by footings.
- F. Permanent Steel Deck Forms:
1. Permanent steel deck forms must not interfere with movement at deck expansion joints.
 2. Clearance between deck forms and bar reinforcement must be at least one inch.
 3. Do not use permanent steel deck forms for sections of deck slabs with longitudinal expansion joints unless additional supports are placed under the joint.
 4. Do not rest form sheets directly on top of girder flanges. Fasten sheets securely to form supports. Provide at least one inch of bearing at each end. Place form supports in direct contact with girder flanges. Attach supports using bolts, clips, or other authorized means.
 5. Locate transverse deck construction joints at the bottom of flutes. Field drill 1/4-inch weep holes at not less than 12 inches on center along the joint line.
 6. Repair galvanized form surfaces damaged before installation by wire brushing to remove loose and cracked coating and applying two coats of zinc-rich primer. Do not use aerosol cans. You do not need to repair minor heat discoloration in welded areas.

3.03 EMBEDDED ITEMS AND OPENINGS IN CONCRETE

- A. Install conduit, pipe sleeves, waterstops, appliance boxes, frames for items recessed in walls, door frames, drains, metal ties, inserts, nailing strips, blocking, grounds, and other fastening devices required for anchorage or attachment of other work. Firmly secure products in position, located accurately as indicated, before beginning concrete placement.
- B. Provide openings in concrete for passage of ducts, and provide clearances therefor as indicated on approved Shop Drawings.
- C. Allow sufficient time between erection of forms and placing of concrete for the various trades to properly install concrete reinforcement, embedded items, sleeves, blockouts, and the like.

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- D. Where masonry walls will be tied to concrete construction in future construction, use dovetail anchor slots positioned for maximum flexibility for masonry installation.

3.04 FORM RELEASE MATERIAL

- A. Coat form contact surfaces with approved form release material before reinforcement is placed. Do not allow excess form release material to accumulate in the forms or to come into contact with surfaces that are required to be bonded to fresh concrete such as concrete reinforcement and embedded items. Apply form release material in compliance with manufacturer's application instructions.
- B. Coat steel forms with non-staining, rust-preventive form release material or otherwise protect against rusting.
- C. Apply form release material to bolts and rods that are to be removed or that are to be free to move.

3.05 REMOVAL OF FORMS

- A. Remove forms by methods which will not injure, mar, gouge, or chip concrete surfaces, overstress concrete members, or distort formwork. Use air pressure or other approved methods. Do not pry against concrete. Cut off nails flush. Leave surfaces clean and unblemished.
1. Where early form removal is not necessary and will not impact the Contractor's schedule, leave forms in place a minimum of seven days after the concrete is placed, except keep the forms in place for at least five days for concrete members over 20 inches in least dimension.
- B. When repair of surface defects or finishing is required at an early age, forms may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations and its own weight.
1. Concrete work that is damaged by removal operations must be repaired as specified in Section 03 35 00, Concrete Finishing. Where exposed surfaces are damaged beyond acceptable repairing measures, the damaged concrete must be removed and replaced with new concrete.
- C. Top forms on sloping surfaces of concrete may be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping surfaces must be performed at once and must be followed by the specified curing.
- D. Wood forms for wall openings must be loosened as soon as this can be accomplished without damage to the concrete.
- E. Formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently so as not to be damaged by removal operations.
- F. Forms and shoring in the formwork used to support the weight of concrete in beams, suspended slabs, girders, and other structural members must remain in place until the concrete has reached adequate strength and stiffness to support itself. Forms must not be removed before the concrete has reached a minimum of 80 percent of the indicated design compressive strength or 2,600 pounds per square inch, whichever is greater, unless otherwise approved in writing by VTA.
- G. When shores and other vertical supports are so arranged that the non-load-carrying form-facing material may be removed without loosening or disturbing the shores and supports, the facing material may be removed at an earlier age provided the concrete surfaces are not damaged by such earlier removal.

- H. Plan reshoring operations in a manner that will ensure that areas of new construction will not be required to support their own weight. Reshoring must be in place before shoring is removed. During reshoring, do not permit live loads on new construction. Do not locate reshores in a manner and location that will overstress members or induce tensile stresses where reinforcing bars have not been provided.
- I. When removal of formwork or reshoring is based on the concrete reaching a specified strength, the concrete must be presumed to have reached this strength when test cylinders, field cured along with the concrete they represent, have reached the strength specified for removal of formwork or reshoring. Except for the field curing and age at test, the cylinders must be molded and tested as specified in Section 03 05 15, Portland Cement Concrete.
- J. After stripping, properly protect all concrete to be exposed in the finish work from damage with boards and building paper to prevent staining, spoiled edges, chips, and the like.

3.06 PLUMBING, LEVELING, REPAIRING AND MAINTAINING FORMS

- A. Check movement using methods, such as plumb lines, tell tales, and survey equipment, to detect movement of formwork during concrete placement.
- B. Before concrete is placed in any form, the horizontal and vertical position of the form must be carefully verified and all inaccuracies corrected. All wedging and bracing must be completed in advance of placing of concrete.
- C. Boards or other form materials that have been damaged or checked or warped prior to placing of concrete must be removed from the forms and replaced with approved materials or otherwise corrected to the satisfaction of VTA.
- D. Assign a sufficient number of workers to keep watch on and maintain the forms during placing of concrete. Satisfactorily remedy any displacement or looseness of forms or reinforcement before placing of concrete. No form must be moved or altered except as may be specifically directed by VTA.

3.07 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable. Remove such material from the Worksite. Apply form release coating as specified for new formwork.
- B. Align and secure joints in a manner that will preclude offsets. Do not use patched forms for exposed concrete surfaces.

3.08 FIELD QUALITY CONTROL AND ASSURANCE

- A. Contractor Quality Control:
 - 1. Before placing concrete, check lines and grades of erected formwork and positioning of embedded inserts, blockouts, and joints for correctness. Verify that embedded piping and conduit are free from obstructions. Make corrections or adjustments to ensure proper size and location of concrete members and stability of forming systems.
 - 2. While placing concrete, provide quality control to assure that formwork and related supports have not been displaced, that loss of cement paste through joints is prevented, and that completed work will be within specified tolerances.

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3. During form removal, verify that architectural features meet the form and texture requirements of the samples approved by VTA.
 4. Prior to formwork erection, inspect form facing material. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable and may be rejected by VTA. Unacceptable and rejected form facing material must be promptly removed from the Worksite.
 5. The engineer responsible for the design of formwork over 12 feet in height or more than 12 feet above ground must inspect the work and verify it is in conformance with the approved Shop Drawings.
 6. The engineer responsible for the design of formwork over 12 feet in height or more than 12 feet above ground must submit a letter of certification that certifies the construction of the formwork is in accordance with the approved Shop Drawings and meets their approval. Submit the letter before placing any concrete in the formwork being certified.
- B. VTA Quality Assurance:
1. Before placing concrete, the Engineer may verify lines and grades of erected formwork and positioning of embedded inserts, blockouts, and joints conform to the requirements of the Contract Documents.

END OF SECTION 03 11 00

SECTION 03 11 14

FALSEWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Layout of falsework.
 2. Falsework design.
 3. Falsework construction.
 4. Falsework lighting.
 5. Removal of falsework.

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 01 55 26, Traffic Control
- D. Section 03 05 18, Prestressed Concrete
- E. Section 03 11 00, Concrete Formwork
- F. Section 03 30 00, Cast-in-Place Concrete
- G. Section 03 41 00, Structural Precast Concrete
- H. Section 05 05 60, Metal Welding
- I. Section 05 12 35, Structural Steel
- J. Section 05 30 00, Metal Decking

1.03 REFERENCED STANDARDS

- A. American Institute of Steel Construction (AISC):
1. AISC Steel Construction Manual, 15th Edition
- B. American Welding Society (AWS):
1. AWS D1.1/D1.1M Structural Welding Code - Steel (2015)
- C. ASTM International (ASTM):

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- 1. ASTM A36/A36M Specification for Carbon Structural Steel
- D. California Code of Regulations, Title 8:
 - 1. Chapter 4, Subchapter 4, Construction Safety Orders
- E. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:
 - 1. Section 12 Temporary Traffic Control
 - 2. Section 48 Temporary Structures
- F. State of California, Department of Transportation (Caltrans), Office of Structure Construction:
 - 1. Falsework Manual
- G. West Coast Lumber Inspection Bureau (WCLB):
 - 1. WCLB No. 17 Standard Grading Rules

1.04 DEFINITIONS

- A. Abbreviations:
 - 1. NDT: Nondestructive Testing
 - 2. RT: Radiographic Testing
 - 3. UT: Ultrasonic Testing
- B. Previously Welded Splice: Splice made in a falsework member in compliance with AWS D1.1/D1.1M or other recognized welding standard before contract award.
- C. Independent Support System: Support system that is in addition to the falsework removal system employing methods of holding falsework from above by winches, hydraulic jacks with prestressing steel, high-strength rods, or cranes.

1.05 SUBMITTALS

- A. Requirements: Submittals for falsework must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications. Shop Drawings and supporting calculations for falsework must be submitted to VTA for review and approval.
- B. Shop Drawings and Calculations:
 - 1. Submit drawings and design calculations, prepared by an engineer who is currently registered as a civil engineer in the State of California, in accordance with the requirements of Section 48, "Temporary Structures," of the Caltrans Standard Specifications for all falsework proposed for structures requiring falsework support. Falsework design calculations must include the stresses, deflections, and reactions in load supporting members.
 - 2. Submit separate drawings and calculations for each single bridge or portion of bridge.
 - 3. For multi-frame bridges, submit a separate shop drawing for each frame.
 - 4. Falsework drawings and calculations must be designed, detailed, stamped, and signed by an engineer who is currently registered as a civil engineer in the State of California.

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5. Except for placement of foundation pads and piles, do not start construction of any unit of falsework until VTA has approved the Shop Drawings and calculations for that unit.
6. Falsework forms must be designed to carry the load imposed upon them without exceeding the estimated soil bearing values and anticipated settlements, and without relying on existing structures for stability or support.
7. When footing type foundations are proposed, determine the bearing value of the soil and show the values assumed in the design of the falsework on the falsework drawings.
8. When pile type foundations are proposed, show the maximum horizontal distance that the top of a falsework pile may be pulled out of position to support its cap. Also, show the maximum allowed deviation of the top of the pile, in its final position, from a vertical line through the point of fixity of the pile.
9. Show anticipated total settlements of falsework and forms. These must include falsework footings settlement and joint take-up. Falsework supporting deck slabs and overhangs on girder bridges must be designed so that there will be no differential settlement between the girders and the deck forms during placement of deck concrete.
10. Foundations for individual steel towers where the maximum leg load exceeds 30 kips must be designed and constructed to provide uniform settlement under all legs of each tower under all loading conditions.
11. The support systems for form panels supporting concrete deck slabs and overhangs on girder bridges must also be considered to be falsework, and must be designed as such.
12. Temporary bracing must be provided, as necessary, to withstand all imposed loads during erection, including erection equipment and operation, construction, and removal of falsework. The falsework drawings must show provisions for such temporary bracing or methods to be used to conform to this requirement during each phase of erection, construction, and removal. Such bracing must be left in place as long as may be required for safety. Wind loads must be included in the design of such bracing or methods.
13. Design of falsework will not be approved by VTA unless it is based on the use of loads, stresses, deflections. The Contractor must be responsible for the proper evaluation of falsework materials and for the design of falsework to safely carry the actual loads imposed.
14. The welding standard to be utilized must be specified on the Shop Drawings.
15. In addition to the requirements in Caltrans Standard Specifications Section 48-2, "Falsework," the following requirements must apply:
 - a. The time to be provided for the review of Shop Drawings and calculations will be as listed below:

Structure or portion of structure	Total review time
Capitol Aerial Guideway Falsework without opening over Capitol Expressway	4 weeks (per frame)
Capitol Aerial Guideway Falsework with openings over Capitol Avenue	6 weeks
Capitol Aerial Guideway Falsework with openings over northbound and/or southbound Capitol Expressway	6 weeks per location
Capitol Aerial Guideway Falsework with openings over street intersections at Story Road, Ocala Avenue and Cunningham Avenue	6 weeks per location
Story Road Pedestrian Overcrossing	6 weeks

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Story Station Access Structures at East Access, West Access, North Median Access, and South Median Access	4 weeks per location
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16. Shop Drawings and design calculations must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.
- C. Forming System: Furnish form design and materials data for each forming system to be used for exposed surfaces. Coordinate with the work of Section 03 11 00, Concrete Formwork.
- D. Certificates:
1. Submit a certificate of compliance for each delivery of structural composite lumber used in falsework.
 2. Submit a letter of certification that certifies all components of manufactured assemblies are used in compliance with the manufacturer's instructions.
 3. Submit a letter of certification for all falsework members with welded splices. The letter must certify that all welding and non-destructive testing (NDT), including visual inspection, comply with these Technical Specifications and the welding standard shown on the Shop Drawings. The letter must be signed by an engineer who is currently registered as a civil engineer in the State of California. Submit the letter before placing any concrete or steel members on the falsework being certified.
 4. Submit a welding certification for falsework members with previously welded splices. Previously welded splice is defined as a splice made in a falsework member in compliance with AWS D1.1/D1.1M or other recognized welding standard before contract award. The certification must:
 - a. Itemize the testing, inspection methods, and acceptance criteria used.
 - b. Include tracking and identifying documents for previously welded members.
 - c. Be signed by an engineer who is currently registered as a civil engineer in the State of California.
 - d. Be submitted before erecting the members.
 5. Submit field acceptance criteria for falsework piles with a calculated nominal resistance greater than 200 tons. Base acceptance criteria on a wave equation analysis performed on dynamic monitoring of falsework pile driving. Analyses must be signed by an engineer who is currently registered as a civil engineer in the State of California. Submit acceptance criteria before falsework erection is complete.
- E. If requested by VTA, submit manufacturer's data for manufactured assemblies to verify manufacturer's instructions or perform tests demonstrating adequacy of the proposed assemblies
- F. Falsework Lighting Plan: Submit a falsework lighting plan before starting construction on falsework containing openings for vehicular traffic, pedestrians, or railroad. The Falsework Lighting Plan must comply with the requirements specified in Section 48, “Temporary Structures,” of the Caltrans Standard Specifications. You may propose a lighting plan that fulfills the light intensity specified using alternative methods. Supply data to allow evaluation of the alternative methods.

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- G. If the licensed engineer responsible for the design of falsework and signing the falsework drawings assigns a representative to perform the certification that the falsework is constructed as shown in the authorized Shop Drawings, as specified in Article 3.05, “Field Quality Control,” herein, submit supporting documentation demonstrating the required experience of the assigned representative.

1.06 FALSEWORK DESIGN CRITERIA

- A. You must design, construct, and maintain falsework that is safe and adequate, provides the necessary rigidity, supports the imposed loads, and produces a completed structure that conforms to the lines and grades shown.
- B. Regulatory Requirements: Falsework must comply with applicable requirements of the California Code of Regulations, Title 8, Construction Safety Orders.
- C. Design Standards and Criteria: In addition to the requirements specified herein, falsework must be designed and constructed in accordance with the requirements of Section 48, “Temporary Structures,” of the Caltrans Standard Specifications and the Caltrans Falsework Manual.
- D. Design Loads: Design loads for falsework must conform with the requirements of Section 48, “Temporary Structures,” of the Caltrans Standard Specifications and the Caltrans Falsework Manual.
- E. Design Stresses, Loadings, and Deflections: The maximum allowable design stresses, loadings, and deflections must conform with the requirements of Section 48, “Temporary Structures,” of the Caltrans Standard Specifications and the Caltrans Falsework Manual.
- F. Falsework Lighting: Design falsework lighting in accordance with the requirements of Section 48, “Temporary Structures,” of the Caltrans Standard Specifications and the Caltrans Falsework Manual.
- G. Refer to Section 01 55 26, Traffic Control, for traffic control requirements related to falsework design.

1.07 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. VTA Quality Assurance:
1. VTA will monitor the implementation of the Contractor’s quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.08 MEASUREMENT AND PAYMENT

- A. Full compensation for all work under this Section must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

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1. Full compensation for all work under this Section for cast-in-place concrete work must be considered as included in the bid items for Structural Concrete of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
2. Full compensation for all work under this Section for precast prestressed concrete girders must be considered as included in the bid items for Erect Precast Prestressed Concrete Girder of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
3. Full compensation for all work under this Section for structural steel work must be considered as included in the bid items for Erect Structural Steel of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials for falsework must conform with the requirements of Section 48, "Temporary Structures," of the Caltrans Standard Specifications and the Caltrans Falsework Manual, except as indicated or specified otherwise herein.
- B. Lumber: All falsework lumber, posts, and timbers must be graded and grade-marked in accordance with WCLB No. 17, dressed or rough. Provide stress-graded lumber for all falsework lumber, conforming with the above-specified WCLB No. 17.

PART 3 - EXECUTION

3.01 LAYOUT OF FALSEWORK

- A. Locate and stake out all forms and falsework, and establish all lines, grades, and elevations.

3.02 FALSEWORK CONSTRUCTION

- A. Construct falsework to conform with the approved falsework Shop Drawings and the requirements of Section 48, "Temporary Structures," of the Caltrans Standard Specifications and the Caltrans Falsework Manual.
- B. Construct falsework and concrete forms on steel structures such that loads applied to girder webs are applied within six inches of a flange or stiffener and do not produce local distortion of the web. Provide temporary struts and ties to resist lateral loads applied to girder flanges and prevent appreciable vertical movement between the edge of deck form and the adjacent steel girder.
- C. Welding must comply with AWS D1.1/D1.1M or other recognized welding standard, as shown on the reviewed Shop Drawings, except for fillet welds if the load demands are 1,000 pounds or less per inch for each 1/8 inch of fillet weld.
- D. Perform NDT on welded splices using UT or RT. Each weld and any repair made to a previously welded splice must be tested. You must select locations for testing. The length of a splice weld where NDT is to be performed must be a cumulative weld length equal to 25 percent of the original splice weld length. The cover pass must be ground smooth at test locations. Acceptance criteria must comply with the specifications for cyclically loaded nontubular connections subject to tensile stress in clause 6 of AWS D1.1/D1.1M. If repairs are required in a portion of the weld, perform additional NDT on the

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repaired sections. The NDT method chosen must be used for an entire splice evaluation, including any repairs.

- E. For previously welded splices, perform and document all necessary testing and inspection required to certify the ability of the falsework members to sustain the design stresses.
- F. The falsework must provide for proper camber and alignment and must be properly designed, constructed, and maintained for the loads that will be imposed upon it.
- G. Care must be taken in the use of falsework and other temporary supports to ensure that the temporary elevation of structural steel provided by the falsework is consistent with the deflections that will occur as the structure is completed.
- H. The falsework design must provide adequate rotational restraint at the ends of all steel members in accordance with AISC Steel Construction Manual.

3.03 FALSEWORK LIGHTING

- A. Construct falsework lighting to conform with the approved Falsework Lighting Plan and the requirements of Section 48, “Temporary Structures,” of the Caltrans Standard Specifications and the Caltrans Falsework Manual.

3.04 REMOVAL OF FALSEWORK

- A. Release and removal of falsework must conform with the requirements of Section 48, “Temporary Structures,” of Caltrans Standard Specifications and the Caltrans Falsework Manual.
- B. Falsework must not be removed until the concrete members have attained sufficient strength to support their weight and the loads to be superimposed thereon safely. In no case must falsework be released before the supported concrete has attained a compressive strength of 2,600 pounds per square inch or 80 percent of the specified strength, whichever is greater.
- C. When erecting Story Station Pedestrian Overcrossing, the falsework must be left in place until all connections are bolted and welded and accepted by VTA unless otherwise provided in the approved Construction Staging and Erection Procedure, as specified in Section 05 12 35, Structural Steel.
- D. Dispose of falsework materials and work debris.
- E. Nothing herein must be construed as relieving the Contractor of any responsibility of the safety of the structure.

3.05 FIELD QUALITY CONTROL

- A. The licensed engineer responsible for the design of falsework and signing the falsework drawings must submit a letter of certification that certifies that the falsework is constructed as shown in the authorized shop drawings before concrete is placed. The certification must include any necessary testing to verify the ability of the falsework members to sustain the stresses required by the falsework design. The licensed engineer may assign a representative to perform this certification as follows:
 - 1. Where falsework contains openings for vehicular traffic or pedestrians, the assigned representative must have at least three years of combined experience in falsework design or supervising falsework construction, and be an engineer who is currently registered as a civil engineer in the State of California.

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2. For other falsework, the assigned representative must have at least three years of combined experience in falsework design or supervising falsework construction.
3. You must certify the experience of the assigned representative and submit supporting documentation demonstrating the required experience.

END OF SECTION 03 11 14

SECTION 03 11 16

ARCHITECTURAL CAST-IN-PLACE CONCRETE FORMING

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
 - 1. Architectural treatment for the surfaces of cast-in-place concrete components
 - 2. Architectural treatment for precast concrete panels used in Mechanically Stabilized Embankment (MSE) system
 - 3. Form liners

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 11 00, Concrete Formwork
- D. Section 03 11 14, Falsework
- E. Section 03 30 00, Cast-in-Place Concrete
- F. Section 03 35 00, Concrete Finishing
- G. Section 03 41 00, Structural Precast Concrete
- H. Section 31 66 17, Mechanically Stabilized Earth Walls

1.03 REFERENCED STANDARDS

- A. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:
 - 1. Section 51 Concrete Structures
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
 - 2. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
 - 3. ASTM D2240 Standard Test Method for Rubber Property—Durometer Hardness

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1.04 SUBMITTALS

- A. General: Submittals for architectural cast-in-place concrete forming must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions and these Technical Specifications.
- B. Product Data:
1. Manufacturer's catalog sheets, including instructions for use and description of application, must be provided on each of the following materials:
 - a. Form liners
 - b. Form liner accessories, including fasteners, sealants, adhesives, rustication, and backup strips
 - c. Form liner release agents and sealers, as scheduled or required
 2. Submit form liner manufacturer's handling and storage procedures.
 3. Submit form liner manufacturer's installation procedures.
- C. Shop Drawings: Shop Drawings must include form liner layout and termination reveal details, indicate backup, rustication, reveal, and chamfer strip locations. Include jointing, form tie locations and pattern of placement.
- D. Site Mock-Ups: Refer to Article 1.05, herein, for requirements.
- E. Certificate of Compliance:
1. Contractor must provide Certificate of Compliance for each type of form liner, form liner adhesive, and form liner release agent.
 2. Certificates of Compliance must include the name, source, and description of all materials used in each type of form liner, and must be signed by the form liner supplier certifying that each material item complies with or exceeds the specified requirements.
 3. When Certificates of Compliance cannot be provided, Contractor must hire a professional testing laboratory to verify compliance of each type of material to be used in each form liner. The cost of testing must be paid for by Contractor.

1.05 QUALITY ASSURANCE AND CONTROL

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.

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- b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
- D. VTA Quality Assurance:
 1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.
- E. Manufacturer Qualifications: A minimum of three years of manufacturing experience with form liners similar to those required for this Project.
- F. Installer Qualifications: A minimum of three years of experience with form liners similar to those required for this Project.
- G. Site Mock-Ups:
 1. Refer to Section 7.43, Submittal of Shop Drawings, Product Data and Samples, or the General Conditions, for mock-up requirements and procedures.
 2. Contractor must provide a mock-up for each form liner module and pattern for evaluation of surface preparation and techniques and application of workmanship. Full size mock-ups must be constructed using personnel, materials, equipment, and methods to be used in the work. Incorporate edge, reveal, and detail as per drawings.
 3. Form liner with a single pattern must be at least 4 feet by 4 feet in size. Mock-ups must incorporate formwork accessories and a minimum of one vertical and one horizontal form liner joint.
 4. Include concrete mix, forming system, form release agents, placement rate, form pressures, joint sealing, vibrating and stripping practices in mock-up fabrication. Contractor must demonstrate patching and repair procedures for spalled concrete and voids caused by honeycombing or bug holes.
 5. Locate mock-up on site in location as directed the Engineer. Clean the sample panel installation using the same materials and tools as planned for the final construction.
 6. If ordered by VTA, additional mock-ups must be constructed and finished until the specified finish and texture are obtained, as determined by VTA.
 7. Approved site mock-ups must set the standard for the concrete features, formed finishes, and colors of the concrete.
 8. Do not proceed with remaining work until workmanship, colors, styles, patterns, and textures are approved by the Engineer.
 9. Maintain mock-up for comparison with finished work.
 10. Remove mock-up at the completion of the work.

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1.06 DELIVERY, STORAGE, AND HANDLING

- A. Form liner delivery, storage and handling must be per the manufacturer's recommendations.
- B. Cover form liners to protect from oil, dirt, and UV exposure. Store form liners off ground in ventilated and protected manner to prevent deterioration from moisture.
- C. Storage of form liner must be out of direct sunlight and in temperatures below 140 degrees Fahrenheit. Store flat (not rolled) to avoid elastomeric sheet "set".
- D. Form liners with deformations to the manufactured surface caused by improper storage practices or any other reason must not be used.
- E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 MEASUREMENT AND PAYMENT

- A. Measurement: Architectural Treatment of the various types and locations listed in the Schedule of Quantities and Prices must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Architectural Treatment of the various types and locations listed in the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing architectural treatment complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
- C. Full compensation for providing architectural treatment mock-ups must be considered as included in the bid item for Architectural Treatment of the various types and locations listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
- D. Full compensation for providing architectural treatment on precast panels of mechanically stabilized embankment must be considered as included in the bid item for Mechanically Stabilized Earth Walls and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 SPECIFIC PRODUCTS

- A. Form liners for architectural texturing must be manufactured by Scott System, Inc. (10777 E. 45th St., Denver, CO 80239; Tel: 303-373-2500; Fax: 303-373-2500; Website: www.scottsystem.com), or VTA approved equal.
- B. Form liner module and pattern must be in accordance with the details shown on the plans or as specified in these Technical Specifications.
- C. Line work for form liner module and pattern will be provided to the Contractor by VTA in AutoCAD format.

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2.02 MATERIALS

- A. Concrete: Refer to Section 03 30 00, Cast-in-Place Concrete, and Section 03 41 00, Structural Precast Concrete, for requirements.
- B. Form Liners:
1. Form liners must be manufactured from an elastomeric material for creating textures in cast-in-place or precast concrete. No substitution of other types of form liner material will be allowed.
 2. Form liners must leave a crisp, sharp definition of the concrete surface texture.
 3. Form liners must be manufactured for multi-use service.
 4. Form liner patterns and textures must be as shown or specified in the Plans.
 5. Elastomeric form liners must comply with the requirements shown in the following table:

Quality characteristic	Test method	Requirement
Tensile strength (min, pounds per square inch)	ASTM D412	1,000
Hardness, Type A (points)	ASTM D2240	50-90
Ultimate elongation (percent)	ASTM D412	280-350
Tear strength (min, pounds per inch)	ASTM D624	120

- C. Form Release Agents: Per manufacturer's recommendations.
- D. Adhesive Binder: Epoxy adhesive as supplied by the textured form liner manufacturer for attachment of liners to formwork. Adhesives must be compatible with the form liner material and with concrete. Adhesives must not cause swelling of the liner material.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF ARCHITECTURAL TREATMENTS

- A. Casting of concrete must conform to form liner manufacturer's recommendations.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- C. Apply release agent according to manufacturer's directions. Schedule concrete pour immediately after application of release agent to avoid precipitation, dust, and debris. Protect reinforcing steel from exposure to release agents.
- D. Thoroughly vibrate concrete to achieve consolidation, and minimize voids. Internally vibrate into previous lift to avoid lift lines. Avoid vibrator contact with the form liner.

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3.02 INSTALLATION OF FORM LINERS

- A. Form liners must be used for textured concrete surfaces. Form liners must be installed in conformance with the manufacturer's recommendations, unless other methods of forming textured concrete surfaces are approved by VTA.
- B. Recurring textural configurations exhibited by repeating, recognizable shadow patterns must be prevented by proper casting of form liner patterns. Textured concrete surfaces with such recurring textural configurations must be reworked to remove such patterns as approved by VTA or the concrete must be replaced.
- C. Seal and repair cuts and tears in form liners under the form liner manufacturer's instructions.
- D. Do not use form liners that are delaminated or deformed.
- E. Form liners with deformations to the manufactured surface caused by improper storage practices or any other reason must not be used.
- F. Except for form liner modules, form liners must extend the full length of texturing, with transverse joints at eight-foot minimum spacing. Form liners for repetitive module pattern must extend the full length and width of the module. Do not use small pieces of form liners.
- G. Align grooves straight and true. Grooves must match at joints between form liners. For grooved patterns, joints in the direction of grooves must be located in depressions.
- H. Butt adjoining liners together without distortion, open cracks, or offsets. Clean joints between liners and remove mortar before use.
- I. On multiple use liners, clean liner before each use. Do not use damaged liner when continued use or repair would diminish the aesthetics of the Work
- J. Anchor liner to form on centers not to exceed 18 inches. Decrease centers as necessary to accommodate form stripping pressures without damaging liner intended for multiple use.
- K. Place rustication lines located as indicated within acceptable industry tolerances.
- L. Form corners indicated to be chamfered with PVC chamfer. Chamfered corners must be smooth, solid, unbroken continuous lines.
- M. You are responsible for design of formwork and back-up of form liner for structural stability and sufficiency.

3.03 RELEASE OF FORM LINERS

- A. Products and application procedures for form release agents must be recommended by the form liner manufacturer.
 - 1. Unless otherwise recommended by the form liner manufacturer, apply the release agent using a natural bristle brush in the direction of the pattern for textures with longitudinal patterns.
- B. Release agents must not cause swelling of the liner material or delamination from the forms. Release agents must not stain the concrete or react with the liner material.

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- C. Proper cleaning and storage of form liner is required to obtain acceptable results. Prevent matrix build-up on the liner surface. Scrub the liner surface with a stiff bristle scrub brush dipped repeatedly in one of the approved release agents. Clean excess release agent from liners using compressed air. Remove release agent buildup due to liner reuse at least every five uses.
- D. Form liners must release without leaving particles or pieces of liner material on the concrete and without pulling or breaking concrete from the textured surface. The concrete surfaces exposed by removing forms must be protected from damage.

3.04 ABRASIVE BLASTING

- A. Except for formed relief textures, abrasive blast concrete surface textures with fine abrasive after removing forms to remove sheen without exposing coarse aggregate.

3.05 CURING

- A. Concrete surfaces with architectural texture must be cured only by the forms-in-place or water methods, as specified in Section 03 35 00, Concrete Finishing. Seals and curing compounds must not be used.

3.06 FIELD QUALITY CONTROL

- A. The mock-ups approved by VTA must be used as the standard of comparison in determining acceptability of architectural texture for concrete surfaces.

END OF SECTION 03 11 16

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SECTION 03 15 13

WATERSTOPS

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:

1. Waterstops
2. Strip waterstops

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 11 00, Concrete Formwork
- D. Section 03 11 16, Architectural Cast-in-Place Concrete Forming
- E. Section 03 20 00, Concrete Reinforcing
- F. Section 03 30 00, Cast-in-Place Concrete
- G. Section 03 35 00, Concrete Finishing

1.03 REFERENCED STANDARDS

- A. U. S. Army Corp of Engineers, Concrete Research Division (CRD):
1. CRD-C572 Polyvinylchloride Waterstops
- B. ASTM International (ASTM):
1. ASTM C542 Standard Specification for Lock-Strip Gaskets
 2. ASTM D395 Standard Test Methods for Rubber Property—Compression Set
 3. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
 4. ASTM D471 Standard Test Method for Rubber Property—Effect of Liquids
 5. ASTM D573 Standard Test Method for Rubber—Deterioration in an Air Oven
 6. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
 7. ASTM D746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

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- 8. ASTM D1149 Standard Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment
 - 9. ASTM D2240 Standard Test Method for Rubber Property—Durometer Hardness
- C. Federal Specification:
- 1. Federal Specification MMM-A-121 Federal Specification Adhesive, Bonding Vulcanized Synthetic Rubber to Steel HAP-Free Replacement

1.04 SUBMITTALS

- A. General: Submittals for waterstops must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Shop Drawings: Submit Shop Drawings showing locations of all joints to receive waterstops and methods of supporting waterstops in forms without displacement from pressure of concrete placement.
- C. Product Data: Submit manufacturers' product data of proposed waterstops for review.
- D. Samples: Submit 12-inch long sample of typical waterstop and sample of field splice.
- E. Certificates of Compliance: Submit a certificate of compliance for waterstop material. The certificate of compliance for PVC waterstop must include a statement that the material complies with item 6 of CRD-C572.

1.05 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. VTA Quality Assurance:
 - 1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.06 STORAGE AND HANDLING

- A. Store waterstops in a manner that provides free circulation of air around the material.
- B. Protect waterstop material from direct sunlight while in storage, and when only partially encased in concrete for over 48 hours.

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1.07 MEASUREMENT AND PAYMENT

- A. Full compensation for all work under this Section must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Waterstops must be manufactured from neoprene or polyvinyl chloride (PVC).
- B. Neoprene must be manufactured from a vulcanized elastomeric compound containing neoprene as the only elastomer and must comply with the requirements shown in the following table:

Quality characteristic	Test method	Requirement
Tensile strength (min, pounds per square inch)	ASTM D412	2,000
Ultimate elongation (min, percent)	ASTM D412	300
Compression set (max, percent, 22 hours at 70 degrees Celsius)	ASTM D395, Method B	30
Tear strength (min, kN/m)	ASTM D624, Die C	26
Hardness, Type A (points)	ASTM D2240	55 plus or minus 5
Ozone resistance (20 percent strain, 100 hours at 100 plus or minus 2.2 degrees Fahrenheit)	ASTM D1149 except 100 plus or minus 20 parts per 100,000,000	No cracks
Brittleness temperature at -40 degrees Celsius	ASTM D746, Section 9.1.2	Pass
Flame propagation	ASTM C542	Must not propagate flame
Change in volume (max, percent, IRM 903, immersed 70 hours at 100 degrees Celsius)	ASTM D471	80
Change in mass (max, percent, immersed 7 days at 70 degrees Celsius)	ASTM D471	15

- C. After accelerated aging under ASTM D573 for 70 hours at 100 degrees Celsius, the elastomer must not show quality characteristic changes greater than those shown in the following table:

Quality characteristic	Requirement
Tensile strength (percent)	-15
Elongation at break (percent)	-40
Hardness (points)	+10

- D. PVC waterstops must be manufactured from polyvinyl chloride complying with CRD-C572 and must comply with the ozone resistance requirement for neoprene.
- E. Furnish waterstops full length for straight portions of joints. Manufacturer's shop splices must be fully vulcanized.
- F. Strip Waterstops:

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1. The neoprene sheet must comply with the specifications for neoprene herein.
2. The neoprene adhesive must comply with Federal Specification MMM-A-121.
3. The protective board must be at least 1/2-inch-thick wood or fiberboard that is at least 4 ft long and the width shown.
4. The neoprene sheet must be smooth and free from pin holes or surface blemishes and show no sign of delamination.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install waterstops accurately in place and secure rigidly against movement by methods adequate to assure proper support and embedment during the placement of concrete.
- B. Unless otherwise indicated, install waterstops so that embedment in concrete will be equal on both sides of the joint.
- C. Provide waterstops for all construction joints in exterior walls, base slabs, suspended slabs, roof slabs, and other locations as indicated.
- D. Use spacers, wire, or other authorized methods to secure reinforcing bars supporting waterstops.
- E. Install waterstops in the longest practicable length, with joints spliced to form a continuous watertight seal for the full length of the joint.
- F. Carefully place and consolidate concrete to ensure a complete filling and bond between the concrete and waterstop. A cement-sand grout slurry may be used where necessary to assure contact and bond of waterstop and concrete without voids.
- G. When installed in an expansion joint, locate waterstop so that the closed hollow center-bulb remains in the gap of the joint, to allow for maximum elongation with minimum stress on that portion of the waterstop embedded in the concrete. Install expansion joint material and a sealant in the joint, as indicated, to prevent foreign matter from accumulating in the joint area. When a sealant is used, place a separator (backer rod) between the sealant and the waterstop to assure that both the waterstop and sealant perform properly.
- H. Repair or replace damaged, defective or misaligned waterstop material in accordance with the manufacturer's instructions.
 1. If waterstops are out of shape or position after placing concrete, remove the concrete and reset waterstops.
- I. Strip Waterstops:
 1. Join neoprene sheets as follows:
 - a. Lap the sheets at least 12 inches.
 - b. Apply the adhesive to both faces at the manufacturer's recommended rate.
 - c. Let the adhesive dry to an aggressive tack.
 - d. Bring the sheets together and roll in both directions to obtain a tight bond.

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2. Abrasive blast clean the concrete surfaces to receive a strip waterstop. Allow the cleaned surfaces to air dry 24 hours before applying the adhesive.
3. Surfaces where adhesive is to be applied must have a cloth finish or a buffed finish. Surfaces must be clean and dry when the adhesive is applied.
4. Apply the adhesive to the concrete and neoprene sheet at the manufacturer's recommended rate. Let the adhesive dry to an aggressive tack. Apply the sheet to the concrete surface and roll in both directions to obtain a tight bond.
5. Completely cover the installed strip waterstops with one layer of protective board attached with adhesive. The protective board must remain in place until backfilling is complete.

3.02 SPLICING

- A. Field splices for neoprene waterstops must be one of the following:
 1. Vulcanized
 2. Mechanical using stainless steel parts
 3. Made with a splicing union of the same stock as the waterstop
- B. Completed field splices must have a full-size tensile strength of 100 pounds per inch of width.
- C. Field splice PVC waterstops by heat sealing under the manufacturer's instructions. Do not burn the plastic when melting.
- D. Cut and splice waterstops at changes in direction as necessary to avoid buckling or distortion of the waterstop.

3.03 FIELD QUALITY CONTROL

- A. The Contractor must inspect waterstops and their joints for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects that could reduce the effectiveness of joints against water penetration.

END OF SECTION 03 15 13

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SECTION 03 15 15

ELASTOMERIC BEARING PADS

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Steel-reinforced elastomeric bearing pads.

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 30 00, Cast-in-Place Concrete
- D. Section 03 41 00, Structural Precast Concrete
- E. Section 05 12 35, Structural Steel
- F. Section 31 66 17, Mechanically Stabilized Earth Walls

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM A36/A36M Specification for Carbon Structural Steel
 2. ASTM A1011/A1011M Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy High-Strength Low-Alloy with Improved Formability, and Ultra High-Strength
 3. ASTM D395 Test Methods for Rubber Property - Compression Set
 4. ASTM D412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers
 5. ASTM D429 Test Methods for Rubber Property - Adhesion to Rigid Substrates
 6. ASTM D573 Test Method for Rubber - Deterioration in an Air Oven
 7. ASTM D1149 Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
 8. ASTM D2240 Test Method for Rubber Property - Durometer Hardness
 9. ASTM D4014 Specification for Plain and Steel-Laminated Elastomeric Bearings for Bridges
 10. ASTM A1008/A1008M Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

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11. ASTM C881/C881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

B. Federal Specification:

1. Federal Specification MMM-A-121 Federal Specification Adhesive, Bonding Vulcanized Synthetic Rubber to Steel

C. SAE International (SAE):

1. SAE AS8660 Silicone Compound Nato Code Number S-736

D. State of California, Department of Transportation (Caltrans), Standard Specifications 2015:

1. Section 51 Concrete Structures

1.04 DEFINITIONS

A. As used in these Technical Specifications, the word "elastomer" or "elastomeric" means "rubber"; the words are interchangeable.

1.05 SUBMITTALS

A. General: Submittals for elastomeric bearing pads must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.

B. Product Data: Submit manufacturer's product data of elastomeric bearing pads for review.

1. Product data must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "No Exceptions Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

C. Samples: Furnish one sample elastomeric bearing pad for each type, size, and thickness of pad used in the Work at least 30 days before use. Samples will be selected by the Engineer at random before delivery to the Worksite. Furnish additional pads to replace the pads selected for testing.

D. Certificates of Compliance: Submit certificates of compliance from the bearing manufacturer certifying that materials and fabrication of elastomeric bearing pads comply with these Technical Specifications as applicable.

E. Test Reports: Submit test reports for proof-tested bearings signed by the personnel conducting the testing. Include the names of the personnel interpreting the test results.

1.06 QUALITY CONTROL AND ASSURANCE

A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.

B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with

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construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.

C. Contractor Quality Control:

1. Sampling, Testing and Inspection:

- a. Hire an Independent Testing Agency Firm to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
- b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
- c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
- d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.

2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.

D. VTA Quality Assurance:

1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.07 MEASUREMENT AND PAYMENT

A. Measurement: Steel Reinforced Elastomeric Bearings will be measured by the individual unit (each).

B. Payment: The contract price paid per individual unit (each) for Steel Reinforced Elastomeric Bearings must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Steel Reinforced Elastomeric Bearings complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.

C. Full compensation for furnishing steel reinforced elastomeric bearing samples and proof testing said samples must be considered as included in the bid item for Steel Reinforced Elastomeric Bearings and no additional compensation will be allowed therefor.

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PART 2 - PRODUCTS

2.01 TYPES OF BEARING PADS

- A. Steel-Reinforced Elastomeric Bearing Pads: Steel-reinforced elastomeric bearing pads must comply with the specifications for steel-laminated elastomeric bearings in ASTM D4014 and the following:
1. Bearing pads must consist of alternating steel laminates and internal elastomer laminates with top, bottom, and side elastomer covers. Steel laminates must have a nominal thickness of 0.075 inch (14 gauge). Internal elastomer laminates must have a thickness of 1/2 inch. Top and bottom elastomer covers must each have a thickness of 1/4 inch. The combined thickness of internal elastomer laminates and top and bottom elastomer covers must be equal to the bearing pad thickness shown. The elastomer cover to the steel laminates at the sides of the bearing must be 1/8 inch. If guide pins or other devices are used to control the side cover over the steel laminates, any exposed portions of the steel laminates must be sealed by vulcanized patching.

2.02 MATERIALS

- A. Elastomer: Virgin crystallization-resistant polychloroprene (neoprene) must be the only polymer in the elastomeric compound and must not be less than 60 percent by volume of the total compound. The elastomer must comply with ASTM D4014, Type CR, Grade 3, with a shear modulus of 110, plus or minus 10, pounds per square inch. Physical requirements of the elastomeric compound include the following:
1. The elastomer must comply with the requirements shown in the following table:

Quality characteristic	Test method	Requirement
Tensile strength (minimum, psi)	ASTM D412	2,250
Ultimate elongation (minimum, percent)	ASTM D412	350
Compression set (maximum, percent, 22 hours at 70 degrees Celsius)	ASTM D395, Method B	25
Tear strength (minimum, kN/m)	ASTM D624, Die C	31.5
Hardness, Type A (points)	ASTM D2240 with 2 kg mass	55 plus or minus 5
Ozone resistance (20 percent strain, 100 hours at 40 plus or minus 2 degrees Celsius)	ASTM D1149 except 100 plus or minus 20 parts per 100,000,000	No cracks
Instantaneous thermal stiffening at -40 degrees Celsius	ASTM D1043	Not more than 4 times the stiffness measured at 23 degrees Celsius
Low temperature brittleness at -40 degrees Celsius	ASTM D746, Section 9.1.2	Pass

2. Heat Resistance: ASTM D573, 70 hours at 212 degrees Fahrenheit:

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- a. Change in durometer hardness: plus 10 points maximum.
 - b. Change in tensile strength: minus 15 percent maximum.
 - c. Change in ultimate elongation: minus 40 percent maximum, but not less than 300 percent total elongation of the material.
- B. Steel Laminates: Steel for internal reinforcement laminates must conform with the following requirements as indicated:
- 1. Steel sheet conforming to ASTM A1011/A1011M, Designation SS, Grade 33 or 36, or ASTM A1008/A1008M, Designation SS, Grade 33 or 40.
 - 2. Steel laminates must have a nominal thickness of 0.075 inch (14 gauge).
- C. Adhesive: Adhesive for the bonding of bearing pads to concrete and steel bearing surfaces must comply with Federal Specification MMM-A-121.
- D. Sheet Metal: Sheet metal must be commercial-quality galvanized sheet steel, smooth and free of kinks, bends, or burrs. Joints must be butt joints sealed with plastic, duct-sealing tape.
- E. Silicone Grease: Silicone grease must comply with SAE AS8660.
- 2.03 FABRICATION**
- A. Laminated steel bearing pads must conform to the applicable requirements of ASTM D4014.
- B. Pads 1/2 inch or less in thickness must be either all elastomer or laminated. Pads over 1/2 inch thick must be laminated. Stacking of individually laminated pads to attain thicknesses over 1/2 inch or the cold bonding of individual pads is not acceptable.
- C. Laminated pads must have reinforcement every 1/2 inch through the entire thickness. Reinforcement must be parallel to the top and bottom surfaces of the pad. Elastomer and reinforcement together must not exceed 1/2 inch in thickness per lamination.
- D. Laminated bearing pads must be molded as a single unit under pressure and heat. Bonding of elastomer to reinforcement laminates must be carried out during molding. Elastomer at outer edges of bonds to external load plates must be shaped to avoid stress concentrations.
- E. Internal steel laminates must be free of sharp edges. Top and bottom steel laminates must be covered uniformly with 1/4 inch of elastomer. Sides must be covered uniformly with 1/8 inch of elastomer.
- F. External load plates must be protected from rusting.
- G. Comply with ASTM D4014 for fabrication tolerances.
- H. The combined thickness of internal elastomer laminates plus top and bottom elastomer covers, and excluding the steel laminates, must be equal to the bearing pad thickness shown on the plans.
- I. Total bearing thickness must be equal to the sum of the thicknesses of the elastomeric laminates and covers and the steel laminates.

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2.04 PROOF TESTING

- A. The Independent Testing Agency must test a specimen taken from the test sample for tensile strength, elongation, and strength, in accordance with the test methods specified in Article 2.02A herein. Specimens must show no loss of bond between the steel and elastomer laminates.
- B. Elastomeric bearing pads not complying with the requirements specified herein will be rejected by VTA.
- C. Elastomeric bearing pads must not be installed in the Work until approved by VTA.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install elastomeric bearing pads at locations indicated in accordance with indicated details.
- B. Apply adhesive to clean concrete bearing surface to a minimum thickness of 1/8 inch, and set bearing pads on adhesive bed as indicated.
- C. Mix and apply the adhesive under the manufacturer's instructions.
- D. Notify the Engineer of the type of bearing pad to be used before constructing the bearing seats. The bearing seat elevation must correspond to the selected bearing thickness.
- E. Lubricate the upper surface of the elastomeric bearing pads with a uniform film of silicone grease before placing the sheet metal cover at the following locations:
 - 1. Bearing pads at Abutment 1 of Capitol Aerial Guideway.
 - 2. Bearing pads at Abutment 76 of Capitol Aerial Guideway.
- F. Lubricate the lower surface of the elastomeric bearing pads with a uniform film of silicone grease at the following locations:
 - 1. Bearing pads at Story Station Pedestrian Overcrossing.
- G. Do not allow grout or concrete seepage into the sliding surface during concrete placement.
- H. Where shown on the plans, bond the bearing pad to steel or concrete surfaces, as specified. Surfaces where adhesive is to be applied must have a cloth finish or a buffed finish. Surfaces must be clean and dry when the adhesive is applied. Apply the adhesive to the neoprene sheet and substrate at the manufacturer's recommended rate. Let the adhesive dry to an aggressive tack. Apply the sheet to the substrate surface and roll in both directions to obtain a tight bond.

END OF SECTION 03 15 15

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Steel reinforcing bars.
 2. Galvanized reinforcing bars.
 3. Wire and spiral reinforcement.
 4. Welded steel wire fabric.
 5. Steel bar mats.
 6. Tie wire.
 7. Accessories
 8. Welding Electrodes
 9. Mechanical Splice Couplers
 10. Welded splices
 11. Headed bar reinforcing.

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 30 00, Cast-in-Place Concrete
- D. Section 03 41 00, Structural Precast Concrete
- E. Section 05 05 60, Metal Welding
- F. Section 05 17 00, Miscellaneous Metal
- G. Section 31 62 00, Driven Piles
- H. Section 31 63 29, Drilled Concrete Piers and Shafts
- I. Section 31 66 17, Mechanically Stabilized Earth Walls
- J. Section 32 35 20, Sound Barrier on Structures
- K. Section 33 40 00, Storm Drainage Utilities

1.03 REFERENCED STANDARDS

- A. American Concrete Institute (ACI):

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1. ACI 301 Specifications for Structural Concrete for Buildings
 2. ACI 318 Building Code Requirements for Structural Concrete
 3. ACI 439.3R Mechanical Couplers
 4. ACI SP-66 ACI Detailing Manual
- B. ASTM International (ASTM):
1. ASTM A184/A184M Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
 2. ASTM A370 Test Methods and Definitions for Mechanical Testing of Steel Products
 3. ASTM A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 4. ASTM A706/A706M Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement
 5. ASTM A767/A767M Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
 6. ASTM E8/E8M Test Methods of Tension Testing of Metallic Materials
 7. ASTM E165/E165M Test Method for Liquid Penetrant Examination
 8. ASTM A970/A970M Specification for Headed Steel Bars for Concrete Reinforcement
 9. ASTM A1064/A1064M Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- C. American Welding Society (AWS):
1. AWS D1.4/D1.4M Structural Welding Code - Reinforcing Steel (2018)
 2. AWS C6.1 Recommended Practices for Friction Welding
- D. Concrete Reinforcing Steel Institute (CRSI):
1. CRSI Manual of Standard Practice
 2. CRSI, Placing Reinforcing Bars
- E. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:
1. Section 52 Reinforcement
- F. State of California, Department of Transportation (Caltrans):
1. California Test 670 Method of Tests for Mechanical and Welded Reinforcing Steel Splices
- 1.04 DEFINITIONS**
- A. Affected Zone: Portion of the reinforcing bar where any properties of the bar, including the physical, metallurgical, or material characteristics, have been changed by either of the following:
1. Fabrication or installation of a splice. The weld and one inch adjacent to the weld is part of the affected zone.
 2. Manufacturing process for headed bar reinforcement.
- B. Group: Set of five or fewer consecutive lots after the first lot.
-

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- C. Lot:
1. 150 count, or fraction thereof, of the same type of mechanical splice coupler model for each bar size, bar deformation pattern, and hoop diameter.
 2. 150 count, or fraction thereof, of complete joint penetration butt-welded splices or resistance-butt-welded splices for each bar size and hoop diameter.
 3. 150 count, or fraction thereof, of headed bar reinforcement for each bar size, head size, head type, method of manufacture, head number of bar material, and head number of head material. A reinforcing bar with a head on each end is counted as 2 headed reinforcing bars for establishing and testing production lots.
- D. Service Splice: Mechanical coupler splice, resistance-butt-welded splice, or complete joint penetration butt-welded splice capable of developing a minimum tensile strength of 80,000 pounds per square inch.
- E. Ultimate Butt Splice: Mechanical coupler splice, resistance-butt-welded splice, or complete joint penetration butt-welded splice capable of demonstrating necking as specified in California Test 670 as either of the following:
1. Except for 30-inch and smaller diameter hoops, for “Necking Option I,” the test sample must fracture in the reinforcing bar outside of the affected zone and show visible necking. For 30-inch and smaller diameter hoops, the test sample must show visible necking at fracture at any location.
 2. For “Necking Option II,” the largest measured strain must be at least six percent for no. 11 and larger bars and nine percent for no. 10 and smaller bars.

1.05 SUBMITTALS

- A. General: Submittals for concrete reinforcing must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Reinforcement Shop Drawings: Reinforcement Shop Drawings must be prepared in accordance with the requirements of ACI SP-66 and must show diagrammatic elevations and plans of superstructure, walls, footings, columns, beams, slabs, and the like, at a scale sufficiently large to show clearly the positions and erection marks of reinforcing bars, dowels, and splices. Shop Drawings must also show details for congested areas and connections. Shop Drawings used in field must be reviewed copies.
1. Submit bar lists, bending diagrams and schedules, and placement plans and details for all reinforcing steel. Bar lists must include weights.
 2. Indicate descriptions, details, dimensions, arrangements and assemblies, and locations of reinforcing steel. Include number of pieces, sizes, and markings of reinforcing steel, laps and splices, supporting devices and accessories, and any other information required for fabrication and placement. Indicate any adjustments required as specified in Article 1.06.B herein.
 3. Check plans for anchor bolt schedules and locations, anchors, hangers, inserts, conduits, sleeves, blockouts, and any other items to be cast in concrete for possible interference with reinforcing steel. Indicate required clearances on Shop Drawings.
 4. Detail reinforcing steel in accordance with requirements of the ACI SP-66. Indicate individual weight of each bar, total weight of each bar size, and total weight of all bars on the list. Base calculated weights upon nominal weights specified in ACI 318, Appendix on Steel Reinforcement Information.
 5. For mechanical splice couplers furnish the following:

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- a. Certified test reports showing that the couplers meet all of the specified requirements.
 - b. Written assembly and installation instructions for each type, model and bar size for which the coupler is designed. Installation instructions must include typical installation sequence, recommended installation tools, guidelines for laboratory testing of couplers and coupler size designations with corresponding range of bar sizes.
 - c. Reports showing the results of all tests.
6. Shop Drawings for all reinforcement work required in the Contract Documents must be submitted in one submittal. Reinforcement Shop Drawings that do not include all work required by the Contract Documents will be considered incomplete and will be returned to the Contractor for resubmittal.
 7. Shop Drawings must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.
- C. Product Data:
1. Submit manufacturers' product data, installation instructions, and testing recommendations for proprietary manufactured materials and reinforcement accessories.
 2. Submit manufacturers' product data, installation instructions, and testing recommendations for proprietary mechanical coupler splicing systems when such splicing methods are permitted.
 3. Product data must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.
- D. Samples:
1. When galvanized reinforcing bars are indicated, furnish two 30-inch long test samples and two additional test samples bent to minimum radius of the rebar from each size and lot shipped to the Worksite.
 - a. Before furnishing test samples, securely bundle and package the test samples in a way that preserves their condition during transportation, identify each test sample by shipment and Contract number using weatherproof markings, and attach to the test samples a completed identification card that identifies the lot number, the date and location where the sample was taken, the intended use of the materials the sample represents, the container the sample was sent in, and the manufacturer of the material.
 2. Samples must be representative of the materials furnished. These samples, as well as any additional random samples taken by VTA, may be tested for specification compliance.
 3. Failure of any sample to meet specification requirements must be cause for rejection of that lot.
- E. Certificates:

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1. For each lot or load of reinforcing steel delivered to the Worksite, furnish mill certificates or test reports of compliance or similar certification, certifying the grades and physical and chemical properties of the reinforcing steel and conformance with applicable ASTM Specifications, including ASTM A370, Method A9.
 - a. Mill certificates must include name of mill, date of rolling, and date of shipping to fabricator and must be signed by the fabricator certifying that each material complies with or exceeds the specified requirements. A mill certificate must be furnished with each lot of material delivered to the Project and the lot must be clearly identified in the certificate.
 2. For galvanized reinforcing bars, furnish certificates of compliance in accordance with ASTM A767/A767M. Include all certifications specified in ASTM A767/A767M.
 3. For welders, furnish welding certificates or affidavits attesting to the welders' qualifications to perform the indicated welding in accordance with the requirements of Section 05 05 60, Metal Welding.
 4. Submit a certificate of compliance for each shipment of headed bar reinforcement. Include with the submittal copies of mill test reports for bar reinforcement and head material, quality control test reports, and daily production logs.
 5. Submit a certificate of compliance for each shipment of reinforcing or hoops shipped to the field with service splices or ultimate butt splices. Include with the submittal the following information:
 - a. Type or series identification of the splice material, including tracking information for traceability.
 - b. Grade and size number of reinforcement to be spliced.
 - c. Statement that the splice material complies with the type of mechanical splice on the Caltrans Authorized Material List for steel reinforcing couplers.
 - d. Additionally, for resistance-butt-welded material, include the heat number, lot number, and mill certificates.
- F. Quality Control Test Reports:
1. Submit a quality control test report for each lot of headed bar reinforcement. Each quality control test report must include the lot number, bar size, type of headed bar reinforcement, physical condition of each test sample, notable defects on any test sample, affected zone limits of each test sample, location of visible necking area on each test sample, and ultimate strength of each test sample.
 - a. The headed bar quality control test report must be prepared by the laboratory performing the testing and signed by an engineer representing the laboratory. The engineer representing the laboratory must be currently registered as a civil engineer in the State of California.
 2. Submit a quality control test report for each lot of reinforcing or hoops shipped to the field with service splices and ultimate butt splices. Each quality control test report must include the following:
 - a. Group number, lot number, and location
 - b. Bar size
 - c. Splice type
 - d. Mechanical splice length
 - e. Location of fracture

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- f. Test specimen length
 - g. Physical condition of splice test sample
 - h. Notable defects
 - i. Total measured slip
 - j. Ultimate tensile strength of each splice
 - k. Additionally for ultimate butt splices, include the location of visible necking area and the largest measured strain.
 - l. The splicing quality control test report must be prepared by the laboratory performing the testing and signed by an engineer representing the laboratory. The engineer representing the laboratory must be currently registered as a civil engineer in the State of California.
 - m. Allow three days for the Engineer's review.
- G. Splice Rejection Mitigation Report: If a lot of service splices or ultimate butt splices is rejected, prepare a splice rejection mitigation report for that rejected lot as specified herein. The splice rejection mitigation report must describe the following items:
- 1. Cause of the failure
 - 2. Method used to identify the cause of failure
 - 3. Identification of affected lots
 - 4. Provisions for preventing similar failures in future lots
 - 5. Procedure for repairing or replacing the splices in the rejected lot
 - 6. Allow three days for the Engineer's review.
- H. Prequalification Reports:
- 1. If any part of the headed reinforcing bar is fabricated in the field, submit a prequalification report that includes a copy of the manufacturer's product literature giving complete data on the head material and installation procedures, names of the individuals who will be performing the fabrication, descriptions of the positions, locations, equipment, and procedures that will be used in the work, certified quality control test results, certifications from the fabricator for welder and procedure prequalification, and the manufacturer's Quality Control Process Control Manual.
 - 2. For each bar size of each coupler model of service splice or ultimate butt splice to be used in the work, submit a splice prequalification report that includes a copy of the manufacturer's product literature giving complete data on the splice material and installation procedures, the names of the operators who will be performing the splicing, descriptions of the positions, locations, equipment, and procedures that will be used in the work, certified test results from the authorized laboratory for the prequalification splice test samples, certifications from the fabricator for operator and procedure prequalification, and the Manufacturer's Quality Control Process Control Manual.
- I. Welding Quality Control Plan: Develop and submit a Welding Quality Control Plan for service and ultimate butt splicing of reinforcing in accordance with Section 05 05 60, Metal Welding.
- J. Temporary Support System:
- 1. If a portion of an assemblage of bar reinforcing steel exceeds 20 feet in height and is not encased in concrete, submit Shop Drawings and design calculations for a temporary support system.
 - 2. Temporary support system Shop Drawings and calculations must be sealed and signed by an engineer who is currently registered as a civil engineer in the State of California.

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3. The temporary support system must be designed to resist all expected loads and prevent the collapse or overturning of the cage.
4. If form installation or other work requires changes to or the temporary release of any part of the temporary support system, the Shop Drawings must show the support system to be used during these changes or the temporary release.
5. The minimum horizontal wind load to be applied to the reinforcing steel assemblage or to a combined assemblage of reinforcing steel and forms must be the sum of the products of the wind impact area and the applicable wind pressure value for each height zone. The wind impact area is the total projected area of the assemblage normal to the direction of the applied wind. Determine wind pressure values using the following table:

Wind Pressure	
Height zone, H (feet above ground)	Wind pressure value (pounds per square foot)
$0 \leq 30$	20
$30 < H \leq 50$	25
$50 < H \leq 100$	30
$H > 100$	35

1.06 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
 1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 3. Welding Quality Control:

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- a. Develop a Welding Quality Control Plan for service and ultimate butt splicing of reinforcing in accordance with Section 05 05 60, Metal Welding.
 - b. Before performing any complete joint penetration butt welds, qualify welders and welding procedures in accordance with Section 05 05 60, Metal Welding.
 - c. Qualify welders and welding procedures on splice test samples of the type to be used in the work.
4. Splice Operator and Procedure Prequalification:
- a. Before performing any service or ultimate butt splicing, obtain certifications from the fabricator for prequalification of the operators and the procedures to be used in the work.
 - b. For each bar size of each splice coupler model type to be used, each operator must prepare four prequalification splice test samples in accordance with California Test 670.
 - c. Splice test samples must have been prepared and tested no more than two years before the submittal of the splice prequalification report.
 - d. Splice test samples and testing must comply with the quality control testing requirements specified in section 52-6.01D(4)(b) of the Caltrans Standard Specifications for the type of splice to be used in the work.
- D. VTA Quality Assurance:
1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.
- E. Tolerances:
1. Fabrication: Fabricate bars to meet the following tolerances:
 - a. Sheared length: plus or minus 1 inch.
 - b. Depth of truss bars: plus 0, minus 1/2 inch.
 - c. Overall dimensions of stirrups, ties and spirals: plus or minus 1/2 inch.
 - d. All other bends: plus or minus 1 inch.
 - e. Fabrication tolerances not indicated on the plans or specified above must comply with the applicable requirements of ACI 301 and CRSI Manual of Standard Practice, Chapter 7.
 2. Placement: Place bars to the following tolerances:
 - a. Clear distance to formed surfaces: plus or minus 1/4 inch.
 - b. Minimum spacing between bars: minus 1/4 inch.
 - c. Top bars in slabs and beams:
 - 1) Member 8 inches deep or less: plus or minus 1/4 inch.
 - 2) Member greater than 8 inches, but less than 2 feet deep: plus or minus 1/2 inch.
 - 3) Members 2 feet or more deep: plus or minus 1 inch.

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- d. Crosswise of members: spaced evenly within 2 inches.
 - e. Lengthwise of members: plus or minus 2 inches.
 - f. Placement tolerances not indicated on the plans or specified above must comply with the requirements of ACI 301, ACI 318, or CRSI Manual of Standard Practice, as applicable.
- F. Adjustments: Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or in excess of the above tolerances, the resulting arrangement of bars must require VTA's approval. Minimum spacings must not be decreased, and the required number of bars must be placed. Bars moved to permit access for cleanup operations must be properly replaced and secured before the start of concrete placement.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver reinforcing bars to the fabricator in bundles, limited to one size and length of bar, securely tied and identified with plastic tags in an exposed position indicating the mill, the melt or heat number, and the grade and size of bars.
- B. Deliver steel reinforcement to the Worksite, store, and cover in a manner which will ensure that no damage must occur to it from moisture, dirt, grease, oil, or other cause which might impair bond with concrete.
- C. Deliver steel reinforcement to the Worksite properly tagged and identified, as specified herein in Article 2.03, in accordance with approved Shop Drawings.
- D. Handle and store galvanized reinforcement in a manner which will prevent damage to the coatings.
- E. Maintain identification of steel reinforcement after bundles are broken.
- F. Remove all unidentified reinforcing steel, anchorage assemblies, and bar couplers received at the Worksite.

1.08 MEASUREMENT AND PAYMENT

- A. Measurement:
 - 1. Bar Reinforcing Steel of the various types listed in the Schedule of Quantities and Prices, must be measured by the pound.
 - a. Bar reinforcing steel involved in constructing Story Station Access Structures must be measured as Bar Reinforcing Steel (Access Structure), unless it is included in a separate bid item.
 - b. Bar reinforcing steel involved in constructing Story Station Pedestrian Overcrossing must be measured as Bar Reinforcing Steel (Pedestrian Overcrossing), unless it is included in a separate bid item.
 - c. Bar reinforcing steel involved in constructing the station platform, walkway stairs and ramp structures, and the Signals/Communication House at Eastridge Station must be measured as Bar Reinforcing Steel (Station), unless it is included in a separate bid item.
 - d. Bar reinforcing steel involved in constructing cast-in-place approach walls to Capitol Aerial Guideways and cast-in-place retaining wall at the southeast corner of Capitol Expressway/Cunningham Avenue must be measured as Bar Reinforcing Steel (Cast-in-Place Retaining Wall), unless it is included in a separate bid item.

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- e. Bar reinforcing steel involved in constructing Capitol Aerial Guideway must be measured as Bar Reinforcing Steel (Bridge), unless it is included in a separate bid item.
 - f. Bar reinforcing steel involved in constructing the Signal/Communications House at Story Station must be measured as Bar Reinforcing Steel (Bridge), unless it is included in a separate bid item.
 - g. Bar reinforcing steel involved in bridge work is measured as Bar Reinforcing Steel (Bridge), unless it is included in a separate bid item.
 - h. Bar reinforcing steel involved in constructing TPSS #33 and TPSS #34 must be measured as Bar Reinforcing Steel (TPSS), unless it is included in a separate bid item.
 - i. Bar reinforcing steel involved in constructing sound wall must be measured as Bar Reinforcing Steel (Sound Wall), unless it is included in a separate bid item.
 - j. Weights of bar reinforcing steel must be determined from computations based on the nominal weights listed in ACI 318, Appendix on Steel Reinforcement Information.
 - k. For galvanized reinforcements, the weights of the zinc coating will not be included.
 - l. Laps of bars for splices indicated must be measured for payment, including locations where you use a continuous bar instead of the splice shown. Splices for Contractor's convenience will not be measured for payment. When bars are spliced by welding, the weight for payment will be as computed for lapped splices.
 - m. Wire Reinforcement:
 - 1) The cross sectional area of reinforcing wire, in hundredths of square inches, is equal to its W-size number. The density of reinforcing wire is 0.2833 pounds per cubic inch.
 - 2) Welded wire reinforcement must be measured based on the measured area covered by the reinforcement and does not include laps.
 - n. Reinforcing bar used for headed bar reinforcement is paid for as Bar Reinforcing Steel of the various types listed in the Schedule of Quantities and Prices, as specified herein. The length of bar used in calculating the weight of reinforcing bar is the entire length of the completed headed bar, including the head thickness.
 - o. If alternative transverse deck reinforcement placement details are shown, the measurement must be based on the detail that shows truss bars.
2. Headed Bar Reinforcement must be measured by the individual unit (each), measured by the quantity of heads.
- a. Reinforcing bar used for headed bar reinforcement is paid for as Bar Reinforcing Steel of the various types listed in the Schedule of Quantities and Prices, as specified herein. The length of bar used in calculating the weight of reinforcing bar is the entire length of the completed headed bar, including the head thickness.
 - b. If alternative headed bar reinforcing details are shown on the drawings, the measurement for payment must be based on the detail without headed bar reinforcing.

B. Payment:

- 1. The contract price paid per pound for Bar Reinforcing Steel of the various types listed in the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Bar Reinforcing Steel complete in place, as shown on the drawings, as specified in these

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- Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
2. The contract price paid per individual unit (each) for Headed Bar Reinforcement must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Headed Bar Reinforcement complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
- C. Full compensation for providing bar reinforcing steel for concrete barrier slabs at the North Approach Walls must be considered as included in the bid item for Barrier Slab and no additional compensation will be allowed therefor.
- D. Full compensation for providing bar reinforcing steel for concrete approach slabs at the aerial guideway must be considered as included in the bid item for Structural Concrete (Approach Slab) and no additional compensation will be allowed therefor.
- E. Full compensation for providing bar reinforcing steel for precast concrete girders, including diaphragm dowels and bolts in precast concrete girders, must be considered as included in the bid item for Furnish Precast Prestressed Concrete Girder (CA WF72PT) and no additional compensation will be allowed therefor.
- F. Full compensation for providing bar reinforcing steel for concrete masonry unit construction must be considered as included in the bid item for Mechanically Stabilized Earth Walls and no additional compensation will be allowed therefor.
- G. Full compensation for providing bar reinforcing steel for concrete face panels of mechanically stabilized earth (MSE) retaining walls, must be considered as included in the bid item for Mechanically Stabilized Earth Walls and no additional compensation will be allowed therefor.
- H. Full compensation for providing bar reinforcing steel, including spirals, for precast prestressed concrete piles must be considered as included in the bid item for Furnish Precast Prestressed Concrete Piling of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
- I. Full compensation for providing bar reinforcing steel, including spirals, for steel pipe piling less than 24 inches in diameter must be considered as included in the bid item for Furnish Steel Pipe Piling of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
- J. Full compensation for providing bar reinforcing steel, including spirals, for cast-in-drilled-hole concrete piling less than 24 inches in diameter must be considered as included in the bid item for Cast-In-Drilled-Hole Concrete Piling of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
- K. Full compensation for providing bar reinforcing steel for concrete sound barrier at aerial guideway and guideway approach walls must be considered as included in the bid item for Sound Barrier and no additional compensation will be allowed therefor.
- L. Full compensation for providing bar reinforcing steel for concrete barriers, curbs, gutters, and walks must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

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- M. Full compensation for providing and constructing clips, ties, bar supports, dowels, spacers, chairs, or other devices for holding bar reinforcing steel in place, including zinc coatings, must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.
- N. Full compensation for additional bar reinforcing steel for splices permitted by VTA for Contractor's convenience must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.
- O. Full compensation for reinforcing steel and accessories, including zinc coatings, required for lump sum items must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel Reinforcing Bars:
 - 1. Reinforcing bars must be deformed bars complying with ASTM A706/A706M, Grade 60, with the following exceptions:
 - a. Plain bars complying with ASTM A706/A706M, Grade 60, may be used for spiral or hoop reinforcement in structures and concrete piles.
 - b. Reinforcing bars for furnishings, sign foundations, minor structures, mechanically stabilized earth (MSE) concrete panels, underground ductwork and structures for facility services, utility structures, and storm drainage utilities may be deformed bars complying with ASTM A615/A615M, Grade 60, unless otherwise specified.
 - c. Reinforcing bars for Type 60MD and Type 60MD (modified) concrete barriers may be deformed or plain bars complying with ASTM A615/A615M, Grade 60 or Grade 40, unless otherwise specified.
 - 2. Weights of Bars: Refer to ACI 318, Appendix on Steel Reinforcement Information.
- B. Galvanized Reinforcing Bars: ASTM A706/A706M, galvanized in accordance with ASTM A767/A767M, Class I, except chromating is not required. Bars must be cut and bent cold before galvanizing.
- C. Reinforcing Wire: ASTM A1064/A1064M for plain wire.
- D. Welded Wire Reinforcement: ASTM A1064/A1064M.
- E. Steel Bar Mats: ASTM A184/A184M, using ASTM A706/A706M, Grade 60 deformed bars, sizes and spacings of members as indicated, welded or clipped at intersections.
- F. Accessories: Provide reinforcement accessories, consisting of bar supports, spacers, hangers, chairs, ties, and similar items as required for spacing, assembling, and supporting reinforcement in place. Conform with CRSI referenced standards and the following requirements:
 - 1. For footings, grade beams, and slabs on grade, provide supports with precast concrete or mortar bases or plates or horizontal runners where wetted base materials will not support chair legs.

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2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms or are in close proximity to finish surfaces, provide supports with legs which are galvanized, plastic-protected, or stainless steel.
 3. For galvanized reinforcement, provide all galvanized accessories.
- G. Tie Wire: No. 16 gage or heavier, black or galvanized, soft or commercial grade steel tie wire. For galvanized reinforcement, provide zinc-coated wire. Where tie wire is in close proximity to finish surfaces of exposed-to-view concrete, provide soft stainless steel wire.
- H. Welding Electrodes: Welding electrodes must be in accordance with AWS D1.4/D1.4M.
- I. Splices: The total slip of service splices or ultimate butt splices must not exceed the values shown in the following table when tested in accordance with California Test 670:

Total Slip	
Reinforcing bar no.	Total slip (inch)
4	0.020
5	0.020
6	0.020
7	0.028
8	0.028
9	0.028
10	0.036
11	0.036
14	0.048
18	0.060

- J. Mechanical Splice Coupler:
1. System Description: Provide bar-splicing connections, produced by threaded reinforcing bar ends and threaded coupler, or by sleeves hydraulically pressed or forged onto butt-ended reinforcing bars, or by other proprietary mechanical splicing method as proposed by the Contractor and approved by VTA. Mechanical splice couplers must be capable of being installed in the clear space indicated and to provide the required clearances.
 2. Mechanical splice couplers must conform to the requirements specified herein for service splices or ultimate butt splices, as shown on the plans or specified in these Technical Specifications. Splices not shown as requiring a service splice or an ultimate butt splice must comply with the specifications for service splices.
 3. Mechanical splice couplers must be on the Caltrans Authorized Material List for steel reinforcing couplers.
- K. Headed Reinforcing Bars: ASTM A970/A970M.
1. At fracture, headed bar reinforcement must comply with the tensile requirements of ASTM A970/A970M, Class A and show signs of visible necking in the reinforcing bar. The visible necking must be located at least one bar diameter away from the affected zone.
 2. Headed bar reinforcement must have full size heads and must be on the Caltrans Authorized Material List.
- L. Dowels:

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1. Reinforcing steel dowels must be deformed bars complying with the requirements for steel reinforcing bars, as specified herein.
2. Threaded rods used as dowels must comply with the requirements of Section 05 17 00, Miscellaneous Metal.

2.02 FABRICATION

A. Fabrication Standards: Fabrication of steel reinforcement must be in accordance with the plans, these Technical Specifications, and approved Shop Drawings. Where specific details are not indicated, comply with applicable requirements of ACI 301, ACI 318, and CRSI Manual of Standard Practice.

B. Cutting and Bending:

1. Cutting and bending must be performed at a central location, equipped and suitable for the purpose.
2. Bars must be accurately cut and bent as indicated. Bars must be bent cold. Heating of bars for bending or straightening is not permitted.
3. Bars must not be bent or straightened in any manner which will injure the material. Do not use bars with kinks or improper bends.
4. Hooks and bends must comply with ACI 318.
5. Label all bars in accordance with bending diagrams and schedules, and secure like pieces in bundles when appropriate.

C. Welding:

1. Welding of reinforcement, where indicated and approved, including preparation of bars and fabrication of any part of headed bar reinforcement, must conform with applicable requirements of AWS D1.4/D1.4M and AWS C6.1.
2. Welders must be prequalified in accordance with the requirements in Section 05 05 60, Metal Welding.
3. Equipment used to perform friction welding must be fitted with an in-process monitoring system to record essential production parameters that describe the process of welding the head onto the reinforcement. Record the friction welding force, forge force, rotational speed, friction upset distance and time, and forge upset distance and time.
4. Complete-Joint-Penetration (CJP) Butt-Welded Splices:
 - a. Complete-joint-penetration butt-welded splices must comply with AWS D1.4/D1.4M.
 - b. Use only the joint details and dimensions shown in Figure 3.2 of AWS D1.4/D1.4M except do not use the “Single V-Groove Weld with Split Pipe Backing” detail.
 - c. Make butt welds with multiple weld passes without an appreciable weaving motion using a stringer bead having a width at most 2.5 times the diameter of the electrode. Perform slagging between each weld pass. Weld reinforcement must not exceed 0.16 inch in convexity.
 - d. Electrodes for welding must have a minimum CVN impact value of 27 J at -4 degrees Fahrenheit.
 - e. For welding of bars complying with ASTM A 615/A 615M, Grade 40 or 60, the requirements of Table 5.2 of AWS D1.4 are superseded by the following:
 - 1) The minimum preheat and interpass temperatures must be 400 degrees Fahrenheit for Grade 40 bars and 600 degrees Fahrenheit for Grade 60 bars. Immediately after completing the welding, cover at least 6 inches of the bar on each side of the splice with insulated wrapping to control the rate of

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cooling. The insulated wrapping must remain in place until the bar has cooled below 200 degrees Fahrenheit.

- f. If welding different grades of reinforcing bars, the electrode must comply with the specifications for Grade 40 bar and the preheat must comply with the specifications for Grade 60 bar.
 - g. If any of the specified preheat, interpass, and post-weld cooling temperatures are not met, remove the weld and heat-affected-zone metal and reweld the splice.
 - h. Protect welding from air currents, drafts, and precipitation to prevent loss of heat or loss of arc shielding.
 - i. Do not direct butt splice reinforcing bars by thermitic welding.
5. Fabricators of resistance-butt-welded splices must be on the Caltrans Authorized Material List for steel reinforcing couplers.
- D. Repair of Damaged Coatings: Bars for galvanized reinforcement must be cut and bent cold before galvanizing. Galvanized coatings damaged by shipping, handling, cutting, bending, or installation must be repaired immediately as specified in ACI 301, and ASTM A767/A767M, ASTM A775/A775M, and ASTM D3963/D3963M, as applicable.
- 1. When the extent of coating damage prior to repair exceeds 2 percent of the bar or wire surface area in any one-foot length, repair of the bar or wire must not be allowed and the coated bar or wire must be rejected.

2.03 IDENTIFICATION

- A. Reinforcing steel must be bundled and tagged with grades and sizes, heat numbers, and suitable identification marks for checking, sorting, and placing. Sizes and mark numbers must correspond to placing Shop Drawings and schedules. Tags and markings must be water-resistant and must not be removed until steel reinforcement is placed in position.
- B. Tag each headed bar in a production lot to be shipped to the Worksite or precast plant in a way that allows accurate identification at the Worksite or precast plant.

2.04 SOURCE QUALITY CONTROL

- A. Contractor's Quality Control:
 - 1. The Contractor must notify VTA 48 hours prior to installation of mechanical splice couplers. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA if requested.
 - 2. Worksite and precast plant practices for galvanized bar reinforcement must comply with sections X1.3.1 through X1.3.12 of appendix X1 of ASTM A767/A767M for bar reinforcement, except replace the word "should" with "must."
 - 3. Headed Bar Reinforcement:
 - a. The Independent Testing Agency must tensile test headed bar reinforcement test samples in accordance with ASTM A970/A970M at a laboratory on the Caltrans Authorized Laboratory List.
 - b. A quality control test must consist of tensile testing four headed bar reinforcement test samples selected from each lot of completed headed bar reinforcement before shipping the lot to the Worksite or precast plant.

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- c. The Independent Testing Agency must not perform tests on test samples from bundles containing fewer than four test samples.
 - d. After completing fabrication of a lot of headed bar reinforcement and before shipping to the Worksite, notify the Independent Testing Agency that the lot is ready for testing. After receiving notification that lots are ready for quality control testing, the Independent Testing Agency must randomly select a minimum of four test samples to be removed from each lot and place tamper-proof markings or seals on the test samples.
 - e. Test samples must be 4 feet long for bar reinforcement sizes no. 9 and below and 6 feet long for bar reinforcement sizes no. 10 and above.
 - f. Before transporting test samples to the authorized laboratory, you must perform the following:
 - 1) Securely bundle and package the four test samples for each test in a way that preserves their condition during transportation
 - 2) Identify each test sample by lot number and Contract number using weatherproof markings
 - 3) Attach a completed identification card to each bundle that identifies the lot number, the date and location where the sample was taken, the intended use of the materials the sample represents, the container the sample was sent in, and the manufacturer of the material. Include copies of the certificates of compliance with the test samples.
 - g. Do not disturb tamper-proof marking or seal before testing. A test sample must be rejected if the tamper-proof marking or seal is disturbed before testing.
 - h. At fracture, headed bar reinforcement test samples must comply with the tensile requirements of ASTM A970/A970M, Class A and show signs of visible necking in the reinforcing bar. The visible necking must be located at least one bar diameter away from the affected zone.
 - 1) If only one test sample complies with the requirements, all headed bar reinforcement in the lot must be rejected.
 - 2) If only two test samples comply with the requirements, the Independent Testing Agency must perform one additional test on the same lot of headed bar reinforcement. This additional test must consist of tensile testing four test samples, randomly selected by the Independent Testing Agency and removed by the Contractor from the lot. If any of the four test samples from this additional test do not comply with the specified requirements, all headed bar reinforcement in the lot must be rejected.
 - 3) If three or more test samples comply with the requirements, all headed bar reinforcement in the lot will be accepted.
 - i. At least five calendar days before performing any testing at the authorized laboratory, notify VTA of the date of the testing, the location of the authorized laboratory where the tests will be conducted, and the number of lots to be tested.
 - j. Maintain a daily production log for the fabrication of headed bar reinforcement for each production lot. The log must include production lot numbers, number of bars in each production lot, heats of bar and head material used in each production lot, and fabrication records, including tracking and production parameters for welds or forgings.
4. Reinforcement Splices: Quality control testing includes total slip testing, service splice testing, and ultimate butt splice testing. Refer to Article 3.05, herein, for requirements.

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PART 3 - EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that surfaces, over or against which concrete is to be placed, are clean and in proper condition for placing reinforcement.
- B. Verify that items to be embedded in concrete inserts, sleeves, and block-outs are secured in place as required.
- C. Before concrete is placed, the reinforcement to be embedded must be free of mortar, oil, dirt, excessive mill scale and scabby rust, and other coatings that would destroy or reduce the bond.
- D. Prior to work of this Section, carefully inspect the installed work of other trades and verify that all work is sufficiently complete to permit the start of work in accordance with this Section and that the completed work of this Section will be in complete accordance with the plans and the approved Shop Drawings. In the event of discrepancy, immediately notify VTA in writing.
- E. In the event conduits, pipes, inserts, sleeves, or any other items interfere with placing the reinforcement as indicated on the plans or approved Shop Drawings, or as otherwise required, immediately notify VTA for review by the Structural Engineer of Record and obtain approval on procedure before placement of reinforcement is started.

3.02 PLACING

- A. **Placing Standards:** Reinforcing steel must be placed in accordance with the plans, approved Shop Drawings, and the applicable requirements of ACI 301, ACI 318, CRSI Manual of Standard Practice, and CRSI Placing Reinforcing Bars. Install reinforcement accurately and secure against movement, particularly under the weight of workers and the placement of concrete.
- B. **Reinforcing Supports:** Bars must be supported on precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, or other authorized devices of sufficient strength to resist crushing under applied loads. Supports must be accurately placed and securely fastened to steel reinforcement in place. Support legs of accessories in forms without embedding in the form surface. Hoops and stirrups must be accurately spaced and wired to the reinforcement. Do not use aluminum, plastic, or wood supports.
- C. **Placing and Tying:**
 - 1. Reinforcing steel must be installed in place, spaced, and securely tied or wired with tie wire at all splices and at crossing points and intersections in the positions indicated. Comply with requirements of CRSI Placing Reinforcing Bars, Chapter 10.
 - 2. Tie bundle bars together at not more than six-foot centers.
 - 3. Welding to secure or support rebar replacement is prohibited.
 - 4. Snap ties are acceptable for intermediate intersections.
 - 5. Rebending of bars on the job to fit different conditions must not be permitted. Point ends of wire ties away from adjacent form surfaces.
 - 6. Do not place bars on layers of fresh concrete as the work progresses.
 - 7. For column and pile bar reinforcing cages measuring 4 feet in diameter and larger:
 - a. Tie all reinforcement intersections with double wire ties on at least four vertical bars of each cage equally spaced around the circumference.

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- b. Tie at least 25 percent of remaining reinforcement intersections in each cage with single wire ties. Stagger tied intersections from adjacent ties.
 - c. Provide bracing to avoid collapse of the cage during assembly, transportation, and installation.
- D. Spacing:
- 1. The center-to-center spacing of parallel bars must be at least 2.5 times the bar diameter.
 - 2. The minimum clear distance between bundles of bars and adjacent bundles or single bars must comply with all of the following:
 - a. 1.5 times the maximum size of the coarse aggregate
 - b. 2 times the larger bar diameter for 2-bar bundles
 - c. 2.5 times the larger bar diameter for 3-bar bundles.
- E. Longitudinal Location of Bends and Ends of Bar: A maximum of plus or minus 3 inches from the indicated location will be permitted, provided that specified protective concrete cover at ends of members is not reduced by more than 1/2 inch.
- F. Adjust or relocate reinforcement in post-tensioned concrete during the installation of prestressing ducts or tendons as required to provide described clearances to the prestressing tendons, anchorages, jacks, and equipment. Obtain authorization from the VTA for any adjustments or relocations.
- G. Splices:
- 1. Lapped Splices:
 - a. Laps of splices must be securely tied together to maintain the alignment of the bars, to provide the required minimum clearances, and to transfer stress by bond.
 - b. Splices of alternate bars must be staggered a minimum clear offset of two feet between splices. Splices must be tied with tie wire, or splices may be lap welded in accordance with AWS D1.4/D1.4M.
 - c. Lapped splices are not permitted for No. 14 and No. 18 bars, hoops, reinforcing bars where you cannot provide a minimum clear distance of two inches between the splice and the nearest adjacent bar, or when specifically excluded by Contract provisions regardless of size.
 - d. For uncoated and galvanized reinforcing bars complying with ASTM A615/A615M, Grade 60, ASTM A706/A706M, or ASTM A767/A767M, Class 1, the length of lap splices must be at least:
 - 1) 45 diameters of the smaller bar spliced for reinforcing bars no. 8 or smaller
 - 2) 60 diameters of the smaller bar spliced for reinforcing bars nos. 9, 10, and 11
 - e. For reinforcing bars complying with ASTM A615/A615M, Grade 40, the length of lap splices must be at least:
 - 1) 30 diameters of the smaller bar spliced for reinforcing bars no. 8 or smaller
 - 2) 45 diameters of the smaller bar spliced for reinforcing bars nos. 9, 10, and 11
 - f. For splices in bundled bars, the length of the lap splices must be:

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- 1) Equal to the length of a single bar lap splice for bundles of two bars
 - 2) 1.2 times the length of a single bar lap splice for bundles of three bars
- g. Lap welded wire reinforcement such that the overlap between the outermost cross wires is at least the larger of the following:
- 1) 6 inches
 - 2) Spacing of the cross wires plus two inches
 - 3) Numerical value of the longitudinal wire size (W-size number) times 4.3 divided by the spacing of the longitudinal wires in inches
2. Mechanical Coupler Splices:
- a. Perform service splicing and ultimate butt splicing of mechanical splices in accordance with the coupler manufacturer's installation instructions, unless otherwise specified, and using the manufacturer's standard equipment, jigs, clamps, and other required accessories.
3. Spiral Reinforcement Splices: Splices must conform with applicable requirements of ACI 318 and as specified herein.
- a. End each unit of spiral reinforcement at both ends by lapping the spiral reinforcement on itself for at least 80 diameters followed by a 135-degree hook with a 6-inch tail hooked around an intersecting longitudinal bar or a mechanical lap splice coupler.
 - b. Discontinuities in spiral reinforcement may be made only where shown or authorized. The spiral on each side of a discontinuity or a lap splice is a separate unit. Where discontinuities in spiral reinforcement are not allowed, splice the spiral reinforcement.
 - c. Lap splices in spiral reinforcement must be lapped at least 80 diameters followed by a 135-degree hook with a 6-inch tail hooked around an intersecting longitudinal bar or a mechanical lap splice coupler.
4. Butt-welded or mechanical splices not shown on the plans as requiring a service splice or an ultimate butt splice must comply with the specifications for service splices.
5. Do not place splices at a location shown as a no-splice zone.
6. Reinforcing bars may be continuous where splices are shown. If splice locations are not shown, determine splice locations using commercial lengths where practicable.
7. Unless another option is shown, stagger splices in adjacent reinforcing steel. The minimum distance between staggered lap splices or staggered mechanical lap splices must be the same as the length specified for a lap splice in the largest bar. The minimum distance between staggered butt splices must be two feet measured between the splice midpoints along a line centered between the axis of the adjacent bars.
- H. Dowels: Provide dowels where indicated or required for connecting construction and for maintaining structural and reinforcement continuity. Dowels must be tied securely in place before concrete is deposited. Provide additional bars for proper support and anchorage where required. Do not bend dowels after embedment.
- I. Welded Wire Reinforcement:

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1. Welded wire reinforcement must be installed in lengths as long as practicable and must be wire-tied at all laps and splices. End laps must be offset in adjacent widths. Lap welded wire reinforcement in accordance with applicable requirements of ACI 318.
 2. Where required welded wire reinforcement must be secured in position with suitable supports, accessories, and tie wire as indicated and required to ensure against movement from workers and placement of concrete lift fabric as concrete is placed to assure proper embedment at position indicated.
 3. You may substitute welded wire reinforcement for reinforcing bars in the following items of work:
 - a. Slope paving and lined ditches
 - b. Retaining walls
 - c. Concrete barriers
 - d. Sidewalks, curbs, and gutters on structures
 - e. Nonstructural aesthetic additions
 - f. Culvert headwalls, end walls, and wing walls
 - g. Shotcrete
 - h. Deck overlays
 - i. Shear reinforcement stirrups in precast girders
 4. Substituted welded wire reinforcement must be on an equivalent area basis. The Engineer determines the exact location. If the welded wire reinforcement does not provide the required area of steel, supplement it with reinforcing bars.
 5. Roll welded wire reinforcement flat before placing concrete. Secure welded wire reinforcement in place with devices that prevent the reinforcement's vertical and transverse movement.
- J. Do not tack weld on reinforcing bars unless shown.

3.03 PROTECTIVE CONCRETE COVER

- A. Unless otherwise shown, reinforcement must have a 2-inch clear cover measured from the surface of the concrete to the outside of the reinforcement.
- B. Splice devices must have a clear cover of at least 1-3/4 inches measured from the surface of the concrete to the outside of the splice device. To provide the specified clear cover to reinforcement, adjust or relocate stirrups, ties, and other reinforcement or place additional reinforcement, if needed.
- C. Metal supports must have a clear cover of at least 1 inch. Do not consider protective coatings on metal supports when determining clear cover. Where the clear cover to reinforcement shown or determined by the Engineer exceeds the minimum specified clear cover, increase the clear cover for metal supports accordingly.

3.04 CLEANING

- A. Reinforcement at time of depositing concrete must be free of corrosion and coatings that may impair bond with concrete, such as form oil, mill scale, or loose deposits of rust and other corrosion.

3.05 FIELD QUALITY CONTROL

- A. Contractor Quality Control:

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1. Placement of Reinforcing Steel: The Independent Testing Agency must perform visual inspection of reinforcing steel in place, including bar supports, tied laps and intersections, welded wire reinforcement, and bar mats.
2. Worksite and precast plant practices for galvanized bar reinforcement must comply with sections X1.3.1 through X1.3.12 of appendix X1 of ASTM A767/A767M for bar reinforcement, except replace the word “should” with “must.”
3. Welds:
 - a. The Independent Testing Agency must perform the following inspection and testing:
 - 1) Visual inspection of reinforcing bar welds.
 - 2) Inspections and tests must be performed in accordance with the applicable requirements of AWS D1.4/D1.4M, Chapters 6 and 7 and AWS C6.1.
 - 3) Inspection of friction welding of headed bar reinforcing must be performed in accordance with AWS C6.1.
 - b. Equipment used to perform friction welding must be fitted with an in-process monitoring system to record essential production parameters that describe the process of welding the head onto the reinforcement. Record the friction welding force, forge force, rotational speed, friction upset distance and time, and forge upset distance and time.
4. Reinforcing Splices:
 - a. Quality control testing includes total slip testing, service splice testing, and ultimate butt splice testing.
 - b. The Independent Testing Agency must perform quality control testing, nondestructive testing, and reporting in accordance with Section 52-6.01D(4), “Quality Control,” of the Caltrans Standard Specifications. The quality control splice test samples must be tested at a laboratory on the Caltrans Authorized Laboratory List.
 - c. At least five calendar days before performing any testing at the authorized laboratory, notify VTA of the date of the testing, the location of the authorized laboratory where the tests will be conducted, the number of lots to be tested, and the group number of each lot.
 - d. Reinforcing splices not complying with the requirements of these Technical Specifications and Section 52-6.01D(4), “Quality Control,” of the Caltrans Standard Specifications must be rejected.
 - e. Before performing service splice or ultimate butt splice testing, the Independent Testing Agency must perform total slip testing on the service splice or ultimate butt splice test samples as specified herein.
 - f. Before transporting splice test samples to an authorized laboratory, you must perform the following:
 - 1) Securely bundle and package the four test samples for each test in a way that preserves their condition during transportation
 - 2) Identify each splice test sample by location, lot number, and Contract number using weatherproof markings
 - 3) Attach a completed identification card to each bundle that identifies the lot number, the date and location where the sample was taken, the intended use of the materials the sample represents, the container the sample was sent in, and the owner or manufacturer of the splice.

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- g. Total Slip Testing:
 - 1) Except for mechanical lap, welded, or hoop splices, the Independent Testing Agency must test one of the four splice test samples for total slip in accordance with California Test 670.
 - 2) If the splice test sample exceeds the total slip value specified Article 2.01I, herein, the Independent Testing Agency must test the three remaining test samples for total slip in accordance with California Test 670. If any of the three remaining test samples exceed the specified total slip value, all splices in the lot must be rejected.

- h. Service Splice Testing:
 - 1) The Independent Testing Agency must perform service splice testing. A service splice test consists of preparing and testing four splice test samples for each lot of completed splices in accordance with Section 52-6.01D(4), “Quality Control,” of the Caltrans Standard Specifications.

- i. Ultimate Butt Splices:
 - 1) After completing the ultimate butt splices in a lot, notify the Independent Testing Agency that the splices are ready for testing. After being notified, the Independent Testing Agency must randomly select four splice test samples to be removed and must place tamper-proof markings or seals on the test samples.
 - 2) Do not disturb the tamper-proof marking or seal before testing. A test sample must be rejected if the tamper-proof marking or seal is disturbed before testing.
 - 3) Except for hoops, the Independent Testing Agency must select splice test samples at the Worksite or precast plant. The Independent Testing Agency must select hoop splice test samples at the Worksite, precast plant, or fabrication plant.

- j. For reinforcing bars where splice test samples were removed, replace the removed portion of the bar or hoop using mechanical ultimate butt splices or replace the bar or hoop in kind.

- k. If an acceptance test result does not comply with the material and quality control requirements specified in Section 52-6.01D(4), “Quality Control,” of the Caltrans Standard Specifications, then all splices in the lot and the group must be rejected. If a lot of splices is rejected, prepare and submit a splice rejection mitigation report for that rejected lot as specified in Article 1.04G, herein.
 - 1) For the other lots in the rejected group that pass quality control testing, the Independent Testing Agency may perform additional acceptance testing for additional splice samples. If an acceptance splice test result complies with the material and quality control requirements, all splices in that lot will be accepted.

- l. If a lot of splices is rejected, do not use the rejected lot or any subsequent lots until:
 - 1) The Quality Control Manager has performed a complete review of your quality control process for these splices

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- 2) You have prepared a splice rejection mitigation report as specified in Article 1.04G, herein
- 3) The Engineer has notified you that the splice rejection mitigation report is authorized

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Conveying and placing concrete
 2. Placement under water
 3. Consolidation
 4. Construction joints
 5. Expansion and contraction joints (control joints)
 6. Curing and protection
 7. Magnesium phosphate concrete (rapid setting concrete)
 8. Drill and bond dowels
 9. Reinforced concrete approach slabs
 10. Structure approach drainage system
 11. Barriers slabs

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 05 15, Portland Cement Concrete
- D. Section 03 11 00, Concrete Formwork
- E. Section 03 11 14, Falsework
- F. Section 03 11 16, Architectural Cast-in-Place Concrete Forming
- G. Section 03 15 13, Waterstops
- H. Section 03 20 00, Concrete Reinforcing
- I. Section 03 35 00, Concrete Finishing
- J. Section 03 53 00, Concrete Topping
- K. Section 03 62 00, Non-Shrink Grouting
- L. Section 05 17 00, Miscellaneous Metal
- M. Section 05 30 00, Metal Decking

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- N. Section 09 96 23, Graffiti-Resistant Coatings
- O. Section 31 23 43, Structure Excavation and Backfill
- P. Section 31 63 29, Drilled Concrete Piers and Shafts
- Q. Section 32 35 20, Sound Barrier on Structures

1.03 REFERENCED STANDARDS

A. American Concrete Institute (ACI):

- 1. ACI CT ACI Concrete Terminology
- 2. ACI Specification for Tolerances for Concrete Construction and Materials
- 3. ACI 301 Standard Specifications for Structural Concrete
- 4. ACI 302.1R Guide for Concrete Floor and Slab Construction
- 5. ACI 303.1 Specification for Cast-In-Place Architectural Concrete
- 6. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
- 7. ACI 304.2R Placing Concrete by Pumping Methods
- 8. ACI 305R Guide to Hot Weather Concreting
- 9. ACI 306.1 Standard Specification for Cold Weather Concreting
- 10. ACI 308 Guide to Curing Concrete
- 11. ACI 309R Guide for Consolidation of Concrete
- 12. ACI 318 Building Code Requirements for Structural Concrete and Commentary

B. ASTM International (ASTM):

- 1. ASTM C31/C31M Standard Practice of Making and Curing Concrete Test Specimens in the Field
- 2. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete
- 3. ASTM C78/C78M Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- 4. ASTM C109/C109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- 5. ASTM C127 Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
- 6. ASTM C203 Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
- 7. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete
- 8. ASTM C596 Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement
- 9. ASTM C779/C779M Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces
- 10. ASTM C881/C881M Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- 11. ASTM C1218/C1218M Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
- 12. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

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| 13. | ASTM D3776/ D3776M | Standard Test Methods for Mass Per Unit Area (Weight) of Fabric |
| 14. | ASTM D4355/D4355M | Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus |
| 15. | ASTM D4397 | Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications |
| 16. | ASTM D4632/D4632M | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles |

C. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:

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|----|------------|-------------------------|
| 1. | Section 29 | Treated Permeable Bases |
| 2. | Section 51 | Concrete Structures |
| 3. | Section 52 | Reinforcement |
| 4. | Section 68 | Subsurface Drains |
| 5. | Section 83 | Railings and Barriers |
| 6. | Section 90 | Concrete |
| 7. | Section 96 | Geosynthetics |

D. State of California, Department of Transportation (Caltrans):

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|----|---------------------|---|
| 1. | California Test 417 | Method of Testing Soils and Waters for Sulfate Content |
| 2. | California Test 551 | Method of Test for Determining Suitability of Materials for Overlayment and Repair of Portland Cement Concrete Pavements and Structures |

1.04 DEFINITIONS

- A. The words and terms used in these Technical Specifications conform with the definitions given in ACI CT.
- B. The term "mass concrete" indicates any structural element having a least dimension of more than seven feet or any volume of concrete with dimensions large enough to require that measures be taken to cope with the generation of heat from hydration of the cement and attendant volume change in order to minimize shrinkage and cracking.

1.05 SUBMITTALS

- A. General: Submittals for cast-in-place concrete must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Shop Drawings:
1. Submit drawings that indicate the locations of all joints in concrete, including construction joints, expansion joints, isolation joints, and contraction joints. Coordinate with the requirements specified in Section 03 11 00, Concrete Formwork.
 2. Submit drawings that indicate concrete placement schedule, method, sequence, location, and boundaries. Include each type and class of concrete, and quantity in cubic yards.

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- a. Shop Drawings must include a plan view and elevation view of each structure, frame or major element and must be drawn at a scale sufficiently large (1/8"=1'-0" minimum) to verify details.
 - b. Shop Drawings must be used as a composite drawing of all systems and facilities and must show the locations of all pipes, conduits, drains, embeds, inserts, openings, anchor bolts, and the like, in sufficient detail so that the elevations and locations of all penetrations and the proposed arrangement of all embedded elements are clearly shown to allow for a detailed review by VTA.
 - c. Details of reinforcement at openings and at all embedded elements must be included at a scale sufficiently large (3/4"=1'-0" minimum) to verify potential conflicts between main reinforcement, pipes, conduits, and proposed openings.
 - d. Adjust the locations of pipes, conduits and openings as directed by VTA and resubmit the Shop Drawings where required for structural or system requirements.
 - e. Special reinforcement where required around openings or in conjunction with pipes, conduits, drains, and the like, but not shown on the plans or details, must be added as directed by VTA.
- C. Product Data:
1. Submit manufacturer's catalog sheets including instructions for use, installation procedures, warnings or precautions, and description of application for each of the following materials:
 - a. Magnesium phosphate concrete (rapid setting concrete)
 - b. Modified high-alumina-based concretes
 - c. Epoxies
 - d. Geocomposite drain
 - e. Plastic pipe
 - f. Filter fabric
- D. Records and Reports: Report the location in the finished work of each mix design, and the start and completion times of placement of each batch of concrete placed for each date concrete is placed.
- E. Certificates:
1. For each shipment of bonding materials and magnesium phosphate concrete, submit evidence of compliance with these Technical Specifications as applicable.
 2. Certificates must include type of material, manufacturing location, and shipping location.
 3. Certificates must be signed by the manufacturer of the material or the manufacturer of assembled materials, and must state that the materials involved comply in all respects with the requirements of these Technical Specifications.
 4. Certificates of Compliance must be furnished for each type of aggregate, cement, or asphalt to be used in treated permeable base. If the treated permeable base is provided by a ready mix supplier, the certificate of compliance must be submitted and signed by the manufacturer of treated permeable base.
 5. A Certificate of Compliance must be furnished for filter fabric.
 6. A Certificate of Compliance must be furnished for the geocomposite drain certifying that the drain produces the required flow rate and complies with these Technical Specifications. The Certificate of Compliance must be accompanied by a flow capability graph for the geocomposite drain showing flow rates and the externally applied pressures and hydraulic gradients. The flow capability graph must be stamped with the verification of an independent testing laboratory.

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7. Certificates of Compliance must include the name, source, and description of all materials used and must be signed by the material supplier certifying that each material item complies with, or exceeds the specified requirements.

- F. Concrete Protection Plan: Submit a concrete protection plan in accordance with the provisions of Article 3.09, “Curing and Protection,” herein and Section 03 35 00, Concrete Finishing. A concrete protection plan is required for concrete placement during the following conditions:
 1. Rain or expected rain
 2. Temperature below 50 degrees Fahrenheit
 3. Temperature above 80 degrees Fahrenheit
 4. Wind greater than 15 miles per hour

- G. Treated Permeable Base Quality Control Plan: Submit a Treated Permeable Base Quality Control Plan for treated permeable base under reinforced concrete approach slabs in accordance with Section 29, “Treated Permeable Bases,” of the Caltrans Standard Specifications.

- H. Mass Concrete Submittals:
 1. Thermal Control Plan:
 - a. Prior to mass concrete construction, submit a Thermal Control Plan with design calculations for each mass concrete element. Submit the Thermal Control Plan with design calculations to the VTA for approval, in conformance with the provisions in these Technical Specifications.
 - b. The Thermal Control Plan and the calculations must be sealed and signed by an engineer who is currently registered as a civil engineer in the State of California. Submit six copies of the Thermal Control Plan and two copies of the design calculations. Include the following:
 - 1) Mix design
 - 2) Duration and method of curing
 - 3) Maximum allowable temperature differentials between the hottest point of the concrete and the exterior concrete faces
 - 4) Procedures to control concrete temperature differentials at time of placement
 - 5) Methods of controlling temperature differentials
 - 6) Temperature differential monitoring and recording system details
 - 7) Temperature sensor types and locations
 - 8) Measures to ensure compliance with maximum temperature and temperature differential requirements
 2. Determine the maximum allowable temperature differential assuming cracking due to heat of hydration does not occur.
 3. Submit temperature data daily as an informational submittal.
 4. Submit a daily progress report as an informational submittal. A copy of the daily report must be available at the Worksite.
 5. Submit a modified Thermal Control Plan to correct deficiencies for replacement mass concrete. Include supporting calculations.

1.06 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.

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- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - a. Laboratory tests must be carried out in facilities that have current accreditation from the AASHTO Accreditation Program for the tests performed.
 - b. Independent Testing Agency personnel performing quality control laboratory testing must have an ACI Concrete Laboratory Testing Technician, Level 1 certification or an ACI Aggregate Testing Technician, Level 2 certification, whichever certification includes the test being performed.
 - c. Independent Testing Agency personnel performing quality control field testing and field and plant inspection must have an ACI Concrete Field Testing Technician, Grade I certification.
 3. Designate in writing a Concrete Quality Control Manager (CQCM), in accordance with Section 03 05 15, Portland Cement Concrete. The CQCM must be responsible directly to the Contractor's Quality Control Manager and the Structural Quality Control Manager for the quality of all cast-in-place concrete operations, including materials and workmanship, performed by the Contractor and all subcontractors. The CQCM must be fully authorized by the Contractor to reject material.
 4. Develop, implement, and maintain a quality control program that includes inspection, sampling, and testing of structural concrete materials for cast-in-place structural concrete members, in accordance with Section 03 05 15, Portland Cement Concrete.
- D. VTA Quality Assurance:
1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.

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2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.
- E. Tolerances:
1. Concrete Tolerances: Comply with the requirements of ACI Specification for Tolerances for Concrete Construction and Materials as applicable. Coordinate with the requirements specified in Section 03 11 00, Concrete Formwork.
 2. Tolerances for Slabs and Flatwork: Comply with the requirements specified in Section 03 35 00, Concrete Finishing.
- F. Architectural Concrete: Where concrete is indicated as architectural concrete exposed to public view, such concrete must be produced in accordance with applicable requirements of ACI 301 and ACI 303.1.
- G. Site Mock-Ups:
1. Refer to Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, for mock-up requirements and procedures.
 2. Refer to Section 03 11 16, Architectural Cast-in-Place Concrete, for architectural cast-in-place concrete requirements.
 3. Construct site mock-ups for formed concrete that will be exposed to the public in the finished work, for review and acceptance by VTA, before starting the placement of concrete. The mock-up for walls must be not less than 4 feet by 6 feet in surface area and the mock-up for columns must be 2'-6" diameter by 4 feet tall.
 4. Approved site mock-ups must set the standard for the concrete features, formed finishes, and colors of the concrete. Provide as many mock-ups as required to show all the different features and formed surfaces of the concrete.
- H. Monitoring of Formwork: Provide monitoring of forms and embedded items to detect movement, or forms and embedded items out-of-alignment, from pressure of concrete placement.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Delivering and placing of concrete in hot weather and cold weather must conform with applicable requirements of ACI 305R and ACI 306.1 and Section 03 05 15, Portland Cement Concrete.
- B. Do not place concrete when the rate of evaporation of surface moisture from concrete exceeds 0.2 pounds per square foot per hour as indicated in Figure 4.2 of ACI 305R.
- C. Do not place concrete in, or adjacent to, any structure where piles are required until all piles in the structure have been driven or installed.

1.08 MEASUREMENT AND PAYMENT

- A. Measurement:
 1. Structural Concrete of the various types and locations listed in the Schedule of Quantities and Prices must be measured by the cubic yard.
 - a. Measurements must be based on the neat lines or pay lines, section profiles, and dimensions indicated on the plans, without deduction for chamfers, reinforcing steel

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- and embedded items, and openings and recesses having an area of less than two square feet.
- b. Structural Concrete involved in constructing the Signals/Communications House at Story Station platform must be measured as Structural Concrete (Bridge).
 - c. Structural Concrete involved in constructing the Signals/Communications House at Eastridge Station must be measured as Structural Concrete (Station).
 - d. Structural Concrete involved in constructing cast-in-place approach walls to the Capitol Aerial Guideway and cast-in-place retaining wall at the southeast corner of Capitol Expressway/Cunningham Avenue must be measured as Structural Concrete (Cast-in-Place Retaining Wall).
- 2. Lightweight Concrete (Pedestrian Overcrossing) (Polymer Fiber) must be measured by the cubic yard.
 - 3. Barrier Slab must be measured by the linear foot.
- B. Payment:
- 1. The contract price paid per cubic yard for Structural Concrete of the various types and locations of listed in the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Structural Concrete of the various types and locations listed in the Schedule of Quantities and Prices complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
 - 2. The contract price paid per cubic yard for Lightweight Concrete (Pedestrian Overcrossing) (Polymer Fiber) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Lightweight Concrete (Pedestrian Overcrossing) (Polymer Fiber), complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by VTA, and no additional compensation will be allowed therefor.
 - 3. The contract price paid per linear foot for Barrier Slab must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing barrier slabs, complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by VTA, and no additional compensation will be allowed therefor.
- C. Full compensation for providing cementitious materials, reinforcement fibers, concrete admixtures, and pigments for integrally colored concrete, must be considered as included in prices paid for the various contract items of concrete work involved and no additional compensation will be allowed therefor.
- D. Full compensation for drilling holes, including coring through reinforcement when approved by VTA, must be considered as included in prices paid for the various contract items of concrete work involved and no additional compensation will be allowed therefor.
- E. Full compensation for preparing concrete placement schedules, coordinating the location of pipes, conduits and other facilities, and modifying the proposed layout of pipes, conduits, and reinforcement must be considered as included in prices paid for the various contract items of concrete work involved and no additional compensation will be allowed therefor.
- F. Full compensation for providing additional concrete used to replace overcut or for over-break, or to repair or replace defective work, must be considered as included in prices paid for the various contract items of concrete work involved and no additional compensation will be allowed therefor.

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- G. Full compensation for coring holes, including control of water from core drilling and repairing any damaged reinforcement, for the installation of railing, guardrail and fence posts will be considered as included in the various bid items of Structural Concrete involved and no additional compensation will be allowed therefor.
- H. Full compensation for roughening existing concrete surfaces to a full amplitude of approximately 1/4 inch, where shown on the plans, must be considered as included in the various bid items of Structural Concrete involved and no additional compensation will be allowed therefor.
- I. Full compensation for furnishing and installing plastic pipe located at vertical drains used behind retaining walls and bridge abutments, including horizontal or sloping drains down slopes and across sidewalk areas, including excavation and backfill involved in placing the plastic pipe, must be considered as included in bid items for Structural Concrete (Bridge) and Structural Concrete (Cast-in-Place Retaining Wall) as applicable and no additional compensation will be allowed therefor.
- J. Full compensation for bar reinforcing steel at approach slabs and the structure approach drainage system for approach slabs consisting of geocomposite drain, plastic pipe, treated permeable base, filter fabric, and drainage pads, must be considered as included in the bid item for Structural Concrete (Approach Slab) and no additional compensation will be allowed therefor.
- K. Full compensation for joint protection at bridge deck-approach slab joints, including joint seals and expansion joint fillers must be considered as included in the bid item for Structural Concrete (Approach Slab) and no additional compensation will be allowed therefor.
- L. Full compensation for constructing expanded polystyrene and polyethylene sheet around the circumference of concrete columns below grade must be considered as included in the bid item for Structural Concrete (Bridge) and no additional compensation will be allowed therefor.
- M. Full compensation for constructing Barrier Slab, including furnishing and installing bar reinforcing steel, steel dowels, and expansion joint filler at barrier slabs, must be considered as included in the bid item for Barrier Slab and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Formwork: Refer to Section 03 11 00, Concrete Formwork, for requirements.
- B. Joint Fillers and Sealers: Refer to Section 07 95 50, Bridge Joint Seals and Assemblies, for requirements.
- C. Waterstops: Refer to Section 03 15 13, Waterstops, for requirements.
- D. Reinforcing Steel: Refer to Section 03 20 00, Concrete Reinforcing, for requirements.
- E. Portland Cement Concrete: Refer to Section 03 05 15, Portland Cement Concrete, for mix designs and other requirements.
- F. Mortar:
 - 1. Mortar must be composed of cement, sand, and water. Materials for mortar must comply with Section 03 05 15, Portland Cement Concrete.

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2. The proportion of sand to cement measured by volume must be two to one, unless specified otherwise.
3. Mortar must contain only enough water to allow placing and packing.
4. Sand particles must be no larger than one half the size of the recess or space in which the mortar is to be placed.

G. Concrete Curing Materials: Refer to Section 03 35 00, Concrete Finishing, for requirements.

H. Bonding Materials:

1. Bonding materials must be magnesium phosphate concrete, modified high-alumina-based concrete, or portland-cement-based concrete.
2. Bonding materials must comply with the requirements shown in the following table:

Quality Characteristic	Test Method	Requirement
Compressive strength (psi, min): at 3 hours at 24 hours	ASTM C109/C109M	3000 5000
Flexural strength at 24 hours (psi, min)	ASTM C78/C78M	500
Bond strength at 24 hours (psi, min): Saturated surface dry concrete Dry concrete	California Test 551	300 400
Water absorption (percent, max)	ASTM C127	10
Abrasion resistance at 24 hours (g, max)	ASTM C779/C779M	25
Drying shrinkage at 4 days (percent, max)	ASTM C596	0.13
Soluble chlorides by weight (percent, max)	ASTM C1218/C1218M	0.05
Water soluble sulfates by weight (percent, max)	California Test 417	0.25

3. Magnesium Phosphate Concrete:
 - a. Magnesium phosphate concrete must be either single component that is water activated or dual component with prepackaged liquid activator.
 - b. Magnesium phosphate concrete must be formulated for a minimum initial set time of 15 minutes and minimum final set time of 25 minutes at 70 degrees Fahrenheit. Store the materials in a cool, dry environment before use.
 - c. The quantity of water for single-component type or liquid activator for dual-component type to be blended with the dry component, must be within the limits recommended by the manufacturer and must be the least quantity required to produce a pourable batter.
 - d. Mix water used with water-activated material must be clean and potable, free of impurities detrimental to bonding materials.
 - e. If authorized by VTA, retarders may be added to magnesium phosphate concrete. The addition of retarders must comply with the manufacturer's instructions.
4. Modified High-Alumina-Based Concretes: Modified high-alumina-based concrete must be water activated.
5. Portland-cement-based concrete must be water activated.

I. Rapid Setting Concrete:

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1. Rapid setting concrete must consist of magnesium phosphate concrete and must comply with the applicable specifications in Article 2.01I, “Bonding Materials,” herein.
2. The Contractor may extend rapid setting concrete using a clean, uniform, and rounded aggregate filler with a moisture content of no more than 0.5 percent. Aggregate gradation must comply with the requirements shown in the following table:

Sieve Size	Percentage passing
1/2”	100
No. 16	0-5

3. The amount of aggregate filler must comply with the manufacturer’s instructions. Concrete strengths for extended concrete must be at least as specified for magnesium phosphate concrete.
 4. Combine components of dual-component magnesium phosphate by mixing only complete units supplied by the manufacturer. Do not add water to dual-component magnesium phosphate.
 5. VTA may require the use of a flow-controlled modified concrete on slopes greater than five percent.
- J. Chemical Adhesives for Bonding Dowels: Chemical adhesives for bonding dowels must be on the Caltrans Authorized Material List for chemical adhesive/cartridge epoxies. The chemical adhesive must be appropriate for the installation conditions.
- K. Vapor Barrier Materials: Refer to Section 07 26 00, Vapor Retarders, for requirements.
- L. Grout for Cooling Pipes: Grout for cooling pipes must be a nonshrink grout mix complying with ASTM C1107/C1107M and ASTM C827/C827M for 0.0 percent shrinkage and 0.0 percent minimum and 4.0 percent maximum expansion.
- M. Building Paper: Building paper must be commercial-quality, 30-pound asphalt felt.
- N. Expanded Polystyrene: Refer to Section 07 95 50, Bridge Joint Seals and Assemblies, for requirements.
1. Where expanded polystyrene is shown around the circumference of concrete columns below grade, install polyethylene sheet around expanded polystyrene prior to backfilling operations. Secure the polyethylene sheet to the expanded polystyrene with compatible waterproof adhesive or other means authorized by the VTA.
- O. Polyethylene Sheet: Polyethylene sheet must comply with ASTM D4397.
- P. Reinforced Concrete Approach Slab Materials:
1. Drainage Pads: Concrete for drainage pads must comply with the requirements for minor concrete, as specified in Section 03 05 15, Portland Cement Concrete.
 2. Filter Fabric:
 - a. Filter fabric must be Class A.
 - b. Woven tape fabric must consist of fabric of woven strips or tapes.
 - c. Woven tape fabric must retain at least 70 percent tensile strength when tested under ASTM D4355/D4355M with 500 hours exposure.

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d. Woven tape fabric must comply with the requirements shown in the following table:

Quality characteristic	Test method	Requirement
Weight (min, ounces per square yard)	ASTM D3776/ D3776M	3
Grab breaking load (min, pounds)	ASTM D4632/D4632M	50
Apparent elongation (min, percent)	ASTM D4632/D4632M	35
Toughness (See Note A) (min, pounds)	--	1,200

Note A: Percent apparent elongation times the grab breaking load

3. Treated Permeable Base:
 - a. Treated permeable base for use under reinforced concrete approach slabs must consist of either asphalt treated permeable base or cement treated permeable base and must conform to the requirements of Section 29, "Treated Permeable Bases," of the Caltrans Standard Specifications.
 - b. For treated permeable base placed around slotted plastic pipe at the bottom of geocomposite drains, see Section 31 23 43, Structure Excavation and Backfill, for requirements.
4. Expansion Joint Filler: Expansion joint filler must comply with ASTM D1751.
5. Expanded Polystyrene and Hardboard: Refer to Section 07 95 50, Bridge Joint Seals and Assemblies, for requirements.
6. Waterproofing Membrane: Refer to Section 07 13 13, Bituminous Membrane Waterproofing, for requirements.
7. Asphalt Panel: Refer to Section 07 13 13, Bituminous Membrane Waterproofing, for requirements.

2.02 SOURCE QUALITY CONTROL AND ASSURANCE

A. Contractor Quality Control:

1. Treated Permeable Base:
 - a. Notify the Engineer of the type of treated permeable base to be used under approach slabs at least 30 days before starting placement. After notification, do not change the type of permeable base without authorization.
 - b. The Independent Testing Agency must test the quality characteristics of asphalt treated permeable base at the frequencies shown in the following table:

Quality characteristic	Test method	Sampling location	Minimum frequency
Aggregate:			

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Quality characteristic	Test method	Sampling location	Minimum frequency
Percentage of crushed particles	California Test 205	Plant	One test before beginning work and every 5,000 cubic yards thereafter, or fraction thereof
Los Angeles rattler	California Test 211	Plant	One test before beginning work and every 50,000 tons thereafter, or fraction thereof
Los Angeles rattler (loss at 500 revolutions)	California Test 211	Plant	One test before beginning work and every 5,000 cubic yards thereafter, or fraction thereof
Film stripping	California Test 302	Plant	One test before beginning work and every 5,000 cubic yards thereafter
Gradation (sieve analysis)	California Test 202	Plant	One per every four hours of production but at least one per day of placement
Cleanness value	California Test 227	Plant	One per every four hours of production but at least one per day
Soundness	California Test 214	Plant	One test before beginning work and every 50,000 tons thereafter, or fraction thereof
Completed Mix:			
Asphalt content	California Test 382	Plant, truck, windrow	One per every four hours of production but at least one per day

B. VTA Quality Assurance:

1. If woven tape fabric is shown, notify the Engineer of the source of woven tape fabric at least 45 days before use.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect forms, earth bearing surfaces, reinforcement, and embedded items, and obtain VTA's written approval before placing concrete. Complete and sign a pour card on the form supplied by VTA. VTA will countersign the card prior to commencing the pour.

3.02 PREPARATION

- A. Place concrete under the observation of the Independent Testing Agency to document requirements and results of the placement.
- B. Whenever possible, place concrete during normal working hours. When concrete- placement schedules require concrete placement at times other than normal working hours, ensure that VTA is notified and is present at the time of placement.

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- C. Do not place concrete until conditions and facilities for the storage, handling, and transportation of concrete test specimens are in compliance with the requirements of ASTM C31/C31M and Section 03 05 15, Portland Cement Concrete, and are approved by VTA.
- D. Prior to placement of concrete, the subgrade must be in a firm, well-drained condition, and of adequate and uniform load-bearing nature to support construction personnel, construction materials, construction equipment, and steel reinforcing mats without tracking, rutting, heaving, or settlement. All weak, soft, saturated, or otherwise unsuitable material must be removed and replaced with structural backfill or lean concrete.
- E. All structure foundations must be inspected and approved, in writing, by a qualified, independent geotechnical engineer prior to placement of footings and base slabs, to confirm the adequacy of the supporting soil for concrete placement.
- F. Earth bottoms or bearing surfaces for footings and slabs must be dampened but not saturated or muddied just before placing concrete.
- G. Thoroughly moisten forms and subgrade with water immediately before placing concrete.
- H. Where a roughened concrete surface is described, roughen the existing concrete surface to a full amplitude of approximately 1/4 inch by abrasive blasting, water blasting, or using mechanical equipment.
- I. Placement of Rapid Setting Concrete:
 - 1. Before placing rapid setting concrete patches, abrasive blast clean the contact surfaces of existing concrete and reinforcing steel. Remove at least 1/8 inch of concrete and all foreign material. Immediately before placing new concrete, clean surfaces by vacuuming and one of the following procedures:
 - a. Pressure jetting
 - b. Other means to remove debris, as authorized by the Engineer.
 - 2. The surface temperature of the existing concrete must be at least 40 degrees Fahrenheit during placement of the rapid setting concrete. Contact surfaces to receive magnesium phosphate concrete must be dry. Contact surfaces to receive modified high-alumina concrete or portland-cement-based concrete may be damp but not saturated.
- J. Install vapor barrier and aggregate drainage layer under slabs on grade as shown on the plans and as specified in Section 07 26 00, Vapor Retarders, and Section 32 11 24, Aggregate Drainage Layer.

3.03 TRANSPORTING

- A. Concrete must be central-mixed concrete from a central batch plant, transported to the Worksite in a truck mixer, in accordance with the requirements specified in Section 03 05 15, Portland Cement Concrete, and ASTM C94/C94M.
- B. Transport concrete to the Worksite in a manner that will assure efficient delivery of concrete to the point of placement without adversely altering specified properties with regard to water-cement ratio, slump, air entrainment, and homogeneity.

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3.04 CONVEYING AND PLACING

- A. Placement Standards: Conveying and placing of concrete must conform with applicable requirements of ACI 301, ACI 302.1R, ACI 304R, and ACI 318.
- B. Handling and Depositing:
1. Place and consolidate concrete using methods that do not cause segregation of the aggregate and that produce dense, homogeneous concrete without voids or rock pockets..
 2. Concrete placement, once started, must be carried on as a continuous operation until the section of approved size and shape is completed.
 3. Place concrete for girder spans in at least two operations. The last operation must consist of placing the deck slab. Allow at least five days between operations.
 4. Concrete must be handled as rapidly as practicable from the mixer to the place of final deposit by methods that prevent the separation or loss of ingredients. Concrete must be deposited, as nearly as practicable, in its final horizontal position to avoid redistribution or flowing. Do not use vibrators for extensive shifting of concrete.
 5. Concrete must not be dropped freely where reinforcing will cause segregation, nor must it be dropped freely more than five feet. Concrete must be deposited to maintain a plastic surface approximately horizontal.
 6. In placing walls, columns, or thin sections (six inches or less in thickness) of heights greater than 10 feet, concrete placement rate, lift thickness, and time intervals between lifts must be as indicated on approved Shop Drawings. Openings in the form, elephant trunk tremies, or other approved devices, must be used that will permit the concrete to be placed without segregation or accumulation of hardened concrete on the forms or metal reinforcement above the level of the fresh concrete.
 7. Concrete that has partially hardened must not be deposited in the work. The discharge of concrete must be started not later than 60 minutes after the introduction of mixing water. Placing of concrete must be completed within 90 minutes after the first introduction of water into the mix.
 8. Place concrete while fresh and before initial set. Do not retemper partially hardened concrete with additional water.
 9. For decks on structural steel, install cross frames and metal decking on the entire width and length of the bridge before placing the deck concrete.
 10. Magnesium phosphate concrete must not be mixed in containers or worked with tools containing zinc, cadmium, aluminum, or copper. Modified high-alumina based concrete must not be mixed in containers or worked with tools containing aluminum. Do not retemper magnesium phosphate concrete and high-alumina based concrete. Finishing tools cleaned with water must be thoroughly dried before working concrete.
 11. Colored Concrete:
 - a. When placing colored concrete, monitor the water content, weight of cementitious materials, and size, weight, and color of aggregate to maintain consistency and accuracy of the mixed colored concrete.
 - b. Schedule the delivery of concrete to provide consistent mix times from batching until discharge. Do not add water after a portion of the batch has been discharged.
 - c. Use consistent finishing practices to ensure uniformity of texture and color.
 12. Mortar:
 - a. Place mortar in recesses and holes, on surfaces, under structural members, and at other locations where described.

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- b. Clean concrete areas to be in contact with mortar of loose or foreign material that would prevent bonding between the mortar and the concrete surfaces. Flush the concrete areas with water and allow them to dry to a surface-dry condition immediately before placing the mortar.
- c. Tightly pack mortar to completely fill spaces. Locations where mortar can escape must be mortar-tight before placing mortar. Cure mortar for 3 days using the water method, as specified in Section 03 35 00, Concrete Finishing.
- d. Do not load mortar until 72 hours after placement unless authorized.

C. Pumping:

- 1. Concrete may be placed by pumping if the maximum slump can be maintained and if accepted in writing by VTA for the location proposed.
- 2. Placing concrete by pumping methods must conform with applicable requirements of ACI 304R and ACI 304.2R.
- 3. Equipment for pumping must be of such size and design as to ensure a continuous flow of concrete at the delivery end without separation of materials. Concrete from end of hose must have a free fall of less than 5 feet. Pump hoses must be supported on horses or similar devices so that reinforcement or post-tensioning ducts or tendons are not moved from their original position.
- 4. The concrete mix must be designed to the same requirements as specified in Section 03 05 15, Portland Cement Concrete, and may be altered for placement purposes with the prior approval of VTA.
- 5. If more than one concrete pump is used to place concrete, designate the pumps to receive colored concrete. The designated pumps must receive only colored concrete throughout the concrete placement operation.

D. Shotcrete is not allowed as an alternative construction method for reinforced concrete members.

3.05 PLACEMENT UNDER WATER

- A. The requirements specified herein do not apply to the construction of cast-in-drilled-hole concrete piles. Construction of cast-in-drilled-hole concrete piles is specified in Section 31 63 29, Drilled Concrete Piers and Shafts.
- B. Only seal course concrete may be placed under water.
- C. If the Engineer determines that it is impossible or inadvisable to dewater excavations before placing concrete, place a seal course under the water using a tremie or a concrete pump. The seal course must be at least two feet thick and thick enough to seal the cofferdam.
- D. The tremie must be a watertight tube at least ten inches in diameter with a hopper at the top. When concrete is deposited into the hopper, flow is induced by raising the discharge end. Equip discharge and tremie tubes with a device to prevent water from entering the tube when charging the tube with concrete. Support the tubes so as to allow for free movement of the discharge end over the entire work surface and rapid lowering of the tube.
- E. Fill the tubes using a method that prevents washing of the concrete. Keep the discharge end submerged in the concrete at all times. The tube must contain enough concrete to prevent water entry.
- F. Place the concrete carefully in a compact mass. Concrete flow must be continuous until completion of the seal course. The seal course must be monolithic and homogeneous. Do not disturb concrete after placement. Maintain still water at the point of placement.

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- G. Cure the seal course concrete for at least 5 days before dewatering the cofferdam. Increase the curing time for seal course concrete placed in water that is below 45 degrees Fahrenheit. Periods of time when the water temperature is continuously below 38 degrees Fahrenheit is not considered as curing time.
- H. Dewater the cofferdam after the seal course has adequate strength to resist the hydrostatic load. After dewatering, clean the top of the concrete of all scum, laitance, and sediment. Remove local high spots to provide the specified clearance for reinforcing steel before placing fresh concrete.

3.06 CONSOLIDATION

- A. Concrete must be thoroughly consolidated and compacted by mechanical vibration during placement in accordance with the requirements of ACI 309R.
- B. VTA will inspect concrete placement to confirm that proper placing methods are being employed, and that special techniques are being used in congested areas and around obstructions such as pipes and other embedded items. Check installation of embedded items for correct location and orientation during concrete placement.
- C. Conduct vibration in a systematic manner by competent, skilled, and experienced workers, with regularly maintained vibrators, and with sufficient back-up units at the Worksite. Use the largest and most powerful vibrator that can be effectively operated in the given work, with a minimum frequency of 8,000 vibrations or impulses per minute, and of sufficient amplitude to effectively consolidate the concrete.
- D. Insert and withdraw the vibrator vertically at uniform spacing over the entire area of the placement. Space the distance between insertions such that "spheres of influence" of each insertion overlap.
- E. Conduct vibration so as to produce concrete that is of uniform texture and appearance, free of honeycombing, air and rock pockets, streaking, cold joints, and visible lift lines.
- F. On vertical surfaces and on all formlined concrete where an as-cast finish is required, use additional vibration and spading as required to bring a full surface of mortar against the forms, so as to eliminate objectionable air voids, bug holes, and other surface defects. Additional procedures for vibrating concrete must consist of the following:
 - 1. Reduce the distance between internal vibration insertions and increase the time for each insertion.
 - 2. Insert the vibrator as close to the face of the form as possible, without contacting the form.
 - 3. Use spading as a supplement to vibration at forms to provide fully filled out form surfaces without air holes and rock pockets.
 - 4. Provide vibration of forms only if approved by VTA for the location.
- G. For structure footings over 2.5 feet in depth that have a top layer of reinforcement, reconsolidate the concrete to a depth of one foot after placing, consolidating, and initial screeding of the concrete. Reconsolidate the concrete as late as the concrete will respond again to vibration but not less than 15 minutes after the initial screeding.

3.07 CONSTRUCTION JOINTS

- A. Construction joints will be permitted only where indicated or approved by VTA.

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- B. Provide and prepare construction joints and install waterstops where indicated in accordance with the applicable requirements of ACI 301 and ACI 304R, and as specified in Section 03 11 00, Concrete Formwork, and Section 03 15 13, Waterstops.
- C. Make construction joints straight and as inconspicuous as possible, and in exact vertical and horizontal alignment with the structure, as the case may be.
- D. Horizontal construction joints:
 - 1. Thoroughly consolidate fresh concrete surfaces without completely removing surface irregularities
 - 2. At joints between girder stems and decks, roughen the surfaces of fresh concrete to at least a 1/4-inch amplitude
- E. Thoroughly clean the surface of the concrete at construction joints and remove laitance, loose or defective concrete, coatings, sand, sealing compound and other foreign material. Prepare surfaces of joints by sandblasting or other approved methods to remove laitance and expose aggregate uniformly.
- F. Flush construction joint surfaces with water and allow the surfaces to dry to a surface-dry condition immediately before placing concrete.
- G. Cold joints in concrete will not be permitted unless planned and treated properly as construction joints and approved by VTA.
- H. If authorized in an emergency, you may place a construction joint at a location not described. The Engineer determines the location of the construction joint and the quantity of additional reinforcing steel to be placed across the joint.
- I. Ensure that reinforcement is continuous across construction joints.
- J. Retighten forms and dampen concrete surfaces before concrete placing is continued.
- K. Allow at least 72 hours to elapse before continuing concrete placement at a construction joint. Approval for accelerating the minimum time elapsing between adjacent placements will be based on tests and methods that confirm that a minimum moisture loss at a relatively constant temperature will be maintained for the period as necessary to control the heat of hydration and hardening of concrete, and to prevent shrinkage and thermal cracking.
- L. Where shown, apply a bond breaker to joint surfaces.

3.08 CONTROL, EXPANSION AND CONTRACTION JOINTS

- A. Refer to Section 03 11 00, Concrete Forming, for slab screeds and for formwork where expansion and contraction joints are indicated as architectural features, such as reveals or rustications.
- B. Refer to Section 03 35 00, Concrete Finishing, for control joint construction and for finishing of edges of expansion joints in slabs with curved edging tool.

3.09 CURING AND PROTECTION

- A. Except for bridge decks, cure newly placed concrete for cast-in-place structures using the water method or the forms-in-place method, in accordance with Section 03 35 00, Concrete Finishing.

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- B. Cure the top surface of bridge decks by both misting and the water method using a curing medium as specified in Section 03 35 00, Concrete Finishing. After strike-off, immediately and continuously mist the deck with an atomizing nozzle that forms a mist and not a spray. Continue misting until the curing medium has been placed and the application of water for the water method has started. At the end of the curing period, remove the curing medium and apply curing compound on the top surface of the bridge deck during the same work shift. The curing compound must be curing compound no. 1, as specified in Section 03 35 00, Concrete Finishing.
- C. Cure the top surface of bridge decks to be sealed with butyl rubber membrane using only the water method, in accordance with Section 03 35 00, Concrete Finishing.
- D. For bridge decks and flat slabs using the water method without a curing medium, keep the entire surface damp by applying water with an atomizing nozzle that forms a mist and not a spray until the concrete has set. After the concrete has set, continuously sprinkle the entire concrete surface with water for at least seven days.
- E. You may use a pigmented curing compound complying with Section 03 35 00, Concrete Finishing, for the following items of work:
 - 1. Concrete surfaces of construction joints
 - 2. Concrete surfaces that are to be buried underground
 - 3. Concrete surfaces not visible from a public traveled way, where only an ordinary surface finish is to be applied and a uniform color is not required
- F. If you use the curing compound method on the bottom slab of box girder spans, the curing compound must be curing compound no. 1.
- G. If ordered during periods of hot weather, apply water to concrete surfaces being cured by the curing compound method or by the forms-in-place method until the Engineer determines that a cooling effect is no longer required. This work is change order work.
- H. Repair any damage to the film of the curing compound with additional curing compound. Repairing damaged curing compound after the deck is opened to traffic is not required.
- I. Curing of Rapid Setting Concrete: Cure modified-high-alumina-based concrete and portland cement based concrete using the curing compound method in accordance with Section 03 35 00, Concrete Finishing. Do not cure magnesium phosphate concrete.
- J. Cure colored concrete by the forms-in-place method or the curing compound method, in accordance with Section 03 35 00, Concrete Finishing.
 - 1. If curing compound is used, the curing compound must be clear or match the color of the colored concrete and must be manufactured specifically for colored concrete. Do not use curing compounds containing calcium chloride. The time between complete surface finishing and applying the curing compound must be the same for each colored concrete component.
- K. Concrete must not be permitted to dry during the curing period because of finishing operations.
- L. Protect fresh concrete from hot sun, drying winds, rain, damage, or soiling. Fog spray freshly placed slabs after bleed water dissipates and after finishing operations commence. Allow no slabs to become dry at any time until finishing operations are complete.
- M. Finishing and curing of slabs are specified in Section 03 35 00, Concrete Finishing.

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- N. Protect concrete from injurious action of the elements and defacement of any kind. Protect exposed concrete corners from traffic or use that will damage them in any way.
- O. Protect concrete during the curing period from mechanical and physical stresses that may be caused by heavy equipment movement, subjecting the concrete to load stress, load shock, or excessive vibration.
- P. Maintain concrete at a temperature of not less than 45 degrees Fahrenheit for 72 hours after placing and at not less than 40 degrees Fahrenheit for an additional four days.
- Q. Cover or otherwise protect joints at all times before joint seals are installed. Do not allow debris or foreign material to enter joints.
- R. Protect surrounding exposed surfaces during placement, finishing, and curing activities of colored concrete.

3.10 REPAIR OF SURFACE DEFECTS

- A. Refer to Section 03 35 00, Concrete Finishing, for requirements.

3.11 CONCRETE BRIDGE DECKS

- A. For concrete decks placed on continuous steel girders or precast concrete girders, place the portion of deck over the supports last.
- B. For decks on precast concrete girders, place intermediate and end diaphragms at least 5 days before placing the deck concrete.
- C. For decks on structural steel, install cross frames the entire width of the bridge before placing the deck concrete.
- D. Deck closure pours must comply with the following:
 - 1. During primary deck placement and for at least 24 hours after completing the deck placement, reinforcing steel protruding into the closure space must be free from any connection to reinforcing steel, concrete, forms, or other attachments of the adjacent structure.
 - 2. Closure pour forms must be supported from the superstructure on both sides of the closure space.

3.12 MASS CONCRETE

- A. Structure concrete elements shown on the Contract Drawings that have a minimum dimension exceeding seven feet must be constructed as mass concrete and must conform to the details shown on the Contract Drawings and these Technical Specifications.
 - 1. The portions of the structures shown in the following table must be constructed of mass concrete in accordance with these Technical Specifications.

Structure	Portion of structure
Capitol Aerial Guideway	Concrete bent cap at Bent 6
Capitol Aerial Guideway	Concrete bent cap at Bent 16
Capitol Aerial Guideway	Concrete bent cap at Bent 17
Capitol Aerial Guideway	Concrete bent cap at Bent 18

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Capitol Aerial Guideway	Concrete bent cap at Bent 46
Capitol Aerial Guideway	Concrete bent cap at Bent 47
Capitol Aerial Guideway	Concrete bent cap at Bent 68
Capitol Aerial Guideway	Concrete bent cap at Bent 69
Story Station Pedestrian Overcrossing	Bent 2

- B. You may use mechanical cooling systems to control internal concrete temperatures during curing. Mechanical cooling systems must comply with the Thermal Control Plan and with the following requirements:
1. Embed the cooling system within the mass concrete element. Surface connections to cooling pipes must be removable to four inches below the concrete surface.
 2. Design the forms such that cooling or temperature monitoring is not disturbed during form removal.
 3. Secure the cooling pipes to prevent movement during concrete placement. Replace damaged cooling pipes immediately.
 4. Pressure test the cooling system for leaks at 30 pounds per square inch for 30 minutes before placing concrete. Coolant must be circulating when concrete placement starts.
 5. Pressure grout the cooling pipes after cooling is complete. Place the grout in accordance with the manufacturer's instructions.
 6. After the surface connections are removed, the holes must be reamed and filled with mortar.
- C. Remove mass concrete elements that do not comply with the temperature acceptance criteria.
- D. Temperature Monitoring:
1. Provide a temperature monitoring and recording system for mass concrete elements. The system must consist of temperature sensors connected to a data acquisition system. The system must be capable of recording, printing, and downloading temperature data to a computer.
 2. Locate temperature sensors within mass concrete elements such that the maximum temperature difference within the element is monitored. At a minimum, monitor temperatures at the following locations:
 - a. Calculated hottest location
 - b. Two outer faces
 - c. Two corners
 - d. Top surfaces
 3. Record temperature readings automatically at least every hour. Install a redundant set of sensors near the primary set with recording capability. Make records using the redundant set if the primary set fails.
 4. You may discontinue hourly temperature recording under the following conditions:
 - a. Maximum internal temperature is falling
 - b. Difference between the interior concrete temperature and the average daily air temperature is less than the allowable temperature differential for three consecutive days
 - c. There are no mass concrete elements to be cast adjacent

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5. Protect the temperature sensor wiring to prevent movement during concrete placement. Keep wire runs as short as possible. Do not let the ends of temperature sensors come into contact with concrete supports, forms, or reinforcement.
6. Do not damage the monitoring and recording system when placing and consolidating concrete.
7. Correct equipment failures in temperature control and monitoring and recording systems immediately.
8. The temperature acceptance criteria for mass concrete elements are as follows:
 - a. Maximum allowable temperature must not exceed 160 degrees Fahrenheit.
 - b. Maximum temperature differential must not exceed that listed in the Thermal Control Plan.
9. If mass concrete elements do not comply with the temperature acceptance criteria:
 - a. Remove the mass concrete elements.
 - b. Modify the Thermal Control Plan and design calculations to correct the problem and submit a modified Thermal Control Plan.
 - c. Mass concrete placement must not begin until the VTA has approved the revised Thermal Control Plan. No extension of time or compensation will be made for any rejected mass concrete element or revisions of the Thermal Control Plan.

3.13 REINFORCED CONCRETE APPROACH SLABS

- A. Finish and treat the top surfaces of approach slabs as specified in Section 03 35 00, Concrete Finishing. Edger finish the slab edges.
- B. Cure approach slabs using curing compound no. 1, in accordance with Specification 03 35 00, Concrete Finishing.
- C. Abrasive blast clean the concrete surfaces and thoroughly clean joints immediately before placing the joint seals. Joint surfaces must be dry when seals are placed.
- D. Filter Fabric:
 1. Place filter fabric immediately after grading and compacting the subgrade. Handle and place filter fabric under the manufacturer's instructions.
 2. Adjacent borders of filter fabric must be overlapped from 12 to 18 inches or stitched. If overlapping the borders, the preceding roll must overlap the following roll in the direction the material is being spread. If stitching the border, use yarn of a contrasting color. Yarn size and composition must be as recommended by the fabric manufacturer. Use five to seven stitches per inch of seam.
 3. Do not operate equipment or vehicles on filter fabric
- E. Treated Permeable Base: The following requirements are for treated permeable base to be used under approach slabs. For treated permeable base to be placed around slotted plastic pipe at the bottom of geocomposite drains, refer to Section 31 23 43, Structure Excavation and Backfill, for requirements.
 1. Treated permeable base must be constructed in accordance with Section 29, "Treated Permeable Bases," of the Caltrans Standard Specifications.
 2. Place and compact asphalt treated permeable base at a temperature from 200 to 250 degrees Fahrenheit. Do not use material stored for more than two hours in the work.

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3. Compact asphalt treated permeable base as soon as the mixture has cooled sufficiently to support the weight of the equipment without undue displacements. Use a vibrating-shoe-type compactor or a roller weighing from 1.5 to 5 tons.
4. Compact cement treated permeable base with a vibrating-shoe-type compactor or with a steel-drum roller weighing from 1.5 to 5 tons. Compaction must start within 1/2 hour of spreading and must consist of two complete coverages of the cement treated permeable base.

F. Concrete for approach slabs must cure for at least five days before opening to traffic.

3.14 DRILL AND BOND DOWELS

A. For drill and bond dowels, drill the holes without damaging the adjacent concrete. Holes for bonded dowels must be 1/2 inch larger than the nominal dowel diameter.

B. If reinforcement is encountered during drilling before the specified depth is attained, notify the Engineer. Unless coring through the reinforcement is authorized, drill a new hole adjacent to the rejected hole to the depth shown.

C. Coat the surface of any dowel coated with zinc or cadmium with a colored lacquer. Allow the lacquer to dry thoroughly before installing the dowel.

D. Each drilled hole must be clean and dry when placing the bonding material and dowel. The bonding material and dowel must completely fill the drilled hole. The surface temperature must be at least 40 degrees Fahrenheit when magnesium phosphate concrete is placed.

E. Thoroughly dry finishing tools cleaned with water before working magnesium phosphate concrete.

F. Leave dowels undisturbed for three hours or until the dowels can be supported by the concrete.

G. Cure modified high-alumina-based concrete and portland-cement-based concrete using the curing compound method in accordance with Section 03 35 00, Concrete Finishing. Do not cure magnesium phosphate concrete.

H. Replace dowels that fail to bond or are damaged.

I. Drill and Bond Dowels (Chemical Adhesive):

1. For drill and bond dowel (chemical adhesive), install dowels under the chemical adhesive manufacturer's instructions.
2. Drill the holes without damaging the adjacent concrete. If reinforcement is encountered during drilling before the specified depth is attained, notify the Engineer. Unless coring through the reinforcement is authorized, drill a new hole adjacent to the rejected hole to the depth shown.
3. Immediately after inserting the dowels into the chemical adhesive, support the dowels as necessary to prevent movement until the epoxy has cured the minimum time specified in the Caltrans Authorized Material List for chemical adhesive/cartridge epoxies.
4. Replace dowels that fail to bond or are damaged. Drill new holes adjacent to rejected dowels and install replacement dowels.

3.15 FIELD QUALITY CONTROL

A. The Independent Testing Agency must perform the following inspections and testing:

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1. Prior to placing concrete, inspect formwork and verify shape, location, and dimensions of the concrete member being formed conform to the approved Shop Drawings and Contract Documents.
 2. Prior to placing concrete, inspect reinforcing steel and verify type, grade, size, and placement conform to the approved Shop Drawings and Contract Documents.
 3. Provide continuous inspection of all concrete placement. Verify that conveying and placing techniques conform to these Technical Specifications.
 4. Provide a quality control field inspector at the concrete deliver point while placement activities are in progress. The quality control inspector must be fully authorized by the Contractor to reject material.
 5. Curing: Provide periodic inspection of concrete surfaces during curing period. Verify that protection and placement of concrete during hot weather and cold weather conforms to the requirements of Section 03 05 15, Portland Cement Concrete.
 6. Mass Concrete:
 - a. Independent Testing Agency personnel performing quality control inspection and testing of mass concrete must be currently registered as a civil engineer in the State of California. The Independent Testing Agency must perform the following duties:
 - 1) Inspect and test the temperature monitoring and recording systems before concrete placement.
 - 2) Be present during mass concrete activities.
 - 3) Provide daily progress reports.
- B. Refer to Section 03 05 15, Portland Cement Concrete for additional concrete quality control inspection and testing requirements.
- C. Refer to Section 03 20 00, Concrete Reinforcing for additional reinforcing quality control inspection and testing requirements.
- D. Tests for Contractor's Benefit: Tests required to verify early form removal, or other reasons for the Contractor's benefit must be performed at the Contractor's expense as part of the Contractor's quality control program.

END OF SECTION 03 30 00

SECTION 03 35 00
CONCRETE FINISHING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements for the following items of work:
1. Furnishing materials for and applying concrete finishes to concrete surfaces.
 - a. TPSS Enclosures
 - b. Stations
 - c. Access Structures
 - d. Guideway Structure
 - e. Guideway Approach Structures
 - f. Story Station Pedestrian Overcrossing
 2. Repair of surface defects
 3. Finishing of formed surfaces
 4. Slabs and flatwork
 5. Curing

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 11 16, Architectural Cast-in-Place Concrete Forming
- D. Section 03 30 00, Cast-in-Place Concrete
- E. Section 03 53 00, Concrete Topping
- F. Section 03 62 00, Non Shrink Grouting
- G. Section 07 90 00, Joint Protection
- H. Section 09 96 00, Graffiti Resistant Coatings
- I. Section 32 16 00, Concrete Curbs, Gutters, and Walks

1.03 REFERENCED STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO M182 Burlap Cloth Made from Jute or Kenaf

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B. American Concrete Institute (ACI):

1. ACI 117 Standard Specification for Tolerances for Concrete Construction and Materials
2. ACI 301 Standard Specifications for Structural Concrete
3. ACI 308 Standard Practice for Curing Concrete
4. ACI 503.4 Standard Specification for Repairing Concrete with Epoxy Mortars

C. Americans with Disabilities Act Accessibility Guidelines (ADAAG):

1. ADAAG Appendix to Part 1192, Section 1

D. ASTM International (ASTM):

1. ASTM C33/C33M Specification for Concrete Aggregates
2. ASTM C150/C150M Specification for Portland Cement
3. ASTM C171 Specifications for Sheet Materials for Curing Concrete
4. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
5. ASTM C979 Standard Specification for Pigments for Integrally Colored Concrete
6. ASTM C881/C881M Specification for Epoxy-Resin-Base Bonding Systems for Concrete
7. ASTM C1028 Standard Test Method for Measuring the Static Coefficient of Friction
8. ASTM D1751 Standard Specification for Preformed Expansion Joint

E. California Code of Regulations:

1. In addition to the foregoing referenced standards, the regulatory requirements that govern the work of this Section include the following governing code: California Code of Regulations (CCR), Title 24, Part 2, 2016 California Building Code, Chapter 19 – Concrete.

F. International Concrete Repair Institute, Inc. (ICRI):

1. ICRI 310.2R Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Over-lays, and Concrete Repair

G. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:

1. Section 42 Groove and Grind Concrete
2. Section 51 Concrete Structures
3. Section 60 Existing Structures
4. Section 73 Concrete Curbs and Sidewalk

1.04 SUBMITTALS

- A. General: Submittals for concrete finishing must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications

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- B. Product Data:
1. Colored Concrete:
 - a. Submit manufacturer's color chart of stock colors for integral colors and color hardeners for final selection of colors by VTA. Obtain VTA approval before beginning work of this Section.
 - b. Submit color additive manufacturer's data, including, but not limited to, color charts or chips, installation instructions, curing recommendations, and ASTM reference test compliance data.
 2. Submit manufacturers' product data, including instructions for use and description of application for manufactured products and curing compounds.
 - a. Product data for manufactured products and curing compounds must be submitted to the Engineer for review by the VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by the Engineer.
- C. Shop Drawings: Submit drawings, or diagrams to scale, that indicate the location in plan and elevation of all concrete finishes.
- D. Certification Letters:
1. Submit a letter of certification that the Contractor to install concrete finishes as required by these specifications is qualified to comply with the specifications herein. Include three quality installations, similar in scope and complexity to that specified herein. Qualification must be submitted to and be subject to the approval of VTA.
 2. Submit a letter of certification that the Contractor to install concrete work at Access Structures as required by these specifications is qualified to comply with the specifications herein. Include three quality installations, similar in scope and complexity to that specified herein. Qualification must be submitted to and be subject to the approval of VTA.
 3. Submit a letter of certification that the Contractor to conduct concrete sandblasting work as required by these specifications is qualified to comply with the specifications herein. Include three quality installations, similar in scope and complexity to that specified herein. Qualification must be submitted to and be subject to the approval of VTA.
 4. Provide certification from a qualified testing agency for the finished coefficient of friction at all walking surfaces. All walking surfaces must maintain the coefficient of friction as specified herein.
- E. Samples:
1. Submit 1/2-pint sample container of aluminum oxide, silicon carbide, or almandite garnet grit particles for review and acceptance where "non-slip finish" is indicated.
- F. Colored Concrete Work Plan: Submit a work plan for mixing, delivery, placement, finishing, and curing of colored concrete.
- G. For each batch of curing compound delivered to the job site or casting site, submit the following:

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1. Split curing compound test samples to the Independent Testing Agency. The test samples must be from the shipping containers at the manufacturer's source of supply.
2. Certificates of Compliance: Submit a certificate of compliance for each batch of curing compound delivered to the job site or casting site. The certificate of compliance must include the following items:
 - a. Test results for the tests specified in Article 2.10, "Quality Control and Assurance," herein.
 - b. Certification that the material was tested within one year before use.
3. If the curing compound is shipped in tanks or tank trucks, submit a shipping invoice with each load. The invoice must show the same information specified for curing compound container labels in Article 2.03, herein.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Concrete Finishing must be measured by the lump sum price as listed in the Schedule of Quantities and Prices
- B. Payment: The lump sum payment for Concrete Finishing must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Concrete Finishing complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
 1. Full compensation for performing profilograph testing shall be considered as included in the contract price paid per cubic yard for structural concrete (bridge), and no additional compensation will be allowed therefor.

1.06 QUALITY CONTROL AND ASSURANCE

- A. Contractor Qualifications:
 1. Contractor for concrete finishing, including but not limited to colored and textured finishes, must provide conclusive proof of qualifications to produce and has previously produced concrete finishes and colors and can comply with the provisions specified herein and shown on the plans. Proof must be in three quality installations, similar in scope and complexity to that specified herein, and located within an 50 mile radius of the Worksite. Evidence that Contractor is qualified to comply with the requirements specified herein must be submitted to and be subject to the approval of VTA.
 2. Contractor for concrete work at access structures, including but not limited to wall finishes and paving, must provide conclusive proof of qualifications to produce and has previously produced finishes and colors and can comply with the provisions specified herein and shown on the plans. Proof must be in three quality installations, similar in scope and complexity to that specified herein, and located within a 50 mile radius of the Worksite. Evidence that Contractor is qualified to comply with the requirements specified herein must be submitted to and be subject to the approval of VTA.
- B. Site Mock-ups:
 1. Refer to Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, for mock-up requirements and procedures.

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2. Construct site mock-ups for concrete flatwork, topping slabs, walks, plazas, paving, and concrete walls and structures, for review and acceptance by VTA, before starting the placement of concrete.
 - a. All concrete features, finishes, textures, and colors, including, but not limited to, natural concrete, integrally colored concrete, stained concrete, shake-on color hardeners, sandblasting, imprinting, as well as sacking and patching smooth, must be included and represented on the mock-up panels.
 - b. Mock-ups must include proper joint spacing and joint sealant.
3. Approved site mock-ups must set the standard for the aesthetic quality of all concrete features, finishes, textures, aesthetic quality, and colors for the affected units of work.
4. Number of mock-up panels:
 - a. The number of mock-up panels required must be the number necessary to obtain the VTA's approval for all the different concrete features, finishes, textures, aesthetic quality, and colors of the concrete.
 - b. At a minimum, construct and display a separate mock-up panel for the following items of concrete work:
 - 1) Walls and surfaces: Including, but not limited to, access structure walls, raised planter walls, planter copings, and exposed concrete foundations.
 - 2) Station Platforms: Standard concrete flatwork, topping slabs, and colored/textured topping slabs.
 - 3) Story Station and Plaza concrete work and surfaces.
 - c. Provide one mock-up panel for each design mix of concrete used in the Work.
 - d. Construct or prepare as many additional samples and mock-ups as may be required, as determined by the VTA, until desired features, textures, finishes, and colors are obtained.
5. Sizes of mock-up panels:
 - a. Unless specified otherwise, mock-up panels must be at least 4 inches thick, 36 inches high, and 36 inches long.
 - b. Sandblast finish mock-ups:
 - 1) Panel must be at least 4 inches thick, 36 inches high, and 72 inches long.
 - 2) On each mock-up panel, divide the large faces into three separate equal areas of 36 inches high by 24 inches wide, by use of adhesive tape or other divider. Using the sandblasting equipment and methods proposed for this Work, abrade each panel with:
 - a) A light sandblast finish entirely covering one of the divided areas.
 - b) A medium sandblast finish entirely covering an adjacent area.
 - c) A heavy sandblast finish entirely covering the remaining adjacent area.
 - d) Affix a permanent identification to each abraded area, showing the date of sandblasting and name of sandblasting company or personnel, and showing the type ("light", "medium", or "heavy") sandblasting represented by the sample.

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- 3) Flatwork sandblast finish mock-ups must be incorporated into colored/textured sample panels as described above. Where concrete mix designs for flatwork differ from other concrete, provide one additional flatwork panel depicting the three sandblast textures described herein.
 - c. The mock-ups for columns must be 2'-6" diameter by 4 feet tall.
6. Display of Mock-up Panels: Each mock-up panel must arrange finishes and colors in adjacencies similar to those shown on the plans.
7. All mock-up panels must be prepared and displayed prior to VTA acceptance of concrete mock-up panels.
8. Maintain VTA-approved mock-up panels on site for a basis of comparison to concrete work in place. Maintain and protect sample concrete display from damage during construction. Sample panels must be removed by Contractor after VTA acceptance of the concrete work in place has been determined.

PART 2 - PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. The Contractor must furnish all materials, tools, equipment, facilities, and services as required for performing the required concrete-finishing work.

2.02 REPAIR AND FINISHING MATERIALS

- A. Concrete Sealer:
 1. Solvent based clear acrylic sealer, that will not cause surfaces to be slick, and will maintain required slab surface coefficient of friction in accordance with ADAAG.
- B. Concrete:
 1. Concrete to be used must comply with the provisions of Section 03 30 00, Cast-in-Place Concrete.
 2. Calcium chloride in the concrete mix is not acceptable.
 3. Concrete used for the topping slabs must be of a lightweight mix design, complying with the provisions of Section 03 53 00, Concrete Topping.
- C. Portland Cement: Refer to Section 03 30 00, Cast-in-Place Concrete, for requirements. Portland cement used for repair and finishing materials must be the same brand as used in the surrounding concrete work. Furnish white portland cement where required to produce color matching color of surrounding concrete.
- D. Aggregate:
 1. For Bonding Grout: ASTM C33/C33M, washed clean sand passing a No. 30 sieve.
 2. For Patching Mortar: ASTM C33/C33M, washed clean, graded fine aggregate of suitable size for areas to be repaired. Clean coarse aggregate up to Size No. 8 may be added for repair of larger pockets and voids.

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- E. Commercial Patching Mortar: A structural repair mortar may be furnished if appropriate for the use and approved by the Engineer.
- F. Epoxy Patching Mortar: As specified in ACI 503.4 for Epoxy Mortar.
- G. Epoxy Adhesive: ASTM C881/C881M, Type II or Type V, epoxy-based bonding agent.
- H. Nonskid Abrasive Finish: Commercial-quality aluminum oxide, silicon carbide, or almandite garnet grit particles.

2.03 CURING MATERIALS

- A. Damp Curing Materials:
 - 1. Waterproof Sheet Materials: ASTM C171, waterproof paper with white paper face, polyethylene film pigmented white, or white burlap-polyethylene sheeting.
 - 2. Burlap: AASHTO M182, of class or weight suitable for the use and location. Do not use burlap where concrete is exposed to direct sunlight.
- B. Curing compound: ASTM C309, clear, non-yellowing, non-staining all resin, liquid membrane-forming type containing a fugitive dye. Chlorinated rubber compounds is not acceptable.
 - 1. The curing compound must comply with the requirements shown in the following table for the curing compound number specified:

Curing compound no.	ASTM C309 classification
1	Pigmented, Type 2, Class B (See Note A)
2	Pigmented, Type 2, Class B
3	Pigmented, Type 2, Class A
4	Nonpigmented, Type 1, Class B
5	Nonpigmented, Type 1, Class A
6	Nonpigmented with fugitive dye, Type 1-D, Class A

Note A: The resin type must be poly-alpha-methylstyrene. The infrared scan for the dried vehicle must match the scan on file at METS.

- 2. If no curing compound number is specified, use any of the curing compounds shown in the table above.
- 3. The curing compound must be manufactured to:
 - a. Remain sprayable at temperatures above 40 degrees Fahrenheit
 - b. Control sagging, pigment settling, leveling, and de-emulsification
 - c. Maintain the specified properties for at least one year
- 4. Pigmented curing compounds must be manufactured such that the pigment does not settle badly, cake or thicken in the container, or become granular or curdled.
- 5. Settlement of pigment must be a thoroughly wetted, soft, mushy mass allowing the complete and easy vertical penetration of a paddle. Settled pigment must be easily predisposed, with minimum resistance to the sideways manual motion of the paddle across the bottom of the container, to form a smooth, uniform product of the proper consistency.
- 6. Do not dilute or alter the curing compound after manufacture.

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7. The curing compound must be packaged in clean 274-gallon totes, 55-gallon barrels, or five-gallon pails, or must be supplied from a suitable storage tank located at the job site or casting site. The containers must comply with 49 CFR 171–180. The 274-gallon totes and 55-gallon barrels must have removable lids and airtight fasteners. The five-gallon pails must be round and have standard full open head and bail. Do not use lids with bungholes.
8. Containers must be filled in a way that prevents skinning.
9. Steel containers and lids must be lined with a coating that prevents destructive action by the compound or chemical agents in the air space above the compound. The coating must not come off the container or lid as skins.
10. Plastic containers and lids must not react with the curing compound.
11. Label each curing compound container with the following:
 - a. Manufacturer's name
 - b. ASTM C309 classification
 - c. Batch number
 - d. Volume
 - e. Date of manufacture
 - f. Volatile organic compound content
 - g. Warning that curing compound containing pigment must be well stirred before using
 - h. Precautions concerning the handling and application of curing compound in compliance with 8 CA Code of Regs §§ 1500–1938 and 3200–6184
 - i. Statement that the contents fully comply with State air pollution control rules and regulations
12. Where concrete surfaces will receive architectural finishes, such as paint, membrane waterproofing, or graffiti-resistant coating, membrane-forming curing compound must not leave a coating or residue that will impair bond of adhesives, paints, and coatings with concrete.
13. Curing compound water loss must not exceed 0.15 kilograms per square meter in 24 hours when tested under California Test 534

2.04 CONTROL AND EXPANSION JOINT SEALANT

- A. Joint Sealants: A two-component elastomeric polyurethane sealant that is mixed and poured in place. When cured, it must form a resilient joint seal with a high resistance to penetration and abrasion, and must remain flexible through exposure to weather and aging. Sealant must be self-leveling as specified in Section 07 90 00 – Joint Protection.
- B. Color: Color must be as selected by VTA from manufacturer's standard color chart. Submit color chart in accordance with submittal requirements of this Section and Section 07 90 00, Joint Protection.
- C. Expansion Joint Filler: 1/2-inch thick in accordance with ASTM D1751, pre-molded non-extruding asphalt impregnated felt

2.05 CONTROL JOINT FORMING

- A. Control joints must be straight and true, of equal depth and width the full length of the joint. Arrange and locate joints as shown on the plans. Joints shown parallel and or perpendicular to other control joints, expansion joints, structural members, planter walls, and other in place construction elements must maintain that relationship the full extent of the joint.

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- B. Form control joints using 1/2-inch wide x 1-inch deep, metal tube, channel, or rod of sufficient gauge to ensure straight and true jointing. Release grips must be provided. Provide grips, screws, and handles on top of form for easy removal.
- C. Acceptable jointing methods: Forming as defined herein, saw cutting is acceptable only in those locations identified in the plans. Tooled joints are not acceptable for joints greater than 18 inches in length. Tooled joints must conform to the joint dimensions and trueness requirements of these specifications and as shown on the plans.

2.06 TOPPING SLAB REINFORCEMENT

- A. Refer to Section 03 53 00, Concrete Topping.

2.07 SLURRY COAT

- A. Water repellent concrete mortar/grout mixture, at locations shown on the plans.

2.08 CONCRETE TEXTURING AND FINISHING

- A. Wall Score/Crack Control Joints: Score joints in locations and as detailed in the plans.
- B. Strike off exposed surfaces of consolidated concrete to the lines and grades shown. Provide a uniform surface texture having the specified finish without undulations or irregularities.
- C. The Engineer determines the acceptability of the surface finishes.
- D. Finish sidewalks, curbs, and stairways on structures in accordance with Section 73-3 of the Caltrans Standard Specifications, except surfaces are not marked.
- E. Ordinary Surface Finish:
 - 1. Ordinary surface finish includes:
 - a. Filling holes or depressions
 - b. Repairing rock pockets and unsound concrete
 - c. Removing fins and projections flush to the surface
 - d. Removing stains and discolorations visible from traveled ways
 - 2. You do not need to remove fins from surfaces that are buried underground or enclosed.
 - 3. Remove form bolts and metal placed for your convenience to at least one inch below the concrete surface. Clean and fill the resulting holes with mortar. You do not need to remove form bolts in box girder cells except you must remove bolts flush if deck forms are removed from the cells.
 - 4. Fill bolt holes with mortar in accordance with Section 03 30 00, Cast-in-Place Concrete. Fill depressions and pockets with packed mortar or shotcrete as determined by the Engineer. Cure filler by keeping the surface damp for three days.
 - 5. For exposed surfaces, add enough white cement to the patching material to match the surrounding concrete after drying.
 - 6. If the Engineer determines that rock pockets are extensive, remove and replace the affected portions of the structure.

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- F. Broom Finish: Broom finish must consist of finishing the surfaces of the designated concrete with a burlap drag or broom device that produces parallel striations. The exact texture and coarseness of the broom finish must match the approved mock-up panel. Refer to Article 1.06B, “Site Mockups,” herein for detailed information regarding VTA acceptance of the basis of quality for broom finishes on this Project.
- G. Sandblast Finishes: Light, medium, and heavy sandblast finishes as indicated in the plans and as specified herein. Refer to Article 1.06B, “Site Mockups,” herein for detailed information regarding VTA acceptance of the basis of quality for sandblast finishes on this Project.
1. Light sandblast finish: Expose fine aggregate with occasional exposure of coarse aggregate, maximum penetration of 1/16 inch.
 2. Medium sandblast finish:
 3. Heavy sandblast finish: Approximately 1/8 inch penetration.
- H. Class 1 Smooth Finishes: “Class 1 Smooth” must be the nomenclature used by this Project to designate the type and quality of finish that will be acceptable for concrete surfaces designated as “Class 1 surface finish,” “Class 1 Smooth” or “Smooth.”
1. Class 1 Smooth surface finish must consist of finishing the surfaces of the designated concrete as necessary to produce smooth, even surfaces of uniform texture and appearance without bulges, depressions, or other imperfections. VTA must be the sole judge of the acceptable quality of finish.
 2. Use power carborundum stones or disks to remove bulges and other imperfections.
 3. Do not apply Class 1 surface finish until a uniform appearance can be attained.
 4. Sand areas not complying with the Class 1 Smooth surface finish requirements using power sanders or other abrasive means authorized by the VTA until the specified smooth, even surface finish of uniform texture and appearance is attained.
 5. Where pock marks, divets, voids and depressions occur on the concrete surface, these imperfections must be sack patched with a concrete grout mix similar to that of the concrete mix and must produce a final coloration similar to that of the primary concrete pour. Over patch depressions and grind smooth after grout has fully set. Surfaces which are deemed by VTA to contain 20 percent or greater coverage of the surface requiring patching must be treated with a thin layer overcoat of the grout to provide for a smooth even coloration of the final finish.
 6. Surface tolerance: CSP 1, as defined in ICRI 310.2R.

2.09 ANTI-GRAFFITI COATING

- A. Provide anti-graffiti coating on concrete surfaces in accordance with Section 09 96 23, Graffiti-Resistant Coatings.

2.10 QUALITY CONTROL AND ASSURANCE

- A. Contractor Quality Control: The Quality Control Testing Firm must perform the following inspections and testing:
1. Test each batch of curing compound delivered to the job site or casting site for the following:
 - a. Water loss at 24 hours under California Test 534
 - b. Reflectance under ASTM E1347
 - c. Viscosity under ASTM D2196

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- d. Nonvolatile content under ASTM D2369
 - e. Pigment content under ASTM D3723
 2. A batch must be no larger than 10,000 gallons.
 3. The Engineer samples the curing compound at any of the following:
 - a. Manufacturer's supply source
 - b. Job site or casting site
 4. The curing compound sampled from shipping containers from the manufacturer's supply source or from the job site must match the test results for viscosity, nonvolatile content, and pigment content within the tolerances specified in the precision and bias statements for the test methods.
 5. Additional testing of the curing compound may be required before its use if the compound has not been used within one year or if the Engineer believes that the compound may no longer be acceptable.
- B. VTA Quality Assurance:
 1. The VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Coefficient of Friction:
 1. Walking Surfaces: All walking surfaces, in wet or dry conditions, must meet the coefficients of friction required by the ADAAG Appendix to Part 1192, Section 1, to provide a 0.6 coefficient of friction for all floors, steps and lift platforms, and a 0.8 coefficient of friction for ramps.
 - a. You may uniformly apply nonskid abrasive finish grit particles onto the floated concrete surface while the concrete is plastic to provide the specified coefficients of friction. A minimum rate of 0.3 pounds of nonskid abrasive finish grit particles per square foot must be uniformly applied. Bury the particles into the concrete to a depth of approximately 0.7 times the diameter of each particle.
 2. Deck Surfaces: Except as specified otherwise for walking surfaces, structure deck surfaces and approach slabs must have a uniform surface texture with a coefficient of friction of not less than 0.35 when opened to traffic or before seal coats are placed, whichever occurs first.
 - a. If portions of completed deck surfaces or approach slabs have a coefficient of friction of less than 0.35, those portions must be ground or grooved parallel to the center line to produce a coefficient of friction of not less than 0.35. Grinding and grooving must comply with Section 42 of the Caltrans Standard Specifications.
 - b. The coefficient of friction requirements do not apply for bridge decks to be covered with membrane seals.

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- B. Ordinary Surface Finish:
1. Apply ordinary surface finish to all concrete surfaces as a final finish or before applying a higher class finish.
 2. Ordinary surface finish must be the final finish for the following surfaces:
 - a. Undersurfaces of slab spans, box girders, spandrel arch spans, and floor slabs between girders of superstructures
 - b. Inside vertical surfaces of T girders of superstructures
 - c. Surfaces to be buried underground or covered with embankment and surfaces of culverts above finished ground that are not visible from the traveled way
 - d. Interior and top surfaces of drainage inlets
- C. Broom Finish: Where indicated on the plans or specified herein, provide a light, medium, heavy or extra heavy broom finish.
- D. Sandblast Finish: Where indicated on the plans or specified herein, provide a light, medium, or heavy sandblast textured finish.
- E. Class 1 Smooth Finish:
1. Class 1 Smooth finishes must be used at all exposed-to-view concrete surfaces above the final platform walking surface, with the following exceptions:
 - a. Concrete curbs, gutters and walking surfaces. Walking surfaces must be in accordance with the concrete finish schedule located at the end of this Section.
 - b. Existing concrete in place unless specifically indicated on the plans to receive a final finish.
 - c. Unexposed surfaces of planter walls, unless identified otherwise in the plans.
 - d. Exposed walls and foundations at the Story Station Access Structures. Conform to finishes as indicated on the plans.
 2. Class 1 surface finish must be the final surface finish for the following surfaces:
 - a. Except for those surfaces listed in ordinary surface finish, the surfaces of bridge superstructures, including the undersurfaces of deck overhangs
 - b. Surfaces of bridge piers, piles, columns, and abutments, and retaining walls above finished ground and to at least one foot below finished ground
 - c. Surfaces of railings
- F. Imprinted Concrete Patterns: Where concrete infill patterned, colored and textured, is indicated on the plans, stamp pattern into concrete. Where colored and textured concrete is indicated on the plans, provide colors, patterns and textures in accordance with the concrete finishes schedule located at the end of this Section.
- G. Concrete Stain: Where indicated on the plans, provide two applications of concrete stain in accordance with manufacturer's recommendations.
- H. Provide clear concrete sealer on all exposed concrete surfaces, including, but not necessarily limited to, walls, pilasters, and walking surfaces, and including colored, textured, and natural concrete surfaces. On walking surfaces, the concrete sealer must maintain the coefficient of friction specified herein.

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Provide silica additive to concrete sealer as required by manufacturer to provide required coefficient of friction.

- I. Repair and patch work.
- J. Do not trowel exterior exposed concrete walking surfaces.

3.02 CURING

- A. Unless otherwise specified, cure newly placed concrete by one of the method specified in this section.

- 1. Water Method:

- a. The water method must consist of keeping the concrete continuously wet by applying water for a curing period of at least seven days after the concrete is placed.
- b. You may use cotton mats, rugs, carpets, or earth or sand blankets as a curing medium to retain the moisture during the curing period.
- c. For curing structures, you may use a curing medium consisting of white opaque polyethylene sheeting extruded onto burlap. The polyethylene sheeting must have a minimum thickness of four mils and must be extruded onto ten-ounce burlap.
- d. For curing columns, you may use a curing medium consisting of polyethylene sheeting with a minimum thickness of ten mils achieved in a single layer of material.
- e. Keep the concrete surface damp by applying water with an atomizing nozzle that forms a mist and not a spray until the surface is covered with the curing medium. Do not apply the water under pressure directly on the concrete or allow the water to flow over or wash the concrete surface. At the end of the curing period, remove the curing medium.
- f. If you use polyethylene sheeting or polyethylene sheeting on burlap as a curing medium:
 - 1) Secure the sheeting and the sheeting joints as necessary to retain moisture.
 - 2) Keep the sheeting within 3 inches of the concrete at all points along the surface being cured.
 - 3) Monitor the concrete temperature during curing.
 - 4) Discontinue the use of these curing media if the concrete temperature cannot be maintained below 140 degrees Fahrenheit.

- 2. Curing Compound Method:

- a. The curing compound method must consist of uniformly spraying the concrete surfaces exposed to the air with a curing compound.
- b. Mixing:
 - 1) Before using a curing compound, completely redisperse settled or separated solids in containers, except tanks, by mixing at low speed in compliance with these specifications and the manufacturer's instructions. Mix manually using a paddle or mix using a mixing blade driven by a drill motor at low speed. Mixing blades must be the type used for mixing paint.
 - 2) Keep on-site storage tanks clean and free of contaminants. Each tank must have a permanent system that completely redisperses settled material without introducing air or other foreign substances.

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- 3) At the time of use, compounds containing pigments must be thoroughly mixed. Use a paddle to loosen all settled pigment from the container bottom and use a power-driven agitator to disperse the pigment uniformly throughout the vehicle.
- 4) Agitation must not introduce air or other foreign substances into the curing compound.

c. Application:

- 1) Apply the curing compound at a nominal rate of 150 square feet per gallon.
- 2) At any point, the application rate must be within plus or minus 50 square feet per gallon of the nominal rate. The average application rate must be within plus or minus 25 square feet per gallon of the nominal rate when tested under California Test 535. Apply the curing compound such that there are no runs, sags, thin areas, skips, or holidays.
- 3) Apply the curing compound using power-operated spraying equipment with an operational pressure gauge and a means of controlling the pressure. The Engineer may allow hand spraying for small and irregular areas that, in the Engineer's opinion, are not reasonably accessible to power-operated spraying equipment.
- 4) Apply the curing compound to the concrete after finishing the surface, immediately before the moisture sheen disappears from the concrete surface but before drying shrinkage or craze cracks start to appear.
- 5) If the concrete surface cracks or dries, immediately and continually apply water with an atomizing nozzle until application of the curing compound is resumed or started. The atomizing nozzle must form a mist and not a spray. Do not apply the water under pressure directly on the concrete or allow the water to flow over or wash the concrete surface. Do not apply the curing compound over freestanding water.
- 6) If the film of curing compound is damaged before the expiration of seven days after the concrete is placed for structures and 72 hours for pavement, immediately repair it with additional compound.

3. Waterproof Membrane Method:

a. The waterproof membrane method must consist of:

- 1) Spraying the exposed finished concrete surfaces with water, using an atomizing nozzle that forms a mist and not a spray, until the concrete has set
- 2) Placing the waterproof curing membrane immediately after spraying
- 3) Keeping the membrane in place for at least 72 hours

b. The membrane must be sheeting material that complies with ASTM C171 for white reflective materials.

c. Use sheeting material of such a width as to completely cover the entire concrete surface. Cement the sheeting joints together securely such that the joints are waterproof. The joint seams must have at least a four-inch lap.

d. Securely weigh down the sheets by placing an earth bank on the sheet edges or by other authorized means.

e. If any portion of the sheets are damaged within 72 hours after being placed, immediately repair the damaged portion by cementing new sheets into place.

f. Do not use a membrane that is no longer waterproof or has been damaged such that it is unfit for curing concrete.

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4. Forms-in-Place Method:
 - a. The forms-in-place method must consist of curing formed concrete surfaces by keeping the forms in place.
 - b. Keep the forms in place for at least seven days after the concrete is placed, except keep the forms in place for at least five days for concrete members over 20 inches in least dimension.
 - c. The joints in the forms and the joints between the end of the forms and the concrete must be kept moisture tight during the curing period. Reseal cracks in the forms and cracks between the forms and the concrete using authorized methods.
5. Cure mortar and grout by keeping the surface damp for 3 days.

3.03 JOINTING

- A. Begin control jointing following concrete placement, finish toweling and removal of all bleed water.
- B. Insert control joint forms coated with form release agent where shown on the plans . Gently tamp form in place making certain top of form is flush with paving surface. Forms must be straight and true and must be flush with adjacent walls, utility boxes, and tiling.
- C. After concrete has sufficiently cured, carefully remove joint inserts. Joints must be clean, dry and free of all loose aggregate, paint, oil, grease and form release materials before application of primer and sealant.
- D. Prime joint surface and apply joint sealant in accordance with joint sealant manufacturer's written recommended practices for priming, mixing, and application.

3.04 SLURRY COAT

- A. Slope of slurry coat to provide adequate drainage in all planters and other locations as identified in the plans .

3.05 SANDBLASTING OF CONCRETE

- A. Apply sandblast textures to walking surfaces in plaza, access structure, and station platform as indicated in the plans.
- B. Apply sandblast textures to concrete walls, planter walls, and exposed structural foundations as indicated in the plans.
- C. Use a subcontractor who has been regularly engaged in the sandblasting of concrete for not less than two years immediately prior to this Work, and who has a record of successful sandblasting acceptable to VTA.
- D. On all exposed surfaces of concrete scheduled to be sandblasted, provide a uniform appearance similar in all respects to the sandblast finish selected by VTA from the mock-ups required under Article 1.06B, "Site Mockups," herein .
 1. Protect all stairway and elevator walls, glass, and other exposed surfaces from overspray of sand to ensure no damage is done to those surfaces.

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E. Procedures:

1. Verify that sandblasting personnel are completely aware of VTA's decision relative to degrees of sandblasting to be performed and areas to be sandblasted.
2. Use special care in abrading edges and corners to provide a smooth and uniform pattern consistent with other sandblasted surfaces.

3.06 SCHEDULE OF FINISHES

- A. Concrete finish in all public areas: Sack and Patch, smooth finish surface tolerance CSP 1, as defined in ICRI 310.2R, unless otherwise indicated on the plans or specified in these Technical Specifications.
- B. Concrete to receive coatings: Prepare surfaces as recommended by the manufacturer of each coating.

3.07 PROTECTION

- A. Protect exposed concrete surfaces, including flatwork, as required to prevent damage due to any cause, including rain, heat, cold, wind, impact or strains, your actions, and the actions of others.
- B. Protect fresh concrete from drying winds, rain, damage, or soiling.
 1. If it is raining, you must provide adequate protection against damage or you must stop placing the concrete before the quantity of surface water is sufficient to damage the surface mortar or cause a flow or wash of the concrete surface.
- C. Refer to Section 03 30 00, Cast-In-Place Concrete, for additional requirements.

3.08 TOLERANCES

- A. Formed Surfaces: Conform with applicable requirements of ACI 117.
- B. Bearing Surfaces:
 1. Where elastomeric bearing pads are indicated, wood float finish the concrete bearing surface to a level plane that varies at most 1/16 inch from a straightedge placed in any direction and is within 1/8 inch of the specified elevation. The bearing area must extend at least 1 inch beyond the limits of the bearing pads.
 2. For bearing assemblies or masonry plates not embedded in concrete, construct the concrete bearing area above grade and grind to a true level plane that does not vary perceptibly from a straightedge placed in any direction and is within 1/8 inch of the elevation shown.

3.09 REPAIR OF SURFACE DEFECTS

- A. Repair Standards: Repair of surface defects must conform with applicable requirements of ACI 301. When using epoxy mortar, conform with applicable requirements of ACI 503.4.
- B. Surface Defects:
 1. Repair of surface defects must begin immediately after form removal and after removal of temporary anchors from exposed concrete. For repair with epoxy mortar, concrete must be dry.

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2. Surface defects are defined to include: form-tie holes, air voids or pockets, bug holes with a nominal diameter or depth greater than 1/4-inch, honeycombed areas, rock pockets, visible construction joints, fins, burrs, and holes and defects resulting from installation or removal of temporary anchors.
3. Repair of surface defects must be tightly bonded and must result in concrete surfaces of uniform color and texture, matching adjacent surfaces, and free of shrinkage cracks.

C. Repair Work:

1. Remove honeycombed and other defective concrete down to sound concrete. Saw-cut the edges perpendicular to the surface or slightly undercut. Feather-edges will not be permitted. Dampen the area to be patched and an area at least 6 inches wide surrounding it to prevent absorption of water from the patching mortar.
2. Where rock pockets or similar defects or voids expose steel reinforcement, cutout to solid surface behind the reinforcing steel to provide suitable key-lock for patching mortar. Patching mortar must envelope the exposed reinforcing bar.
3. Bond patching mortar to concrete with bonding grout or epoxy adhesive. Bonding grout must consist of one part portland cement to one part No. 30 mesh sand, mixed to the consistency of a thick cream, and then well brushed onto the concrete. Bond commercial patching mortar to concrete in accordance with the manufacturer's instructions.
4. Make the patching mortar of the same materials and of approximately the same proportions as used for the concrete, except omit the coarse aggregate. Use not more than one part portland cement to 2-1/2 parts sand by damp loose volume, and substitute white portland cement for a portion of the regular gray portland cement to produce patching mix matching the surrounding concrete in color when dry. Determine the proportion of white portland cement by trial mixes and test areas, prior to repair of actual defective areas.
5. After surface water has evaporated from the area to be patched, brush the bond coat well into the surface. When the bond coat begins to lose the water sheen, apply the patching mortar. Compact the mortar into place and strike off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave the patch undisturbed for at least 1 hour before being finally finished. Keep the patched area damp for 7 days.
6. Neatly finish patched surfaces to match adjacent surrounding surface texture of concrete. Grind or fill surfaces to produce level and plumb, true planes.
7. For walls and concrete surfaces exposed in the finish work, form tie holes must be patched and finished flush with adjacent surface. For holes passing entirely through walls, a plunger type injection gun or other suitable device must be used to completely fill the holes.
8. Patching of honeycombed areas or rock pockets that are too large and unsatisfactory for mortar patching must be cut out to solid surface, keyed, and packed solid with matching concrete to produce firm bond and flush surface. Patching must match texture of adjacent surfaces where exposed in the finished work.
9. Repair work in exposed locations that does not match the texture and color of surrounding adjacent surfaces or that was not well performed must be removed and performed again until the repair work conforms with Specification requirements.
10. Surfaces to receive membrane waterproofing must have fins and loose material removed, and voids and cracks patched flush with adjacent surfaces.
11. Completed repairs must be cured as herein specified under Article 3.02, Curing.
12. Holes and defects resulting from the installation or removal of temporary anchors must be completely filled using a plunger type injection gun or other suitable device, and must be finished flush with adjacent surface.

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3.10 FINISHING ROADWAY SURFACES

- A. Construct concrete roadway surfaces of structures, approach slabs, sleeper slabs, and adjoining approach pavement, and concrete decks to be covered with another material, to the grade and cross section shown. Surfaces must comply with the specified smoothness, surface texture, and surface crack requirements.
- B. The Engineer sets deck elevation control points for your use in establishing the grade and cross section of the deck surface. The grade established by the deck elevation control points includes all camber allowances. Elevation control points will not be closer together than approximately eight feet longitudinally and 24 feet transversely to the bridge centerline.
- C. Before starting concrete placement for any deck section:
 - 1. Set to grade all rails and headers used to support or control the finishing equipment
 - 2. Check rails and headers to ensure the completed deck complies with smoothness requirements
 - 3. Move the finishing equipment over the length of the section to check steel and bulkhead clearances
- D. Finish bridge decks to be covered with membrane seals to a smooth surface free of mortar ridges and other projections.
- E. On structures, the Contractor will be responsible for setting deck elevation control points to establish the grade and cross-section of the concrete deck surface, including all camber allowances.
- F. Complete the smoothness testing and any required grinding before applying seal coats.

3.11 FINISHING PEDESTRIAN BRIDGE SURFACES

- A. Construct deck surfaces, including ramps and landings of bridges to the grade and cross section shown. Surfaces must comply with the specified smoothness, surface texture, and surface crack requirements.
- B. Pedestrian bridge deck finishes must have a broom finish. Apply the broom finish perpendicular to the path of travel. Water mist may be applied to the bridge deck surface immediately before brooming.
- C. The Contractor will be responsible for setting deck elevation control points to establish the grade and cross-section of the concrete deck surface, including all camber allowances.
- D. Clean any discolored concrete by abrasive blast cleaning or other method authorized by the Engineer.

3.12 FIELD QUALITY CONTROL AND ASSURANCE

- A. Surface Smoothness:
 - 1. Except for pedestrian overcrossings, deck surfaces must comply with the following smoothness requirements:
 - a. Profile trace having no high points over 0.02 foot
 - b. Profile count of five or less in any 100-foot section for portions within the traveled way
 - c. Surface not varying more than 0.02 foot from the lower edge of a 12-foot-long straightedge placed transversely to traffic

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2. Pedestrian overcrossing deck surfaces must comply with the following smoothness requirements:
 - a. Surfaces between grade changes must not vary more than 0.02 foot from the lower edge of a 12-foot-long straightedge placed parallel to the centerline of the pedestrian overcrossing
 - b. Surface must not vary more than 0.01 foot from the lower edge of a 6-foot-long straightedge placed perpendicular to the centerline of the pedestrian overcrossing
 3. Grind surfaces not complying with the smoothness requirements until the required smoothness is attained. Grinding must not reduce the concrete cover on the reinforcing steel to less than 1-1/2 inches.
 4. Replace portions of decks that cannot be corrected by grinding.
- B. Crack Intensity:
1. The Engineer measures crack intensity of deck surfaces after curing, before prestressing, and before falsework release. Clean the surface for the Engineer to measure surface crack intensity.
 2. In any 500 square foot portion of a new bridge deck surface, if there are more than 50 feet of cracks having a width at any point of over 0.02 inch, treat the deck with methacrylate resin under Section 60-3.03B of the Caltrans Standard Specifications. Treat the entire deck width between barriers to 5 feet beyond where the furthest continuous crack emanating from the 500 square foot section is 0.02 inch wide. Treat the deck surface before grinding.
 3. In any 100 square foot portion of a new pedestrian overcrossing deck surface, if there are more than 10 feet of cracks having a width at any point of over 0.02 inch, treat the deck with methacrylate resin under section 60-3.03B of the Caltrans Standard Specifications. Treat the entire deck width between the curbs to 5 feet beyond where the furthest continuous crack emanating from the 100 square foot section is 0.02 inch wide. Treat the deck surface before grinding.
- C. Contractor Quality Control: The Quality Control Testing Firm must perform the following inspections and testing:
1. Provide continuous inspection of concrete finishing and placement of curing compound for bridge decks and stairs.
 2. Provide continuous inspection of curing compound placement for all concrete including the requirement to place curing compound on concrete after form removal.
 3. Except for pedestrian overcrossings, the smoothness of completed deck surfaces must be tested by the Quality Control Testing Firm in the presence of the Engineer using the following:
 - a. Bridge profilograph, provided by the Contractor, under California Test 547. The bridge profilograph shall be supplied by the Contractor and approved by the Engineer. Two profiles are obtained in each lane approximately 3 feet from the lane lines and one profile is obtained in each shoulder approximately 3 feet from the curb or rail face. Profiles are taken parallel to the direction of traffic.
 - b. 12-foot-long straightedge placed transversely to traffic.
 4. The smoothness of the completed pedestrian overcrossing deck surfaces must be tested by the Quality Control Testing Firm in the presence of the Engineer using the following:

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- a. 6-foot-long straightedge placed perpendicular to the centerline of the pedestrian overcrossing
 - b. 12-foot-long straightedge placed parallel to the centerline of the bridge.
- D. Engineer Quality Assurance:
1. The Engineer will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of the Engineer to detect defective work or material must not prevent later rejection when such defect is discovered, nor must it obligate the Engineer for final acceptance.

END OF SECTION 03 35 00

SECTION 03 41 00

STRUCTURAL PRECAST CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Precast components of bridge structures
 2. Precast components of earth retaining systems
 3. Precast concrete panel sound walls
 4. Reinforcing steel
 5. Portland cement concrete
 6. Anchors, lift devices, and accessories

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 05 15, Portland Cement Concrete
- D. Section 03 05 18, Prestressed Concrete
- E. Section 03 35 00, Concrete Finishing
- F. Section 03 11 00, Concrete Formwork
- G. Section 03 11 16, Architectural Cast-in-Place Concrete Forming
- H. Section 03 20 00, Concrete Reinforcing
- I. Section 03 62 00, Non-Shrink Grouting
- J. Section 09 96 23, Graffiti-Resistant Coatings
- K. Section 31 62 00, Driven Piles
- L. Section 31 66 17, Mechanically Stabilized Earth Walls

1.03 REFERENCED STANDARDS

- A. American Concrete Institute (ACI):
1. ACI 117 Specifications for Tolerances for Concrete Construction and Materials

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- | | | |
|----|--------------|--|
| 2. | ACI 301 | Specifications for Structural Concrete |
| 3. | ACI 318/318R | Building Code Requirements for Concrete and Commentary |
- B. ASTM International (ASTM):
- | | | |
|-----|-------------------|--|
| 1. | ASTM A123/A123 | Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| 2. | ASTM A153/A153M | Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| 3. | ASTM C31/C31M | Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| 4. | ASTM C39/C39M | Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| 5. | ASTM C138/C138M | Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete |
| 6. | ASTM C143/C143M | Standard Test Method for Slump of Hydraulic-Cement Concrete |
| 7. | ASTM C172/C172M | Standard Practice for Sampling Freshly Mixed Concrete |
| 8. | ASTM C173/C173M | Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method |
| 9. | ASTM C231/C231M | Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |
| 10. | ASTM C1064/C1064M | Standard Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete |
| 11. | ASTM C1107/C1107M | Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) |
- C. Precast/Prestressed Concrete Institute (PCI):
- | | | |
|----|-------------|--|
| 1. | PCI MNL-116 | Manual for Quality Control for Plants and Production of Structural Precast Concrete Products |
| 2. | PCI MNL-135 | Tolerances for Precast and Prestressed Concrete Construction |
- D. State of California, Department of Transportation (Caltrans):
- | | | |
|----|---------------------|---|
| 1. | California Test 521 | Compressive Strength of Molded Concrete Cylinders (Equivalent to ASTM C39/C39M) |
| 2. | California Test 540 | Making, Handling and Storing Concrete Compressive Test Specimens in the Field (Equivalent to ASTM C31/C31M) |
- E. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:
- | | | |
|----|------------|-----------------------|
| 1. | Section 50 | Prestressing Concrete |
| 2. | Section 90 | Concrete |
- 1.04 DEFINITIONS**
- A. Structural precast concrete members are categorized into the following tiers:
- | | |
|----|---|
| 1. | Tier 1: Components of bridge structures, including girders and piling. |
| 2. | Tier 2: Components of earth retaining systems, mechanically stabilized earth wall panels, TPSS screens, and sound wall panels and supports. |
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1.05 SUBMITTALS

- A. General: Submittals for structural precast concrete must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions and these Technical Specifications.
- B. Shop Drawings and Calculations: Submit Shop Drawings showing the following:
1. Detailed drawings of units, members, and components, showing dimensions and sections of each.
 2. Shop Drawings must show complete details and substantiating calculations of the method and materials the Contractor proposes to use, including quantities, dimensions, and locations of sleeves, anchors, brackets, inserts, reglets, reinforcing steel, lift devices, accessories, and methods of securing same in forms.
 3. Casting, consolidating, and finishing procedures.
 4. Shop Drawings and calculations must be stamped and wet signed by an engineer who is currently registered as a civil engineer in the State of California.
 5. Shop Drawings for precast prestressed girders must include the following items:
 - a. Anticipated deflections of the girders before deck placement and the methods of accommodation. Include the following anticipated deflections:
 - 1) Upward deflection due to prestressing forces
 - 2) Downward deflection due to girder dead load
 - 3) Deflection due to creep and shrinkage from the time of girder stressing to the planned deck placement
 - b. Deflection calculations that consider the age of the girder concrete when stressing and the planned placement of the deck. Use the concrete producer's estimated modulus of elasticity at the applicable concrete age for calculating deflections.
 - c. For segmental or spliced-girder construction, Shop Drawings must include the following additional information:
 - 1) Details showing construction joints or closure joints
 - 2) Arrangement of bar reinforcing steel, prestressing tendons, and pressure grouting pipe
 - 3) Materials and methods for making closures
 - 4) Construction joint keys and surface treatment
 - 5) Other requested information
 - d. For segmental girder construction, Shop Drawings must include concrete form and casting details.
 6. Shop Drawings and calculations must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by VTA.
- C. Mix Designs: Submit mix designs in accordance with the requirements specified in Section 03 05 15, Portland Cement Concrete.

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1. Mix designs must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.
- D. Product Data: Submit manufacturer's product data of manufactured products and accessories. Include manufacturer's detailed drawings and dimensions when applicable.
- E. Samples: Samples require approval of the VTA, as follows:
1. For precast concrete to be exposed in the finished work to public view, submit form facing material, 24 inches by 24 inches or larger in size as appropriate.
 2. For precast concrete to receive sandblasted or other surface finish, submit sample of concrete with specified finish, 24 inches by 24 inches or larger in size as appropriate.
 3. If curing compound is used, provide certificate of compliance as specified in Section 03 35 00, Concrete Finishing.
- F. Precast Concrete Quality Control Plan (PCQCP): In compliance with applicable requirements of Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions, provide a Precast Concrete Quality Control Plan (PCQCP), as part of the Structural Quality Control Plan (SQCP), to ensure uniformity of materials, conformance with accepted mix designs, and compliance with these Technical Specifications. No structural precast concrete operations must be performed until the PCQCP is approved in writing by VTA. Allow 25 days for review.
1. Prior to performing any precasting operations, submit to the VTA a Precast Concrete Quality Control Plan (PCQCP). Include in the PCQCP each item of work to be precast.
 2. Include in the plan all tests the Independent Testing Agency will perform to verify compliance with Specification requirements, and the laboratory that the Independent Testing Agency intends to engage to perform the tests.
 3. As a minimum, each PCQCP must include the following:
 - a. The name of the precasting plant, concrete plants, and any testing laboratory to be used.
 - b. A manual prepared by the precasting plant that includes equipment description, testing procedures, safety plan, and the names, qualifications, and documentation of certifications for all personnel to be used in the Work.
 - c. The names, qualifications, and documentation of certifications for the Precast Quality Control Manager (PCQCM) and all quality control personnel to be used.
 - d. An organizational chart showing all quality control personnel and their assigned quality control responsibilities.
 - e. The methods and frequencies for performing all required quality control procedures, including all inspections, material testing, and any required survey procedures for all components of the precast elements including prestressing systems, concrete, grout, reinforcement, steel components embedded or attached to the precast member, miscellaneous metal, and formwork.
 - f. A system for identification and tracking of required precast element repairs, and a procedure for the reinspection of any repaired precast element. The system must have provisions for a method of reporting nonconforming precast elements to the VTA.
 - g. Forms to be used for Certificates of Compliance, daily production logs, and daily reports.

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4. Submit a separate PCQCP for each plant.
 5. For internally monitored tier 1 precast bridge components, include the following as part of the PCQCP:
 - a. Authorized mix design
 - b. Duration and method of curing
 - c. Concrete temperature monitoring and recording system details
 - d. Temperature sensor types and locations
 - e. Measures to ensure compliance with maximum temperature and temperature gain requirements, including maximum concrete temperature at discharge and controlling enclosure temperature
 6. Submit a revised PCQCP for any changes to the following:
 - a. Concrete plants
 - b. Material sources
 - c. Material testing procedures
 - d. Testing laboratory
 - e. Procedures and equipment
 - f. Systems for tracking and identifying precast concrete members
 - g. Quality Control personnel
 - h. Methods for controlling internal concrete temperature
 7. Allow seven days for the review of a revised PCQCP.
 8. After submitting the PCQCP required herein, a meeting between the VTA, the Contractor, the Precast Concrete Quality Control Manager, the Independent Testing Agency, and a representative from each entity performing precast concrete operations for this project, must be held to discuss the requirements for precast concrete quality control.
 9. The Precast Concrete Quality Control Plan must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by VTA.
 10. After authorization, make one copy of the PCQCP available at each location where work is performed.
 11. It is expressly understood that the VTA's review of the Contractor's PCQCP must not relieve the Contractor of any responsibility under the Contract for the successful completion of the work in conformance with the requirements of the plans and these Technical Specifications. The VTA's review must neither constitute a waiver of any of the requirements of the plans and these Technical Specifications nor relieve the Contractor of any obligation thereunder; and defective work, materials, and equipment may be rejected notwithstanding approval of the PCQCP.
- G. Precast Prestressed Girder Erection Work Plan:
1. For precast prestressed concrete girders, submit a Girder Erection Work Plan. Include procedures, details, and sequences for unloading, lifting, and erecting girders and for temporary bracing installation. The work plan must be signed by an engineer who is currently registered as a civil engineer in the State of California.
 2. The Girder Erection Work Plan must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and

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stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.

H. Certificates:

1. Submit evidence of current plant certification under the PCI Plant Certification Program, the Caltrans Precast Fabrication Qualification Audit Program, or approval by the International Code Council (ICC).
2. Submit manufacturers' certifications of compliance for materials as required by PCI MNL-116.
3. Submit a certificate of compliance for the cementitious material used in precast concrete members. The certificate must be signed by the precast concrete product manufacturer.
4. For welders, furnish welding certificates or affidavits attesting to the welders' qualifications to perform the indicated and specified welding.
5. For each batch of curing compound delivered to the Worksite or casting site, submit a certificate of compliance to the Engineer. The certificate of compliance must include test results for the tests specified in section 90-1.01D(6) of the Caltrans Standard Specifications and certification that the material was tested within one year before use.
6. Submit a certificate of compliance for each precast concrete member. The certificate of compliance must be signed by the Precast Concrete Quality Control Manager (PCQCM).

I. Laboratory Test Reports:

1. Laboratory test reports must show the name of testing agency, date of testing, types of tests performed and must be signed by a principal of the testing agency who is currently registered as a civil engineer in the State of California. Laboratory tests must not be older than eight months and must certify that the tested materials meet the specified standards.
2. Laboratory test reports for concrete mix designs must clearly identify each material or mix number of each mix tested to verify the correlation between the tested mix designs and the proposed mix designs.
3. When required by other portions of these Technical Specifications, laboratory test reports must be submitted for each material to be used in each class of concrete, or for each mix design and must show compliance with appropriate ASTM Standards and these Technical Specifications.

J. Precast Report: Refer to Article 2.03, “Source Quality Control,” herein.

1.06 QUALITY ASSURANCE AND CONTROL

A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.

B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.

C. Contractor Quality Control:

1. The Contractor's quality control personnel must maintain quality control prior to precasting, during precasting, and after precasting, and as specified in this section and additionally as necessary to ensure that materials and workmanship conform to the details shown on the plans, and these Technical Specifications.

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2. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 - e. Select samples that fairly represent average quality and grading of aggregates proposed for the work. When aggregates have been approved, no change will be allowed without written permission of the VTA. Maintain stocks of accepted aggregates so no pour need be interrupted
 - f. Perform tests under the appropriate California Test methods or ASTM test methods, as specified herein. Use testing equipment that is in good condition and properly calibrated. If tests are performed during the Contract, notify VTA in advance so that VTA can witness the test procedures.

3. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - a. Independent Testing Agency personnel performing quality control laboratory testing must have the following certifications, as applicable:
 - 1) ACI Strength Testing Technician
 - 2) ACI Concrete Laboratory Testing Technician Level 1
 - 3) ACI Aggregate Testing Technician Level 2

 - b. Independent Testing Agency personnel performing quality control field testing and field and plant inspection must have an ACI Concrete Field Testing Technician, Grade I certification.

4. Precast Concrete Quality Control Manager (PCQCM):
 - a. The Contractor must designate in writing a Precast Concrete Quality Control Manager (PCQCM) for each precasting facility. The PCQCM must be responsible directly to the Contractor's Structural Quality Control Manager (SQCM) for the quality of structural precast concrete operations, including materials and workmanship performed by the Contractor and all subcontractors.
 - b. The PCQCM must cooperate with the Independent Testing Agency and notify the Independent Testing Agency 48 hours in advance of all precast concrete operations.
 - c. The PCQCM must be the sole individual responsible to the Contractor's Structural Quality Control Manager (SQCM) for receiving, reviewing, and approving all correspondence, submittals, and reports related to quality control and quality assurance of structural precast concrete operations.
 - d. The PCQCM must be currently registered as a civil engineer in the State of California or must currently have a Plant Quality Personnel Level II certification from the Precast/Prestressed Concrete Institute.

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- e. The PCQCM must be your employee or must be hired by a subcontractor providing only quality control services. The PCQCM must not be employed or compensated by a subcontractor or by other persons or entities hired by subcontractors who will provide other services or materials for the project.
- f. The responsibilities of the PCQCM may be fulfilled by the Contractor's Structural Quality Control Manager (SQCM).

5. Qualifications of Fabricator:

- a. The fabricator of precast concrete products must be an active and approved participant in the PCI Plant Certification Program, the Caltrans Precast Fabrication Audit Program, or an ICC-approved precast fabricator.
- b. Precast concrete work must be produced in a plant or production facility by a fabricator who has been regularly and continuously engaged in the manufacture of precast concrete products.
- c. The fabricator must have sufficient production capacity to produce the required units without causing any delay in the work.

6. Qualifications of Installer: Experience in performing work specified herein, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

7. Tolerances: Fabricate and erect precast concrete members within the tolerances recommended in PCI MNL-116 and PCI MNL-135, unless otherwise specified in the plans.

8. Mock-Ups: Construct site mock-ups for all architectural concrete work and formed concrete exposed to the public in accordance with the provisions of Section 03 35 00, Concrete Finishing.

9. Control Samples: All finishes and colors must match the VTA's control samples. Control samples require the VTA's approval before they may be used as a standard.

10. Precast Concrete Panel Sound Wall Test Panel:

- a. Construct a test panel, demonstrating the construction procedure that will be used to attain the final finish, pattern, and color. If ordered, construct additional test panels until a satisfactory finish, pattern, and color on each side of the panel is attained. The authorized test panel will be the standard of comparison for the precast concrete panels.

D. VTA Quality Assurance:

- 1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
- 1. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units to the Worksite in such quantities and at such times to ensure continuity of installation.
- B. Carefully handle, store, transport, and erect precast concrete members to avoid twisting, racking, or other distortion that would result in cracking or damage to the members.

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- C. Handle, store, transport, and erect precast members in a position such that the points of support and directions of the reactions with respect to the member are approximately the same as when the member is in its final position.
- D. If storage of precast units at the Worksite is necessary, store units in a manner that will prevent cracking, distortion, staining, or other damage. Support members at their normal support points.

1.08 MEASUREMENT AND PAYMENT

- A. Measurement:
 - 1. Furnish Precast Prestressed Concrete Girder (CA WF72PT) must be measured by the individual unit (each).
 - 2. Erect Precast Prestressed Concrete Girder (CA WF72PT) must be measured by the individual unit (each).
 - 3. Furnish and Erect Precast Concrete Wall of the various types listed on the Schedule of Quantities and Prices must be measured by the linear foot.
- B. Payment:
 - 1. The contract price paid per individual unit (each) for Furnish Precast Prestressed Concrete Girder (CA WF72PT) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in fabricating and delivering precast prestressed concrete girders to the Worksite ready to incorporate into the work complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
 - 2. The contract price paid per individual unit (each) for Erect Precast Prestressed Concrete Girder (CA WF72PT) must include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all Work involved in erecting precast prestressed concrete girders at the Worksite into the final position in the work, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
 - 3. The contract price paid per linear foot for Furnish and Erect Precast Concrete Wall of the various types listed on the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all Work involved in furnishing and erecting precast concrete wall at the Worksite into the final position in the work, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
- C. Full compensation for providing bar reinforcing steel and prestressing steel for precast concrete girders, including diaphragm dowels and bolts in precast concrete girders, must be considered as included in the bid item for Furnish Precast Prestressed Concrete Girder (CA WF72PT) and no additional compensation will be allowed therefor.
- D. Full compensation for providing formliner texture and bar reinforcing steel for precast concrete wall panels and earthwork involved in installing precast concrete wall must be considered as included in the bid item for Furnish and Erect Precast Concrete Wall of the various types listed on the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
- E. Full compensation for developing and conforming to the Precast Concrete Quality Control Plan (PCQCP) must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

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- F. Full compensation for furnishing precast driven piles must be considered as included in the bid item for Furnish Precast Prestressed Concrete Piling of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
- G. Full compensation for driving precast driven piles must be considered as included in the bid item for Drive Precast Prestressed Concrete Piling of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforcing Steel: Comply with applicable requirements of Section 03 20 00, Concrete Reinforcing.
- B. Portland Cement Concrete:
 - 1. Comply with applicable requirements of Section 03 05 15, Portland Cement Concrete. Provide class of concrete as indicated on the plans.
 - 2. Coloring material for colored concrete must be a standard commercial brand of chemically inert mineral oxide coloring material accurately measured by weight in a definite manner for each batch of concrete to produce a consistently even color. Material must be readily dispersible in water. Color must be as selected by the VTA from samples prepared and submitted by the Contractor.
- C. Anchors, Lift Devices, and Accessories: Provide concrete inserts, reglets, anchors, brackets, and fasteners as indicated or required for fabrication and installation work. All items must be zinc-coated or galvanized in accordance with ASTM A153/A153M or ASTM A123, as applicable. Contractor must select the lift devices, and must be responsible for their performance and for any damage resulting from the use of faulty or inferior devices. Lift devices must not be visible on exposed faces of precast members.
- D. Concrete Forming: Refer to Section 03 11 00, Concrete Formwork for requirements.
- E. Concrete for keyways must have a cementitious material content of at least 590 pounds per cubic yard and a 1-inch maximum grading. Penetration of the concrete must be near the lower limit of the specified nominal penetration.
- F. Grout: Grout must comply with ASTM C1107/C1107M.
- G. Deck shear connector rods, shown as tie rods, must comply with the following:
 - 1. Steel fastener components must comply with the provisions in Section 05 12 35, Structural Steel, and Section 05 17 00, Miscellaneous Metal.
 - 2. Lock washers must be ANSI heavy duty spring washers.
 - 3. All metal must be hot-dip galvanized after fabrication under ASTM A123/A123M.
- H. Utility Structures: Precast concrete structures for utilities are specified in Section 33 40 00, Storm Drainage Utility.

2.02 FABRICATION

- A. Requirements and Standards:

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1. Manufacture precast concrete units in accordance with PCI MNL-116 and applicable requirements of ACI 318/318R, Chapter 16.
 2. Forms must be accurately constructed to produce members to dimension, shape, configuration, and profile indicated. When not otherwise indicated, construct forms to produce smooth concrete.
 3. Concrete reinforcement, lifting reinforcement, and concrete inserts and anchorage devices must be placed and secured against movement as required.
 4. Concrete must be placed and consolidated to shape, configuration, and dimensions indicated.
 5. Members must be moist cured in accordance with curing requirements specified in PCI MNL-116. Minimum curing period for combined initial curing and secondary curing must be seven days or until the specified strength of concrete is attained.
- B. Finishes:
1. Provide finishes for exposed concrete matching approved samples and mock-ups and the approved control samples.
 2. Provide Class 1 Smooth Surface Finish as specified in Section 03 35 00, Concrete Finishing, unless otherwise specified in the plans or these Technical Specifications.
 3. When sandblasted finish is indicated, provide "sandblast finish" as specified in Section 03 35 00, Concrete Finishing. Degree of sandblasting must be as required to provide surface finish matching the approved control sample.
 4. Each surface finish must be of uniform color and texture.
 5. For segmental or spliced-girder construction, materials for construction joints or closure joints at exterior girders must match the color and texture of the adjoining concrete.
- C. Markings: Provide permanent markings in precast units to identify pick-up points and orientation in the structure, conforming with the markings indicated on Shop Drawings. Imprint the date of casting on each precast unit where it will not show in the finished structure.
- D. Curing:
1. Cure precast concrete using steam curing or any of the applicable methods specified in Section 03 35 00, Concrete Finishing. Cure for the minimum time specified for each method or until the concrete reaches its design strength, whichever is less.
 - a. If the curing compound method is used for precast concrete panel sound walls, cure the panels using curing compound no. 4.
 2. Steam curing must comply with the following:
 - a. After placing the concrete, hold it for a 4-hour minimum presteaming period. If the ambient air temperature is below 50 degrees Fahrenheit, apply steam during the presteaming period to hold the air surrounding the concrete at a temperature of 50 to 90 degrees Fahrenheit.
 - b. To prevent moisture loss on the exposed surfaces during the presteaming period, cover the concrete as soon as possible after casting or keep the exposed surfaces wet by fog spray, curing compound, or wet blankets.
 - c. Enclosures for steam curing must allow free circulation of steam around the concrete and must be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers is allowed if they are kept in good repair and secured in such a way that prevents the loss of steam and moisture.
 - d. Steam at the jets must be at low pressure and in a saturated condition. Steam jets must not impinge directly on the concrete, test cylinders, or forms. During

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application of the steam, the temperature rise within the enclosure must not exceed 40 degrees Fahrenheit per hour. Except for internally monitored components, the curing temperature throughout the enclosure must not exceed 150 degrees Fahrenheit. Maintain the curing temperature at a constant level for the time necessary to develop the required transfer strength. Cover control cylinders to prevent moisture loss and place them in a location where the temperature is representative of the average enclosure temperature.

- e. Detension the concrete in pretension beds immediately after the steam curing is completed while the concrete and forms are still warm, or maintain the temperature under the enclosure above 60 degrees Fahrenheit until the stress is transferred to the concrete.
 - f. Curing is complete at the end of the steam curing cycle.
- 3. Apply curing compound using power-operated spraying equipment. You may request application by hand spraying for small quantities of precast concrete members.
 - 4. For internally monitored precast bridge components with a maximum internal concrete temperature of 161 to 165 degrees Fahrenheit, the following apply:
 - a. Do not apply curing compound.
 - b. Cure an additional seven days using the water cure method.
 - c. After seven days apply a silane waterproofing treatment under the following conditions:
 - 1) Silane waterproofing treatment selected for use must be on the Caltrans Authorized Material List for silane reactive penetrating sealers.
 - 2) Concrete surfaces must be completely dry when silane is applied.
 - 3) Apply a single application of undiluted silane under the manufacturer's application instructions until surfaces are saturated.
 - 5. Cure test cylinders for determining time of prestressing loading in the same manner as the concrete in the member.
 - 6. Cure test cylinders for determining compliance with 28-day strength requirements in the same manner as the member until completion of the steam curing process followed by a water bath or moist room at 60 to 80 degrees Fahrenheit until tested.

E. Girders:

- 1. Before curing activities, the top surface of each precast member must be given a coarse texture by brooming with a stiff bristled broom or by other suitable devices that results in uniform transverse scoring.
- 2. The top surface texture of precast concrete girders must have at least a 1/4-inch amplitude.
- 3. At spliced-girder closure joints:
 - a. If shear keys are not shown, the vertical surfaces of the girder segment ends must be given a coarse texture as specified for the top surface of precast members.
 - b. Post-tensioning ducts must extend out of the vertical surface of the girder segment closure end sufficiently to facilitate splicing of the duct.
- 4. For spliced girders, pretension strand extending from the closure end of the girder segment to be embedded in the closure joint must be free of mortar, oil, dirt, excessive mill scale and scabby rust, and other coatings that would destroy or reduce the bond.

F. Precast Concrete Panel Sound Walls:

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1. Form the cast side (down) of the precast panels using a formliner with a texture of a nominal 4 by 16 inch slump stone block within the limits shown on the plans. Install the formliner such that no form joints show in the finished surface.
2. The work side (top) must be given a broom finish texture within the limits shown on the plans by brooming with a stiff bristled broom or by other suitable devices that results in uniform transverse scoring.

2.03 SOURCE QUALITY CONTROL AND ASSURANCE

A. Contractor Quality Control:

1. Cooperate with and notify the VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. The VTA may elect to observe these procedures.
2. In accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions, the Independent Testing Agency must perform such inspections and tests as required to verify compliance with these Technical Specifications.
3. Concrete must be tested for compressive strength as specified in Section 03 05 15, Portland Cement Concrete. A set of seven cylinders must be prepared for every ten precast units, or fraction thereof, cast in any one day. Two cylinders must be tested at three days, two cylinders at seven days, two cylinders at 28 days, and one cylinder must be retained for further testing as may be required. Cylinders must be prepared and moist cured in accordance with ASTM C31/C31M, and tested in accordance with ASTM C39/C39M.
4. Reporting:
 - a. The Independent Testing Agency must provide reports to the VTA and PCQCM on a daily basis for each day that precasting, sampling, inspection, and testing operations are performed.
 - b. A daily production log for precasting must be kept by the PCQCM for each day that precasting operations, including setting forms, placing reinforcement, setting prestressing steel, casting, curing, post tensioning, and form release, are performed. The log must include the facility location, and must include a specific description of casting or related operations, any problems or deficiencies discovered, any testing or repair work performed, and the names of all Contractor and Independent Testing Agency quality control personnel and the specific quality control tasks they performed that day. The daily report from each Contractor and all Independent Testing Agency quality control personnel must also be included in the log. This daily log must be available for viewing by the VTA at the precasting facility.
 - c. The PCQCM must maintain a daily production log of precasting activities for each day's precasting. Precasting activities include setting forms, placing reinforcement, setting prestressing steel, casting, curing, post tensioning, and form release. This daily log must be available at the precasting plant. The daily log must include the following items:
 - 1) Plant location
 - 2) Specific description of casting or related activities
 - 3) Any problems or deficiencies discovered
 - 4) Any testing or repair work performed
 - 5) Names of all Independent Testing Agency quality control personnel and the specific quality control inspections they performed that day
 - 6) Reports for that day's precasting activities from all Independent Testing Agency quality control personnel, including before, during, and after precast inspections

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- 7) Daily temperature data for internally monitored tier 1 precast concrete members
 - d. All reports regarding material tests and any required survey checks must be signed by the person who performed the test or check, and then submitted directly to the PCQCM for review and signature prior to submittal to the VTA. Corresponding names must be clearly printed or type-written next to all signatures.
 - e. Immediately notify VTA when any precasting problems or deficiencies are discovered, and submit the proposed repair or process changes necessary to correct them. The VTA must have 4 weeks to review these procedures. No remedial work must begin until the VTA approves these procedures in writing.
 - f. Precast Concrete Report:
 - 1) Following the completion of any precast element and before shipping precast concrete members, submit a Precast Concrete Report to the VTA. The report must include the following:
 - a) Reports of all material tests and any survey checks
 - b) Documentation that you have evaluated all tests, you corrected all rejected deficiencies, and repairs have been reexamined with the required tests and found acceptable
 - c) Daily production logs
 - d) Certificates of compliance
 - e) Documentation of inspections
 - 2) Each person who performs a material test or survey check must sign the corresponding report and submit the report directly to the quality control manager
 - g. At the completion of any precast element, and if the PCQCM determines that element is in conformance with these Technical Specifications, the PCQCM must sign and furnish to the VTA, a Certificate of Compliance. This Certificate of Compliance must be submitted with the precast report. The certificate must state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work, have been performed in conformance with the details shown on the plans and the provisions of these Technical Specifications.
5. For tier 1 and tier 2 precast concrete members:
- a. Fabricate precast concrete members at a plant on the Caltrans Authorized Facility Audit List
 - b. Assign a precast concrete quality control manager to the plant
 - c. Assign an Independent Testing Agency quality control inspector who is either currently registered as a civil engineer in the State of California or:
 - 1) For tier 1, has a Plant Quality Personnel Level II certification from the Precast/Prestressed Concrete Institute
 - 2) For tier 2, has a Plant Quality Personnel Level I certification from the Precast/Prestressed Concrete Institute
 - d. Prepare a PCQCP
 - e. Perform precast concrete materials testing
 - f. Maintain a daily production log

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- g. Prepare a precast concrete report
 - h. Prepare a certificate of compliance
6. For each mix design used for precast concrete members, perform sampling and testing at the minimum frequencies shown in the following table:

Quality characteristic	Test method	Minimum testing frequency
Compressive strength (See Note A)	ASTM C172/C172M, ASTM C31/C31M, and ASTM C39/C39M	Once per 100 cubic yards of concrete cast, or every day of casting, whichever is more frequent
Slump	ASTM C143/C143M	
Temperature at time of mixing	ASTM C1064/C1064M	
Density	ASTM C138	Once per 600 cubic yards of concrete cast or every 7 days of batching, whichever is more frequent
Air content	ASTM C231/C231M or ASTM C173/C173M (See Note B)	If concrete is air entrained, once for each set of cylinders, and when conditions warrant

Note A: Cylinders must be 6 by 12 inches.

Note B: ASTM C173/C173M must be used for lightweight concrete.

- 7. If concrete is batched at more than one plant, perform the tests at each plant.
- 8. Refer to Section 03 05 15, Portland Cement Concrete, for additional concrete materials testing and analyses requirements.

B. VTA Quality Assurance:

- 1. Precast concrete materials must be available to VTA for inspection. Allow VTA free access at all times to any portion of the fabrication site where material is stored or work is performed.
- 2. Precast concrete members are inspected at the fabrication site. Notify VTA when materials are delivered to the fabrication site. Allow 10 days after notifying VTA before starting fabrication.

C. Tolerances: For dimensional tolerances of precast concrete members, comply with PCI MNL-135.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine all parts of the supporting structure and the conditions under which the precast concrete units are to be erected and installed. Verify the locations of anchors to pre-determine the accuracy of the installation of each member.

3.02 ERECTION AND INSTALLATION

- A. Transport and erect precast concrete units in accordance with PCI MNL-116 and as specified herein.
- B. Erect precast concrete units and accurately install in place with mechanical hoisting equipment more than adequate for the loads.

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- C. Maintain precast concrete unit in upright position at all times. Handle unit only by indicated lifting devices or cushioned pads, and in a manner that will not overstress or damage the unit.
- D. Erect precast concrete units in accordance with indicated erection tolerances and the requirements of ACI 117. Comply with erection sequences indicated. Position units to avoid eccentric application of forces, and make complete and uniform contact with bearing surfaces.
- E. Provide anchorage and attachment welding and bolting, as indicated, in accordance with PCI MNL-116. Provide touch-up painting of field welds and abraded steel surfaces.
- F. At completion, units must be plumb, level, and square, true to line, with angles and edges parallel with related building lines.
- G. Girders:
 - 1. For girders with a concrete deck shown, clean top surfaces of laitance and curing compound before placing deck concrete.
 - 2. You may make adjustments to accommodate girder deflections before placing deck concrete, including adjustments to bearing seat elevations. Adjustments are limited by the following:
 - a. Minimum permanent vertical clearance under the structure is not reduced.
 - b. Deck profile grade and cross slope cannot be changed.
 - c. A minimum of one inch of deck slab concrete is maintained between the deck slab reinforcement and the top of the girders.
 - 3. Adjustments to accommodate girder deflections are not considered a change in dimensions.
 - 4. Grout keyways after precast members are in final position. Before grouting, abrasive blast clean the keyways to expose clean aggregate. Flush keyways with water and allow them to dry to a surface dry condition immediately before placing the grout.
 - 5. No equipment or other loads are allowed on spans that have been grouted until 72 hours after the last grout is placed.
 - 6. Erect precast girders onto the supporting concrete, such as bent caps or abutments, after the concrete attains a compressive strength of 2,880 pounds per square inch or 80 percent of the specified strength, whichever is greater.
 - 7. Do not tension or tighten transverse post-tensioning tendons until 24 hours after grouting the last keyway.
 - 8. The specifications for prestressing force distribution and sequencing of stressing in the post-tensioning activity in Section 50-1.03B(2)(a) of the Caltrans Standard Specifications do not apply if post-tensioning of spliced girders before starting deck construction is described. The composite deck-girder structure must be post-tensioned in a subsequent stage.
 - 9. Temporary spliced-girder supports must comply with the specifications for falsework in Section 03 11 14, Falsework.
 - 10. Before post-tensioning of spliced girders, remove the forms at cast-in-place concrete closures and intermediate diaphragms to allow inspection for concrete consolidation.

3.03 FIELD QUALITY CONTROL

- A. The Independent Testing Agency must perform the following inspections and testing:
 - 1. Structural precast member placement and inspection in accordance with ACI 117 and PCI MNL-116.

END OF SECTION 03 41 00

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SECTION 03 53 00
CONCRETE TOPPING

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes requirements for furnishings and applying concrete topping and related materials.
 - 1. Formwork
 - 2. Bond Breaker Membrane
 - 3. Joint Fillers and Sealers
 - 4. Portland Cement Concrete
 - 5. Nonslip Aggregate Materials
 - 6. Concrete Hardener
 - 7. Concrete Curing Materials

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 03 05 15 – Portland Cement Concrete
- C. Section 03 11 00 – Concrete Formwork
- D. Section 03 35 00 – Concrete Finishing
- E. Section 07 90 00 – Joint Protection
- F. Section 09 96 00 – High Performance Coatings
- G. Section 32 17 26 – Tactile Warning Surfacing

1.03 REFERENCED STANDARDS

- A. American Concrete Institute (ACI):
 - 1. ACI 117 Specification for Tolerances for Concrete Construction and Materials
 - 2. ACI 301 Specifications for Structural Concrete for Buildings
 - 3. ACI 302.1R Guide to Concrete Floor and Slab Construction
 - 4. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete

- B. ASTM International (ASTM):
 - 1. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - 2. ASTM C1017 Standard Specification for chemical Admixtures for Use in Producing Flowing Concrete

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3. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural construction (Nonextruding and Resilient Bituminous Types)
4. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

C. Americans with Disabilities Act Accessibility Guidelines (ADAAG):

1. ADAAG Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities.

1.04 SUBMITTALS

A. General

1. Submittals for Concrete Topping must be made in accordance with the provisions in these technical specifications.
2. Contractor must submit the following Shop Drawings:
 - a. Submit drawings that indicate the locations of all joints in concrete slabs, including construction joints, expansion joints, isolation joints, weakened plane joints and contraction joints. Comply with the requirements specified in Section 03 11 00 – Concrete Formwork.
 - b. Submit drawings that indicate concrete placement method, sequence, and location.
3. Product Data: Submit manufacturers' product data for nonslip floor ingredients, concrete hardener material, control joint sealant, and expansion joint sealant.
4. Samples: Submit 1/2-pint sample container of aluminum oxide anti-slip materials for approval. Samples require approval of the Engineer before they may be incorporated in the Work.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Concrete Topping must be measured by the lump sum price as listed in the Schedule of Quantities and Prices
- B. Payment: The lump sum payment for Concrete Topping must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Concrete Topping complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Specialist Applicator and Installer: Topping slabs must be installed and finished by a skilled and experienced installer specializing in the installation and finishing of architectural concrete slabs. The Contractor must submit evidence that the slab installer and finisher is approved by the manufacturer of the nonslip materials.
- B. Floor Finish: "Nonslip finish" in combination with a "troweled finish" or fine "broom finish" conforming to applicable requirements of ACI 301.
- C. Floor Tolerance: "Flat" tolerance conforming to ACI 117.

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- D. Cold Joints: Cold joints in concrete will not be permitted unless planned and treated properly as construction joints and submitted for approval as specified under “Submittals” above.
- E. Site Mock-Ups: Provide site mock-up, at least 3 feet by 4 feet in size, of exposed slab finish for the Engineer’s review and approval. Provide additional mock-ups, as required, until the desired finish is obtained. Site mock-up requires approval of the Engineer before work may proceed.
 - 1. Different concrete finishes must be included and represented on the sample mock-up panel with a minimum 18 by 18 inch area for each different finish.
 - 2. Include typical expansion joint detail and control joint in mock-up.
 - 3. Approved sample panel must not remain as part of the Work. Remove sample after final Acceptance of project.
- F. Manufacturer’s Instructions: Application of the nonslip floor ingredients and concrete hardener material and finishing of the concrete topping slabs must be in accordance with the written or printed instructions and recommendations of the manufacturer of nonslip floor ingredients and concrete hardener materials.
- G. Manufacturer’s Field Services: The Contractor must engage the manufacturer of the nonslip floor ingredients and concrete hardener materials to provide field services for Quality Assurance.
- H. Surfaces must maintain a minimum coefficient of friction as specified by the ADAAG Appendix to Part 1192 Advisory Guidelines Section 1.

PART 2 – PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. The Contractor must furnish all materials, tools, equipment, facilities, and services as required for performing the required topping slab placing and finishing work.

2.02 MATERIALS

- A. Formwork: Refer to Section 03 11 00 – Concrete Formwork, for requirements.
- B. Bond Breaker and Isolating Membrane: Fluid Applied:
 - 1. Basis of Design: Fluid applied asphaltic rubber waterproofing material; WATER BLOCK as manufactured by Innovative Waterproofing Solutions, Phone: (616)-551-2610, Website: www.WaterproofingRedefined.com
 - a. Proprietary Products: Use of manufacturer’s proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer’s material data that indicates compliance with the requirements of Part 1 of this Section.
- C. Portland Cement Concrete: Comply with Section 03 05 15 – Portland Cement Concrete, and the following requirements:
 - 1. Topping slab concrete must have a minimum compressive strength at 28 Days of 4,000

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psi. Maximum size of aggregate must be one inch, except that 3/8 inch maximum size aggregate must be used for locations where congestion and other conditions indicate the need for smaller aggregate. Minimum cement content per cubic yard of concrete must be six and a half 94-pound sacks.

2. Mix design for topping-slab concrete must include up to ten percent replacement of the cement content with fly ash (ASTM C618) along with a plasticizing admixture, conforming with ASTM C1017, to provide a dense and plastic concrete mix that will trowel more easily with less surface bleeding of water.

- D. Nonslip Aggregate Material: Crushed ceramically bonded or fused aluminum oxide as specified in ACI 301. Provide 25 pounds per 100 square feet as specified. All aggregate particles must pass a No. 8 U.S. Standard Sieve, and must be graded from No. 16 to No. 8 mesh.
- E. Concrete Hardener and Dustproof: Chemical clear liquid hardener which produces a dense, hard, and dustproof concrete surface, manufactured specifically for the intended purpose.
- F. Concrete Curing Materials: Refer to Section 03 35 00, Concrete Finishing, for requirements.
 1. Provide for damp curing only. Curing compound will not be permitted on floors to receive concrete hardener and dustproof.

2.03 CONTROL AND EXPANSION JOINT SEALANT

- A. Joint Filler and Sealants: Provide a two-component elastomeric polyurethane sealant that is mixed and poured in place. When cured, it must form a resilient joint seal with a high resistance to penetration and abrasion, and must remain flexible through exposure to weather and aging. Sealant must be self-leveling.
- B. Sealant Color: Submit color chart in accordance with submittal requirements of this Section 07 90 00 – Joint Protection.
- C. Expansion Joint Filler: One-half inch thick in accordance with ASTM D1751, pre-molded non-extruding asphalt impregnated felt.

2.04 CONTROL JOINT FORMING

- A. Comply with requirements of Section 03 30 00 – Cast-In-Place Concrete.
- B. Control joints must be straight and true, of equal depth and width the full length of the joint. Arrange and locate joints as shown on the Construction Drawings.
- C. Form control joints only by saw cutting surface of concrete.

PART 3 – EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. The requirements of Section 03 30 00 – Cast-In-Place Concrete, Section 03 05 15 – Portland Cement Concrete, and Section 03 35 00 – Concrete Finishing, must apply to the work of this Section as applicable.

3.02 EXAMINATION

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- A. Inspect forms, structural slab surfaces, waterproof membranes and protection board where they occur, reinforcement, and embedded items, and obtain the Engineer's approval thereof before placing concrete. Complete and sign a pour card. The Engineer will countersign the card prior to commencing the pour.

3.03 PREPARATION

- A. At least 48 hours prior to actual placement, notify the Engineer and nonslip material manufacturer's representative of the intention to deliver and place concrete.
- B. Before placing concrete, broom clean structural slab surfaces and install bond breaker membrane where indicated.

3.04 PLACING AND FINISHING

- A. Placement and Finishing Standards: Concrete topping slabs must be placed, consolidated, and finished in accordance with applicable requirements of ACI 301.
- B. Placement:
 - 1. Topping slabs must be placed and finished monolithically. Strike off and screed slabs to true, plane surfaces at required elevations, and thoroughly compact concrete with vibrators, floats, and tampers to force coarse aggregate below the surface. Finish slab within four hours of concrete placement.
 - 2. Topping slab must vary from three-inches to the appropriate height at the high point to provide a finished surface that will slope to drains as indicated on the Drawings. Whether indicated or not, in areas where drains occur, slope finished slab to drains. Slope must be a minimum of 1/8 inch per foot unless otherwise indicated.
- C. Finishes:
 - 1. Surface tolerance: CSP 1, troweled finish with nonslip finish as required by ACI 301.
 - 2. Topping slabs must receive a "troweled finish" or fine "broom finish" in combination with a "nonslip finish," as selected by the Engineer from Contractor- prepared mock-ups, with "flat" tolerance, as specified in ACI 117.
 - 3. Application of the nonslip material and finishing of the topping slabs must conform with the nonslip material manufacturer's application instructions and recommendations.

3.05 CURING

- A. Curing of concrete topping slabs must conform with applicable requirements of ACI 301, except that the duration of the curing period must be ten Days minimum.
- B. Provide damp curing only as specified in Section 03 35 00 – Concrete Finishing. Curing compounds will not be permitted.

3.06 APPLICATION OF CONCRETE HARDENER

- A. Allow slab surfaces to cure and dry a minimum period of 28 Days before applying hardener/dustproofer material. Slab surfaces must be clean and dry at the time hardener/dustproofer material is applied.

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- B. Apply clear liquid hardener/dustproofer compound to slab surfaces, after the damp-curing and drying period, in accordance with the manufacturer's application instructions. Rate of application and number of coats must conform with the manufacturer's instructions and recommendations.

3.07 PROTECTION

- A. Protect exposed concrete slab surfaces as required to prevent damage from impact or stains.
- B. Protect fresh concrete from drying winds, rain, damage, or soiling.
- C. Refer to Section 03 30 00 – Cast-In-Place Concrete for additional requirements.

END OF SECTION 03 53 00

SECTION 03 62 00

NON-SHRINK GROUTING

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:

1. Cementitious Grout
2. Epoxy Grout
3. Non-Shrink Grout Under Base Plates, Masonry Plates, and Bearing Assemblies
4. Non-Shrink Grout In Anchor Rod Blockouts, Sleeves, or Canisters
5. Non-Shrink Grout in Post Pockets

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 30 00, Cast-in-Place Concrete
- D. Section 03 41 00, Structural Precast Concrete
- E. Section 04 22 00, Concrete Unit Masonry
- F. Section 05 52 00, Metal Railings (Stations)
- G. Section 05 52 01, Metal Railing (Bridge)

1.03 REFERENCED STANDARDS

- A. American Concrete Institute (ACI):
1. ACI 503.2 Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
- B. ASTM International (ASTM):
1. ASTM C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
 2. ASTM C157/C157M Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
 3. ASTM C531 Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes

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| 4. | ASTM C579 | Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes |
| 5. | ASTM C827/C827M | Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures |
| 6. | ASTM C881/C881M | Specification for Epoxy-Resin-Base Bonding Systems for Concrete |
| 7. | ASTM C1090/C1090M | Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout |
| 8. | ASTM C1107/C1107M | Specification for Packaged Dry, Hydraulic-Cement Grout (Non- shrinkable) |
| 9. | ASTM D257 | Standard Test Methods for DC Resistance or Conductance of Insulating Materials |
- C. U. S. Army Corps of Engineers, Concrete Research Division (CRD):
- | | | |
|----|----------|---|
| 1. | CRD-C620 | Standard Method of Sampling Fresh Grout |
| 2. | CRD-C621 | Non-shrink Grout |

1.04 DEFINITIONS

- A. For the purpose of these Technical Specifications, "non-shrink grout" must be defined as a high-strength mortar or grout which does not shrink in the plastic state, is dimensionally stable in the hardened state, and bonds permanently to a clean metal baseplate and concrete substrate.

1.05 SUBMITTALS

- A. General: Submittals for non-shrink grouting must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Product Data: Submit manufacturer's product data and installation instructions.
- C. Certification: Submit certificates of compliance or laboratory test reports which indicate the following:
1. Materials used in the grout are free from metallic components and corrosion-producing elements.
 2. Materials meet specified shrinkage and compressive strength requirements.
 3. Submit certified test data or trial batch reports to prequalify the materials, mix proportions, mixing equipment, and procedures proposed for use in the work before placing the non-shrink grout.
 - a. Certified test data and trial batch reports must include date of mixing, mixing equipment and procedures, batch size, weight, type, and source for each ingredient, slump, air content if an air-entraining admixture is used, age at the time of testing, compressive strength, and the signature of an official of the testing firm.
 - b. Certified test data must show the following:
 - 1) Results of 90 percent or more of at least 20 consecutive tests exceed the compressive strength described at the maximum number of days specified or allowed and none of the test results are less than 95 percent of the strength described.

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- 2) All tests are the most recent tests made on concrete of the proposed mix design and were made within one year of the proposed use of the concrete.
- c. Trial batch test reports must show the following:
 - 1) Average compressive strength for five consecutive cubes taken from a single batch and tested at not more than the maximum age specified or allowed is at least 600 pounds per square inch greater than the 28 day compressive strength described.
 - 2) No individual cube has a strength less than the strength described at the maximum age specified or allowed.
 - 3) Data contained in the report is from trial batches produced within one year of the proposed use of the concrete.

1.06 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
 - 1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 - 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
- D. VTA Quality Assurance:
 - 1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

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1.07 ENVIRONMENTAL REQUIREMENTS

- A. Handle grout the same as concrete with regard to temperature and curing, as specified in Section 03 30 00, Cast-in-Place Concrete, Section 03 05 18, Portland Cement Concrete, and Section 03 35 00, Concrete Finishing.

1.08 MEASUREMENT AND PAYMENT

- A. Full compensation for all work under this Section must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cementitious Grout: Provide non-shrink, non-metallic, non-corrosive hydraulic cement-based grout conforming to the following requirements:
1. Applicable Standards: ASTM C1107/C1107M and CRD-C621.
 2. Grout must be manufactured specifically for use in supporting heavy loads.
 3. Grout: ASTM C1107/C1107M, Grade A, B, or C, as appropriate for the condition or circumstance.
 4. Shrinkage at 28 days:
 - a. Shrinkage before hardening: None (0.00 shrinkage when tested in accordance with ASTM C827/C827M)
 - b. Shrinkage after hardening: None (0.00 shrinkage when tested in accordance with CRD-C621)
 5. Compressive strength, minimum:
 - a. At one day: 1,000 pounds per square inch
 - b. At three days: 2,500 pounds per square inch
 - c. At seven days: 3,500 pounds per square inch
 - d. At 28 days: 5,000 pounds per square inch
 6. Initial setting time, after addition of water: approximately one hour at 70 degrees Fahrenheit.
 7. Provide nonsag trowelability or flowability as necessary for the particular application.
- B. Water: Water must conform to the requirements in Section 03 05 15, Portland Cement Concrete.
- C. Admixtures: Admixtures must conform to the requirements in Section 03 05 15, Portland Cement Concrete, except that admixtures must not contain more than 0.25 percent chlorides as Cl by weight of admixture when tested under California Test 415
- D. Epoxy Grout: Provide non-shrink, non-metallic, non-corrosive, high electrical resistant epoxy grout conforming to the following requirements:
1. Shrinkage at 28 days: None (0.00 shrinkage when tested in accordance with ASTM C827/C827M modified procedure) with a minimum effective bearing area (EBA) of 95 percent coverage of the tested base plate.

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2. Compressive strength, minimum: 9,000 psi at one day and 13,000 psi at seven days, when tested in accordance with ASTM C579 Test Method B.
 3. Coefficient of expansion, maximum: 18×10^{-6} inch/inch/degree Fahrenheit, when tested in accordance with ASTM C531.
 4. Volume resistivity, minimum: 1.00×10^{12} ohms-cm, when tested in accordance with ASTM D257.
 5. An acceptable product is Five Star DP Epoxy Grout as manufactured by Five Star Products, Inc., Shelton, CT 06484, (203)336-7900.
 6. Provide flowable consistency as necessary for the particular application.
 7. Epoxy grouts which are volatile and which give off noxious fumes are not acceptable.
- E. Epoxy Adhesive: ASTM C881/C881M, Type V, Grade 2.
1. Use Class B whenever the surface temperature is from 40 to 60 degrees Fahrenheit or if a faster cure is required.
 2. Use Class C whenever the surface temperature is above 60 degrees Fahrenheit.
- F. Prequalify non-shrink cementitious grout and epoxy grout before use, as specified herein.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Concrete surfaces to receive grout must be prepared by chipping, sandblasting, water blasting, or other accepted methods to remove defective concrete, laitance, dirt, oil, grease, and other foreign matter to achieve sound, clean concrete surfaces. Lightly roughen concrete for bond, but not enough to interfere with proper placement of grout.
- B. Cover concrete areas with protective waterproof covering until ready to place grout.
- C. Remove foreign matter from steel surfaces to be in contact with grout. Clean contact steel surfaces as necessary by wire brushing and wiping dust clean.
- D. Align and level components to be grouted, and maintain in final position until grout placement is complete and accepted.
- E. Install forms for grout around the column base plates and other spaces to be grouted. The tops of such forms must be one inch above the surfaces to be grouted.
- F. Remove protective waterproof covering and clean contaminated surfaces immediately before grouting.
- G. Provide air-relief holes in large baseplates and in baseplates where underneath obstructions may cause air entrapment.
- H. Saturate concrete surfaces with clean water, and remove excess water immediately before grouting.
- I. Where necessary or appropriate for better bond, epoxy adhesive as specified herein may be applied to clean, dry substrate surfaces in accordance with applicable requirements of ACI 503.2. Coat the blast-cleaned concrete surface with epoxy using a brush or roller. Place freshly-mixed non-shrink grout while the epoxy is tacky. Apply new coat of epoxy if the epoxy sets.

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3.02 MIXING

- A. Mix grout ingredients for both cementitious grout and epoxy grout in accordance with the respective manufacturer's mixing instructions and recommendations. Mix grout materials in proper mechanical mixers.
- B. Mix grout as close to work area as possible.

3.03 PLACING GROUT

- A. Place grout in accordance with the respective manufacturer's installation instructions and recommendations. Pour grout from one side only until grout rises at least one inch above the plate on opposite side of said plate. Strapping and plunging or other recommended method may be used to force grout to flow under the entire area.
- B. Neatly trowel edges of grout base, tapered at an angle of 60 degrees when measured from the horizontal, or as indicated. Provide dry-pack cementitious grout where additional grout is required for shoulders.
- C. Do not remove leveling shims for at least 48 hours after grout has been placed.
- D. After shims have been removed, if used, fill voids with grout, packing the material with a suitable tool.
- E. Do not use grout which has begun to set or if more than one hour has elapsed after initial mixing.
- F. Grouting and constructing non-shrink grout pads under masonry plates must be done after girder erection and before placing deck concrete.
- G. For non-shrink cementitious grout or epoxy grout installed in pipe sleeves, metal canisters, or post pockets, fill the pipes sleeves, metal canisters, or post pockets completely with non-shrink grout.

3.04 CURING

- A. Cementitious grout must be cured the same as specified for concrete in Section 03 35 00, Concrete Finishing.
- B. Epoxy grout must be cured as recommended by the grout manufacturer.

3.05 FIELD QUALITY CONTROL

- A. The Independent Testing Agency must perform the following sampling, testing, and inspections. Sampling and testing of grout must conform with applicable ASTM or CRD-C620 requirements.
 - 1. Visual Inspections: The Independent Testing Agency must perform visual inspection of the grout mixing and placement to determine and verify that grout consistency, slump, and stiffness are appropriate and proper for the location and type of installation.
 - 2. Strength Tests: The Independent Testing Agency must test non-shrink grout for compressive strength in accordance with ASTM C1107/C1107M. Cube molds must be metal. Cylinder molds, plastic cube molds, or plastic cube inserts must not be used. Compressive strength of grout must meet the following requirements:
 - a. Cementitious Grout: 5,000 psi minimum at 28 days when tested in accordance with ASTM C1107/C1107M.

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- b. Epoxy Grout: 9,000 psi minimum at one day and 13,000 psi minimum at seven days when tested in accordance with ASTM C579 Test Method B.

END OF SECTION 03 62 00

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SECTION 05 05 13

SHOP-APPLIED COATINGS FOR METAL

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for Shop-applied coatings for metals.

1.02 RELATED SECTIONS

- A. Section 08 90 00 – Louvers and Vents
- B. Section 09 91 00 - Painting
- C. Section 34 23 13 – Overhead Contact System Metal Poles

1.03 REFERENCED STANDARDS

- A. American Architectural Manufacturers Association (AAMA):
1. AAMA 621 Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates
 2. AAMA 2603 Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
 3. AAMA 2604 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions
 4. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions
- B. ASTM International (ASTM):
1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus
 2. ASTM D1654 Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
 3. ASTM D2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates
 4. ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
 5. ASTM D3359 Standard Test Methods for Rating Adhesion by Tape Test
 6. ASTM D3364 Standard Test Method for Film Hardness by Pencil Test
 7. ASTM D4214 Standard Test Methods for Evaluating Degree of Chalking of Exterior Paint Films
 8. ASTM D7901 Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base

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- 9. ASTM E1980 Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
- 10. ASTM G85 Standard Practice for Modified Salt Spray (Fog) Testing

1.04 SUBMITTALS

A. General

- 1. Submittals for Shop-Applied Coatings must be made in accordance with the provisions in these technical specifications.
- 2. The Contractor must submit the following:
 - a. Product Data: For each type of coating product specified.
 - b. Samples:
 - 1) Samples for Selection: For each color, gloss specified.
 - 2) Samples for Verification: For each coating product, for each color, gloss, and texture specified, on specified substrate.
 - c. Product test reports.
 - d. Qualifications: For shop-applied coatings Applicator.
 - e. Maintenance data.
 - f. Warranty: Sample of special warranty.
- 3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Full compensation for all work under this Section shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefore.

1.06 QUALITY ASSURANCE

- A. Applicator Qualifications: Coating manufacturer's certified Applicator who is equipped, trained and approved for application of coatings required for this Project, and is approved to provide warranty specified in this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, unload, and store shop-coated items so that they remain free of damage or deformation. Package and protect items during shipping and handling. Protect stored items from water; stack to facilitate drainage. Keep shop-coated items out of contact with materials that may adversely affect the coating.
- B. Protect shop-coated items with protective covering until installed.

1.08 COORDINATION

- A. Coordinate submittal and selection procedures for items to receive shop-applied coatings. Where items are indicated to match coatings selected for other items, adjust formulations as required to achieve match. Submit samples for verification indicating compliance with matching requirements.

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1.09 WARRANTY

- A. Coating Warranty: Coating Applicator's warranty in which Applicator agrees to repair finish or replace coated items that demonstrate deterioration of shop-applied finishes within warranty period indicated.
1. Exposed Coating: Deterioration includes but is not limited to:
 - a. Color fading in excess of 5 Delta E Hunter units per ASTM D 2244.
 - b. Peeling, checking, or cracking of coating adhesion to metal.
 - c. Chalking in excess of a No. 8 per ASTM D 4214, when tested per Method D 659.
 - d. Corrosion of substrate in excess of a No. 6 on cut edges and a No. 8 on field surfaces, when measured per ASTM D 1654.
 2. Warranty Period: Minimum of three (3) years from date of Substantial Completion, unless otherwise stated.

PART 2 – PRODUCTS

2.01 HIGH-PERFORMANCE ORGANIC FINISH MATERIALS – EXTRUSIONS

- A. Liquid Fluoropolymer Aluminum Extrusion Coatings, AAMA 2605: Minimum 70 percent PVDF resin, by weight, in color coat and clear topcoat.
1. Pencil Hardness, ASTM D 3363: F, minimum.
 2. Salt Spray Resistance – ASTM G 85 – 2,000 hours.
 3. Humidity – ASTM D 2247 – 1,000 hours.
 4. Dry Film Thickness, ASTM D 1400: 0.20mil primer coat plus 1.0 mil color coat, 1.20 mil total, minimum thickness.
 5. Dry Film Thickness, ASTM D 1400: 0.20 mil primer coat plus 1.0 mil barrier coat, 1.0 mil color coat and 0.4 mil clear topcoat, 2.6 mil total, minimum thickness.
- B. Liquid Fluoropolymer Aluminum Extrusion Coatings, AAMA 2604: 50% PVDF resin, by weight, in color coat.
1. Pencil Hardness, ASTM D 3363: F, minimum.
 2. Salt Spray Resistance – ASTM B117.
 3. Dry Film Thickness, ASTM D 7901: 0.20 mil primer coat plus 1.0 mil color coat, 1.2 mil total, minimum thickness.

2.02 POWDER COATING MATERIALS – EXTRUSIONS

- A. Powder Coatings, Fluoropolymer, meeting performance requirements of AAMA 2605:
1. Pencil Hardness, ASTM D 3363: F, minimum.
 2. Salt Spray Resistance, ASTM G 85: 2,000 hours.
 3. Humidity Resistance, ASTM D 2247: 4,000 hours.
 4. Dry Film Thickness, ASTM D 7901: 0.20-0.30 mil primer coat plus 1.5 to 2.5 mil Duranar Powder Topcoat, 1.7 mil total, minimum thickness.
- B. Powder Coatings, Fluoropolymer, meeting performance requirements of AAMA 2605:
1. Pencil Hardness, ASTM D 3363: F, minimum.
 2. Salt Spray Resistance, ASTM G 85: 2,000 hours.
 3. Humidity Resistance, ASTM D 2247: 4,000 hours.

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- 4. Dry Film Thickness, ASTM D 7901: 2.0 mil, minimum thickness.
- C. Powder Coatings, Polyester, meeting performance requirements of AAMA 2604.
 - 1. Pencil Hardness, ASTM D 3363: H – 2H.
 - 2. Salt Spray Resistance, ASTM B 117: 3,000 hours.
 - 3. Humidity Resistance, ASTM D 2247: 3,000 hours.
 - 4. Dry Film Thickness, ASTM D 7901: 2.0 mil, minimum thickness.
- D. Powder Coatings, Polyester, meeting performance requirements of AAMA 2604
 - 1. Pencil Hardness, ASTM D 3363: H2 – H3.
 - 2. Salt Spray Resistance, ASTM D 117: 5000 hours
 - 3. Humidity Resistance, ASTM D 2247: 3000 hours
 - 4. Adhesion, ASTM D 3359: 5B
 - 5. Warranty Period: 3 years
 - 6. Dry Film Thickness (DFT), ASTM D 7901:
 - a) Prime Coat: 5 mils on the bottom 8 feet of the pole and 3 mils above 8 feet, minimum thickness.
 - b.) Exterior Coat: 3 mils, minimum thickness.

2.03 HIGH-PERFORMANCE ORGANIC FINISH MATERIALS – COIL COATINGS

- A. Liquid Fluoropolymer Aluminum Sheet Coil Coatings, AAMA 2605: 70 percent PVDF resin, by weight, in color coat and clear topcoat.
 - 1. Pencil Hardness, ASTM D 3363: HB – H.
 - 2. Salt Spray Resistance, ASTM G 85: 1,000 hours.
 - 3. Humidity Resistance, ASTM D 2247: 1,000 hours.
 - 4. Dry Film Thickness, ASTM D 7901: 0.15 mil primer coat plus 0.70 mil color coat, 0.85 mil total, minimum thickness.
 - 5. Dry Film Thickness, ASTM D 7901: 0.15 mil primer coat plus 0.70 mil barrier coat, 0.70 mil color coat and 0.45 mil clear topcoat, 2.0 mil total, minimum thickness.
 - 6. Dry Film Thickness, ASTM D 7901: 0.80 mil primer coat plus 0.80 mil color coat, 1.60 mil total, minimum thickness.
 - 7. Dry Film Thickness, ASTM D 7901: 0.80 mil primer coat plus 0.80 mil color coat and 0.80 clear topcoat, 2.40 mil total, minimum thickness.
- B. Liquid Fluoropolymer Aluminum Sheet Coil Coatings, AAMA 2605: FEVE resin, clear topcoat.
 - 1. Pencil Hardness, ASTM D 3363: HB – H.
 - 2. Salt Spray Resistance, ASTM G 85: 3,000 hours.
 - 3. Humidity Resistance, ASTM D 2247: 3,000 hours.
 - 4. Dry Film Thickness, ASTM D 7901: 0.6 mil clear coat.
- C. Liquid Fluoropolymer Steel Sheet Coil Coatings, AAMA 621: Minimum 70 percent PVDF resin, by weight, in color coat and clear topcoat.
 - 1. Pencil Hardness, ASTM D 3363: HB – H.
 - 2. Salt Spray Resistance, ASTM B 117: 1,000 hours.
 - 3. Humidity Resistance, ASTM D 2247: 1,000 hours.
 - 4. Dry Film Thickness, ASTM D 7901: 0.15 mil primer coat plus 0.70 mil color coat, 0.85 mil total, minimum thickness.

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5. Dry Film Thickness, ASTM D 7901: 0.15 mil primer coat plus 0.70 mil barrier coat, 0.70 mil color coat and 0.45 mil clear topcoat, 2.0 mil total, minimum thickness.
6. Dry Film Thickness, ASTM D 7901: 0.80 mil primer coat plus 0.80 mil color coat, 1.60 mil total, minimum thickness.
7. Dry Film Thickness, ASTM D 7901: 0.80 mil primer coat plus 0.80 mil color coat and 0.80 mil clear topcoat, 2.40 mil total, minimum thickness.

D. Liquid Fluoropolymer Steel Sheet Coil Coatings, AAMA 621: FEVE resin, clear topcoat.

1. Pencil Hardness, ASTM D 3363: HB – H.
2. Salt Spray Resistance, ASTM B 117: 1,000 hours.
3. Humidity Resistance, ASTM D 2247: 1,000 hours.
4. Dry Film Thickness, ASTM D 7901: 0.6 mil clear coat.

2.04 INTERIOR ORGANIC FINISHING MATERIALS – EXTRUSION

A. Liquid acrylic and polyester one coat finishes meeting AAMA 2603

1. Pencil Hardness – H minimum
2. Salt Spray Resistance, ASTM B117: 1500 hours
3. Humidity Resistance, ASTM D2247: 1500 hours
4. Dry Film Thickness, ASTM D1400: 1.0 mil +/- 0.2 mil

B. Powder polyester one coat finish meeting AAMA 2603

1. Pencil Hardness: H minimum
2. Salt Spray Resistance, ASTM B117: 1500 hours
3. Humidity Resistance, ASTM D2247: 1500 hours
4. Dry Film Thickness, ASTM D1400: 2.5 mils +/- 0.5

2.05 INTERIOR ORGANIC FINISHING MATERIALS – COIL

A. Liquid acrylic one coat finish:

1. Pencil Hardness: HB-H.
2. Salt Spray Resistance, ASTM B117: 1,000 hours.
3. Humidity resistance, ASTM D2247: 1,000 hours.
4. Dry Film Thickness, ASTM D1005: 0.75-0.85 mils.

2.06 FINISHES

A. Pretreatment: Mechanically clean and chemically pretreat fabricated items in accordance with coating manufacturer's requirements and AAMA requirements for finish indicated.

B. Application: Apply primer and finish coats in accordance with coating manufacturer's requirements for finish indicated.

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PART 3 – EXECUTION

3.01 INSTALLATION

- A. Refer to individual specifications sections for installation requirements for items receiving shop-applied coatings.

3.02 PROTECTION

- A. Remove protective wrap from coated items at time of installation.

END OF SECTION 05 05 13

SECTION 05 05 60

METAL WELDING

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Welding Rod/Electrodes
 2. Stud Connectors
 3. Shop and Field Welding
 4. Inspections and Tests by the Contractor
 5. Inspections and Tests by VTA

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 20 00, Concrete Reinforcing
- D. Section 05 12 35, Structural Steel
- E. Section 05 17 00, Miscellaneous Metal
- F. Section 05 30 00, Metal Decking
- G. Section 05 40 00, Cold-Formed Metal Framing
- H. Section 05 50 00, Metal Fabrications
- I. Section 05 52 00, Metal Railings (Stations)
- J. Section 05 52 01, Metal Railings (Bridge)
- K. Section 07 95 60, Bridge PTFE Spherical Bearings
- L. Section 31 62 00, Driven Piles
- M. Section 31 63 29, Drilled Concrete Piers and Shafts

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI)/American Institute of Steel Construction (AISC):
1. ANSI/AISC 341 Seismic Provisions for Structural Steel Buildings

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- 2. ANSI/AISC 360 Specifications for Structural Steel Buildings
- B. American Society for Nondestructive Testing (ASNT):
 - 1. SNT-TC-1A Recommended Practice
- C. ASTM International (ASTM):
 - 1. ASTM E94 Guide for Radiographic Testing
 - 2. ASTM E164 Practice for Ultrasonic Contact Examination of Weldments
 - 3. ASTM E165/E165M Test Method for Liquid Penetrant Inspection Method
 - 4. ASTM E709 Guide for Magnetic Particle Examination
 - 5. ASTM E1032 Method for Radiographic Examination of Weldments
- D. American Welding Society (AWS):
 - 1. AWS A2.4 Standard Symbols for Welding, Brazing and Nondestructive Examination
 - 2. AWS A3.0M/A3.0 Standard Welding Terms and Definitions, Including Terms for Brazing, Soldering, Thermal Spraying and Thermal Cutting
 - 3. AWS A5 Welding Rods, Electrodes, and Filler Metals Series
 - 4. AWS A5.20/A5.20M Specification for Carbon Steel Electrodes for Flux Cored Arc Welding
 - 5. AWS B1.10M/B1.10 Guide for the Nondestructive Inspection of Welds
 - 6. AWS C5.4 Recommended Practices for Stud Welding
 - 7. AWS D1.1/D1.1M Structural Welding Code Steel (2015)
 - 8. AWS D1.2/D1.2M Structural Welding Code Aluminum (2014)
 - 9. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel (2018)
 - 10. AWS D1.4/D1.4M Structural Welding Code Reinforcing Steel (2018)
 - 11. AWS D1.5M/D1.5 Bridge Welding Code (2015)
 - 12. AWS D1.6/D1.6M Structural Welding Code - Stainless Steel (2017)
 - 13. AWS D1.8/D1.8M Structural Welding Code – Seismic Supplement (2016)
 - 14. AWS D9.1M/D9.1 Sheet Metal Welding Code (2012)
 - 15. AWS D10.4 Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing
 - 16. AWS QC 1 Standard for AWS Certification of Welding and Inspectors

1.04 REGULATORY REQUIREMENTS

- A. In addition to the foregoing referenced standards, the regulatory requirements that govern the work of this Section include the following code:
 - 1. California Code of Regulations, Title 24, Part 2, 2019 California Building Code, Chapter 22, “Steel”, Section 2209, “Welding”, and State Chapter 22A, “Steel”, Section 2209A, “Welding”.

1.05 DESCRIPTION

- A. Structural Steel (POC) Members: Structural steel framing and all associated connections and components at the Story Station Pedestrian Overcrossing, including the structural steel framing at the south median pedestrian overcrossing landing and the structural steel framing members of the railings. Structural steel framing elements include, but are not necessarily limited to, arch ribs, arch ties, floor

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beams and bracings, stud connectors, sole plates, masonry plates, hangers, and all associated steel connections and connection assemblies.

- B. Hollow Structural Sections (HSS): Hollow structural sections (HSS) must be considered structural tubing and must conform to all requirements specified for tubular members herein.

1.06 DEFINITIONS

- A. Abbreviations:

1. CJP: Complete joint penetration
2. MT: Magnetic Particle Testing
3. NDT: Nondestructive Testing
4. RT: Radiographic Testing
5. UT: Ultrasonic Testing

- B. Continuous inspection: Contractor's Independent Testing Agency must be within close proximity of all welders or welding operators such that inspections by the Independent Testing Agency of each welding activity at each welding location do not lapse for a period exceeding 30 minutes.

- C. Longitudinal weld length: The length of a continuous longitudinal weld.

- D. Circumferential weld length: The length of a continuous weld around the circumference of a tubular member.

- E. Puddle weld: The term "puddle weld" shown on the plans indicates arc spot weld.

- F. Spiral weld length: The length of one full 360-degree spiral weld revolution around the circumference of a tubular member.

1.07 SUBMITTALS

- A. General: Submittals for metal welding must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.

1. For Shop Drawings and other submittals, employ the standard welding symbols of AWS A2.4 and the standard welding terms of AWS A3.0M/A3.0.

- B. Welder Qualifications: Submit copies of qualification test records for each welder, welding operator, and tack welder to be employed in the work. Comply with requirements of AWS D1.1/D1.1M, unless specified otherwise herein. Submit welders' identification marks (I.D.) for each welder along with qualifications.

1. For Structural Steel (POC) Members, other than pipe and tubular members, comply with requirements of AWS D1.5M/D1.5.
2. For pipe and tubular members, comply with requirements of Clause 9 of AWS D1.1/D1.1M.
3. For aluminum welders, comply with AWS D1.2/D1.2M.

- C. Welding Procedure Specifications (WPS):

1. Prior to commencement of welding, submit the procedure specifications that will be used for welding. The WPS must contain all data indicated in AWS D1.1/D1.1M, D1.2/D1.2M, and

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D1.5M/D1.5, as applicable, and any other information necessary to produce welded joints in compliance with this specification. A unique WPS must be developed for each weld and joint type.

2. For procedures other than those prequalified in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, AWS D1.3/D1.3M, and D1.5M/D1.5, submit a copy of Procedure Qualification Records (PQR) in accordance with the qualification requirements of AWS D1.1/D1.1M, AWS D1.2/D1.2M, AWS D1.3/D1.3M, and AWS D1.5M/D1.5, as applicable.
3. WPS must also include the mitigation of corrosion of welds, including heat treatment and chemical compatibility, as applicable.
4. Welding Procedure Specifications must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.

D. Welding Records and Data:

1. Submit all radiographs upon completion of fabrication.
2. Submit certifications that magnetic particle and dye-penetrant inspections have been satisfactorily completed.
3. Submit records of ultrasonic testing upon completion.
4. If field welding is permitted, submit descriptive data for field welding equipment.

E. Mill Certificates: Submit mill certificates and certified copy of reports for analyses and tests required by referenced ASTM and AWS specifications.

F. Welding Quality Control Plan (WQCP): Prior to performing any welding operations, submit a Welding Quality Control Plan (WQCP). Include in the WQCP each item of work to be welded. No welding must be performed until the WQCP is approved in writing by VTA.

1. The following items must be included in the WQCP. The WQCP must be divided into the designated section with each revision and addendum clearly annotated and numbered as shown below. Each welding and nondestructive testing (NDT) firm must have separate sections for each firm.

a. Organization:

- 1) The name of the welding firm.
- 2) Name of Welding Quality Control Manager (WQCM) hired by Contractor.
- 3) Name of Independent Testing Agency hired by Contractor that will perform inspections and NDT.
- 4) Organizational chart showing the WQCM, all subcontractors performing welding, welding inspectors, and Independent Testing Agency personnel, including NDT firms and their personnel.

b. Qualifications/Certifications:

- 1) Copy of AISC Certification, if applicable.
- 2) Name, qualifications, and documentation of certifications for the Welding Quality Control Manager (WQCM) and welding inspectors.
- 3) A master list of qualified welders that will document the welders and welding operators name, ID, the qualified welding process, welding position, and the date for each individual qualification and person qualified.

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- 4) The written description of the Contractor's process for maintaining and providing VTA a current master list of qualified welders and welding operators that documents the names of each welder with the process, position, and date qualified as described above.
 - 5) Documentation of all certifications for welders, welding operators, and tack welders for each welding process, position and the joint detail used. Certifications must list the filler metals used, test position, base metal and thickness, tests performed, and the witnessing authority (third party certified welding inspector). Documentation must be approved by VTA prior to any welding performed by the welder or welding operator.
- c. Quality Control Procedures:
- 1) The methods and frequencies for performing all required visual inspections and documentation by which continuous visual inspection will not lapse for a period exceeding 30 minutes.
 - 2) A written description of the system and method of documentation the contractor will use for the identification and tracking of all welds, NDT, any required repairs, and re-inspection of non-conforming welds. The Contractor's system must include provisions for permanently identifying each weld and the person who performed the weld, NDT, inspection, and repair.
 - 3) Copies of the Quality Control forms to be used to include certificates of compliance, daily production logs, daily reports, weld repair tracking logs and visual inspection report forms.
 - 4) The methods, procedures, and log to track rejected lengths of weld by welder, position, process, joint configuration, and piece number.
 - 5) Standard procedures for identifying members distorted by welding and monitoring methods for straightening members distorted by welding.
 - 6) Fracture Control Plans which are applicable to the welding being performed.
- d. Welding Procedure Specifications (WPS) and Procedure Qualification Record (PQR):
- 1) Prequalified Welding Procedure Specifications (WPS), if applicable.
 - 2) Documentation, when applicable, of Procedure Qualification Record (PQR) tests within the allowable period of effectiveness including all worksheets.
 - 3) Non-prequalified Welding Procedure Specifications (WPSs) supported by PQR testing.
 - 4) Documentation of the filler metal, flux, filler metal flux combination and shielding gas certifications to be used in the work and documentation of manufacturer's recommended operating ranges.
- e. Nondestructive Testing (NDT) Other Than Visual Procedures:
- 1) Written Practice of the NDT inspection personnel or firm.
 - 2) Name of certifying authority and outside Level III, if applicable.
 - 3) Names, qualifications, and documentation of certifications of NDT personnel to be used to include level of certifications and expiration date.
 - a) Submit qualifications of the American Society for Nondestructive Testing (ASNT) NDT Level III demonstrating experience in the

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UT of tubular structures as part of the Welding Quality Control Plan.

- 4) List of NDT equipment, calibration procedures, frequencies and current qualification/calibration documentation of equipment to be used.
 - 5) Procedures, methods and frequencies for performing all required NDT as required by the contract documents to include minimum amounts required.
 - a) Written procedures for ultrasonic testing of tubular T-, Y-, and K-groove welds must comply with a written procedure meeting the requirements of Annex Q of AWS D1.1/D1.1M, and the requirements specified in Article 2.04D herein.
 - 6) Code of Safe Practices when Radiographic Testing (RT) is performed.
 - 7) Copies of NDT report forms to be used.
2. Before submitting a WQCP, hold a pre-welding meeting to discuss the requirements for the WQCP. The meeting attendees must include VTA, the Structural Engineer of Record, the WQCM, and a representative from each entity performing welding or inspection for the Work.
 3. Submit an amended WQCP or an addendum to the WQCP for any changes to WPSs, Independent Testing Agency, WQCM, welding inspectors, NDT personnel or procedures, systems for tracking and identifying welds, or welding personnel. VTA must have 21 calendar days to complete the review of the amended WQCP or addendum to the WQCP. Work that is affected by any of the proposed revisions must not be performed until the amended WQCP or addendum has been reviewed and returned to the Contractor.
 4. After final approval by VTA of the WQCP, amended WQCP, or addendum, the Contractor must submit 7 copies to VTA of the approved documents. Make one copy available at each location where work is performed.
 5. Submit two copies of a WQCP for each subcontractor or supplier for each item of work for which welding is performed.
 6. Welding Quality Control Plan (WQCP) must be submitted to the Engineer for review by the Engineer and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by the Engineer.
 7. It is expressly understood that the VTA's review of the Contractor's WQCP must not relieve the Contractor of any responsibility under the Contract for the successful completion of the Work in conformance with the requirements of the plans and the Technical Specifications. The VTA's review must not constitute a waiver of any requirement of the plans and these Technical Specifications nor relieve the Contractor of any obligation thereunder; and defective work, materials, and equipment may be rejected notwithstanding approval of the WQCP.
 8. A copy of the Engineer-approved WQCP and any authorized addendums must be available at each location where welding is to be performed.
- G. Welding Report: The Independent Testing Agency must submit a welding report within seven days following the performance of any welding.
1. The welding report must include the following, at a minimum:
 - a. Daily production log for welding for each day that welding is performed. The daily production log must include:

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- 1) Locations of all welding
 - 2) For each location, the welders' names, quantity of welding performed, any problems or deficiencies discovered, and any testing or repair work performed
 - 3) Daily report from each welding inspector
- b. Reports of all visual weld inspections and NDT performed, whether specified, additional, or informational. A representative of the Independent Testing Agency must sign all visual inspection and NDT reports and submit them daily to the WQCM for review and signature before submittal to the Engineer. Corresponding names must be clearly printed or typewritten adjacent to all signatures.
- c. Radiographs and radiographic reports, and other required NDT reports.
- d. Summary of welding and NDT activities that occurred during the reporting period.
- e. Reports of each application of heat straightening.
- f. Summarized log listing the rejected lengths of weld by welder, position, process, joint configuration, and piece number.
- g. Documentation that the Contractor has:
- 1) Evaluated all radiographs and radiograph reports and NDT and NDT reports.
 - 2) Corrected all rejectable deficiencies and that all repaired welds have been reexamined using the required NDT and found acceptable.
- h. Reports or chart recordings of each application of any stress relieving used.
- i. Reports and chart recordings for any electroslag welding used.
2. Clearly write the following information on the outside of radiographic film envelopes: Name of the WQCM, name of the Independent Testing Agency performing NDT, name of the radiographer, date, contract number, complete part description, all included weld numbers, report numbers, and station markers or views as detailed in the WQCP.
3. Clearly write on all interleaves the part description and all included weld numbers and station markers or views as detailed in the WQCP. Use a maximum of two pieces of film for each interleave.
4. The Engineer may review the welding report to determine whether the Contractor is complying with the WQCP and the plans and these Technical Specifications.
5. Except for field welded steel pipe piling and field welded bar reinforcement in cast-in-place concrete piling:
- a. Allow the Engineer 21 calendar days to review the report.
 - b. The Contractor may encase in concrete or cover welds for which the welding report has been submitted before receiving authorization of the welding report. If the Contractor chooses this option, the Contractor will not be relieved of the responsibility for incorporating material in the work that complies with the plans and these Technical Specifications. Material not complying with the plans and these Technical Specifications is subject to rejection.
6. For field welded steel pipe piling and field welded bar reinforcement in CIP concrete piling:
- a. Allow the Engineer four calendar days to review the welding report.
 - b. Do not install the steel pipe piling or encase the reinforcement in concrete until the Engineer has authorized the welding report.

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- H. Certificates: Submit a certificate of compliance for each item of work for which welding is performed. The certificate must be signed by the Welding Quality Control Manager (WQCM) and a representative of the Independent Testing Agency. The certificate must state that all of the materials and workmanship incorporated in the Work, and all required tests and inspections of this Work, have been performed in compliance with the plans and these Technical Specifications.

1.08 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow the Engineer and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify the Engineer at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. The Engineer may elect to observe these procedures. Provide samples and facilities for inspection to the Engineer without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by the Engineer.
 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 3. Welding Quality Control Manager:
 - a. The Contractor must designate in writing a Welding Quality Control Manager (WQCM). The WQCM must be responsible directly to the Contractor's Structural Quality Control Manager (SQCM) for the quality of all welding operations, including materials and workmanship performed by the Contractor and all subcontractors.
 - b. The WQCM must cooperate with the Independent Testing Agency and notify the Independent Testing Agency 48 hours in advance of all welding.
 - c. The WQCM must be the sole individual responsible to the Contractor's Structural Quality Control Manager (SQCM) for receiving, reviewing, and approving all correspondence, submittals, and reports related to quality control and quality assurance of welding operations.
 - d. The WQCM must be your employee or must be hired by a subcontractor providing only quality control services. The WQCM must not be employed or compensated by a subcontractor or by other persons or entities hired by subcontractors who will provide other services or materials for the project.

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- e. The WQCM must be currently registered as a civil engineer in the State of California or must be currently certified as an AWS Certified Welding Inspector (CWI) in accordance with AWS QC 1.
 - f. The responsibilities of the WQCM may be fulfilled by the Contractor's Structural Quality Control Manager (SQCM).
4. Welding inspectors and personnel, personnel performing NDT, or NDT firms to be used in the work must not be employed or compensated by any subcontractor or by other persons or entities hired by subcontractors who will provide other services or materials for the Work.
5. An independent third party authorized by the Engineer must witness the qualification tests for welders or welding operators. The independent third party must be currently certified as a CWI and must not be an employee of the Contractor performing the welding. Allow 21 calendar days for the Engineer to review the qualifications and copy of the current certification of the independent third party.
- D. Engineer Quality Assurance:
- 1. The Engineer will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - 2. The Engineer has the authority to verify the qualifications or certifications of any welder, welding inspector, or NDT personnel to specified levels by retests or other means determined by the Engineer.
- E. Qualifications of Welders and Welding Procedures: Welders, welding operators, tack welders, and welding procedures must be prequalified or qualified in accordance with AWS D1.1/D1.1M, Clause 4, Qualification, unless specified otherwise herein:
- 1. Structural Steel (POC) Members, Other Than Pipe and Tubular Members: AWS D1.5M/D1.5, Clause 5, Qualification.
 - a. Welding and welding operator period of effectiveness for fracture critical members must be in accordance with Clause 12.8.2 of AWS D1.5M/D1.5.
 - b. For steel members shown on the plans as fracture critical members, welding requirements and welding inspection requirements must be in accordance with "AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members" of AWS D1.5M/D1.5.
 - 2. Pipe and Tubular Members: AWS D1.1/D1.1M, Clause 9, Tubular Structures.
 - a. Welding and welding operator period of effectiveness for fracture critical members must be in accordance with Clause 12.8.2 of AWS D1.5M/D1.5.
 - b. For steel members shown on the plans as fracture critical members, including structural tubular members, welding requirements and welding inspection requirements must be in accordance with "AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members" of AWS D1.5M/D1.5.
 - c. All welds for structural tubing members shown on the plans as fracture critical members or main tension members require qualification using AWS D1.1/D1.1M Article 9.14.
 - d. Pipe Piles:

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- 1) For welding and prequalifying base metal under Table 3.1 of AWS D1.1/D1.1M, treat steel pipe piles complying with ASTM A252 as either ASTM A572/572M, Grade 50, or ASTM A709/709M, Grade 50.
 - 2) For groove welds using submerged arc welding from both sides without backgouging, qualify the WPS in accordance with Table 4.5 of AWS D1.1/D1.1M.
 - 3) Except for tack welding, do not use gas metal arc welding for welding of steel pipe piles. If gas metal arc welding is used for tack welding, do not deposit filler metal by short circuiting transfer.
3. Miscellaneous Metal, Metal Fabrications, Steel Stairs, and Railings: AWS D1.1/D1.1M, Clause 4, Qualification, and Clause 9, Tubular Structures, as applicable.
 4. Stud Connectors:
 - a. AWS D1.1/D1.1M, Clause 7.6, “Stud Application Qualification Requirements,” unless specified otherwise herein.
 - b. Stud connectors of Structural Steel (POC) Members: AWS D1.5M/D1.5, Clause 7.6, “Stud Application Qualification Requirements.”
 5. Structural Aluminum: AWS D1.2/D1.2M, Clause 3, Qualification.
 6. Sheet Steel (Structural): AWS D1.3/D1.3M, Clause 4, Qualification. Prequalification is not applicable to sheet steel.
 7. Concrete Reinforcing Steel: AWS D1.4/D1.4M, Clause 8, Qualification. Coordinate with requirements specified in Section 03 20 00, Concrete Reinforcing.
 - a. Concrete Reinforcing Steel (Headed Reinforcement): AWS C6.1. Coordinate with requirements specified in Section 03 20 00, Concrete Reinforcing.
 8. Stainless Steel: AWS D1.6/D1.6M, Clause 6, Qualification.
 9. Sheet Metal:
 - a. Welders: AWS D9.1M/D9.1, Clause 6, Qualification of Arc Welders and Arc Welding Operators, and Clause 11, Qualification of Braze Welders and Braze Welding Operators.
 - b. Welding Procedures: AWS D9.1M/D9.1, Clause 5, Arc Welding Procedure Qualification, and Clause 10, Braze Welding Procedure Qualification.
 10. If welding will be performed without gas shielding, then qualification must also include welding without gas shielding.
 11. Requalification of technicians is required for any deviation from the required essential items.
- F. Qualifications of Welding Inspectors: Welds to be inspected by the Independent Testing Agency must be inspected and certified by an AWS Certified Welding Inspector (CWI), currently certified in accordance with AWS QC 1.
1. The Welding Inspector may be assisted by an Assistant Welding Inspector provided that this individual is currently certified as an AWS Certified Associate Welding Inspector in accordance with AWS QC 1. The Assistant Welding Inspector may perform inspection under the direct supervision of the Welding Inspector provided the assistant is always within visible and audible range of the Welding Inspector. The Welding Inspector must be responsible for signing all reports and for determining if welded materials comply with the workmanship and acceptance criteria. The ratio of Welding Assistants to Welding Inspectors must not exceed 5 to 1.

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2. Clauses 6.1.4.1 and 6.1.4.3 of AWS D1.1/D1.1M, the 2nd paragraph of clause 9.1.2 of AWS D1.4/D1.4M, clauses 6.1.3.1 through 6.1.3.3 of AWS D1.5M/D1.5, and clause 7.2.3 of AWS D1.8/D1.8M are amended as specified herein.
- G. Qualification of Nondestructive Testing Personnel: Personnel performing nondestructive testing (NDT) must be qualified and certified in accordance with SNT-TC-1A and the written practice of the NDT firm. The written practice of the NDT firm must comply with or exceed the guidelines of SNT-TC-1A. Only persons certified as NDT Level II technicians or persons certified as NDT Level III technicians and certified to perform the work of Level II technicians may perform nondestructive testing, review the results, and prepare the written reports.
- H. Qualification of Stud Connector Manufacturer: Only products of manufacturers qualified in accordance with AWS D1.1/D1.1M, Clause 7.9, “Manufacturer’s Stud Base Qualification Requirements,” will be accepted for this work, unless specified otherwise herein.
1. Stud connectors of Structural Steel (POC) Members: Only products of manufacturers qualified in accordance with AWS D1.5M/D1.5, Annex E, “Manufacturer’s Stud Base Qualification Requirements,” will be accepted for this work.
- I. Weldability of Steel: For structural steel requiring impact test qualification and for corrosion-resistant structural steel, the weldability of the steel and the procedures for welding it must be established by qualification in accordance with Clause 4 and Part C of Clause 9 of AWS D1.1/D1.1M, and Clause 5 of AWS D1.5M/D1.5, as applicable.
- J. Moment-Resisting Frames: Welding of beam-to-column joint connections in moment-resisting frames must conform with ANSI/AISC 341 and ANSI/AISC 360.
- K. Stainless Steel:
1. Iron Contamination of Stainless Steel: Iron contamination of stainless steel will not be accepted.
 2. Welds must be ground smooth and polished at the factory to blend in with the surrounding finish surfaces. Refer also to Section 05 70 00, Decorative Metal, for requirements.

1.09 MEASUREMENT AND PAYMENT

- A. Full compensation for all work under this Section must be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 WELDING ROD/ELECTRODES

- A. Electrodes for structural plate, shapes, pipe, tubular members, and bars must conform with AWS A5 Series Standards and must be coated rods or wire of size and classification number as recommended by their manufacturers for the positions and other conditions of actual use. Matching filler metal requirements must conform with AWS D1.1/D1.1M and AWS D1.5M/D1.5, as applicable.
- B. Electrodes for sheet steel must conform with AWS A5 Series Standards and must be coated rods or wire of size and classification number as recommended by their manufacturers for the positions and other conditions of actual use. Matching filler metal requirements must conform with AWS D1.3/D1.3M.

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- C. Welding electrodes and welding rods for stainless steel must conform with AWS A5.4 and AWS A5.9 as recommended by their manufacturers for the positions and other conditions of actual use. Matching filler metals must be compatible with the Type 316 or Type 304 stainless steel, as applicable.
- D. Electrodes for aluminum must conform with AWS A5.10 Series Standards and must be coated rods or wire of size and classification number as recommended by their manufacturers for the positions and other conditions of actual use. Matching filler metal requirements must conform with AWS D1.2/D1.2M.
- E. Do not perform welding using flux-cored welding electrodes that comply with AWS A5.20/A5.20M, E6XT-4 or E7XT-4.

2.02 SHOP WELDING

- A. Perform shop welding in accordance with the California Building Code, Section 2209 and State Section 2209A, AWS D1.1/D1.1M, AWS D1.2/D1.2M, AWS D1.3/D1.3M, AWS D1.4/D1.4M, AWS D1.5M/D1.5, AWS D1.6/D1.6M, and AWS D9.1M/D9.1, as applicable to the work.
- B. Steel for members shown on the plans as fracture critical members, including structural tubing members, must comply with the welding requirements and welding inspection requirements in “AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members” of AWS D1.5M/D1.5.
- C. Welding details for cyclically loaded tubular members, as specified in AWS D1.1/D1.1M, must be used for structure tubing members shown on the plans as fracture critical members or main tension members.
- D. Welders must mark adjacent to completed welds their welder I.D., using metal stamp, metal engraving, keel, paint stick, or other appropriate marking material.
- E. Replace Table 2.2 of AWS D1.5M/D1.5 with the following table:

Base metal thickness of the thicker part joined (inches)	Minimum effective partial joint penetration groove weld size (inches) (See Note A)
Over 1/4 to 1/2 inclusive	3/16
Over 1/2 to 3/4 inclusive	1/4
Over 3/4 to 1-1/2 inclusive	5/16
Over 1-1/2 to 2-1/4 inclusive	3/8
Over 2-1/4 to 6 inclusive	1/2
Over 6	5/8

Note A: Weld size need not exceed the thickness of the thinner part joined.

- F. For the purpose of determining preheat and interpass temperatures and weld metal requirements for tubular Structural Steel (POC) Members, use the values for ASTM A709/A709M Grade 50.
- G. The flat side of butt-welded joints must not deviate from flatness by more than 0.20 inch in a 2-foot length centered over the weld.
- H. Do not weld or tack brackets, clips, shipping devices, or other material not described to any part of the girders unless shown on the shop drawings.
- I. Grind weld surfaces smooth and flush when NDT is required.

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- J. For welds indicated to be subject to tensile forces that are to receive RT, grind smooth and flush on both sides of welds before testing.
- K. For groove weld surface profiles that interfere with NDT procedures, grind welds smooth and blend with the adjacent material.
- L. For fillet weld surface profiles that interfere with NDT procedures, grind welds and blend the toes smoothly with the adjacent base metal.
- M. Welding of stud connectors must conform with AWS C5.4, the stud manufacturer's instructions, and AWS D1.1/D1.1M, Clause 7, "Stud Welding," unless otherwise specified herein.
 - 1. Welding of stud connectors of Structural Steel (POC) Members must conform with AWS C5.4, the stud manufacturer's instructions, and AWS D1.5M/D1.5, Clause 7, "Stud Welding."
- N. Metal Decking:
 - 1. Welding of metal decking must conform with applicable requirements of AWS D1.3/D1.3M.
 - 2. Weld washers must be used on all deck units with metal thickness less than 0.028 inches. Weld washers must be mild steel, uncoated, 3/4 inch outside diameter, 3/8 inch hole diameter, and 1/8 inch thick.
 - 3. Where weld washers are not used, a minimum visible 5/8 inch diameter arc spot weld must be used. Weld metal must penetrate all layers of deck material at end laps and must have good fusion to the supporting members.
- O. Welding of stainless steel pipe and stainless steel tubular members must conform with applicable requirements of AWS D10.4.
- P. Concrete Reinforcing Steel: Perform welding of concrete reinforcing steel in accordance with the requirements of Section 03 20 00, Concrete Reinforcing.
- Q. Pipe Piles: Refer to Section 31 62 00, Driven Piles, for additional requirements for welding steel pipe piles.

2.03 INSPECTIONS AND TESTS OF SHOP WELDS BY THE CONTRACTOR

- A. Inspection of welds on Structural Steel (POC) Members must comply with AWS D1.5M/D1.5.
- B. Visual Inspection: All welds must be visibly examined by the Independent Testing Agency in accordance with AWS D1.1/D1.1M, AWS D1.3/D1.3M, AWS D1.4/D1.4M, and AWS D1.5M/D1.5, as applicable. Quality of welds and standards of acceptance must be in accordance with AWS D1.1/D1.1M, AWS D1.3/D1.3M, AWS D1.4/D1.4M, and AWS D1.5M/D1.5.
 - 1. Continuous inspection must be provided by the Independent Testing Agency when any weld is being performed. A sufficient number of welding inspectors must be provided to ensure continuous inspection.
 - a. Continuous inspection, as a minimum, must include having a welding inspector within close proximity of all welders or welding operators such that inspections by the Independent Testing Agency of each welding activity at each welding location do not lapse for a period exceeding 30 minutes.

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2. If any welding deficiencies are discovered by visual inspection ordered or performed by the VTA, the VTA will not pay for the costs associated with the repair of a deficient area or any delays caused by the repair.
- C. Nondestructive Testing (NDT): Nondestructive testing must be performed by the Independent Testing Agency and must conform with AWS B1.10M/B1.10. Quality of welds and standards of acceptance must be in accordance with AWS D1.1/D1.1M, AWS D1.3/D1.3M, AWS D1.4/D1.4M, and AWS D1.5M/D1.5, as applicable.
1. Structural Steel (POC) Members:
 - a. Perform nondestructive testing of nontubular steel members for the bridge in accordance with AWS D1.5M/D1.5.
 - b. Quality of welds and standards of acceptance must be in accordance with AWS D1.5M/D1.5.
 - c. For steel members shown on the plans as fracture critical members, including structural tubular members, welding requirements and welding inspection requirements must be in accordance with “AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members” of AWS D1.5M/D1.5.
 - d. Perform nondestructive testing in accordance with the frequencies in Clause 6.7 of AWS D1.5M/D1.5.
 - e. In addition to NDT requirements in AWS D1.5M/D1.5, ultrasonically test 25 percent of all main member complete joint penetration groove welds in butt joints subject to calculated tension in material over 1/2 inch thick.
 - f. Nondestructive testing procedures for tubular steel members must comply with AWS D1.1/D1.1M, and as specified herein.
 - g. Perform nondestructive testing of tubular steel members in accordance with the frequencies in Clause 6.7 and Clause 12 of AWS D1.5M/D1.5, except as modified in the following table:

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**Nondestructive Testing Methods and Frequency for
Tubular Structural Steel (POC) Members and Components**

Weld Type	Joint Type	Member Type	NDT Method	Minimum Frequency
CJP groove welds	Circumferential butt joints	Fracture Critical Member or Main Tension Member	RT and UT	100% of each joint
		Main Compression Member or Secondary Member	UT	25% of each joint
	T-, Y-, and K-connections	All	UT	100% of each joint
	Longitudinal seam weld See AWS 9.26.2	All	UT	25% of each joint
	Longitudinal seam weld within 6 inches of a CJP weld for a tension or fracture critical member	All	UT	100% of each joint
	Longitudinal seam weld within 6 inches of a circumferential weld	All	UT	100% of each joint
PJP groove welds and fillet welds in primary members	Circumferential butt joints	Main Compression Member	MT	25% of each joint
	T-, Y-, and K-connections	All	MT	100% of each joint
PJP groove welds and fillet welds in secondary members	Any	All	MT	10% of each joint

- h. If unacceptable discontinuities are found, additional testing must be performed in accordance with AWS D1.5M/D1.5, Clause 6.7.
 - i. The root pass of complete joint penetration single sided welds performed without backing must be tested by 100% MT prior to subsequent passes.
2. Structural Steel, Other Than Structural Steel (POC) Members:
- a. Perform nondestructive testing in accordance with AWS D1.1/D1.1M and the frequency requirements shown in the following table:

Weld Type	Joint Type	NDT Method	Minimum Frequency
CJP groove weld	Longitudinal seam weld	UT or RT	Random 25%
	Longitudinal seam weld within 6 inches of a circumferential weld	UT or RT	100% of each joint
CJP groove weld with backing	Any non-longitudinal welds	UT or RT	100% of each joint
Fillet welds	Any	MT	Random 25%

- b. Quality of welds and standards of acceptance must be in accordance with AWS D1.1/D1.1M, Clause 6.

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3. Steel Pipe Piles:
 - a. Butt welded seams subsequently formed, including skelp end welds, must be 100 percent ultrasonically tested in the final formed and welded condition. The acceptance criteria for UT must comply with one of the following:
 - 1) API 5L for API-licensed facilities
 - 2) AWS D1.1/D1.1M for cyclically loaded nontubular connections for welds subject to tensile stress
 4. The Independent Testing Agency selects the random locations for NDT.
 5. Clause 6.6.5 of AWS D1.1/D1.1M, clause 9.6.5 of AWS D1.4/D1.4M, and clause 6.6.5 of AWS D1.5M/D1.5 do not apply.
 6. VTA may order the Independent Testing Agency to perform NDT that is in addition to the visual inspection or NDT specified in these Technical Specifications or AWS welding code. The additional NDT and associated repair work is Change Order work. If the NDT discloses an attempt to defraud or reveals that rejectable indications or inclusions are present in more than 20 percent of the tested weld length, the VTA will not pay for the costs associated with the repair of the deficient area, the NDT of the weld and of the repair, or any delays caused by the repair.
 7. If less than 100 percent of NDT is specified for any weld, the entire length of weld must comply with the specified acceptance criteria. If any welding deficiencies are discovered by additional NDT ordered by VTA that uses the same NDT method as that originally specified, the VTA will not pay for the costs associated with the repair of the deficient area, including NDT of the weld and of the weld repair, or any delays caused by the repair.
- D. Radiographic Testing (RT): Radiographic testing of welds must be performed by the Independent Testing Agency and must conform with AWS D1.1/D1.1M, AWS D1.5M/D1.5 and ASTM E94, and ASTM E0132, as applicable.
- E. Ultrasonic Testing (UT):
1. Ultrasonic testing of welds must be performed by the Independent Testing Agency and must conform with AWS D1.1/D1.1M, AWS D1.5M/D1.5 and ASTM E164, as applicable.
 2. Complete joint penetration groove welds not accessible for radiographic testing must, with Engineer's approval, be subjected to ultrasonic testing.
 3. All ultrasonic testing of tubular T-, Y-, and K- groove welds must comply with a written procedure meeting the requirements of Annex Q of AWS D1.1/D1.1M, which has been prepared and approved by an NDT Level III who is experienced in UT of tubular structures. In addition to the requirements of Annex Q, the written procedure must contain the following additional information.
 - a. Type of weld joint configuration to be examined, including diameter, thickness, and dihedral angle.
 - b. Surface temperature range.
 - c. Use of electronic gates, suppression, or alarms.
 - d. Method of determining acoustical continuity of base metal, and for establishing geometry as a function of local dihedral angle and thickness.
 - e. Methods for determining effective beam angle (in curved material and HSS corners), indexing root area, and discontinuity requirements.
 - f. Method of verifying rejectable indications during excavation and repair.
 - g. Any computerized hardware and/or software used for location and sizing of indications.

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4. Acceptance and rejection criteria of tubular steel members must comply with the following table:

Maximum discontinuity amplitude level obtained	Maximum discontinuity lengths by weld classes			
	Compression or Shear	Tension or subject to stress reversal	Tubular Class R (Substitute for RT)	Tubular Class X (T-, Y-, and K-Connections)
Level 1- Equal to or greater than SSL	Greater than 5 dB above SSL = None allowed. 0 through 5 dB above SSL = 3/4 inch.	Greater than 5 dB above SSL = None allowed. 0 through 5 dB above SSL = 1/2 inch.	See AWS D1.1/D1.1M Figure 9.29	See AWS D1.1/D1.1M Figure 9.30 (Utilizes height)
Level 2- Between the SSL and the DRL	2 inches	Middle 1/2 weld = 2 inches. Top & bottom 1/4 of weld = 3/4 inch.	See AWS D1.1/D1.1M Figure 9.29	See AWS D1.1/D1.1M Figure 9.30 (Utilizes height)
Level 3- Equal to or less than the DRL	Disregard. Level 3 discontinuities must be recorded.			
SSL = Standard Sensitivity Level. DRL = Disregard Level.				

5. Replace paragraph 3 of clause 6.26.3.2 of AWS D1.5M/D1.5 with the following:
- a. If indications that exhibit these planar characteristics are present at scanning sensitivity, or other evidence exists to suggest the presence of transverse cracks, a more detailed evaluation of the discontinuity by other means must be performed (e.g., alternate UT techniques, RT, grinding, or gouging for visual inspection or MT of the excavated areas).
6. Replace the scanning angle in clause 6.24.2.2 of AWS D1.5M/D1.5 with: Up to 45 degrees.
- F. Magnetic Particle Inspection (MT): Magnetic particle inspection of welds must be performed by the Independent Testing Agency and the procedure and technique must conform with ASTM E709.
- G. Liquid Penetrant Inspection (PT): Liquid dye penetrant inspection of welds must be performed by the Independent Testing Agency and must conform with ASTM E165/E165M. Liquid penetrant inspection must be used for detecting discontinuities that are open to the surface.
- H. Test Results: Test result information must be forwarded to VTA by the Independent Testing Agency immediately after test results are available, stating the acceptance or rejection of fabricated components, so that repairs and reinspection or testing may be performed as soon as possible.
- I. Repairs: Unacceptable welds must be repaired in accordance with AWS D1.1/D1.1M, D1.3/D1.3M, D1.4/D1.4M, and AWS D1.5M/D1.5, as applicable.
1. The Independent Testing Agency must notify VTA immediately if the Independent Testing Agency discovers welding problems, deficiencies, base metal repairs, or any other type of

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- repairs not included in the WQCP. Submit the proposed repair procedures to correct them. Allow VTA seven days to review the repair procedures.
2. The Contractor must receive authorization before performing the following:
 - a. Third-time excavations of welds or base metal to repair unacceptable discontinuities, regardless of NDT method
 - b. Repairs of cracks
 - c. Repairs not included in the WQCP
 3. Requests to perform third-time excavations, repairs of cracks, or repairs not included in the WQCP must include an engineering evaluation. At a minimum, the engineering evaluation must address the cause of each defect, why the repair will not degrade the material properties, and what steps are being taken to prevent similar defects from happening again.
 4. Repair welding for fracture critical members must be done in accordance with AWS D1.5M/D1.5, Clause 12.17.
 5. Without authorization from the Engineer, circumferential welds of tubular members and end plate-to-tubular member welds may be repaired only one time.
 6. If repairs are required in a portion of a tested weld of a Structural Steel (POC) Member, additional testing must be performed in accordance with AWS D1.5M/D1.5, Clause 6.7.
 7. Unless specified otherwise herein, if repairs are required in a portion of a tested weld, perform NDT as specified for the original weld on the repaired portion plus at least 2 inches on each side of the repaired area.
- J. Replace clause 6.5.4 of AWS D1.5M/D1.5 with the following:
1. The Contractor's Independent Testing Agency must inspect and approve each joint preparation, assembly practice, welding technique, joint fit-up, and the performance of each welder, welding operator, and tack welder to make certain that the applicable requirements of this code and the qualified WPS are met. The Independent Testing Agency must examine the work to make certain that it complies with clauses 3 and 6.26. The size and contour of all welds must be measured using suitable gauges. Visual inspection for cracks in welds and base metal, and for other discontinuities must be aided by strong light, magnifiers, or other devices as necessary. The Independent Testing Agency may use acceptance criteria different from those specified in this code if authorized by VTA.
- K. Replace clause 6.14.6.1 of AWS D1.1/D1.1M, clause 9.8.1 of AWS D1.4/D1.4M, and clause 6.1.3.4 of AWS D1.5M/D1.5 with:
1. Personnel performing NDT must be qualified and certified in accordance with American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A and the written practice of the NDT firm. The written practice of the NDT firm must comply with or exceed the guidelines of the ASNT Recommended Practice No. SNT-TC-1A. Individuals who perform NDT, review the results, and prepare the written reports must be one of the following:
 - a. Certified NDT Level II technicians
 - b. Level III technicians certified to perform the work of Level II technicians.
- L. For each inspection, including fit-up, WPS verification, and final weld inspection, the Independent Testing Agency must confirm and document compliance with these Technical Specifications, AWS welding codes and any referenced drawings.

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- M. The Independent Testing Agency must document inspection and approval of all joint preparations, assembly practices, joint fit-ups, and welding techniques and performance of each welder, welding operator, and tack welder on a daily basis for each day welding is performed.

2.04 INSPECTIONS AND TESTS OF SHOP WELDS BY VTA

- A. All welds may be subject to inspections and tests by VTA. Welds to be inspected and tested by VTA will be selected at random.
- B. VTA will make test results available to the Contractor.
- C. VTA determines the location of all NDT testing for welding.
- D. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
- E. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

2.05 WELD JOINT DETAILS

- A. If weld joint details proposed for use in the work are not prequalified under Clause 3 or Part B of Clause 9 of AWS D1.1/D1.1M or figure 2.4 or 2.5 of AWS D1.5M/D1.5, submit the proposed WPS and the intended weld joint locations.
- B. Upon authorization of the proposed joint detail locations and qualification of the proposed joint details, welders and welding operators using these details must weld an additional qualification test plate using the WPS variables and the weld joint detail to be used in production. The test plate must have the maximum thickness to be used in production and a minimum length of 18 inches and be mechanically and radiographically tested. Mechanical and radiographic testing and acceptance criteria must comply with the applicable AWS codes. The type of mechanical testing must be authorized.
- C. If a nonprequalified weld joint configuration is proposed using a combination of WPSs for work welded in accordance with AWS D1.1/D1.1M, the Contractor may conduct a single test combining the WPSs to be used in production, if the essential variables, including weld bead placement, of each process are limited to those established in table 4.5 of AWS D1.1/D1.1M.
- D. VTA will witness all procedure qualification tests for WPSs that were not previously authorized by the Structural Engineer of Record.
- E. The Contractor must notify VTA at least seven days before performing any procedure qualification tests. Witnessing of qualification tests by VTA does not constitute authorization of the intended joint locations, welding parameters, or essential variables.
- F. Weld joint geometry and details for tubular steel members must be in accordance with AWS D1.1/D1.1M, including thickness and size transition and girth weld alignment. Longitudinal seam welds must be staggered a minimum of 90 degrees and oriented such that holes, penetrations, welded connections, must not be located on the face of the seam.

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- G. Dimensional details and workmanship for welded joints in tubular and pipe connections must comply with Clause 2, Part A, "Common Requirements for Design of Welded Connections" and Clause 9 of AWS D1.1/D1.1M.
- H. Except for fillet and fatigue-resistant welds, exposed circumferential welds of tubular members must be ground flush with the base metal before galvanizing or painting. Ground flush is specified as minus 0, plus 0.08-inch.
- I. Replace the first sentence of clause 5.21.1.1 of AWS D1.1/D1.1M with the following:
 - 1. The separation between surfaces of plug and slot welds, and of joints landing on a backing, must not exceed 1/16 inch [2 mm].
- J. Replace clause 3.3.1.1 of AWS D1.5M/D1.5 with the following:
 - 1. The separation between surfaces of plug and slot welds, and of joints landing on a backing, must not exceed 1/16 inch [2 mm].

2.06 WELDING PROCEDURES QUALIFICATION

- A. Welding procedures qualification for work welded in accordance with AWS D1.5M/D1.5 must comply with clause 5.12 or 5.12.4 of AWS D1.5M/D1.5 and the following:
 - 1. Macroetch tests are required for all WPS qualification tests, and acceptance must comply with clause 5.19.3 of AWS D1.5M/D1.5.
 - 2. If a nonstandard weld joint is to be made using a combination of WPSs, the Contractor may conduct a test in accordance with figure 5.3 of AWS D1.5M/D1.5, combining the qualified or prequalified WPSs to be used in production, if the essential variables, including weld bead placement, of each process are limited to those established in table 5.4 of AWS D1.5M/D1.5.
 - 3. Before preparing mechanical test specimens, inspect the PQR welds by visual and radiographic tests. The backing bar must be three inches in width and must remain in place during NDT. Results of the visual and radiographic tests must comply with clause 6.26.2 of AWS D1.5M/D1.5 excluding clause 6.26.2.2. All other requirements for clause 5.17 are applicable.
- B. Welding procedure specifications for tubular steel members are not considered prequalified. Qualification must be in accordance with AWS D1.1/D1.1M, Clause 4, Part B and all the mechanical tests shown therein, excluding CVN tests. Additionally, the following requirements apply:
 - 1. All CJP and PJP T-, Y-, and K- connections without backing or welding from one side only requires mock-ups. Mock-up production and macroetch requirements must be in accordance with AWS D1.1/D1.1M and must be witnessed by VTA.
 - 2. CVN tests and all-weld-metal tension tests must be performed in accordance with AWS D1.5. Groove welds must have a CVN test value equal to, or exceeding that, specified in Table 12.1 of AWS D1.5M/D1.5. A representative test plate weld using one-inch thick plate utilizing the appropriate WPS parameters must be used.
 - 3. Qualification for WPSs must be within the limitation of essential variables outlined in 5.12.4 of AWS D1.5M/D1.5.
- C. When electric resistance welding is used for work welded in accordance with AWS D1.1/D1.1M, the welding procedure must be qualified in accordance with Clause 4 of AWS D1.1/D1.1M. Welding procedures must be qualified for the thickness and the pole diameter tested. Test samples for tapered

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poles must be obtained from three locations, each end and the middle of the tapered pole, to qualify for the diameter range tested.

2.07 BACKING FOR WELDS

- A. For welds subject to computed stresses, backing for welds that is left in place in the completed structure must be a single length and the same material as the structural steel being welded.
- B. Single length backing may be either a continuous strip or multiple lengths joined by complete joint penetration butt welds before being installed as backing.
- C. Butt welds in backing material are subject to the same type and frequency of testing as specified for the type of joint in the material being joined. Grind butt welds in backing material flush as necessary to obtain proper inspection and fit-up in the welded joint where backing is used.
- D. Butt-welded circumferential joints of tubular sections requiring CJP groove welds must be made using a metal sleeve backing ring inside each joint. The sleeve must have at least a 1/8-inch nominal thickness and be manufactured from steel having the same chemical composition as the steel in the tubular sections to be joined. If the sections to be joined have different specified minimum yield strengths, the sleeve must have the same chemical composition as the tubular section having the higher minimum yield strength. The width of the metal sleeve must be consistent with the type of NDT selected and must be a minimum width of one inch. At fitting time, the sleeve must be centered at the joint and in contact with the tubular section at the point of the weld.

PART 3 - EXECUTION

3.01 FIELD WELDING

- A. Field welding, where indicated or permitted by VTA, must be performed as herein specified for shop welding. The Contractor must identify a risk for fire damage and maintain a fire watch during the work as approved by VTA.

3.02 FIELD INSPECTIONS AND TESTS

- A. The Independent Testing Agency must perform inspections and tests of field welds as herein specified for shop welds.
- B. VTA reserves the right to perform inspections and tests of field welds as herein specified for shop welds.

3.03 CLEANING

- A. Welds of stainless steel must be cleaned in accordance with Section 05 70 00, Decorative Metal, and must be protected from damage and corrosion at the factory, during shipping, and at the Worksite until acceptance of the work by VTA.

END OF SECTION 05 05 60

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SECTION 05 12 35

STRUCTURAL STEEL

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
 - 1. Structural steel for bridges, including structural steel framing and all associated connections at the Story Station Pedestrian Overcrossing.
 - 2. Structural steel for non-bridge structures, including structural steel framing and all associated connections at the Story Station access structures, including the elevator towers, the various canopy structures at Story Station and Eastridge Station, and structural steel posts supporting precast concrete walls at sound wall and at TPSS #33 & #34 screen walls.

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 02 43 13, BRT Ocala Station Relocation
- D. Section 03 11 14, Falsework
- E. Section 04 55 26, Traffic Control
- F. Section 05 05 60, Metal Welding
- G. Section 05 17 00, Miscellaneous Metal
- H. Section 05 30 00, Metal Decking
- I. Section 05 50 00, Metal Fabrications
- J. Section 05 52 00, Metal Railings (Stations)
- K. Section 05 52 01, Metal Railing (Bridge)
- L. Section 09 91 00, Painting
- M. Section 10 73 16, Canopies

1.03 REFERENCED STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO) / State of California Department of Transportation (Caltrans):

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1. AASHTO-CA BDS-6 AASHTO LRFD Bridge Design Specifications, 2012 (6th Edition) with California Amendments, preface dated January 2014

- B. American National Standards Institute (ANSI)/American Institute of Steel Construction (AISC):
 1. AISC Steel Construction Manual, 15th Edition
 2. AISC 303 Code of Standard Practice for Steel Buildings and Bridges
 3. AISC 348 Specifications for Structural Joints Using High-Strength Bolts
 4. ANSI/AISC 341 Seismic Provisions for Structural Steel Buildings
 5. ANSI/AISC 360 Specifications for Structural Steel Buildings

- C. ASTM International (ASTM):
 1. ASTM A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
 2. ASTM A27/A27M Specification for Steel Castings, Carbon, for General Application
 3. ASTM A36/A36M Specification for Carbon Structural Steel
 4. ASTM A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
 5. ASTM A108 Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
 6. ASTM A153/A153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 7. ASTM A307 Specification For Carbon Steel Bolts, and Studs, 60,000 psi Tensile Strength
 8. ASTM A500/A500M Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 9. ASTM A563 Specification for Carbon and Alloy Steel Nuts
 10. ASTM A572/A572M Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 11. ASTM A668/A668M Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
 12. ASTM A673/A673M Specification for Sampling Procedure for Impact Testing of Structural Steel
 13. ASTM A709/A709M Specification for Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
 14. ASTM A992/A992M Standard Specification for Structural Steel Shapes
 15. ASTM A1085/A1085M Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
 16. ASTM E23 Standard Test Methods for Notched Bar Impact Testing of Metallic Materials
 17. ASTM F436/F436M Specification for Hardened Steel Washers
 18. ASTM F959 Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
 19. ASTM F3125/F31325M Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

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D. American Welding Society (AWS):

- | | | |
|----|----------------|--|
| 1. | AWS A2.4 | Standard Symbols for Welding, Brazing and Nondestructive Examination |
| 2. | AWS D1.1/D1.1M | Structural Welding Code – Steel (2015) |
| 3. | AWS D1.5M/D1.5 | Bridge Welding Code (2015) |

E. SSPC: The Society for Protective Coatings (SSPC):

- | | | |
|----|---------------|--|
| 1. | SSPC-SP 1 | Solvent Cleaning |
| 2. | SSPC-SP 3 | Power Tool Cleaning |
| 3. | SSPC-SP 10 | Near-White Blast Cleaning |
| 4. | SSPC-SP 11 | Power Tool Cleaning to Bare Metal |
| 5. | SSPC-PA 1 | Shop, Field, and Maintenance Painting |
| 6. | SSPC-Paint 20 | Zinc-Rich Primers (Type I – Inorganic and Type II – Organic) |
| 7. | SSPC-Paint 22 | Epoxy-Polyamide Paints (Primers, Intermediate & Topcoat) |

F. American Iron and Steel Institute (AISI)

- | | | |
|----|-------------|---|
| 1. | AISI C-1018 | Steel Bars, Forgings, and Tubing 0.15 - 0.20C |
| 2. | AISI C-1035 | Steel Bars, Forgings, and Tubing 0.31 - 0.38C |

G. Steel Structures Technology Center, Inc. (SSTC):

- | | |
|----|-----------------------------|
| 1. | Structural Bolting Handbook |
|----|-----------------------------|

1.04 REGULATORY REQUIREMENTS

A. The regulatory requirements which govern the work of this Section include the following governing code:

- | | |
|----|---|
| 1. | California Code of Regulations (CCR), Title 24, Part 2, 2019 California Building Code, Chapter 22, “Steel”, and State Chapter 22A, “Steel”. |
|----|---|

1.05 DESCRIPTION

A. Structural Steel for Bridges: Structural steel for bridges includes, but is not necessarily limited to, the following items of work:

- | | |
|----|--|
| 1. | Structural steel framing and all associated connections at the Story Station Pedestrian Overcrossing, including the structural steel framing at the south median pedestrian overcrossing landing and the structural steel framing members of the railings. |
|----|--|

B. Structural Steel for Non-Bridge Structures: Structural steel for non-bridge structures includes, but is not necessarily limited to, the following items of work:

- | | |
|----|--|
| 1. | Structural steel framing and all associated connections at the Story Station Access Structures, including the elevator tower. |
| 2. | Structural steel framing and all associated connections at the various canopy structures at Story Station and Eastridge Station. |
| 3. | Structural steel posts at precast concrete walls. |

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- C. Structural Steel (Access Structure) consists of structural steel members of the Story Station Access Structures including, but not necessarily limited to, elevator tower structural steel framing and all associated connections, excluding steel members of the canopy structures.
- D. Structural Steel (Pedestrian Overcrossing) consists of structural steel members of the pedestrian overcrossing, the structural steel framing supporting the metal decking at the south median pedestrian overcrossing landing, and the structural framing supporting the metal fence screens. Structural framing elements include, but are not necessarily limited to, arch ribs, arch ties, floor beams and bracings, stud connectors, sole plates, masonry plates, hangers, and all associated steel connections and connection assemblies.
- E. Structural Steel (TPSS) and Structural Steel (Sound Wall) consists of structural steel posts at pilasters supporting precast concrete wall panels.

1.06 SUBMITTALS

- A. General: Submittals for structural steel must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Shop Drawings and Camber Calculations:
 - 1. Submit detailed Shop Drawings of structural steel work prior to fabrication, showing sizes, details of fabrication and construction, methods of assembly, locations of hardware, anchors, and accessories, and erection sequence and details. Include procedures for heavy lifts and rigging. Erection drawings must be referenced to the plans.
 - 2. Shop Drawings must include the following items:
 - a. Sequence of shop and field assembly and erection. For continuous members, include proposed steel erection procedures with calculations that show steel member capacity and geometry will be correct.
 - b. Welding sequences, techniques, and procedures.
 - c. Layout drawing of the entire structure with locations of butta welded splices.
 - d. Locations of temporary supports and welds.
 - e. Vertical alignment of arch ribs and tie beams at each stage of erection.
 - f. Match-marking diagrams.
 - g. Details for connections not shown or dimensioned on the plans.
 - h. Details of allowed options incorporated into the work.
 - i. Direction of rolling of plates where orientation is specified.
 - j. Distortion control plan.
 - k. Dimensional tolerances. Include measures for controlling accumulated error to meet overall tolerances.
 - l. Material specification and grade listed on the bill of materials.
 - m. Identification of tension members and fracture critical members.
 - n. Proposed deviations from plans, these Technical Specifications, or previously submitted Shop Drawings.
 - o. Contract plan sheet references for details.
 - p. Cuts and copes.
 - q. Gussets, connections, holes, fasteners.
 - r. Camber.
 - s. Type of finish and paint system.
 - t. Weights of members.
 - u. Critical clearances.

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3. Welds, both shop and field, must be indicated by standard welding symbols of AWS A2.4. Drawings must show the size, length, and type of each weld.
 - a. Indicate individual welders' identification (I.D.) on project record drawings.
 4. Submit camber calculations with the shop drawings
 5. Investigate stresses caused by the proposed erection procedure. Submit drawings showing details of required temporary supports, staying, and bracing. Include descriptive data and design calculations, to illustrate the erection, transportation, and handling procedures, including sequence of erecting and transfer of loads if applicable.
 6. Furnish setting diagrams, match-marking diagrams, templates, and directions for the erection of structural framing, anchor bolts, bearing plates, and other embedded items.
 7. The Contractor must be responsible for errors of fabrication and for correct fitting of structural members.
 8. Shop Drawings for all structural steel framing work at the Story Station Pedestrian Overcrossing must be submitted in one submittal. Shop Drawings that do not include all work required for the Story Station Pedestrian Overcrossing will be considered incomplete and will be returned to the Contractor for resubmittal.
 9. Shop Drawings for all structural steel framing work at the Story Station Access Structures, including the elevator towers, and canopy structures must be submitted in one submittal. Shop Drawings that do not include all work required for the Story Station Access Structures, elevator towers, and canopy structures will be considered incomplete and will be returned to the Contractor for resubmittal.
 10. Shop Drawings must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by VTA.
- C. Detailing Requirements: Requirements for the detailing of structural steel work are specified herein under Part 2 - Products because of the close relationship of detailing with fabrication requirements.
- D. Product Data:
1. Submit manufacturer's product data of load-indicator washers (Compressible Washer-type direct tension indicators) when proposed for use.
 2. Product data must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by VTA.
- E. Mill Test Reports:
1. Submit certified mill test reports of structural steel materials before fabrication. Certified mill test reports must cover chemical analysis and physical properties of each heat of steel from which the material for structural steel will be furnished, in conformance with the hereinafter specified ASTM Specifications. Mill Certificates must include name of mill, date of rolling, date of shipping, ultimate tensile strength, yield strength, CVN impact test results if impact testing is specified, and percent of elongation.
 2. Submit copies of mill orders when orders are placed.
 3. Steel materials which are not properly certified as conforming with specified ASTM Specifications will be rejected.

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4. Mill Certificates must be furnished with each lot of material shipped to the Worksite and must be signed by the Contractor which will serve to certify that all structural steel materials installed comply with specified requirements.
- F. Welding Records and Data: Refer to Section 05 05 60, Metal Welding, for requirements.
- G. Construction Staging and Erection Procedure:
1. For the staging, fabrication, and erection of structural steel, submit a Construction Staging and Erection Procedure for each steel structure, which must include Shop Drawings and calculations sufficient for VTA to determine the adequacy of the proposed methods. As a minimum, the following information must be included in the submittal:
 - a. Plan showing the location of all roadways, utilities, and other appurtenances in areas to be used to fabricate and erect structural steel.
 - b. Complete equipment positioning and storage plan describing construction methods that utilize equipment and warning devices, horizontal and vertical positioning of equipment during construction, operating radii, and equipment storage.
 - c. The limits of the potential crane influence area, taken as circular areas with radii matching the boom length and radius points located at the boom pivot point.
 - d. The vertical alignment of arch ribs and tie beams at each stage of erection, order of lifts, repositioning of equipment and counterweights, and location and method of attaching deadmen.
 - e. The type, size and arrangements of slings, shackles or other lifting and connecting devices including related technical data.
 - f. Lifting equipment information including rating data. Information must include counter weights to be used and boom capability. The manufacturer's rated capacity of the crane and of all lifting and connecting devices must be adequate for the total pick load including spreaders and other material.
 - g. Crane capacity rating charts, the rated capacity of all lifting and connecting devices and the anticipated factors of safety must be clearly shown.
 - h. Methods and materials for temporary structures or the strengthening or bracing of a member (either temporarily or permanently) for erection purposes.
 - i. Details of proposed foundations, pads, and cribbing for support of outrigger loading.
 - j. Contractor must locate and show on the work plans all utilities and piping in the areas of crane operations and include the details of how to protect utilities and piping in place.
 - k. The Contractor must include the proposed dates for fabrication and staging work, and the hours of operation. Attention is directed to Section 01 55 26, Traffic Control, for lane closure restrictions and other traffic control requirements.
 - l. Fabrication and Erection Safety Plan: The Construction Staging and Erection Procedure submittal must include a Fabrication and Erection Safety Plan that must outline the measures and procedures that will be employed to provide for the safety of workers, inspectors, and Worksite personnel, and utility facilities and operations. In addition, the Fabrication and Erection Safety Plan must show how the proposed fabrication and erection sequence will operate in and around any utilities in the area to meet all safety orders and requirements.
 2. Arch ribs and tie beams must be stabilized with falsework, temporary braces, or holding cranes until a sufficient number of adjacent steel members, including, but not necessarily limited to, floor beams, cross frames, and hangers, are erected and connected to provide necessary lateral stability. When erecting tie beam assemblies, including floor beams and cross frames, and hangers, the falsework must be left in place until all connections are bolted

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and accepted by VTA unless otherwise provided in the approved erection procedure. Care must be taken in the use of falsework and other temporary supports to ensure that the temporary elevation of structural steel provided by the falsework is consistent with the deflections that will occur as the structure is completed. Falsework must conform to the requirements in Section 03 11 14, Falsework.

3. The Construction Staging and Erection Procedure submittal must be stamped and signed by an engineer who is currently registered as a civil engineer in the State of California.
 4. The Construction Staging and Erection Procedure submittal must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by VTA.
 5. The time to be provided for the review of the Construction Staging and Erection Procedure submittal will be 12 weeks.
- H. Test Reports: Submit reports from testing performed on fastener components and assemblies before shipment to the Worksite. Test reports must include the rotational capacity lot numbers and the reports listed in the "Certification," "Report," "Number of Tests and Retests," and "Certification and Test Report" sections of the referenced ASTM standards. For ASTM F1554 anchor bolts, include chemical composition and carbon equivalence for each heat of steel.
- I. Certificates:
1. Submit a calibration certificate for each bolt tension measuring device and calibrated wrench before use.
 2. Submit certification showing the maximum allowable dry film thickness for inorganic zinc-rich coatings to be used on faying surfaces of high-strength bolted connections as determined under appendix A of AISC 348.
 3. Submit certification from the stud connector manufacturer that the stud base is qualified as described in AWS D1.1/D1.1M, Clause 7.2.4 and AWS D1.5M/D1.5, Clause 7.2.4.
- J. For high strength connections, submit a record of which lots are used in each joint as an informational submittal.

1.07 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations. The fabrication, priming, and erection of structural steel framing must comply with the applicable provisions of AISC 303, AISC 348, and ANSI/AISC 360, except where more stringent requirements are shown in the plans or specified in these Technical Specifications.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
1. Sampling, Testing and Inspection:

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- a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
- D. VTA Quality Assurance:
1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.
- E. Fabricator's Shop or Facility: Fabricator's shop or facility may be inspected and must be approved by VTA before the start of fabrication work. Notify VTA in writing at least 14 calendar days before the scheduled start of fabrication work. Fabrication of structural steel must be performed by an approved fabricator at an approved facility.
- F. Indicated Dimensions: Unless otherwise indicated, dimensions at expansion joints and similar construction were determined for a temperature of 50 degrees Fahrenheit. Make proper adjustments for temperature when the structure is to be fabricated and installed at any other temperature.
- G. Torque Wrenches and Bolt Tension Measuring Devices:
1. Each manual torque wrench must have a dial gauge or digital read out. Any electric, pneumatic, or hydraulic calibrated wrench used to tension fasteners must have an adjustable control unit to shut off the wrench at the desired torque.
 2. Bolt tension measuring devices and calibrated wrenches must be calibrated not more than one year before use and at least yearly during the project. The calibration must be performed by an authorized repair and calibration center approved by the tool manufacturer. Certification equipment and calibration standards must be traceable to the National Institute of Standards and Technology (NIST).
 3. Calibrate bolt tension measuring devices to be accurate to within one percent of actual tension. Calibration must consist of at least four evenly spaced verification readings performed over a range of 20 to 80 percent of full scale.
 4. Calibrate calibrated wrenches to be accurate to within two percent of actual torque. Calibration must consist of at least four evenly spaced verification readings performed over a range of 20 to 100 percent of full scale. If a torque multiplier is used, calibrate the torque multiplier and calibrated wrench as a unit. Include sockets and extensions of the same length to be used in the work during calibration. Adjust the manufacturer's torque multiplier during

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calibration so that the product of the torque multiplier and the input calibrated wrench reading is within two percent of actual torque value. Use this system only as calibrated.

5. If VTA has reason to question the accuracy of the tension measuring device or calibrated wrench, in the opinion of the VTA, use of the tension measuring device or calibrated wrench must be discontinued until renewed calibration certification is submitted and approved by the VTA.

- H. Qualifications of Welders and Welding Procedures: Refer to Section 05 05 60, Metal Welding, for requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Avoid bending, scraping, and overstressing the steelwork. Block with wood, or otherwise protect, projecting parts which may be bent or damaged.

- B. Member Markings:

1. Mark the weight of any member weighing over 6,000 pounds on the member.
2. Mark the piece (mark) number, corresponding to shop erection sequence drawing, on all members.
3. Match-mark all shop pre-fitted members.
4. Match-mark connecting parts that are preassembled for setting up for welding or for drilling or reaming holes for field connections.
5. Use low-stress stamps for fracture critical members and tension members.

- C. Ship small parts, such as bolts, nuts, washers, pins, fillers, clips, and small connecting plates and anchors, in boxes, crates, or barrels. Pack separately each length and diameter of bolt and each size of nut and washer. Plainly mark an itemized list and description of the contents on the outside of each container.

- D. Load, transport, unload, and store structural steel materials in such a manner that the metal is kept clean and free from injury. Store materials above ground on platforms, skids, or other supports, and keep material clean, drained, covered, and protected from corrosion.

- E. Do not bend, scrape, or overstress members during handling and shipping. The Engineer must reject bent or damaged members.

- F. Handle and store steel members in such a manner that they will have the required alignment and curvature, if any, after erection. Support long members on skids placed to prevent deflection.

- G. Identify each lot of fabricated steel to be shipped to the Worksite by assigning an individual lot number that identifies steel by heat number and tag in such a manner that each such lot can be accurately identified at the Worksite.

- H. Remove all unidentified structural steel and anchorage assemblies received at the Worksite.

1.09 MEASUREMENT AND PAYMENT

- A. Measurement:

1. Furnish Structural Steel:
 - a. Furnish Structural Steel (Access Structures) must be measured by the pound.

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- b. Furnish Structural Steel (Pedestrian Overcrossing) must be measured by the pound.
 2. Erect Structural Steel:
 - a. Erect Structural Steel (Access Structures) must be measured by the pound.
 - b. Erect Structural Steel (Pedestrian Overcrossing) must be measured by the pound.
 3. Clean and Paint Structural Steel (Access Structures) must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
 4. Clean and Paint Structural Steel (Pedestrian Overcrossing) must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
 5. Structural Steel (TPSS) must be measured by the pound.
 6. Structural Steel (Sound Wall) must be measured by the pound.
 7. Weights must be calculated in accordance with AISC 303.
- B. Payment:
 1. The contract price paid per pound for Furnish Structural Steel of the various types listed in the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in fabricating and delivering structural steel to the Worksite ready to incorporate into the work complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
 2. The contract price paid per pound for Erect Structural Steel of the various types listed in the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in erecting structural steel at the Worksite into the final position in the work, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
 3. The lump sum payment for Clean and Paint Structural Steel for the various types listed in the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in cleaning, priming and applying finish coats to the steel surfaces, repairing damages to primed and galvanized surfaces prior to application of finish coats, and touching-up damaged paint system after erection, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
 4. The contract price paid per pound for Structural Steel (TPSS) and Structural Steel (Sound Wall) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in furnishing and installing structural steel at the Worksite into the final position in the work, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
- C. Full compensation for furnishing all bolts, nuts and washers, stud connectors, welding materials, preformed fabric pads and elastomeric bearing pads, or other materials required for the erection and connection or splicing of the structural steel, galvanizing the structural steel when galvanizing is shown on the drawings or specified in these Technical Specifications, and conforming to the qualification and testing requirements associated with member fabrication, must be considered as included in the bid item for Furnish Structural Steel of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.

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- D. Full compensation for connecting and splicing the structural steel, installing stud connectors, preformed fabric pads and elastomeric bearing pads, furnishing and applying caulk, furnishing and placing non-shrink grout for masonry or bearing plates and anchor bolts, checking bolt tension, and conforming to qualification and testing requirements associated with member erection, connection or splicing, must be considered as included in the bid item for Erect Structural Steel of the various types listed in the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.
- E. Full compensation for furnishing and applying thread locking system must be considered as included in the prices paid for the various contract item of work requiring the system and no additional compensation will be allowed therefor.
- F. Full compensation for furnishing and constructing structural steel framing members, anchorages, and connections that are part of the various canopy structures, as shown on the drawings, must be considered as included in the bid items for the various canopies and no additional compensation will be allowed therefor. Attention is directed to Section 10 73 16, Canopies, for measurement and payment of canopies.
- G. Full compensation for furnishing and installing metal decking and stud connectors used with metal decking must be considered as included in the bid item for Metal Decking and no additional compensation will be allowed therefor. Attention is directed to Section 05 30 00, Metal Decking, for measurement and payment of metal decking at Story Station Pedestrian Overcrossing.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL MATERIALS

- A. General:
 - 1. Identify all materials by heat and lot, if applicable. Correlate with certified mill test reports.
 - 2. Manufactured steel clips and angles will be accepted where such will meet the requirements of the plans and are shown on the Shop Drawings.
 - 3. All structural steel that is precut before arrival at the fabrication site must be cut so that the primary direction of rolling is parallel to the direction of the main tensile or compressive stress in the member.
- B. Structural Steel Shapes, Plates, and Bars:
 - 1. Structural Steel for Bridges: Unless otherwise described herein, structural steel for bridges must comply with ASTM A709/A709M.
 - a. Steel W-Shapes and WT-Shapes: ASTM A709/A709M, Grade 50S.
 - b. Steel Channels and Angles: ASTM A709/A709M, Grade 36.
 - c. Steel Plates and Bars: ASTM A709/A709M, Grade 50.
 - d. Steel Rods: ASTM A709/A709, Grade 36.
 - e. Structural Tubing: ASTM A1085/A1085M.
 - 2. Structural Steel for Non-Bridge Structures:
 - a. Steel W-Shapes and WT-Shapes: ASTM A992/A992M.
 - b. Steel Channels and Angles: ASTM A36/A36M.
 - c. Steel Plates and Bars: ASTM A572/A572M, Grade 50, or ASTM A36/A36M.

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- d. Steel Rods: ASTM A36/A36M.
 - e. Structural Tubing: ASTM A500/A500M, Grade C or as indicated.
- C. Structural Pipe: ASTM A53/A53M, Type E or Type S, Grade B. Hydrostatic testing does not apply.
- 1. Refer to Section 31 62 00, Driven Piles, for pipe pile requirements.
- D. Steel Pins:
- 1. Greater than 9 inches in diameter: ASTM A668/A668M, Class C or D.
 - 2. 9 inches and less in diameter: ASTM A668/A668M, Class C or D, or ASTM A108, Grades 1016 through 1030.
 - 3. Pin nuts: ASTM A709/A709M or ASTM A563, including appendix X1. Zinc-coated nuts tightened beyond snug or wrench tight must be furnished with a dry lubricant complying with supplementary requirement S2 in ASTM A563.
 - 4. Threads for pin ends and pin nuts 1-1/2 inches or more in diameter must comply with the following:
 - a. External threads must be Unified Inch Screw Threads, UN Series with 6 threads per inch, complying with ANSI B1.1 with Class 2A tolerances.
 - b. Internal threads must be Unified Inch Screw Threads, UN Series with 6 threads per inch, complying with ANSI B1.1 with Class 2B tolerances.
- E. Anchors and Fasteners:
- 1. Bolts: ASTM A307, Grade A.
 - 2. High-Strength Bolts: ASTM F3125/F3125M, Grade A325, Type 1, slip-critical type, or ASTM F3125/F3125M, Grade A490, Type 1, slip-critical type, as shown on the Plans.
 - a. ASTM F3125/F3125M, Grade A490 high-strength bolts must not be galvanized.
 - b. Do not use a cleaning process that introduces hydrogen into the steel of ASTM F3125/F3125M, Grade A490 high-strength bolts.
 - 3. Hex Nuts and Washers:
 - a. Nuts: ASTM A563, Grade DH, including S1 supplementary requirements.
 - 1) Galvanized nuts to be tightened beyond snug or wrench tight must be furnished with a dry lubricant complying with supplementary requirement S2 in ASTM A563.
 - b. Washers: ASTM F436/F436M, Type 1, including S1 supplementary requirements. Washers over oversized or slotted holes must comply with AISC 348 Section 6.
 - c. Finish of nuts and washers must match the finish of the connecting anchor or fastener.
 - d. Tapered washers must be provided on bolted connections to channels and other structural shapes with sloping flanges
 - 4. Load-Indicator Washers (Direct Tension Indicators): ASTM F959, Type 325, zinc-coated. The use of these devices must conform to the requirements in AISC 348.
 - 5. Lubricant for Bolts: Molybdenum disulfide base.
 - 6. Threaded Rods: Carbon steel, ASTM A36, manufactured to American Standard Bolt dimensions with “Free Fit - Class 2” threads.

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- a. All unfinished bolts must have a lock washer under nut.
 - b. Rods embedded in concrete, grout or adhesive must be galvanized unless noted otherwise.
7. Anchor Rods and Anchor Bolts: ASTM F1554, Grade 36, Class 2A, or Grade 55, weldable steel, Class 2A.
- a. Rods and bolts embedded in concrete, grout, or adhesive must be galvanized unless noted otherwise.
 - b. Embedded rods must be threaded full length unless noted otherwise.
8. High-Strength Anchor Rods and High-Strength Anchor Bolts: ASTM F1554, Grade 105, Class 2A. Hardened washers must be used.
- a. High-strength anchor rods and anchor bolts must not be galvanized.
 - b. Do not use a cleaning process that introduces hydrogen into the steel.
9. Tension Control Bolts: ASTM F3125, Grade F1852, Type 1.
10. Where shown on the plans, anchors and fasteners must be hot-dip galvanized in accordance with ASTM A153/A153M. Nuts and washers that are part of an anchor or fastener assembly to be galvanized must also be galvanized in accordance with ASTM A153A/A153M.
- F. Stud Connectors: ASTM A108, Grade 1015, 1018, or 1020, either semi-killed or killed deoxidation. Stud connectors must meet the requirements of AWS D1.5M/D1.5, Clause 7, for Type B studs.
1. Stud connectors must be produced by cold heading, cold rolling, or cold machining. Finished stud connectors must be uniform quality and free of injurious laps, fins, seams, cracks, twists, bends, or other defects. Studs must not have radial cracks or bursts in the head that extend more than one-half the distance from the head periphery to the shank. Tensile strength of stud connectors must be determined by tests of bar stock after drawing or of full diameter finished studs. Material properties must conform to the following:
 - a. Tensile Strength: 65,000 pounds per square inch, minimum
 - b. Yield Strength: 51,000 pounds per square inch, minimum
 - c. Elongation: 20 percent in 2 inches, minimum
 - d. Reduction of Area: 50 percent, minimum
 2. Stud connectors must be furnished with arc shields (ferrules) of heat-resistant ceramic or other suitable material for welding.
- G. Forgings: ASTM A668/A668M, Class D for carbon steel, and Class G for alloy steel.
1. Clevises and turnbuckles must conform to AISI C-1035.
 2. Sleeve nuts must conform to AISI C-1018, Grade 2.
- H. Castings:
1. Carbon-steel castings: ASTM A27/A27M, Grade 65-35, Class 1
 2. Malleable iron castings: ASTM A47/A47M, Class 32510
 3. Gray iron castings: ASTM A48, Class C30B
- I. Welding Electrodes: Refer to Section 05 05 60, Metal Welding, for requirements.

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- J. Shop Painting Materials: As herein specified under Article 2.04.
- K. Non-Shrink Grout: Refer to Section 03 61 11, Non-Shrink Grout, for requirements.
- L. Hollow Structural Sections (HSS): Hollow structural sections (HSS) must be considered structural tubing and must conform to all requirements specified for structural tubing herein.
- M. Caulking: Polysulfide or polyurethane caulking complying with ASTM C920, Type S, Grade NS.
- N. Sealing Compound: Polysulfide or polyurethane type complying with ASTM C920, Type S, Grade NS, Class 25, Use M.

2.02 CHARPY V-NOTCH (CVN) REQUIREMENTS

- A. The Independent Testing Agency must determine Charpy V-notch (CVN) values for structural steel for bridges in accordance with ASTM E23, and as specified herein. Sampling procedures must comply with ASTM A673.
 - 1. Use the Frequency H (Heat) testing for steels complying with ASTM A709/A709M, Grades 36, 50, 50W, and HPS 50W.
 - 2. Use the Frequency P (Piece) testing for steels complying with ASTM A709/A709M, Grades HPS 70W, 100, and 100W.
 - 3. Non-Fracture Critical Steel Members:
 - a. Non-fracture-critical steel members must conform to the marking requirements specified for Zone 2 of “Non-Fracture-Critical, T, Tension Components” of ASTM A709/A709M.
 - b. Impact Test Qualification: Specific test requirements for Charpy impact testing for non-fracture critical members must be as follows:

1) Material complying with ASTM A709/A709M	CVN impact value (ft-lb at temperature)
Grade 36	15 at 40 degrees Fahrenheit
Grade 50 (Thickness up to 2 inches) (See Note A)	15 at 40 degrees Fahrenheit
Grade 50W (Thickness up to 2 inches) (See Note A)	15 at 40 degrees Fahrenheit
Grade 50 (Thickness over 2 inches up to 4 inches) (See Note A)	20 at 40 degrees Fahrenheit
Grade 50W (Thickness over 2 inches up to 4 inches) (See Note A)	20 at 40 degrees Fahrenheit
Grade HPS 50W (Thickness up to 4 inches) (See Note A)	20 at 10 degrees Fahrenheit
Note A: If the material yield strength is more than 65,000 pounds per square inch, reduce the temperature for the CVN impact value 15 degrees Fahrenheit for each increment of 10,000 pounds per square inch above 65,000 pounds per square inch.	

- 4. Fracture Critical Members:

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- a. Steel for members shown on the plans as fracture critical members must conform to the marking requirements specified for Zone 2 of “Fracture-Critical, F, Tension Components” of ASTM A709/A709M.
- b. Steel for members shown on the plans as fracture critical members must comply with the CVN impact requirements for Zone 2, welding requirements, and welding inspection requirements in “AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members” of AWS D1.5M/D1.5.
- c. Steel members shown on the plans as fracture critical members must be produced by a fabricator certified under AISC Certification Program for Steel Bridge Fabricators, Intermediate Bridges with Fracture-Critical Members.
- d. Steel for structural tubing members shown as fracture critical or main tension members must comply with the CVN testing requirements in ASTM A1085.

2.03 DETAILING REQUIREMENTS

A. Detailing Standards:

1. Except as specified otherwise herein or as indicated otherwise on the plans, detailing and tolerances must conform with applicable requirements of Steel Construction Manual, ANSI/AISC 360 and AISC 303.
2. Connection details for structural steel for bridges must comply with AASHTO-CA BDS-6.
3. Special seismic detailing provisions must conform with ANSI/AISC 341.
4. Items to be galvanized must be detailed as specified in Section 05 50 00, Metal Fabrications.

B. Required Provisions:

1. All working points indicated on the plans must be adhered to in the detailing of the work.
2. Substitutions of sections must be made only as approved by the Structural Engineer of Record.
3. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members.
4. Detail and fabricate work with suitable drain and vent holes as required to provide positive drainage and to prevent the trapping of moisture and stagnant air.

C. Connections:

1. Connections must be as indicated and as specified herein.
2. Furnish all bolts and bolt placement lists for field and shop connections, including all temporary carbon steel erection bolts and clips required for field erection. For high-strength connections, submit a record of which lots are used in each joint as an informational submittal.
3. Except as otherwise indicated, all connections must be shop welded and field bolted. Field welded connections will be permitted only where indicated on the plans or where specifically approved by VTA in writing.
4. Framed beam connections which are not detailed or otherwise indicated must be shop welded and field bolted in accordance with AISC Steel Construction Manual, ANSI/AISC 341 and ANSI/AISC 360.
5. Detail field splice connections to develop the full strength of the section in which the splice is made.
6. All joints made with high strength bolts must be considered to be slip-critical connections with threads included in the plane of shear, except where indicated otherwise on the plans.
7. Tapered washers must be provided on bolted connections to channels and other structural shapes with sloping flanges.

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2.04 FABRICATION

- A. The requirements specified herein apply to work performed at the source and at the Worksite.
- B. Structural steelwork must conform with the applicable requirements of the California Building Code, ANSI/AISC 341, and ANSI/AISC 360.
- C. Welding and welded connections must conform with the requirements of Section 05 05 60, Metal Welding.
- D. Steel members and metal fabrications must be prefabricated and preassembled in the factory or shop as far as practicable.
- E. Steel for members shown on the plans as fracture critical members must be produced by a fabricator certified under AISC Certification Program for Steel Bridge Fabricators, Intermediate Bridges with Fracture-Critical Members.
- F. Form and fabricate the work to meet installation conditions. Include accessories to adequately secure the work in place.
- G. Cutting, drilling, punching, and welding must be neatly performed with burrs and rough, torn, or ragged edges removed. Remove all weld flux.
- H. Straighten rolled material, if necessary, before it is laid out for fabrication, in a manner conforming to the mill tolerances specified in ASTM A6/A6M, and by a process and in a manner which will not injure the material. Sharp kinks and bends will be cause for rejection of the material. Heat shrinking of low-alloy structural steel, including ASTM A709/A709M, Grade 50 and ASTM A992/A992M steel, will not be permitted.
- I. Perform shearing, flame cutting, and chipping carefully and accurately so as not to induce residual stress in the metal being cut. The radii of re-entrant gas-cut fillets must be not less than 3/4 inch and as much larger as practicable. Perform flame cutting in such manner that metal being cut is not carrying stress. Cut edges exposed in the finished work must be machine cut, sheared, or flame cut, and ground flush. Mechanically cut edges must be clean cut without torn or ragged edges. All working points must be maintained.
- J. Fabricate bearing stiffeners and stiffeners intended as supports for concentrated loads as indicated. Mill or grind bearing surfaces of these stiffeners.
- K. Bend load-carrying cold-rolled steel plates cold at right angles to the direction of rolling. The radius of bend, measured to the concave face of the metal, must be not less than indicated in the following table, in which T is the thickness of the plate.

Angle Through Which Plate is Bent	Minimum Radius
61 to 120 degrees	1.0 T
121 to 150 degrees	2.0 T

- 1. If a shorter radius is indicated, bend the plate hot. Before bending, round plate edges, where bending occurs, to a radius of 1/16 inch.
- L. Connections must be bolted or welded as indicated.

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M. Bolt Holes:

1. Bolt holes must be one of the following:
 - a. Punched full size
 - b. Drilled full size
 - c. Subpunched and reamed
 - d. Subdrilled and reamed
2. Finished holes for bolts must be cylindrical and perpendicular to the plane of the connection.
3. Finished holes for bolts must be at most 1/16 inch larger than the nominal bolt diameter
4. Finished holes for bolts must be clean cut without torn or ragged edges
5. Finished holes for bolts must be without irregularities that prevent solid seating
6. Holes punched full size, subpunched, or subdrilled must pass a pin 1/8 inch smaller than the nominal hole size without drifting in at least 75 percent of the holes for each connection after assembling and before any reaming.
7. All holes must pass a pin 3/16 inch smaller in diameter than the nominal hole size.
8. Do not correct mispunched or misdrilled holes by welding unless authorized.
9. Holes must be drilled or punched at right angles to the surface of the metal and must not be made or enlarged by burning.
10. The following bolt holes must be drilled. Do not punch or subpunch the following items:
 - a. Holes in base or bearing plates
 - b. Structural steel with yield strength of 36,000 pounds per square inch and thicker than 7/8 inch
 - c. Structural steel with yield strength greater than 36,000 pounds per square inch and thicker than 3/4 inch
11. Punching:
 - a. The diameter of the punching die must not exceed the punch diameter by more than 3/32 inch.
 - b. Subpunch holes to be reamed to a diameter 1/4 inch smaller than the finished hole
12. Drilling:
 - a. Drill full-sized holes with the parts assembled or to a steel template with hardened bushings. If authorized by VTA, you may drill full-sized holes with gang drill equipment.
 - b. The Engineer may request a proof assembly to check the fit of major field connections.
 - c. Subdrill holes to be reamed to a diameter 1/4 inch smaller than the finished hole.
 - d. Drill through templates after the templates have been firmly clamped or bolted.
 - e. If members are drilled while assembled, hold the parts together securely during drilling.
 - f. You may stack drill plates using gang drills if parts are firmly clamped during drilling and drill bits remain perpendicular to the work during drilling.
13. Reaming:
 - a. Perform reaming after built-up members are assembled and firmly bolted together or after templates are securely located over the member. Remove shavings after

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- reaming. Mark pieces reamed together so that they may be reassembled in the same position. Do not interchange reamed parts.
 - b. Reaming templates must have hardened steel bushings.
 - c. Reaming templates must have accurately dimensioned holes and have reference lines for locating templates on members.
 - d. Reaming templates must be firmly clamped or bolted in position.
 - e. Templates used for reaming of matching members or the opposite faces of one member must be exact duplicates.
 - f. For reaming holes in assembled material, do not mix full-sized holes with subpunched or subdrilled holes.

- N. For high-strength bolting, assemble joints and install bolts in accordance with AISC 348. Hardened-face washers must be used for all connections using ASTM F1554, Grade 105 anchor rods. Assembly of joints using load-indicator washers must conform to ASTM F959. High-strength bolting will be inspected by a qualified inspector employed by the Independent Testing Agency.

- O. For items bearing on concrete, provide steel bearing plates and anchors as indicated. Base or bearing plates must be leveled by means of adjustment nuts. Templates must be furnished, together with instructions for setting of anchors, anchor bolts, and bearing plates. Contractor must assure that anchors and related items are properly set in concrete during the progress of the work.

- P. Flatness of Faying and Bearing Surfaces:
 - 1. Surfaces of bearing and base plates and other metal surfaces that contact each other or ground concrete surfaces must be flat to within 1/32 inch in 12 inches and 1/16 inch overall.
 - 2. Surfaces of bearing and base plates and other metal bearing surfaces that contact non-shrink grout, mortar, preformed fabric pads, or elastomeric bearing pads must be flat to within 1/8 inch in 12 inches and 3/16 inch overall.

- Q. Include reinforcing angles, clip angles, plates, punched straps, brackets, and hangers as required to complete the work as indicated.

- R. Provide drainage holes in structural components where water may accumulate without escape.

- S. Fabricate architecturally exposed structural steel members straight within one-half of the standard camber and sweep tolerances permitted by ASTM A6/A6M.

- T. Cut and fabricate steel plates for flanges, eyebars, hanger plates, and splice plates for flanges and eyebars such that the primary direction of rolling is parallel to the direction of the main tensile or compressive stress in the member. All structural steel that is precut before arrival at the fabrication site must be cut so that the primary direction of rolling is parallel to the direction of the main tensile or compressive stress in the member.

- U. Ends of beam stiffeners shown as tight-fit must bear on the beam flange with at least point bearing. Local clearances between the end of the stiffener and the beam flange must be at most 1/16 inch.

- V. Pin Connections:
 - 1. Holes for pins must be true to the diameter specified, at right angles to the member axis, and parallel with each other except for pins where nonparallel holes are required. Holes must be smooth and straight with the final surface produced by a finishing cut.

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2. The distance between holes for pins must not vary by more than 1/32 inch from that shown when measured outside-to-outside for tension members and inside-to-inside for compression members.
 3. The diameter of holes for pins must not exceed the pin diameter by more than 1/50 inch for pins 5 inches or less in diameter or 1/32 inch for larger pins.
 4. Bore holes for pins in built-up members after assembly. If authorized by VTA, holes may be bored before assembly if the same degree of accuracy is achieved as boring after assembly.
 5. Bore pin-connected hanger plates in pairs or in stacks bolted or clamped together such that each pair of hanger plates is matched.
- W. Caulk contact surfaces of stiffeners, railings, built-up members, or open seams more than 6 mils wide with sealing compound or other authorized material. Apply the sealing compound at least 72 hours after the last application of undercoat unless otherwise authorized. Cure the sealing compound under the manufacturer's instructions before performing subsequent painting activities. If no finish coats are applied, the sealing compound color must be gray.
- X. Bent Plates:
1. Cold-bent load-carrying rolled steel plates must comply with the following requirements:
 - a. Direction of bending must be at right angles to the direction of rolling.
 - b. Radius of bend measured to the concave face must comply with Manual of Steel Construction of the AISC.
 - c. Before bending, the corners of the plate must be rounded to a 1/16-inch radius throughout that portion of the plate where bending is to occur.
 2. Plates to be bent to a smaller radius than specified in Manual of Steel Construction of the AISC must be bent hot. Hot bent plates must have the direction of bending at right angles to the direction of rolling.
- Y. Castings:
1. Steel, gray iron, and malleable iron castings must have continuous fillets cast in place in reentrant angles. The radius of curvature of the exposed surface of a fillet will define the fillet size. The size of fillets must be at least one-half the thickness of the thinnest adjoining member but not less than 1/2 inch.
 2. Finished casting dimensions must be at least equal to the dimensions shown. Castings must not be more than 7.5 percent overweight.

2.05 CURVED STRUCTURAL TUBING MEMBERS

- A. The structural tubing members must be curved by a method that will obtain uniform curvature. The structural tubing members must be supported or braced in such a manner that the tendency of the members to deflect laterally during the curving process will not cause the members to overturn.
- B. The bending stress in curved structural tubing members due to bending must not exceed allowable design stress, as specified in AASHTO-CA BDS-6.
- C. Curve structural tubing members before cleaning and painting.
- D. Locate connection plates and stiffeners after curving unless provisions are made for structural tubing member shrinkage. The curving operation for structural tubing members must be conducted before all required welding of attachments are completed.

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- E. Camber structural tubing members before curving. Include allowance for shrinkage due to cutting, welding, and heat curving.
- F. Measure horizontal curvature and vertical camber for final acceptance after welding and heating activities are completed and the members have cooled to a uniform temperature. Check curvature with the members positioned to minimize bending stress by measuring offsets from a string line or wire or other means authorized by the VTA.
- G. Shop assemble structural tubing members in pairs in an upright position. Support members using a similar method and at the same points to be used during field erection. Connect adequate lateral and sway bracing to ensure arch rib and tie beam stability before establishing geometry of field connections.
- H. Base metal and weld metal that is sharply bent or kinked must be rejected and replaced.

2.06 SHOP ASSEMBLY

- A. Prepare and paint contact surfaces of high-strength bolted connections before assembly. Thoroughly clean all other surfaces of metal in contact to bare metal before assembly. Remove all rust, mill scale, and foreign material.
- B. Preassemble completed subassemblies for structures or units of structures before erection to verify geometry and to verify or prepare field connections.
- C. Bolted trusses, skew portals, skew connections, rigid frames, bents, and towers must be completely preassembled, adjusted to line and camber, and prepared for welding or checked for bolt fit before erection.
- D. Preassemble truss work in lengths of at least three abutting panels and adjust members for line and camber. Prepare joints for welding or drill or ream holes for field connections during preassembly. For holes previously drilled full size, check holes for bolt fit.
- E. Preassemble prepared splice joints for welded arch ribs with abutting members and adjust for line and camber.
- F. Preassembly methods must be compatible with the erection methods used.
- G. Preassemble all machinery completely. Fit bearings to the clearances and alignments specified. Gear reductions and line gears must have gear center distances set and the gears match-marked.

2.07 CLEANING AND PAINTING

- A. Interior, Non-Corrosive Applications:
 - 1. After fabrication and immediately before shop painting, structural steel materials must be washed with solvent to remove dust and residue in accordance with SSPC-SP 1.
 - a. Structural steel materials not exposed to the public must be power-tool cleaned in accordance with SSPC-SP 3 to remove mill scale, rust, grease, oil, and any other foreign matter.
 - b. Structural steel materials exposed to public view must be blast cleaned in accordance with SSPC-SP 10 or power-tool cleaned in accordance with SSPC-SP 11 to remove all visible mill scale, rust, grease, oil, and any other foreign matter.

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2. If materials are not painted immediately after cleaning then those materials must be washed with solvent to remove dust and residue in accordance with SSPC SP 1.
 3. After preparation, steel materials must be shop painted in accordance with the requirements specified in Section 09 91 00, Painting.
- B. Exterior Applications:
1. Steelwork to be exposed to weather must be blast cleaned in accordance with SSPC-SP 10, Near White Blast Cleaning, or power-tool cleaned in accordance with SSPC-SP 11, Power Tool Cleaning to Bare Metal. For new steel bridges, cleaning must be in accordance with SSPC-SP 10.
 2. After cleaning, solvent wash in accordance with SSPC-SP 1.
 3. Where steel components are indicated to be painted, steel materials must be shop painted in accordance with the requirements specified in Section 09 91 00, Painting.
 4. Where steel components are indicated to be galvanized, comply with galvanizing requirements of Section 05 50 00, Metal Fabrications.
 - a. Galvanized components must be prepared and painted in accordance with the requirements for cleaning and painting in Section 05 50 00, Metal Fabrication.
- C. Steel Materials to Receive Spray-Applied Fireproofing:
1. Steel materials must be power-tool cleaned in accordance with SSPC-SP 3 to remove mill scale, rust, grease, oil, and any other foreign matter. Welds must thoroughly wire brushed.
 2. After cleaning and just before delivery of steel to the Worksite, steel materials must be washed with solvent to remove dust and residue in accordance with SSPC-SP 1.
 3. Steel materials to receive spray-applied fireproofing must be shop painted with a primer if recommended by the manufacturer of the fireproofing material, and the primer must be approved by the manufacturer of the fireproofing material.

2.08 SOURCE QUALITY CONTROL

- A. The Independent Testing Agency must inspect structural steel at the fabrication site. Notify VTA when materials are delivered to the fabrication site. Allow at least 14 calendar days between giving notice and starting fabrication.
- B. Furnish steel materials to be incorporated into the work with certificates of compliance and certified mill test reports. Mill test reports must indicate where the steel and iron were melted and manufactured.
- C. Check Testing: Structural steel must conform to the designated ASTM Standard and the check testing requirements of this Section.
1. Check samples must be furnished for each heat of maximum thickness of tension flanges and webs of fracture critical members.
 2. The Independent Testing Agency must test check samples for compliance with the requirements specified in ASTM and these Technical Specifications at a laboratory authorized by VTA. Check samples must be delivered to the laboratory performing the check testing at the Contractor's expense. Check sample test results must be reported to the Contractor and VTA within 30 days of delivery to the authorized laboratory. In the event several samples are submitted to the laboratory on the same day, an additional day will be added for every two samples submitted. The test reports must be made for the group of samples.
 3. Furnish plates, shapes, or bars with extra length to provide for removal of check samples.

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4. Take samples from any location within the plate. Mark donor plates with the same identifying numbers as the test samples.
 5. Remove material for test samples in VTA's presence. Test samples for plates over 24 inches wide must be 10 by 12 inches with the long dimension transverse to the direction of rolling. Test samples for other products must be 12 inches long taken in the direction of rolling with a width equal to the product width.
 6. Submit test samples to the laboratory before fabricating into components. Mark samples with the direction of rolling, heat numbers, and plate numbers using paint or indelible marking material. You may steel stamp samples in one corner of the plate instead of marking.
 7. The results of the tensile and impact tests must not vary more than five percent below specified minimum or five percent above specified maximum requirements. If the initial check test results vary more than five percent but not more than 10 percent from the specified requirements, a retest may be performed on another sample from the same heat and thickness. The results of the retest must not vary more than 5 percent from the original specified requirements. If the results of check tests exceed these permissible variations, all material planned for use from the heat represented by said check samples must be subject to rejection.
- D. Rotational Capacity Testing Prior to Shipment to Worksite:
1. Rotational capacity tests must be performed by the Independent Testing Agency on all lots of high-strength fastener assemblies for bolted connections prior to shipment of these lots to the Worksite. Galvanized assemblies must be tested after all fabrication, coating, and lubrication of components has been completed. Use one hardened washer under the nut for testing.
 2. Test each combination of bolt production lot, nut lot, and washer lot as an assembly. Assign a rotational capacity lot number to each combination of lots tested. Mark each shipping unit of fastener assemblies with the rotational capacity lot number.
 3. Test two fastener assemblies from each lot. Both fastener assemblies tested from a rotational capacity lot must pass for the lot to be acceptable.
 4. The Independent Testing Agency must perform rotational capacity tests on and determine acceptance of ASTM F3125/F3125M, Grade A325 fastener assemblies in accordance with Section 55-1.01D(3)(b)(iii), "Rotational Capacity Testing," of the Caltrans Standard Specifications before shipment to the Worksite. The Independent Testing Agency must perform rotational capacity tests on and determine acceptance of ASTM F3125/F3125M, Grade A490 fastener assemblies in accordance with ASTM F3125/F3125M Annex A2 before shipment to the Worksite.
 - a. Fasteners are considered to be long bolts when full nut thread engagement can be achieved when installed in a bolt tension measuring device.
 - b. Fasteners are considered to be short bolts when full nut thread engagement cannot be achieved when installed in a bolt tension measuring device.
- E. The Independent Testing Agency must perform nondestructive testing (NDT) on 100 percent of two pins as follows:
1. Magnetic Particle Testing (MT) in accordance with ASTM A788, S 18, with no linear indication allowed exceeding 3 mm.
 2. Ultrasonic Testing (UT) in accordance with ASTM A788, S 20, level S and level DA in two perpendicular directions.

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PART 3 - EXECUTION

3.01 ERECTION AND INSTALLATION

- A. Reference Standards: Erection and installation of structural steel must conform with the applicable requirements of AISC 303 and ANSI/AISC 360.
- B. Lines and Levels: Structural steel must be installed accurately at established lines and levels. Steel must be plumb and level before bolting is commenced. Installation must be in accordance with accepted Shop Drawings and actual conditions, true and horizontal or perpendicular as the case may be, level and square, with angles and edges parallel with related lines of the building or structure. Finished members must be true to line and free from twists, bends, and open joints.
- C. Temporary Bracing: Temporary bracing must be provided as required and must be kept in position until final completion. Shop fabricated items subject to damage must be braced and carefully handled to prevent distortions or other damage. All items installed before concrete is placed must be properly braced to prevent distortion by pressure of concrete. Bracing must be watched and maintained by the Contractor during concreting operations.
- D. Anchors, Anchor Bolts, Studs, and Fasteners:
1. Shop connections must be welded and field connections bolted, unless indicated otherwise. Use washers under bolt heads and nuts to give full grip when nuts are turned tight. Use beveled washers where bolts bear on sloping surfaces.
 2. Anchors, bolts and washers, inserts, studs, and fasteners as required for the erection, installation, and completion of the work, and other miscellaneous steel or iron fastenings to be installed in forms before concrete placement, or built into concrete, must be provided as indicated at the time scheduled for this work.
 3. Bolts and anchors must be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.
 4. The embedded end of each anchor bolt must terminate with a head or a nut and washer. Anchor bolts must allow true positioning of bearing assemblies.
 5. If anchor bolts are installed in pipe sleeves or metal canisters, fill the pipes or canisters completely with non-shrink grout, as specified in Section 03 62 00, Non-Shrink Grouting.
- E. Base Plates, Bearing Assemblies, and Masonry Plates:
1. Set bearing assemblies level. The Engineer provides adjustments to horizontal positions of bearing assemblies due to temperature. Attain full bearing on the concrete under bearing assemblies.
 2. Immediately before setting bearing assemblies or masonry plates on ground concrete surfaces, thoroughly clean and apply caulking to all contact surfaces.
 3. Bases and plates which require grouting must be supported at the correct level by means of adjustment nuts on anchor bolts or shim plates, unless otherwise shown on the plans.
 4. Bases and plates must be set accurately using a high-strength, non-shrink grout, as specified in Section 03 62 00, Non-Shrink Grouting.
 5. During welding, protect bearings and bearing surfaces using authorized methods.
 6. Grouting and constructing non-shrink grout pads under masonry plates at the Story Station Pedestrian Overcrossing must be done after erection of both the eastern and western spans, after all temporary falsework has been removed, after all spans have been adjusted to final alignment, and before placing deck concrete.
- F. Erection and Assembly:

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1. Erect steel members onto the supporting concrete, such as bents or concrete seats, after the concrete attains a compressive strength of 2,880 pounds per square inch or 80 percent of the specified strength, whichever is greater.
 2. After erection and field assembly, the various members forming parts of the completed structure must be aligned and adjusted accurately before being fastened. Tolerances must conform with the applicable requirements of AISC 303. Follow all match-marks. Do not damage or distort members when hammering.
 3. Fastening of splices of compression members must be performed after the abutting surfaces have been brought into contact. Bearing surfaces and surfaces which will be in permanent contact must be cleaned before the members are assembled. Splices will be permitted only where indicated.
 4. Unless removal is required, erection bolts used in welded construction may be tightened securely and left in place. If erection bolts are removed, the holes must be filled with plug welds and ground smooth. Poor matching of holes must be corrected by drilling to the next larger size and providing the next larger size bolt. Welding for re-drilling will not be permitted.
 5. For moment-resisting joints with flanges or combined flange-reinforcing plates 1-1/2 inches thick or thicker, web bolts must not be tightened past snug-tight until after completion of joint penetration welds.
 6. Neatly finish exposed parts of the work. Slightly round edges and sharp corners, including edges marred, cut, or roughened during handling or erection.
- G. Driftpins: Driftpins may be used only to bring together the several parts or components. Fit-up bolts and driftpins must not be used to bring out-of-tolerance fabricated members and components into alignment. Driftpins must not be used with such force as to distort or damage the material.
- H. Gas Cutting: The use of a gas-cutting torch in the field for correcting fabrication errors will not be permitted.
- I. Bolting:
1. Bolts must be driven accurately into holes without damaging the thread. Bolt heads must be protected from damage during driving. Washers must be placed under all bolt heads and nuts. Bolt heads and nuts must rest squarely against the washers.
 2. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers must be provided to give full bearing to the head or nut. Bolt threads must be upset or spoiled to prevent the nuts from backing off.
 3. Bolts transmitting shear must be threaded to such a length that not more than one thread will be within the grip of the metal.
 4. For all bolts, thread stickout after tensioning must be at least flush with the outer nut face. At least three full threads must be located within the grip of the connection.
 5. You may use one additional hardened washer under the nonturning element to correct excessive thread stickout.
 6. Thread stickout of studs, rods, and anchor bolts must be at least flush with the outer nut face and at most one inch.
 7. Thread stickout is defined as the threaded end of a bolt, stud, rod, anchor bolt, and the like projecting past the outer nut face.
 8. Bolt heads and nuts must be drawn tight against the work with a suitable wrench not less than 15 inches long. Bolt heads must be tapped with a hammer while the nut is being tightened. After having been finally tightened, nuts must be locked by upsetting or spoiling the threads as close as possible to the nut face and to a depth of penetration necessary to deform one or more threads on the bolt.

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J. High-Strength Bolting:

1. Prepare faying surfaces and assemble joints as slip-critical connections in accordance with AISC 348.
 - a. Inorganic zinc-rich primer used on faying surfaces must comply with the slip coefficient specifications for Class B coatings on blast-cleaned steel in appendix A of AISC 348.
2. Tension high-strength bolted connections as slip-critical connections in accordance with AISC 348.
3. Assembly of joints using load-indicator washers must conform to ASTM F959 and the following:
 - a. Install one indicator under each bolt head. The protrusions must contact the bolt head.
 - b. Hold the bolt head stationary and turn the nut.
 - c. Follow the manufacturer's installation procedures.
 - d. Tension bolts in not less than 2 stages until at least 50 percent of the gaps on each indicator are between 0.000 and 0.005 inch. Indicators with all protrusions completely crushed are rejected.
4. Contact surfaces of joints must be free of paint, lacquer, or other friction-reducing coatings.
5. Bolted connections in structural steel joints must be high-strength bolted connections consisting of one of the following:
 - a. High strength steel bolt, hardened hex nut, and hardened washer. You may use a direct tension indicator with the bolt, nut, and hardened washer.
 - b. Tension control bolt, hardened hex nut, and hardened washer.
6. Each length and diameter of fastener assembly used in any single joint of a high-strength bolted connection must be from the same rotational capacity lot. Keep a record of which lots are used in each joint.
7. Use the same bolt head orientation within a single high-strength bolted connection.
8. Install the hardened washer under the element turned in tightening.
9. Except as otherwise indicated, locate nuts on the side of the member not visible from the traveled way. Locate nuts for bolts partially embedded in concrete on the side of the member to be encased in concrete.
10. Seal the sheared ends of tension control bolts with caulking. Caulking must be gray and at least 50 mils thick. Apply caulk to a clean surface the same day the splined end is sheared off.
11. Do not torque the splined end of tension control bolts before final tensioning.
12. If surface moisture is present at a high-strength bolted connection:
 - a. Do not install high-strength fastener assemblies having components furnished with water soluble lubricants.
 - b. The Engineer may require you to perform additional fastener testing if fastener assemblies are furnished with lubricants not soluble in water.

K. Pin Connections:

1. Pins must be straight, smooth, and free from flaws, turned to the dimensions shown, and have the final surface produced by a finishing cut.
2. Coat machined surfaces of pins and holes with an easily removed rust inhibitor.

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3. Use pilot and driving nuts for driving pins. Drive pins such that the members will bear fully on them. For field assembly use a positive locking device to tighten and secure pin nuts.

L. Sliding Joints: Properly clean sliding-joint assembly bearing surfaces and lubricate as required.

M. Staging, fabrication, and erection of structural steel must conform to the approved Construction Staging and Erection Procedure submittal in accordance with Article 1.06G herein.

N. Field Welding: Field welding and welded connections must conform to the requirements of Section 05 05 60, Metal Welding.

3.02 FIELD PAINTING

A. After installation of structural steelwork, abraded areas, field bolts, and welds must be touched up and spot painted with the same corrosion-inhibitive primer as was used for shop painting in accordance with SSPC-PA 1. Field welds must be thoroughly wire-brushed or disc-sanded prior to touch-up painting.

B. Steel to receive spray-applied fireproofing must not be touch-up painted.

C. Final field painting of exposed structural steel is specified in Section 09 91 00, Painting.

3.03 FIELD QUALITY CONTROL

A. The Independent Testing Agency must perform the following inspections and testing:

1. Inspections and tests of field welding in accordance with Section 05 05 60, Metal Welding.

2. Inspection of items embedded in concrete must be performed prior to any concrete placement.

3. Installation Tension Testing and Rotational Capacity Testing After Arrival on Worksite:

a. Installation tension tests and rotational capacity tests must be performed by the Independent Testing Agency on high-strength fastener assemblies after the arrival of the fastener assemblies on the project Worksite and prior to acceptance or installation. Installation tension tests and rotational capacity tests must be performed at the Worksite, in the presence of the Engineer, on each rotational capacity lot of fastener assemblies before installation.

b. VTA will reject uninstalled fasteners in the same rotational capacity lot as fasteners that fail a Worksite installation tension test or rotational capacity test.

c. The Independent Testing Agency must perform additional rotational capacity tests, installation tension tests, and tests to determine new inspection torques on rotational capacity lots if any of the following occur:

1) Any fastener is not used within three months after arrival on the Worksite.

2) Fasteners are improperly handled, stored, or subjected to inclement weather before final tightening.

3) Changes are noted in the original surface condition of threads, washers, or nut lubricant.

4) Required inspections are not performed within 48 hours after all fasteners in a joint have been tensioned.

d. The rotational capacity tests must be performed in conformance with the requirements for rotational capacity tests in Article 2.05B, "Rotational Capacity Testing Prior to Shipment to Worksite," herein.

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- e. If the bolt head is the turned element during installation, perform installation tension testing and verification tension testing, including determining inspection torque, by turning the bolt head.
- f. Installation Tension Testing:
 - 1) The Independent Testing Agency must test three representative high-strength fastener assemblies in accordance with section 8 of AISC 348. For short bolts, test three representative high-strength fastener assemblies in accordance with "Pre-Installation Verification Procedures" of Structural Bolting Handbook of the Steel Structures Technology Center.
 - 2) If using direct tension indicators, the Independent Testing Agency must perform installation verification tests in accordance with appendix X1 of ASTM F959 except that bolts must be initially tensioned to a value 5 percent greater than the minimum required bolt tension.
- g. Verification Tension Testing:
 - 1) The Independent Testing Agency must perform fastener tension testing to verify minimum tension in high-strength bolted connections no later than 48 hours after all fasteners in a connection have been tensioned.
 - 2) The Independent Testing Agency must select fasteners to be tested. The Independent Testing Agency must perform testing such that the Engineer can read the torque wrench or access direct tension indicator gaps during testing.
 - 3) Test 10 percent of each type of fastener assembly in each high-strength bolted connection for minimum tension using the procedure described in section 10 of AISC 348. Check at least two assemblies per connection. For short bolts, determine the inspection torque using steps 1 through 7 of "Arbitration of Disputes, Torque Method-Short Bolts" in Structural Bolting Handbook of the Steel Structures Technology Center.
 - 4) The Independent Testing Agency must determine and use a separate inspecting torque for each different rotational capacity lot of fasteners.

END OF SECTION 05 12 35

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SECTION 05 17 00

MISCELLANEOUS METAL

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Miscellaneous metal (bridge)
 2. Miscellaneous metal (restrainers)
 3. Miscellaneous metal (pedestrian overcrossing)
 4. Miscellaneous metal (station)
 5. Miscellaneous metal (access structure)
 6. Miscellaneous metal (bridge) (TES pole anchorage units)
 7. Miscellaneous metal (bridge) (miscellaneous pole anchorage)

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 05 05 60, Metal Welding
- D. Section 05 12 35, Structural Steel
- E. Section 05 30 00, Metal Decking
- F. Section 05 50 00, Metal Fabrications
- G. Section 05 52 00, Metal Railings (Stations)
- H. Section 05 52 01, Metal Railing (Bridge)
- I. Section 07 95 60, Bridge PTFE Spherical Bearings
- J. Section 09 91 00, Painting
- K. Section 10 73 16, Canopies

1.03 REFERENCED STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)
1. AASHTO M 105 Standard Specification for Gray Iron Castings
 2. AASHTO M 180 Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail

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3. AASHTO M 306 Standard Specification for Drainage, Sewer, Utility, and Related Castings
- B. American Institute of Steel Construction (AISC):
1. AISC 303 Code of Standard Practice for Steel Buildings and Bridges
- C. American Iron and Steel Institute (AISI):
1. AISI C-1035 Steel Bars, Forgings, and Tubing 0.31 - 0.38C
- D. American Society of Mechanical Engineers (ASME):
1. ASME B1.1 Unified Inch Screw Threads, UN and UNR Thread Form
2. ASME B1.13M Metric Screw Threads: M Profile
3. ASME B18.22M Metric Plain Washers
- E. ASTM International (ASTM):
1. ASTM A27/A27M Specification for Steel Castings, Carbon, for General Application
2. ASTM A36/A36M Specification for Carbon Structural Steel
3. ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings
4. ASTM A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
5. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
6. ASTM A153/A153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
7. ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
8. ASTM A276/A276M Standard Specification for Stainless Steel Bars and Shapes
9. ASTM A307 Specification For Carbon Steel Bolts, and Studs, 60,000 psi Tensile Strength
10. ASTM A449 Specification for Quenched and Tempered Steel Bolts and Studs
11. ASTM A536 Standard Specification for Ductile Iron Castings
12. ASTM A563 Specification for Carbon and Alloy Steel Nuts
13. ASTM A575 Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
14. ASTM A576 Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
15. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
16. ASTM A684/A684M Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled
17. ASTM A722/A722M Standard Specification for High-Strength Steel Bars for Prestressed Concrete
18. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
19. ASTM C920 Standard Specification for Elastomeric Joint Sealants

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|-----|-------------------|--|
| 20. | ASTM D1785 | Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| 21. | ASTM D2996 | Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe |
| 22. | ASTM D4417 | Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel |
| 23. | ASTM F436/F436M | Specification for Hardened Steel Washers |
| 24. | ASTM F593 | Standard Specification for Stainless Steel Bolts, Hex Cap screws, and Studs |
| 25. | ASTM F594 | Standard Specification for Stainless Steel Nuts |
| 26. | ASTM F836M | Standard Specification for Style 1 Stainless Steel Metric Nuts (Metric) |
| 27. | ASTM F844 | Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use |
| 28. | ASTM F959 | Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners |
| 29. | ASTM F1554 | Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength |
| 30. | ASTM F3125/F3125M | Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength |
| 31. | ASTM G154 | Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials |
- F. American Welding Society (AWS):
- | | | |
|----|----------------|--|
| 1. | AWS D1.1/D1.1M | Structural Welding Code – Steel (2015) |
|----|----------------|--|
- G. State of California Department of Transportation (Caltrans):
- | | | |
|----|---------------------|--|
| 1. | California Test 681 | Method of Testing Creep Performance of Concrete Anchorage Device |
| 2. | California Test 682 | Method for Determining Ultimate Tensile Strength of Concrete Anchorage Devices |
- H. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:
- | | | |
|----|------------|---------------------------|
| 1. | Section 55 | Steel Structures |
| 2. | Section 59 | Structural Steel Coatings |
| 3. | Section 60 | Existing Structures |
| 4. | Section 75 | Miscellaneous Metal |
| 5. | Section 95 | Epoxy |
- I. Steel Structures Painting Council (SSPC):
- | | | |
|----|-----------|--|
| 1. | SSPC-AB 1 | Mineral and Slag Abrasives |
| 2. | SSPC-AB 2 | Cleanliness of Recycled Ferrous Metallic Abrasives |
| 3. | SSPC-AB 3 | Ferrous Metal Abrasive |
| 4. | SSPC-SP 2 | Hand Tool Cleaning |
| 5. | SSPC-SP 6 | Commercial Blast Cleaning |
| 6. | SSPC-PA 1 | Shop, Field, and Maintenance Painting |
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1.04 REGULATORY REQUIREMENTS

- A. The regulatory requirements which govern the work of this Section include the following governing code:
1. California Code of Regulations (CCR), Title 24, Part 2, 2019 California Building Code, Chapter 22, “Steel”, and State Chapter 22A, “Steel”.

1.05 DESCRIPTION

- A. Miscellaneous Metal: Miscellaneous metal includes, but is not necessarily limited to, the following items of work:
1. Steel and cast steel portions of bearing plates, bars, rockers, assemblies, and other expansion or fixed bearing devices in concrete structures, except bridge PTFE spherical bearings. Refer to Section 07 95 60, Bridge PTFE Spherical Bearings, for requirements for bridge PTFE spherical bearings.
 - a. Base plates and masonry plates at Story Station Pedestrian Overcrossing must not be considered miscellaneous metal. Refer to Section 05 12 35, Structural Steel, for requirements for base plates and masonry plates at Story Station Pedestrian Overcrossing.
 2. Equalizing bolts and expansion joint armor in concrete structures
 3. Expansion joint armor in steel structures
 4. Manhole frames and covers, frames and grates, ladder rungs, guard posts, and access door assemblies
 5. Bridge deck drainage system, including piping, flumes, expansion couplings, pipe hangers, couplings, and connections for the Capitol Aerial Guideway and Story Station Pedestrian Overcrossing
 6. Deck drains, area drains, retaining wall drains, and drainage piping not included in bridge deck drainage system
 7. Bridge joint restrainers and associated components
 8. Steel sheet covers at soffit access openings
 9. Steel checker plate cover assemblies at the Capitol Story Aerial Guideway
 10. Wire mesh at soffit vents
 11. Removable steel stairs, including stair railings at Story Station Platform
 12. Metal pole anchorage assemblies embedded in cast-in-place concrete that is part of the Capitol Aerial Guideway and Guideway Approach Walls
 13. Platform edge angles on Eastridge Station platform and Story Station platform
 14. Elevator tower guide rail supports, embeds, and angles
 15. Ledger angle and anchor bolts at elevator tower roof
 16. Traction electrification system guy anchor assemblies
 17. IDS poles, including base plates, access hole cover plates, and associated connections, at the Capitol Aerial Guideway and guideway Approach Walls
- B. Miscellaneous Metal (Bridge) consists of miscellaneous metal items that are part of the Capitol Aerial Guideway, except the various types of miscellaneous metal described in items C through E below.
- C. Miscellaneous Metal (Restrainers) consists of restrainer units and associated component parts as described herein that are part of the Capitol Aerial Guideway. Restrainer units and associated component parts includes, but is not necessarily limited to, the following items of work:

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1. Cables
 2. Swaged fittings
 3. Studs
 4. Nuts
 5. Cable yield indicators
 6. Disc springs
 7. Elastomeric bearing pads
 8. Bearing plates
- D. Miscellaneous Metal (Bridge) (TES Pole Anchorage Units) consists of anchorage assembly units at TES pole on the Capitol Aerial Guideway.
- E. Miscellaneous Metal (Bridge) (Miscellaneous Pole Anchorage) consists of anchorage assemblies other than those for TES poles and canopy poles on the Capitol Aerial Guideway and Guideway Approach Walls, including, but not necessarily limited to, anchorage assemblies for LRT signal poles, light poles, and IDS poles.
- F. Miscellaneous Metal (Pedestrian Overcrossing) consists of miscellaneous metal items that are part of the Story Station Pedestrian Overcrossing.
- G. Miscellaneous Metal (Station) consists of miscellaneous metal items that are part of Eastridge Station.
- H. Miscellaneous Metal (Access Structure) consists of miscellaneous metal items that are part of Story Station Access Structures.

1.06 SUBMITTALS

- A. General: Submittals for miscellaneous metal must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Mill Test Reports:
1. Submit two certified copies of mill test reports for each manufactured length of bridge joint restrainer cable.
 2. Submit two certified copies of the mill test and heat treating reports for each heat of bars used for cable yield indicators of bridge joint restrainers.
- C. Certificates:
1. Submit a certificate of compliance for anchorage devices.
 2. Submit a work plan for placing the nonskid surface showing application method, spread rate of epoxy and grit, and number of coats.
 3. Bridge Deck Drainage System:
 - a. Submit certificate of compliance for fiberglass pipe and fittings. Include laboratory test results.
- D. Samples:
1. Bridge Joint Restrainers: Submit the following materials at the manufacturer's plant. Items to be submitted at the manufacturer's plant must be submitted with all manufacturer's plant-applied coatings

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- a. One cable-type restrainer test sample for each 200 restrainers or fraction thereof produced. The sample restrainer must consist of a cable fitted with a swaged fitting and right hand thread stud at both ends, and must be three feet in total length
- b. One turnbuckle fitted with an 8-inch stud at each end for each 200 turnbuckles or fraction thereof.
- c. Greater of one percent or eight of the cable yield indicators produced from each mill heat.
- d. Two disc springs of each size produced from each mill heat.

1.07 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
 1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
- D. VTA Quality Assurance:
 1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.
- E. Fabricator's Shop or Facility: Fabricator's shop or facility may be inspected and must be approved by VTA before the start of fabrication work. Notify VTA in writing at least 14 calendar days before the scheduled start of fabrication work. Fabrication of miscellaneous metalwork must be performed by an approved fabricator at an approved facility.

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- F. Qualifications of Welders and Welding Procedures: Refer to Section 05 05 60, Metal Welding, for requirements.
- G. Indicated Dimensions: Unless otherwise indicated, dimensions at expansion joints and similar construction were determined for a temperature of 50 degrees Fahrenheit. Make proper adjustments for temperature when the structure is to be fabricated and installed at any other temperature.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Avoid bending, scraping, and overstressing the steelwork. Block with wood, or otherwise protect, projecting parts which may be bent or damaged.
- B. Mark weight and piece (mark) number, corresponding to shop erection sequence drawing, on all members. Match-mark all shop pre-fitted members. Use low-stress stamps for fracture critical members and tension members.
- C. Ship small parts, such as bolts, nuts, washers, pins, fillers, clips, and small connecting plates and anchors, in boxes, crates, or barrels. Pack separately each length and diameter of bolt and each size of nut and washer. Plainly mark an itemized list and description of the contents on the outside of each container.
- D. Load, transport, unload, and store structural steel materials in such a manner that the metal is kept clean and free from injury. Store materials above ground on platforms, skids, or other supports, and cover and protect from corrosion.
- E. Handle and store beams and girders in such a manner that they will have the required camber after erection.
- F. Identify each lot of fabricated steel to be shipped to the Worksite by assigning an individual lot number that identifies steel by heat number and tag in such a manner that each such lot can be accurately identified at the Worksite.
- G. Remove all unidentified structural steel, miscellaneous metal and anchorage assemblies received at the Worksite.

1.09 MEASUREMENT AND PAYMENT

- A. Measurement:
 - 1. Miscellaneous Metal (Bridge) must be measured by the pound.
 - 2. Miscellaneous Metal (Restrainers) must be measured by the pound. The weights of nonmetallic materials used in constructing restrainer units and component parts must not be included.
 - 3. Miscellaneous Metal (Bridge) (TES Pole Anchorage Units) must be measured by the individual unit (each).
 - 4. Miscellaneous Metal (Bridge) (Miscellaneous Pole Anchorage) must be measured by the pound.
 - 5. Miscellaneous Metal (Pedestrian Overcrossing) must be measured by the pound.
 - 6. Miscellaneous Metal (Station) must be measured by the pound.
 - 7. Miscellaneous Metal (Access Structure) must be measured by the pound.
 - 8. Weights must be determined from scale weighings.
 - 9. The payment quantity for miscellaneous metal must not include the weight of epoxy and grit for a nonskid surface

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10. IDS poles, including base plates, access hole cover plates, and associated connections at the Guideway Approach Walls must be measured as Miscellaneous Metal (Bridge).
11. Guy anchor bracket assemblies on Capitol Aerial Guideway must be measured as Miscellaneous Metal (Bridge).
12. LRT signal pole anchorages and IDS pole anchorages at the Guideway Approach Walls must be measured as Miscellaneous Metal (Bridge) (Miscellaneous Pole Anchorage).

B. Payment:

1. The contract price paid per pound for Miscellaneous Metal (Bridge) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Miscellaneous Metal (Bridge) complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
2. The contract price paid per pound for Miscellaneous Metal (Restrainers) must include full compensation for furnishing all labor, materials (including non-metallic materials for restrainer units), tools, equipment and incidentals, and for doing all Work involved in constructing Miscellaneous Metal (Restrainers) complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
3. The contract price paid per pound for Miscellaneous Metal (Pedestrian Overcrossing) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Miscellaneous Metal (Pedestrian Overcrossing) complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
4. The contract price paid per pound for Miscellaneous Metal (Station) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Miscellaneous Metal (Station) complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
5. The contract price paid per pound for Miscellaneous Metal (Access Structure) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Miscellaneous Metal (Access Structure) complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
6. The contract price paid per individual unit (each) for Miscellaneous Metal (Bridge) (TES Pole Anchorage Units) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Miscellaneous Metal (Bridge) (TES Pole Anchorage Units) complete in place, including spare nuts and washers, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
7. The contract price paid per pound for Miscellaneous Metal (Bridge) (Miscellaneous Pole Anchorage) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Miscellaneous Metal (Bridge) (Miscellaneous Pole Anchorage) complete in place, including anchor bolts, anchor plates, nuts, and washers, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.

- C. Full compensation for furnishing and applying thread locking system must be considered as included in the prices paid for the various contract item of work requiring the system and no additional compensation will be allowed therefor.**

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- D. Full compensation for furnishing and installing nonmetallic materials for restrainer units and associated component parts must be considered as included in the bid item for Miscellaneous Metal (Restrainers) and no additional compensation will be allowed therefor.
- E. Full compensation for furnishing and constructing miscellaneous metal that is part of TVM and shelter canopies, as shown on the drawings, must be considered as included in the bid items for the various canopies and no additional compensation will be allowed therefor. Attention is directed to Section 10 73 16, Canopies, for measurement and payment.
- F. Full compensation for furnishing and installing metal decking and stud connectors used with metal decking must be considered as included in the bid item for Metal Decking and no additional compensation will be allowed therefor. Attention is directed to Section 05 30 00, Metal Decking, for measurement and payment for metal decking at Story Station Pedestrian Overcrossing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel Bars, Plates, and Shapes: ASTM A36/A36M, ASTM A575, or ASTM A576 (AISI or M Grades 1016–1030).
- B. Steel fastener components for general applications:
 - 1. Bolts and studs: ASTM A307
 - 2. Anchor bolts and anchor rods: ASTM F1554, Grade 36, Class 2A, or Grade 55, weldable steel, Class 2A. Hardened washers must be used.
 - 3. High-strength bolts and studs: ASTM A449, Type 1. Hardened washers must be used.
 - 4. High-strength threaded rods: ASTM A449, Type 1. Hardened washers must be used.
 - 5. High-strength anchor rods and high-strength anchor bolts: ASTM F1554, Grade 105, Class 2A. Hardened washers must be used.
 - a. High-strength anchor rods and anchor bolts must not be galvanized.
 - b. Do not use a cleaning process that introduces hydrogen into the steel.
 - 6. Nuts: ASTM A563, including appendix X1. Zinc-coated nuts tightened beyond snug or wrench tight must be furnished with a dry lubricant complying with supplementary requirement S2 in ASTM A563.
 - 7. Washers: ASTM F844
 - 8. Hardened washers: ASTM F436, Type 1, including S1 supplementary requirements.
- C. Components of high strength steel fastener assemblies for use in high strength joints:
 - 1. Bolts: ASTM F3125/F3125M, Grade A325, Type 1
 - 2. Tension Control Bolts: ASTM F3125/F3125M, Grade F1852, Type 1
 - 3. Nuts: ASTM A563, including appendix X1b. Zinc-coated nuts tightened beyond snug or wrench tight must be furnished with a dry lubricant complying with supplementary requirement S2 in ASTM A563.
 - 4. Hardened Washers: ASTM F436, Type 1, Circular, including S1 supplementary requirements
 - 5. Direct Tension Indicators: ASTM F959, Type 325, zinc-coated
- D. Stainless Steel Fasteners, Alloys 304 and 316, for general applications:

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1. Bolts, screws, studs, threaded rods, and non-headed anchor bolts: ASTM F593
 2. Nuts: ASTM F594 or F836M
 3. Washers: ASTM A240/A240M and ASME B18.22M
- E. Gray iron castings:
1. Inside a roadbed: AASHTO M 306
 2. Outside a roadbed: AASHTO M 306 except only AASHTO M 105, Class 35B is allowed.
- F. Ductile iron castings: ASTM A536, Grade 80-55-06
- G. Carbon-steel castings: ASTM A27/A27M, Grade 65-35, Class 1
- H. Malleable iron castings: ASTM A47/A47M, Grade 32510
- I. Cast iron pipe: Commercial quality
- J. Steel pipe: Commercial quality, welded or extruded
- K. Other parts for general applications: Commercial quality
- L. Sealing compound for caulking and adhesive sealing must be polysulfide or polyurethane complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
- M. Mortar placed under miscellaneous metal masonry plates or bearing assemblies, or in miscellaneous metal anchor bolt sleeves or canisters:
1. Mortar must be composed of cement, sand, and water.
 2. Materials for mortar must comply with section 03 05 15, Portland Cement Concrete.
 3. The proportion of sand to cement measured by volume must be three to one.
 4. Mortar must contain only enough water to allow placing and packing.
 5. Sand particles must be no larger than 1/2 the size of the recess or space in which the mortar is to be placed.
- N. Non-Shrink Grout: Refer to Section 03 62 00, Non-Shrink Grouting, for requirements.

2.02 MISCELLANEOUS METAL COMPONENTS

- A. Fabricate the following parts from the corresponding materials shown:
1. Bearing assemblies: ASTM A36/A36M
 2. Access opening covers: Commercial-quality sheet steel
 3. Access doors: Galvanized sheet steel complying with ASTM A653/A653M, Coating Designation G210 [Z600]
 4. Springs for deck drain grating latches: Commercial-quality, stainless steel spring wire containing a nominal composition of 18 percent chromium and 8 percent nickel
 5. Pipe bends: Commercial-quality tube bends or fabricated bends of equal smoothness. Do not use miter-joint bends
 6. Metal parts of anchorage devices except iron castings for cast-in-place inserts: Steel or stainless steel
 7. Iron castings for cast-in-place inserts: Malleable iron or ductile iron

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- B. Fabricate expansion joint armor from steel plates, angles, or other structural shapes. Shape the armor to the section of the concrete deck and match-mark it in the shop.
- C. Transition Fittings:
1. Transition fittings between pipes of different diameters must be smooth and uniform, without sags, projections, or offsets
 2. Transition fittings between pipes of different diameters must be at least 4 inches in length for each 1-inch reduction in pipe diameter.
- D. Bridge Joint Restrainers:
1. Bridge joint restrainers consist of cables, swaged fittings, studs, nuts, cable yield indicators, disc springs, PVC pipe, elastomeric bearing pads, and bearing plates.
 2. Cables: Cables must be galvanized, 3/4-inch preformed, 6 by 19, wire strand core or independent wire rope core, complying with Federal Specification RR-W-410, right regular lay, manufactured of improved plow steel with a minimum breaking strength of 23 tons.
 3. Swaged Fittings: Swaged fittings must be machined from hot-rolled steel bars complying with AISI C-1035.
 - a. Each swaged fitting must be annealed, suitable for cold swaging.
 - b. Each swaged fitting must have a hole drilled through the head to accommodate the locking pin.
 - c. Each swaged fitting must have the manufacturer's identifying mark stamped on the body.
 4. Locking Pins: The locking pin must be a 1/4-inch-diameter, zinc-plated steel spring pin. The pin must keep the stud in proper position.
 5. Studs: Each stud must comply with ASTM A449 after galvanizing. Before galvanizing, mill a 3/8-inch slot for the locking pin in the stud end.
 6. Nuts must comply with ASTM A563, including appendix X1, except lubrication is not required.
 7. Cable Yield Indicators: Each cable yield indicator must be machined from hot-rolled steel bars complying with AISI C-1035.
 - a. Each cable yield indicator must be annealed, suitable for cold swaging.
 - b. Each cable yield indicator must have the heat number and manufacturer's identifying mark stamped on the end surface.
 8. Disc Springs: Disc springs must be made from steel complying with ASTM A684/A684M, Grade 1075.
 9. Steel parts must comply with ASTM A36/A36M or A576, Grade 1030 (AISI 1030) and must not be rimmed or capped steel.
 10. Pipe sleeves must be commercial-quality welded steel pipe.
 11. Elastomeric bearing pads must comply with Section 03 15 15, Elastomeric Bearing Pads, except pads may consist of only elastomer and laminated reinforcement is not required.
 12. PVC pipe must be commercial quality.
 13. Expanded Polystyrene and Hardboard: Refer to Section 07 95 50, Bridge Joint Seals and Assemblies, for requirements.
- E. Bolted and Threaded Bar Connections:

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1. High strength bolted connections must comply with the fabrication, erection and installation, and quality control requirements for high strength steel fasteners and bolted connections, as specified in Section 05 12 35, Structural Steel.
2. Equalizing bolts must be bolts or threaded bars. Threaded bars shown as prestressing steel must comply with the specifications for plain bars in ASTM A722/A722M, including supplementary requirements.
 - a. Nuts must be capable of holding the prestressing steel at a force producing a stress of at least 95 percent of the specified ultimate tensile strength of the steel.
 - b. Nuts must permanently secure the ends of the prestressing steel.
3. Abrasives Used for Blast Cleaning:
 - a. Abrasives used for blast cleaning must be of a grading suitable to produce satisfactory results. Unless other abrasives are authorized, use only the following abrasives:
 - 1) Clean dry sand. Do not use unwashed beach sand containing salt or excessive silt.
 - 2) Mineral grit.
 - 3) Steel shot.
 - 4) Steel grit.
 - 5) Manufactured abrasives
 - b. Mineral, manufactured, and slag abrasives must comply with the requirements for Class A, Grade 2 to 3 abrasives in SSPC-AB 1 and must not contain hazardous material.
 - c. Steel abrasive must comply with SSPC-AB 3. Recycled steel abrasive must comply with SSPC-AB 2.
4. Thread-locking systems must consist of a cleaner, primer, and anaerobic thread-locking adhesive, and must be on Caltrans's Authorized Material List for anaerobic thread-locking systems. Apply all components of the system under the manufacturer's instructions.

F. Anchorage Devices:

1. General:
 - a. Concrete anchorage devices must be on the Caltrans Authorized Material List for stud mechanical expansion anchors, shell-type mechanical expansion anchors, resin capsule anchors, or cast-in-place inserts.
 - b. Concrete anchorage devices must be mechanical expansion anchors or resin capsule anchors installed in drilled holes or must be cast-in-place concrete inserts.
 - c. An anchorage device must be a complete system, including threaded studs, hex nuts, and cut washers. Thread dimensions for externally threaded anchorage devices before zinc coating must comply with ASME B1.1 having Class 2A tolerances or ASME B1.13M having Grade 6g tolerances. Thread dimensions for internally threaded concrete anchorage devices must comply with ASTM A563.
 - d. Except for mechanical expansion anchors and iron castings for cast-in-place inserts, metal parts of anchorage devices must be hot-dip or mechanically galvanized.
2. Mechanical Expansion Anchors:

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- a. Mechanical expansion anchors must be either of the following:
 - 1) Hot-dip or mechanically galvanized
 - 2) Made from stainless steel
 - 3) Coated with electrodeposited zinc complying with ASTM B633
- b. Mechanical expansion anchors must be the integral stud type or the shell type with internal threads and an independent stud. Do not use self-drilling mechanical expansion anchors.
- c. When tested under California Test 681, mechanical expansion anchors must withstand the application of a sustained tension test load of at least the values shown in the following table for at least 48 hours with a movement of at most 0.035 inch:

Mechanical Expansion Anchor Sustained Tension Test Load

Stud diameter (inches)	Sustained tension test load (pounds)
3/4 (See Note A)	5,000
5/8	4,100
1/2	3,200
3/8	2,100
1/4	1,000

Note A: Maximum stud diameter allowed for mechanical expansion anchors

- 3. Resin Capsule Anchors:
 - a. When tested under California Test 681, resin capsule anchors must withstand the application of a sustained tension test load of at least the values shown in the following table for at least 48 hours with a movement of at most 0.010 inch:

Resin Capsule Anchor Sustained Tension Test Load

Stud diameter (inches)	Sustained tension test load (pounds)
1-1/4	31,000
1	17,900
7/8	14,400
3/4	5,000
5/8	4,100
1/2	3,200
3/8	2,100
1/4	1,000

- 4. Cast-in-Place Concrete Inserts:
 - a. Cast-in-place concrete inserts must be ferrule loop or cast iron.
 - b. Iron castings for cast-in-place inserts must be mechanically galvanized.
 - c. When tested under California Test 682, cast-in-place inserts must withstand the minimum ultimate test loads shown in the following table:

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Cast-in-Place Insert Ultimate Tension Test Load

Stud diameter (inches)	Ultimate tensile load (pounds)
1-1/4	25,000
1-1/8	19,800
1	16,000
7/8	11,600
3/4	7,200
5/8	6,600
1/2	4,200

G. Bridge Deck Drainage System:

1. Pipe Connections and Joints:

a. Self-tapping screws for sleeve connections must:

- 1) Be stainless steel with hex-heads
- 2) Be installed in holes drilled to fit the screws
- 3) Comply with ASTM A276, Type 304, for a project in a non-freeze-thaw area
- 4) Comply with ASTM A276, Type 316, for a project in a freeze-thaw area

b. Drain pipe joints must be watertight, smooth, and free from projections or offsets over 1/16 inch on the inside. Mechanical couplings in piping must be gasketed short-sleeve type consisting of:

- 1) Mild steel middle ring with pipe stop
- 2) Two rubber compound wedge section ring gaskets
- 3) Two mild steel follower rings
- 4) Mild steel bolts to compress the gaskets

2. Fiberglass Pipes and Fittings:

a. You may use fiberglass pipes and fittings with the same diameters and minimum bend radii as shown instead of welded pipe.

b. Fiberglass pipe and fittings must:

- 1) Comply with ASTM D2996
- 2) Have a minimum short-term rupture strength of 30,000 psi

c. For joining pipe and fittings, use the adhesive type recommended by the manufacturer.

d. Fiberglass pipe not enclosed in a box girder cell or encased in concrete must be made from UV-resistant resin pigmented with concrete-gray color or be coated with a concrete-gray resin-rich exterior coating. Do not use paint.

e. Fiberglass pipe with UV protection must withstand at least 2,500 hours of accelerated weathering when tested under ASTM G154 with UVB-313 lamps. The resting cycle must be 4 hours of UV exposure at 140 degrees Fahrenheit and then 4 hours of condensate exposure at 120 degrees Fahrenheit. After testing, the pipe

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surface must show no fiber exposure, crazing, or checking and only slight chalking or color change.

3. PVC Pipes and Fittings:
 - a. For drainage pipe NPS 8 or smaller encased in concrete or enclosed in a box girder cell and exposed for at most 20 feet within the cell, you may use PVC pipe and fittings with the same diameters and minimum bend radii shown instead of welded pipe.
 - b. PVC pipe and fittings must be schedule 40, complying with ASTM D1785.

H. Nonskid Surface:

1. Epoxy must comply with Section 95-1.02C, Section 95-1.02D, or Section 95-1.02G of the Caltrans Standard Specifications.
2. Grit:
 - a. Grit must be commercial-quality aluminum oxide, silicon carbide, or almandite garnet grit particles
 - b. Grit must be screen size no. 12–30 or no. 14–35
 - c. Grit must be applied uniformly at a rate of at least 0.3 pounds per square foot of surface area.

I. Frames, Grates, and Covers: Fabricate the following parts from the corresponding materials shown:

1. Raised pattern plates must be commercial quality.
2. Grates: Grates must be produced from one of the following:
 - a. Structural steel complying with either of the following:
 - 1) ASTM A36/A36M
 - 2) ASTM A576, Grades 1021, 1022, 1026, 1029, or 1030
 - b. Ductile iron castings
 - c. Carbon-steel castings
3. Manhole frames and covers must comply with AASHTO M 306.
4. Galvanize cast iron manhole frames and covers for sidewalks after fabrication and before assembling component parts. Coat other cast iron items with commercial-quality asphalt except machined surfaces of manhole frames and covers for decks.
5. Drainage inlet frames and grates except those on bridges need not be galvanized or coated with asphalt.
6. Match-mark frames and grates and frames and covers in pairs before delivery to the Worksite. Grates and covers must fit into their frames without rocking.

2.03 FABRICATION

- A. Cutting, drilling, punching, and welding must be neatly performed with burrs and rough edges removed. Remove all weld flux, burrs, rough and sharp edges, and other flaws.
- B. Straighten warped pieces after fabricating and galvanizing in a manner which will not injure the material.

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- C. Welding and welded connections must conform with the requirements of Section 05 05 60, Metal Welding.
- D. Miscellaneous metal must be prefabricated and preassembled in the factory or shop as far as practicable.
- E. Form and fabricate the work to meet installation conditions. Include accessories to adequately secure the work in place.
- F. Holes must be drilled or punched at right angles to the surface of the metal and must not be made or enlarged by burning. Holes in base or bearing plates, Grade 36 structural steel thicker than 7/8 inch, and high-strength structural steel thicker than 3/4 inch must be drilled. Holes must be provided in members to permit connecting the work of other trades. Holes for bolts must be punched or drilled at most 1/16 inch larger than the nominal diameter of the bolt.
- G. For items bearing on concrete, provide steel bearing plates and anchors as indicated. Base or bearing plates must be leveled by means of adjustment nuts. Templates must be furnished, together with instructions for setting of anchors, anchor bolts, and bearing plates. Contractor must assure that anchors and related items are properly set in concrete during the progress of the work.
- H. Fabricate metal bearing surfaces which will come in contact with preformed elastomeric bearing pads or grout, flat to within 1/8 inch tolerance in 12 inches and to within 3/16 inch overall. Fabricate surfaces of bearing and base plates and other metal surfaces that contact each other or ground concrete surfaces flat to within 1/32 inch in 12 inches and 1/16 inch overall.
- I. Include reinforcing angles, clip angles, plates, punched straps, brackets, and hangers as required to complete the work as indicated.
- J. Provide drainage holes in structural components where water may accumulate without escape.
- K. Castings:
 - 1. Steel, gray iron, and malleable iron castings must have continuous fillets cast in place in reentrant angles. The radius of curvature of the exposed surface of a fillet will define the fillet size. The size of fillets must be at least one-half the thickness of the thinnest adjoining member but not less than 1/2 inch.
 - 2. Finished casting dimensions must be at least equal to the dimensions shown. Castings must not be more than 7.5 percent overweight.
- L. Bridge Joint Restrainers:
 - 1. You are responsible for determining the required lengths of cable-type restrainers.
 - 2. Each swaged fitting, turnbuckle, stud, and nut assembly must develop the specified breaking strength of the cable.
 - 3. Machine the wall of the reduced section of the cable yield indicator such that the indicator yields at a load of from 36,000 to 38,000 pounds when tested in compression along the major axis at a test speed of at most 1/2 inch per minute.
 - 4. Clean and paint disc springs the described color using a paint recommended by the manufacturer of the disc springs. Disc springs do not need to be galvanized.
 - 5. The minimum size of fillet welds must comply with AWS D1.1/D1.1M except as follows:

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Minimum Fillet Weld Sizes	
Base metal thickness of thicker part joined (inches)	Minimum size of fillet weld (inches) (See Note A)
Over 3/4 to 1-1/2 inclusive	5/16
Over 1-1/2 to 2-1/4 inclusive	3/8
Over 2-1/4 to 6 inclusive	1/2
Over 6	5/8
Note A: Weld size need not exceed the thickness of the thinner part joined.	

6. You may drill holes in steel parts after galvanizing if you repair the holes as specified for repairing damaged galvanized surfaces in Article 2.05, "Galvanizing," herein.
7. The finish coat must match color no. 26373 of FED-STD-595.
8. Securely wrap each free end of restrainer-unit cables to prevent separation.
9. Ship cable-type restrainers as complete units.

2.04 GALVANIZING

A. Galvanize miscellaneous metal materials under the following requirements and specifications:

1. Rolled, pressed, and forged steel shapes, plates, bars, and strip greater than or equal to 1/8 inch thick: ASTM A123/A123M
 - a. Except for pregalvanized standard pipe, galvanize material after fabrication into the largest practical sections.
2. Steel less than 1/8 inch thick: Galvanize before or after fabrication.
 - a. Galvanized before fabrication: ASTM A653/A653M, Coating Designation G210.
 - b. Galvanized after fabrication: ASTM A123/A123M, except the weight of zinc coating must average at least 1.2 ounces per square foot of surface area with no individual specimen having a coating weight of less than 1.0 ounce per square foot.
3. Standard pipe: ASTM A53/A53M, except the zinc coating for fence pipes and structural shapes except for metal line posts for barbed and woven wire fences must average at least 1.2 ounces per square foot of surface area with no individual specimen having a coating weight of less than 1.0 ounce per square foot.
4. Iron and steel hardware except threaded studs, bolts, nuts, and washers specified to comply with ASTM A307; F3125/F3125M, Grade A325; A449; A563; F436; or F1554: ASTM A153/A153M.
 - a. Galvanize after fabrication.
 - b. For threaded studs, bolts, nuts, and washers specified to comply with ASTM A307; F3125/F3125M, Grade A325; A449; A563; F436; or F1554, galvanize under their ASTMs.
5. Rail elements, backup plates, terminal sections, and end and return caps of guardrail: AASHTO M180
6. Fabrication includes shearing, cutting, punching, forming, drilling, milling, bending, welding, and riveting.

B. Galvanizing is not required for stainless steel, monel metal, and similar corrosion-resistant parts.

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- C. Galvanizing is not required for the following miscellaneous metal:
 - 1. Portions of plates, shapes, or other items embedded more than two inches in concrete.
 - 2. Embedded steel pipe ending at or below the surface of encasing concrete.
 - 3. Items described to receive other finishes.
- D. Clean welded areas before galvanizing to remove slag or other material that would interfere with the adherence of the zinc.
- E. Galvanize parts of fastener assemblies separately before assembly.
- F. Tapping of nuts or other internally threaded parts to be used with zinc-coated bolts, anchor bars, or studs must be performed after galvanizing and comply with thread dimensions and overlapping allowances in ASTM A563.
- G. Repair damaged galvanized surfaces as follows:
 - 1. Clean by thoroughly wire brushing damaged areas and removing loose and cracked coating.
 - 2. Paint cleaned areas with two applications of organic zinc-rich primer from the Authorized Material List for organic zinc-rich primers. Do not use aerosol cans.

2.05 SOURCE QUALITY CONTROL

- A. The Independent Testing Agency must inspect miscellaneous metal materials, including bridge joint restrainer materials, at the fabrication site. Notify VTA when materials have been delivered to the fabrication site. Allow at least 14 calendar days between giving notice and starting fabrication.

PART 3 - EXECUTION

3.01 MISCELLANEOUS METAL CONSTRUCTION

- A. Straighten warped sections of expansion joint armor before placing. Secure the expansion joint armor in the correct position during concrete placement.
- B. Bridge Joint Restrainers:
 - 1. Place new concrete adjacent to bridge joint restrainers before installing them.
- C. Bolted and Threaded Bar Connections:
 - 1. Where cleaning is described, clean nuts, bolts, threaded bars, and plate washers under SSPC-SP 6 or SSPC-SP 2 before painting.
 - 2. Surfaces blast cleaned under SSPC-SP 6 must have a dense, uniform, angular anchor pattern of at least 1.5 mils when measured under ASTM D4417. Paint blast-cleaned surfaces the same day blast cleaning is performed unless otherwise authorized.
 - 3. Reclean surfaces that rust or become contaminated before paint is applied.
 - 4. Paint surfaces with two applications of organic zinc-rich primer from the Authorized Material List for organic zinc-rich primers. Do not use aerosol cans. For threads engaged by nuts, apply the second application to the nuts and threads after installation.
- D. Anchorage Devices:

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1. Install mechanical expansion anchors, resin capsule anchors, and cast-in-place inserts under the manufacturer's instructions.
2. If the manufacturer's instructions do not include torque requirements, tighten nuts used to attach equipment or fixtures to anchorage devices to the installation torque requirements shown in the following table:

Torque Requirements			
Stud diameter (inches)	Installation torque requirements (foot-pounds)		
	Shell-type mechanical expansion anchors	Integral-stud-type mechanical expansion anchors	Resin capsule anchors and cast-in-place inserts
1-1/4	--	--	400
1	--	--	230
7/8	--	--	175
3/4	80	175	150
5/8	35	90	75
1/2	22	50	30
3/8	11	25	18
1/4	4	7	--

3. Install concrete anchorage devices such that the attached equipment or fixtures bear firmly against the concrete.
4. Install shell-type mechanical expansion anchors such that the top surface of the anchor body remains 1/2 to 1 inch below the concrete surface after expansion. After installation of shell-type mechanical expansion anchors and before mounting equipment or fixtures, demonstrate to the Engineer that the expansion anchors are firmly seated within these tolerances.
5. If miscellaneous metal anchor bolts are installed in pipe sleeves or metal canisters, fill the pipes or canisters completely with mortar as specified herein, or non-shrink grout in accordance with Section 03 62 00, Non-Shrink Grouting.
6. The embedded end of each anchor bolt must terminate with a head or a nut and washer. Anchor bolts must allow true positioning of bearing assemblies.

E. Bridge Deck Drainage System:

1. Securely cover deck drain grates and other grating openings to prevent intrusion of debris until after final cleanup of the deck and drainage areas.
2. Provide a transition section where a pipe under a walkway or other improved area must be of a smaller diameter than the downdrain pipe.
3. Couplings used to connect PVC or fiberglass pipe to steel must be threaded or flanged. For PVC or fiberglass pipe, do not use the sleeve connections shown.
4. If fiberglass pipe is used, support spacing for fiberglass pipe must be the same as shown for welded steel pipe. Each pipe support must have a width of at least 1-1/2 inches.
5. If PVC pipe is used, pipe support spacing for PVC pipe must be at most six feet.

F. Base Plates, Bearing Assemblies, and Masonry Plates:

1. Miscellaneous metal bearing assemblies or masonry plates placed on mortar pads or non-shrink grout pads must comply with the following requirements:
 - a. Where mortar pads or non-shrink grout pads are shown in the plans, either mortar or non-shrink grout may be used.
 - b. Attain full bearing on the concrete under bearing assemblies.

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- c. Immediately before setting bearing assemblies or masonry plates on ground concrete surfaces, thoroughly clean and apply caulking to all contact surfaces.
 - d. During welding, protect bearing surfaces using authorized methods.
 2. Set bearing plates level. Set rockers and expansion devices to comply with the temperature at the time of erection or to the specified setting.
- G. Nonskid Surface:
 1. Where a nonskid surface is shown on steel plates, apply an epoxy mixed with grit.
 2. The finish color of the nonskid surface must be light gray.
 3. Before applying epoxy and grit to a galvanized surface, prepare the surface in accordance with the following:
 - a. Clean galvanized surfaces by pressure washing or steam cleaning.
 - b. Roughen galvanized areas after cleaning by abrasive blasting. Use an abrasive no larger than 30 mesh. Do not remove galvanizing.
 - c. Apply two finish coats in at least two applications. Apply the first finish coat the same day abrasive blasting is performed unless otherwise authorized. Apply the second finish coat after the first finish coat has dried at least 12 hours unless otherwise authorized. The dry film thickness of each finish coat must be at least two mils. The dry film thickness of all coats must be from 4 to 8 mils.
 - d. The second finish coat color must match color no. 14090 of FED-STD-595.
 4. If authorized, you may use a commercial-quality nonskid surface made of a two-component UV-resistant epoxy and grit if the quality is equal to the epoxy-grit mixture specified.

3.02 FIELD PAINTING

- A. After installation of miscellaneous metalwork, abraded areas, field bolts, and welds must be touched up and spot painted with the same corrosion-inhibitive primer as was used for shop painting in accordance with SSPC-PA 1. Field welds must be thoroughly wire-brushed or disc-sanded prior to touch-up painting.
- B. Final field painting of exposed miscellaneous metal is specified in Section 09 91 00, Painting.

3.03 FIELD QUALITY CONTROL

- A. The Independent Testing Agency must perform the following inspections and testing:
 1. Test spring latches and other mechanical devices before delivery to the Worksite. They must operate smoothly and properly.
 2. Inspection of items embedded in concrete must be performed prior to any concrete placement.
 3. Inspections and tests of field welding in accordance with Section 05 05 60, Metal Welding.
- B. Bridge Deck Drainage System:
 1. After installing the drainage system and final cleanup of the deck and drainage areas, test each drain pipe and facility except short free fall pipes in the Engineer's presence by discharging 100 gallons of water into the drain. The test must demonstrate the proper operation of the drain pipe and facility. If the test indicates obstructions in the pipe, clear the pipe and repeat the test until the drain pipe and facility are unobstructed.

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- C. Nonskid Surface:
 - 1. Before applying any nonskid material, demonstrate the method of application to the Engineer by preparing a one square foot test sample applied on hardboard at least 1/4 inch thick. The nonskid surface must have a total thickness of 1/8 to 3/16 inch.
- D. Notify the Engineer at least two days before tightening and setting cable-type restrainer units.

END OF SECTION 05 17 00

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SECTION 05 30 00

METAL DECKING

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Metal decking for bridges
 2. Metal decking for Access Structures
 3. Accessories
 4. Galvanizing repair materials
 5. Stud connectors
 6. Angles and channels for metal deck penetrations and sleeves

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 05 15, Portland Cement Concrete
- D. Section 03 30 00, Cast-in-Place Concrete
- E. Section 05 05 60, Metal Welding
- F. Section 05 12 35, Structural Steel
- G. Section 05 17 00, Miscellaneous Metal
- H. Section 05 12 35, Structural Steel
- I. Section 05 50 00, Metal Fabrications
- J. Section 10 73 16, Canopies

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM A446/A446M Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
 2. ASTM A653/A653M Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

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3. ASTM A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

B. Steel Deck Institute (SDI):

1. SDI Publication No. 27 Design Manual for Composite Decks, Form Decks, Roof Decks and Cellular Metal Floor Deck with Electrical Distribution

1.04 REGULATORY REQUIREMENTS

A. The regulatory requirements which govern the work of this Section include the following governing code:

1. California Code of Regulations (CCR), Title 24, Part 2, 2019 California Building Code, Chapter 22, “Steel”, and State Chapter 22A, “Steel”.

1.05 DESCRIPTION

A. Metal Decking (Pedestrian Overcrossing) consists of metal decking at the Story Station Pedestrian Overcrossing, including the south median pedestrian overcrossing landing, and all associated accessories and stud connectors.

B. Metal Decking (Access Structure) consists of roof metal decking at the elevator towers of Story Station Access Structures, including all associated accessories and stud connectors.

C. For permanent steel deck forms, refer to Section 03 11 00, Concrete Formwork.

1.06 SUBMITTALS

A. General: Submittals for metal decking must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.

B. Shop Drawings: Submit detailed Shop Drawings of metal decking, showing grade, size, section profile, and thickness of decking, lapping of decking, locations of welds, and method of attachment.

1. Shop Drawings must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.

C. Product Data: Submit manufacturer's product data and design data of the floor and roof decking, along with applicable accessories.

1. Submit product data on galvanizing repair materials.

2. Product data must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked “Reviewed” or “Make Corrections Noted” and returned to the Contractor by VTA.

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- D. Certification: Submit evidence that the shear capacity of manufacturer's decking has been accepted by the International Conference of Building Officials and that a valid Research Recommendation is on file.
1. Certification must be submitted to VTA for review by VTA and the Structural Engineer of Record. Do not order materials, begin fabrication, or begin construction of work related to the submittal until the submittal has been reviewed and stamped by the Structural Engineer of Record with a Shop Drawing stamp marked "Reviewed" or "Make Corrections Noted" and returned to the Contractor by VTA.
- E. Mill Certificates:
1. The Contractor must provide Mill Certificates for each heat of each type of metal deck to be used on project. Mill Certificates must include name of mill, date of rolling, date of shipping, yield point and minimum tensile strength.
 2. Mill Certificates must be provided with each lot of material shipped to the Worksite and must be signed by the Contractor which will serve to certify that all metal deck materials installed comply with specified requirements.
 3. When Mill Certificates cannot be provided, the Contractor must hire a professional testing laboratory to verify compliance and provide laboratory test reports. The cost of testing must be paid for by the Contractor.
- F. Laboratory Test Reports:
1. Laboratory test reports must show the name of testing agency, date of testing, types of tests performed and must be signed by a principal of the testing agency who is currently registered as a civil engineer in the State of California.
 2. When required by other portions of these Technical Specifications, laboratory test reports must be submitted for each deck type tested to show compliance with appropriate ASTM Standards and these Technical Specifications.

1.07 QUALITY CONTROL AND ASSURANCE

- A. Qualifications of Welders and Welding Procedures: Refer to Section 05 05 22, Metal Welding, for requirements.
- B. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- C. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- D. Contractor Quality Control:
1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.

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- b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 - e. If the Independent Testing Agency, through oversight or otherwise, has accepted material or work which is defective or contrary to these Technical Specifications, this material or work, regardless of state of completion, may be rejected.
 - f. The Contractor must identify and tag each lot of deck to be shipped to the Worksite by heat number in such a manner that it can be accurately identified at the Worksite.
 - g. The Contractor must remove all unidentified metal deck received at the Worksite.
2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 3. Installer Qualifications: Company specializing in performing the work of this Section approved by manufacturer and having previous experience in its installation.
- E. VTA Quality Assurance:
1. VTA may monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.08 MEASUREMENT AND PAYMENT

- A. Measurement:
1. Metal Decking (Pedestrian Overcrossing) must be measured by the square foot.
 2. Metal Decking (Access Structure) must be measured by the square foot.
- B. Payment:
1. The contract price paid per square foot for Metal Decking (Pedestrian Overcrossing) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Decking complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
 2. The contract price paid per square foot for Metal Decking (Access Structure) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Decking complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
- C. Full compensation for furnishing and installing stud connectors, metal deck accessories, and steel angles and channels at metal deck penetrations and sleeves, and for repairing galvanized finish must be

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considered as included in the bid item for Metal Decking (Pedestrian Overcrossing) and no additional compensation will be allowed therefor.

- D. Full compensation for furnishing and installing metal deck accessories, installing puddle welds and seam welds, and for repairing galvanized finish must be considered as included in the bid item for Metal Decking (Access Structure) and no additional compensation will be allowed therefor.
- E. Full compensation for furnishing and installing metal decking, including all associated accessories and stud connectors, at the various canopy structures at Story Station and Eastridge Station must be considered as included in the bid item for Canopies and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Decking: Unless otherwise specified, metal decking must be formed of steel sheet conforming to ASTM A653/A653M, Designation SS, Coating Designation G90 (1.25 ounce commercial zinc coating) conforming to ASTM A653/A653M. When grade is not indicated, provide minimum Grade 50 decking. Type of decking units, weight of metal (metal gage), and section profile must be as indicated.
 - 1. Metal Decking (Pedestrian Overcrossing) must comply with ASTM A653/A653M, Designation SS, Grades 50 through 80, coating designation G90.
 - a. The web angle measured from the horizontal plane must be between 55 degrees and 90 degrees and the webs must not have reentrant bends in their flat width.
 - 2. Metal Decking (Access Structure) must comply with ASTM A653/A653M, Designation SS, Grades 50 through 80, coating designation G90.
 - 3. Metal decking at the various canopy structures at Story Station and Eastridge Station must comply with ASTM A653/A653M, Designation SS, Grades 50 through 80, coating designation G90.
 - 4. Section properties must be computed in accordance with AISI's North American Specification for the Design of Cold Formed Steel Structural Members.
 - 5. Metal decking must have indentations or embossments meeting the requirements for Type I, Type II, or Type III patterns of ANSI/SDI Composite Steel Floor Deck-Slabs (ANSI/SDI C) on the deck web, flange, or both to provide a mechanical bond with the concrete.
 - a. The design embossment height must not be less than 0.035 inches and must not be greater than 0.105 inches. Embossment must not be less than 90 percent of the design embossment depth.
 - 6. Side laps must be male-female interlocking type, suitable for button punching.
 - 7. Delivered minimum thickness must be in accordance with AISI's North American Specification for the Design of Cold Formed Steel Structural Members.
- B. Accessories: Provide cell end closures, column flashings, recessed sump pans, and any other closures and flashings as indicated or required for complete and finished installations and as required to prevent leakage of concrete. Provide cover caps for covering abutting ends where required. Accessories and flashings must be of the same material as the decking and must be not lighter than 22 gage.

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Accessories must be the decking manufacturer's standard types, galvanized, and must be provided as follows:

1. Adjusting plates or segments of deck units in locations too narrow to accommodate full-size units.
 2. End closures to close the open ends at openings through the roof, where units terminate at exterior walls, and other locations where required. Closures must be not lighter than 22 gage.
 3. Provide sump pans at drains as indicated, fabricated from metal not lighter than 14 gage.
- C. Welding Electrodes: Refer to Section 05 05 60, Metal Welding, for requirements.
- D. Stud Connectors: Refer to Section 05 12 35, Structural Steel, for requirements.
- E. Galvanizing Repair Materials: Conform with requirements of ASTM A780. Commercial cold galvanizing compounds manufactured for the purpose will be accepted provided they meet or exceed requirements of ASTM A780.
- F. Angles and channels for deck penetrations must conform to the requirements in Section 05 12 35, Structural Steel.

2.02 FABRICATION

- A. Metal decking and associated metal fabrications must conform with applicable requirements of the California Building Code, Chapters 22 and 22A, and SDI Publication No. 27.
- B. Fabricate metal decking for composite construction with stud connectors or lugs to provide mechanical key for transferring horizontal shear and for preventing vertical separation. Provide decking with stud connectors and hold-down lugs to achieve composite action between decking and concrete fill.
- C. Welding and welded connections must conform with the requirements of Section 05 05 22, Metal Welding.
- D. Steel decking and associated fabrications must be prefabricated and preassembled in the factory or shop as far as practicable.
- E. Galvanized metalwork necessitating welding which in any manner removes or damages original galvanizing must be restored by galvanizing repair in accordance with ASTM A780.
- F. Metal Decking (Access Structure) must be PLB-36 FORMLOK by Verco Decking, Inc., or approved equal.
- G. Metal decking at the various canopy structures at Story Station and Eastridge Station must be PLBCD-36 FORMLOK by Verco Decking, Inc., or approved equal.
- H. Weld stud connectors through steel deck to structural members below.

2.03 INSPECTIONS AND TESTS

- A. Materials, fabrications, and welding may be subject to inspections in the shop conducted by VTA. Tests must be performed by the Independent Testing Agency, at Contractor's expense, using an approved independent testing laboratory.

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- B. Welds must be inspected by the Independent Testing Agency as specified in Section 05 05 60, Metal Welding.

PART 3 - EXECUTION

3.01 ERECTION AND INSTALLATION

- A. Install decking as indicated and in accordance with the approved submittals and the decking manufacturer's installation instructions. Provide decking complete, including shaping, cutting, fitting, drilling, welding, flashings, closure strips, closure plates, fasteners, and accessories necessary for a complete and finished installation.
1. Furnish and install diagonal supports at columns and any other miscellaneous structural supports which are required to carry the metal deck and are not shown on the plans.
- B. Install decking in straight and continuous rows as far as practicable, with ribs at right angles to structural supporting members.
1. End laps must occur at points of support only, and where sheets are lapped, end laps must be not less than 2 inches.
 2. Where ends of decking sheets abut without overlapping at supports, each end of decking must have a minimum bearing of two inches on supports.
 3. Locate transverse deck construction joints at the bottom of flutes.
 4. Care must be exercised to properly fit male-female units of side laps before crimping or connecting.
- C. Stud connectors to be installed on metal decking must be installed directly over webs of beams for single row installations.
- D. Type of welding, number of welds, size of welds, and locations of welds must be in accordance with the approved Shop Drawings and the decking manufacturer's installation instructions. Welding must conform with the requirements for structural sheet steel of Section 05 05 60, Metal Welding.
- E. Welds must be cleaned immediately by wire-brushing, and must be coated with galvanizing repair material before being covered by the succeeding sheet.
- F. Decking must be weighted at the point of welding with sand bags or other approved method to hold them in firm contact with each other and structural supports.
- G. Secure solid welds where sheets are warped or bent to certain radii and where decking is placed on a slope while supporting members are framed in a straight position.
- H. Button punches or crimping devices may not be substituted for welding.
- I. Holes and openings for services and other projections through decking must be cut and fitted neatly and accurately and must be reinforced as necessary for rigidity and load-carrying capacity.
- J. Metal floor deck holes and openings to be cut after the concrete pour, must not be field cut until concrete has reached 75 percent of its design strength and a minimum seven days.
- K. Metal decking must not interfere with movement at deck expansion joints.

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- L. Clearance between metal decking and bar reinforcement must be at least one inch.
- M. Metal decking must be installed continuous over two spans minimum.

3.02 GALVANIZING REPAIR

- A. Galvanized surfaces which have become damaged from welding, handling, or installation must be repaired immediately after installation with galvanizing repair material in accordance with ASTM A780. Galvanizing repair must be performed and completed before concrete is placed.
- B. Repair galvanized metal decking surfaces damaged before installation by wire brushing to remove loose and cracked coating and applying two coats of zinc-rich primer. Do not use aerosol cans.
- C. You do not need to repair minor heat discoloration in welded areas.

3.03 CONCRETE FILL

- A. Concrete fill, where indicated, must conform with applicable requirements of Section 03 30 00, Cast-in-Place Concrete, and Section 03 05 15, Portland Cement Concrete.

3.04 FIELD QUALITY CONTROL

- A. Field welds and stud connectors must be inspected and approved by the Independent Testing Agency in writing as specified in Section 05 05 60, Metal Welding.
- B. Metal decking which is found to be damaged must be removed and replaced at the Contractor's expense.

END OF SECTION 05 30 00

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for furnishing metal studs and accessories for constructing Story Station and the Eastridge Station Signals/Communications House Structures and Story Station Elevators as shown on the drawings, as specified herein, and as needed for a complete and proper installation.

1.02 RELATED SECTIONS

- A. Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Conditions
- B. Section 13 60 00, Eastridge Station Communications/Signal Building Structure

1.03 REFERENCED STANDARDS

- A. American Iron and Steel Institute (AISI):
1. AISI S100 Specification for the Design of Cold-Formed Steel Structural Members
- B. American Society for Testing and Materials (ASTM):
1. ASTM A1011 Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 2. ASTM A1008 Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 3. ASTM A449 Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
 4. ASTM C955 Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
 5. ASTM C1007 Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories

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6. ASTM C1513 Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections

C. Steel Structures Painting Council (SSPC):

1. SSPC-PA 1 Shop, Field, and Maintenance Painting

D. SAE International

1. SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures for submittal requirements and procedures including but not limited to shop drawings, product data and samples.

B. Shop Drawings: Submit detailed Shop Drawings for Story Station Elevators of steel studs and joists, showing grade, size, and thickness of framing members, layout of framing, installation details, and methods of anchorage and attachment, including metal fasteners. Indicate strapping, bracing, splices, bridging, reinforcing channels, opening framing, supplemental framing, connection details, attachment of other work, and accessories as required for proper installation.

C. Product Data: Submit manufacturer's product data and installation instructions of the framing members, along with applicable accessories.

1.05 DELIVERY AND STORAGE

A. Protect metal framing members from corrosion and damage. Deliver to site in manufacturer's unopened containers or bundles, fully identified by type, size, and grade. Store off the ground in a dry ventilated space.

1.06 QUALITY CONTROL AND ASSURANCE

A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.

B. Inspection by City and Other Governing and Regulatory Authorities: Allow the Engineer and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the Contract Drawings, Contract Specifications, and other local, state and federal laws and regulations.

C. Engineer Quality Assurance:

1. The Engineer will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with the provisions of

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Section 6.26 - Quality Assurance and Quality Control Requirements, of the Special Conditions.

1.07 MEASUREMENT AND PAYMENT

A. Measurement

1. Furnish Cold-Formed Metal Framing
 - a. Furnish Cold-Formed Metal Framing for the Story Station Signal/Communications house must be measured by the pound.
 - b. Furnish Cold-Formed Metal Framing for the Eastridge Station Signal/Communications house must be measured by the pound.
 - c. Furnish Cold-formed Metal Framing for the Story Station Elevators must be measured by the pound.

B. Payment

1. The contract price paid per pound for Furnish Cold-Formed Metal Framing of the various types listed in the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in fabricating and delivering cold-formed metal framing to the Worksite ready to incorporate into the work complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
2. The contract price paid per pound for Erect Cold-Formed Metal Framing of the various types listed in the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in erecting cold-formed metal framing at the Worksite into the final position in the work, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Steel: Steel for light gage structural framing, studs, tracks, joists, bridging, sills and headers, shall conform to ASTM A1011/A1011M, minimum Grade 33, or ASTM A1008/A1008M, minimum Grade C, with a minimum yield point of 33,000 psi. Light gage structural framing shall conform to applicable requirements of AISI S100. Framing members and accessories shall be delivered to the job with manufacturer's standard oven-dried coat of corrosion- inhibitive metal primer.
- B. Framing Members:
 1. Studs: Punched "C" studs or standard punched channel studs of sizes indicated conforming to ASTM C955. Studs shall be 16 gage steel. Short lengths may be 18 gage steel. Studs shall be unpunched where required to be bolted.

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2. Tracks: Unpunched channels conforming to ASTM C955, of same size, type, and, gage (metal thickness) as studs, for floor and ceiling tracks.
 3. Joists: Punched channel joists conforming to ASTM C955 of sizes indicated. Joists shall be 16 gage steel as indicated. Short lengths may be 18 gage steel. Joists shall be unpunched where required to be bolted. Provide joists for floors, ceilings, and soffits as indicated.
 4. Heavier Members: Where studs or joists are required to be heavier steel because of long lengths or heavy loads, provide 12 or 14 gage components as indicated or required.
- C. Screws: Self-drilling, self-tapping dual-hardened steel screws conforming to ASTM C1513 and manufactured specifically for the purpose and capable of penetrating 12 gage or heavier sheet steel of structural quality. Screws shall meet SAE J429 Grade 5 and ASTM A449 strength and ductility requirements. Provide screws with corrosion-inhibitive coating.
- D. Bolts: 1/4-inch diameter galvanized steel bolts with matching nuts. Provide galvanized washers for all bolt heads and nuts.
- E. Powder-Driven Fasteners: 1/4-inch diameter fasteners with washers, may be used for attaching tracks in lieu of anchor bolts if first approved by the Engineer for the location. Use washers with all inserts. Powder-driven fasteners will not be permitted for use on concrete curbs or along the edge of concrete or a concrete joint.
- F. Expansion Bolts: Galvanized expansion type anchors with matching galvanized steel bolts or studs, minimum 1/4-inch diameter, may be used for attaching tracks in lieu of anchor bolts if first approved by the Engineer for the location. Use washers under all bolt heads and nuts. Expansion bolts shall be located at least 4 inches from the edges or corners of concrete.

2.02 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and ASTM C1007 requirements except where more stringent requirements are shown or specified herein.
- B. Fabricate framing assemblies in jig templates.
- C. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.
- D. Fabrication Tolerances: Fabricate assemblies to a maximum allowable tolerance variation per ASTM C1007 except where more stringent requirements are specified herein.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install steel studs and joists as indicated and in accordance with the approved submittals, the manufacturer's installation instructions, and ASTM C1007 by skilled installers experienced in the type of work involved.

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- B. Provide bridging for studs and joists in accordance with the framing manufacturer's instructions.
1. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
 2. Install horizontal bridging in stud system, spaced in rows not more than 48-inches apart. Fasten at each stud intersection.
- C. Install backing plates, supplementary framing, blocking, bracing, and reinforcing of the various types indicated or required for the mounting of all items on or in partitions, framed walls, or shafts. Exact position of backing work shall be as designated by the trade whose work will be fastened thereto. The end result shall be that all items attached to or framed in gypsum wallboard surfaces shall be firmly and solidly mounted.
1. Backing plates for grab bars, handrails, and cabinets shall be a minimum of 16 gage galvanized steel, 4 inches in height, and shall span at least two studs. Backing plates for toilet accessories and other items requiring backing shall be a minimum of 20 gage galvanized steel, 4 inches in height, and shall span at least one stud past point of connection.
- D. Provide miscellaneous steel sections and accessories, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, as indicated or required to complete the work and provide a stable framing system.
- E. Erection technique shall result in plumb and straight walls and level ceilings and soffits with no waves or buckles or unevenness at joints. Finished walls shall be a flat plane to within plus or minus 1/8 inch in 8 feet when checked in any direction with an 8-foot straightedge and plumb to within plus or minus 1/8 inch, top to bottom. Finished ceilings shall be level and flat to within plus or minus 1/8 inch in 8 feet when checked with a carpenter's level or surveyor's level.
- F. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- G. Install continuous top and bottom tracks. Align tracks accurately and securely anchor at corners and ends, and at 24-inches on center for powder-driven anchors, 32-inches on center for expansion anchors unless noted otherwise on Contract Drawings.
- H. Align studs vertically where wall framing continuity is interrupted by floor framing. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- I. Anchor studs abutting structural columns or walls to supporting structure.
- J. Install headers over wall openings wider than the stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes, complete with clip-angle connectors, web stiffeners, or gusset plates.
1. Frame wall openings with not less than a double stud at each jamb of frame.
 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full height wall studs.

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- K. Install slide clips or deep leg track where studs are attached to building structure to allow for building slab deflection without transmitting forces to metal studs.

END OF SECTION 05 40 00

SECTION 05 50 00

METAL FABRICATIONS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for metal fabrications as listed below for Architectural Elements as shown on Architectural Drawings. For Structural Steel and related Structural Elements, see Section – 05 12 35 – Structural Steel, Section 05 17 00 – Miscellaneous Metal and Structural Drawings.

1. Steel Clips, Brackets, Angles, Tubes, Pipes, and Shapes
2. Anchors, Bolts, and Fasteners
3. Signs
4. Speaker Housings
5. Leaning Rails
6. Kiosks
7. Glazing Frames and Stops at Wind Screen Modules
8. Bike Ledge Angle
9. Stainless Steel Requirements
10. Galvanizing of Steel and Ferrous Metals
11. Windscreen
12. Gates at TPSS

1.02 RELATED SECTIONS

- A. Section 05 05 60, Metal Welding
- B. Section 05 52 00, Metal Railings (Stations)
- C. Section 05 52 01, Metal Railings (Bridge)
- D. Section 05 51 33, Metal Ladders
- F. Section 05 55 16, Metal Stair Nosings
- F. Section 08 90 00, Louvers and Vents
- G. Section 09 91 00, Painting
- H. Section 10 12 00, Display Cases
- I. Section 10 73 16, Canopies
- J. Section 26 50 00, Lighting
- K. Section 32 31 10, Ornamental Fence and Gate
- L. Section 32 31 26, Wire Fences and Gates

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M. Division 26, Electrical, for power and lighting requirements related to these specifications

1.03 REFERENCED STANDARDS

A. ASTM International (ASTM):

1. ASTM A27 Standard Specification for Steel Castings, Carbon, for General Application
2. ASTM A36 Standard Specification for Carbon Structural Steel
3. ASTM A47 Standard Specification for Ferritic Malleable Iron Castings
4. ASTM A48 Standard Specification for Gray Iron Castings
5. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
6. ASTM A108 Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
7. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
8. ASTM A143 Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
9. ASTM A153 Standard Specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
10. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
11. ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
12. ASTM A283 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
13. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
14. ASTM A312 Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
15. ASTM A384 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
16. ASTM A480 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
17. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
18. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
19. ASTM A663 Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
20. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
21. ASTM A675 Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
22. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
23. ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
24. ASTM D2092 Standard Guide for Preparation of Zinc-Coated (Galvanized) Steel

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- 25. ASTM F593 Surfaces for Painting
Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- 26. ASTM F594 Standard Specification for Stainless Steel Nuts
- 27. ASTM F837 Standard Specification for Stainless Steel Socket Head Cap Screws
- 28. ASTM F879 Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws
- 29. ASTM F880 Standard Specification for Stainless Steel Socket, Square Head, and Slotted Headless-Set Screws

B. American Welding Society (AWS):

- 1. D1.1 Structural Welding Code – Steel

C. American National Standards Institute (ANSI):

- 1. B27.2, Type B Standard for washers

D. Steel Structures Painting Council (SSPC):

- 1. PA 1 Shop, Field, and Maintenance Painting
- 2. Paint 20 Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic")
- 3. PS 12.00 Guide for Selecting Zinc-Rich Painting Systems
- 4. SP 1 Solvent Cleaning
- 5. SP 10 Near-White Blast Cleaning

E. California Code of Regulations 2018:

- 1. Table 16B Special Loads, California Building Code

F. National Association of Architectural Metal Manufacturers (NAAMM):

- 1. NAAMM AMP 521 Pipe Railing Systems Manual, Including Round Tube

G. Specialty Steel Industry of North America (SSINA):

- 1. "Designer Handbook" series including the following industry standards:
 - a. Design Guidelines for the Selection and Use of Stainless Steel, as follows:
 - 1) Specifications for Stainless Steel
 - 2) Special Finishes for Stainless Steel
 - 3) Stainless Steel Fabrication
 - 4) Stainless Steel Fasteners

1.04 SUBMITTALS

A. General

- 1. Submittals for Metal Fabrications must be made in accordance with the provisions in these technical specifications.
- 2. The Contractor must submit the following:
 - a. Product Data: For manufactured or prefabricated items, submit manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation

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instructions for products being provided and installed under the Work of this Section. Indicate in the transmittal that copies of the installation instructions have been provided to the respective installing subcontractors.

- b. Shop Drawings:
 - 1) Verify measurements at the platforms and take field dimensions for fitting and proper attachment to related work before producing shop drawings.
 - 2) Submit shop drawings for the fabrication and erection of assemblies of miscellaneous metal work, which are not completely defined in the manufacturer's data. Included must be plans, elevations, and details of sections and connections. Show accessories and anchorage items to be incorporated into the work.
 - 3) Include settings drawings and templates for location and installation of miscellaneous metal items and anchorage devices.
- c. Samples:
 - 1) Submit 3 samples, 12 inch x 12 inch, of each type of mesh for confirmation of mesh type and spacing for the Story Station Access Structures. Submit 3 samples each of 3 additional meshes of similar type and spacing for selection and approval of wire cloth type.
 - 2) Submit one 12 inch long sample of stainless steel glazing stops with glazing tape attached.
- 3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Metal Fabrications must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Metal Fabrications must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Fabrications complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Work Quality:
 - 1. Shop and field work must be performed by mechanics, craftspersons, artisans, and workers skilled and experienced in the fabrication and installation of the decorative metalwork involved.
 - 2. Stainless steel work must conform with the quality requirements of the herein referenced Specialty Steel Industry of North America, "Designer Handbook" series standards. Pipe and tube railings must conform with NAAMM "Pipe Railing Systems Manual, including Round Tube".
- B. Iron Contamination (Rust): Stainless steel with iron contamination will not be accepted. Dies for forming stainless-steel components must be stainless steel or chrome-plated to prevent embedment

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of minute iron particles. All stainless-steel work must be polished and cleaned after fabrication and installation to prevent rusting susceptibility.

- C. Welds of Stainless Steel: Exposed welds must be ground smooth and polished to match the adjacent surrounding finish of the stainless steel.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Steel Plates, Shapes and Bars: ASTM A36.
- B. Steel Plates to be Bent or Cold Formed: ASTM A283/A283M, Grade C.
- C. Steel Bars and Bar Size Shapes: ASTM A663/A663M, or ASTM A675/A675M.
- D. Steel Tubing: ASTM A500, Grade B.
- E. Cold Finished Steel Bars: ASTM A108, grade as selected by fabricator.
- F. Cold Rolled Carbon Steel Sheets: ASTM A1008.
- G. Galvanized Carbon Steel Sheets: ASTM A653/A653M, Z275 zinc coating.
- H. Gray Iron Castings: ASTM A48/A48M, Class 30.
- I. Malleable Iron Castings: ASTM A47/A47M, grade as selected by fabricator.
- J. Steel Pipe: ASTM A53/A53M, type as selected by fabricator, Grade A, standard weight (Schedule 40), black finish unless galvanized indicated on the Drawings.
 - 1. Outside diameter (O.D.) dimensions referenced on the Drawings are nominal dimensions. Contractor must select and provide stock from standard Schedule 40 pipes which provides the closest possible match to the O.D. dimension given.
 - 2. Radius bends in pipes 45-degrees or greater must be bent with the smallest possible, standard elbow bends which will prevent buckling, wrinkling, or deformation of the pipe.
- K. Aluminum: 6063-T5; 204-R1 Aluminum finish, unless otherwise indicated to be clear anodized.
- L. Primer Paint: Solvent-based, inorganic zinc primer. Materials must conform to SSPC Paint 20. Where shop primed materials are to be finish painted and prime coat materials are by a different manufacturer than the finish coat materials, confirm compatibility of the primers with the manufacturer of the finish coat paints specified in Section 09 91 00 – Painting, for exterior metal. All shop applied primers must be products of the manufacturer of the finish coat products.
- M. Concrete Inserts: Threaded or wedge type, galvanized ferrous castings, malleable iron ASTM A47/A47M, or cast steel ASTM A27/A27M. Provide bolts, washers, and shims as required, hot dip galvanized, ASTM A153/A153M.
- N. Isolator for Metals Causing Electrolytic Action: Asphalt bitumen emulsion.
- O. Expansive Grout: Hallemite "Por-Rok," Master Builders Co. "Embeco", or VTA-approved equal.

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P. Anchors, Bolts, and Fastenings:

1. General: ASTM A307.
2. Machine Bolts and Nuts: Other than those with self-locking screw heads, must be American National coarse thread series. Self-locking threads must be manufacturer's approved standard types. Nuts of the self-locking type may be used instead of upsetting the bolt threads as hereinafter specified. Bolts and nuts must be regular square head types.
3. Washers: Round washers must conform to American Standard B27.2, Type B.
4. Screws: Stainless steel Phillips head, flush head or countersunk unless noted otherwise in these technical specifications or on the Drawings.
5. All exposed Anchors, Bolts, and Fastenings in public areas must be tamper resistant when possible.

Q. Stainless Steel:

1. Stainless Steel Sheet, Strips, Flat Bars, and Plate: Must conform to ASTM A666, ASTM A240, and ASTM A480, Type 316, of thickness indicated, with ASTM A480 or NAAMM AMP 521 No. 4 polished finish.
2. Anchor Plates: Provide stainless steel anchor plates conforming to ASTM A240/A240M and ASTM A480/A480M, Type 316, with ASTM A480/A480M or NAAMM AMP 521 No. 4 polished finish.
3. Welding Rod/Electrodes: Refer to Section 05 05 60, Metal Welding, for requirements. Provide stainless steel welding electrodes.
4. Anchors, Fasteners, and Accessories: Provide all required anchors, fasteners, miscellaneous components, and accessories as required for complete and finished decorative metal installations. Bolts, studs, and nuts must conform with ASTM F593, F594, F837, F879, and F880 as applicable, Type 316. Comply also with applicable requirements of SSINA's "Stainless Steel Fasteners." Anchors and fasteners must be tamper-resistant where exposed.
 - a. Self-Tapping Screws, Washers and Shims: Oval head, counter-sunk phillips self-tapping screws, washers, and horseshoe shims must consist of a 316 stainless steel alloy.
 - b. Expansion Bolts: Where anchors are not included in the concrete or masonry construction, provide stainless steel expansion type anchors with matching stainless steel bolts or studs with nuts, of sizes as indicated or required to meet installation conditions. Provide stainless steel washers under all bolt heads and nuts. Expansion bolts require approval of the Engineer before they may be installed in post-tensioned slabs. Expansion bolts will not be permitted for use on concrete curbs or along the edge of concrete or a concrete joint.
 - c. Butt joints in stainless steel pipe or tube railings must not be welded. Instead, railing joints must have internal, tight-fitting stainless steel sleeve, secured with tamper-resistant, counter-sunk stainless steel fasteners, located at the railing bottom. Butt joints in railings must be precision-manufactured to provide tight hairline joints, slightly eased at edges to eliminate burrs and sharp edges. Provide for expansion and contraction at joints when railings exceed runs of 40 feet in length.
 - d. Decorative metalwork must be prefabricated and preassembled in the factory or shop as far as practicable.
 - e. All stainless steelwork, after receiving NAAMM AMP 521 No. 4 polished finish, must receive a final polishing using non-ferrous grit no coarser than 180.

R. Anti-nesting Bird Wire: Refer to Section 10 81 13, Bird Control Devices.

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- S. Windscreen: Stainless steel perforated panels: 1/8-inch thick Stainless Steel (316), Round whole Stagger pattern (1/4-inch by 3/8-inch) finished end pattern with minimum edge, and 40 percent open area.
- T. Metal Stair Nosings: Refer to Section 05 55 16, Metal Stair Nosing.
- U. Dissimilar Metals: Provide positive insulation of metals from contact with other different metals to prevent galvanic action corrosion, discolorations, and staining using neoprene washers.
- V. Wire Mesh for Gates at TPSS: Single Weave, non-crimped woven wire, 1/8-inch thick, Galvanized Steel, one-inch square openings.

2.02 FABRICATION

- A. Workmanship: Use materials of the composition, thicknesses and sizes shown, or if not shown, of the required size and thickness to provide adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use the type of materials shown or specified for the various components of work.
- B. Install anchors and other connecting members which occur in concrete in the concrete as the work progresses to avoid unnecessary cutting and drilling.
- C. Provide templates and patterns. Supervise proper location and installation of built-in items. Provide holes and connections for the work of other trades and make necessary connections thereto .
- D. As far as possible, work must be shop fitted and assembled, ready for erection. Shop and field connections must be riveted, welded or attached with screws, countersunk and finished flush where exposed.
- E. Provide positive insulation of metals from contact with masonry and different metals from contact with each other to prevent corrosion .
- F. Form exposed work true to line and level, with accurate angles, surfaces and straight, sharp edges. Ease exposed edges to a radius of approximately 0.8 mm unless otherwise shown. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.
- G. Weld corners and seams continuously and in accordance with the recommendations of AWS. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
- H. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible. Where exposed fasteners are used, they must be Phillips flathead and countersunk screws or bolts, unless otherwise shown.
- I. Provide for anchorage of the type shown, coordinated with the supporting structure. Fabricate and space anchoring devices to provide adequate support for the intended use .
- J. Cut, reinforce, drill and tap miscellaneous metalwork items as indicated, to receive finish hardware or similar items of work .

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- K. Provide solid internal reinforcing at corners of stainless steel glazing stop frames .
- L. Metal work fabricator must carefully coordinate the dimensions and requirements of all fabricated metal work with the dimensions and requirements of all adjacent assemblies, supported by or abutting metal work. Fabricator must bring any discrepancies discovered to the attention of VTA immediately.

2.03 CLEANING AND SHOP PAINTING

- A. Shop paint miscellaneous metalwork, except for those members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise indicated.
- B. Reference Standards: Comply with the applicable provisions and recommendations of SSPC and AISC for shop painting of structural steel .
- C. General: Prepare and clean substrates in accordance with the paint manufacturer's written instructions, and as herein specified, for each particular substrate condition:
 - 1. Ground smooth or remove projections and irregular surfaces. Remove weld accumulations, spatter, and slag.
 - 2. Remove accessories, cover plates and similar items in place and not to be painted, or provide suitable protection from surface preparation and painting operations. Remove such items if necessary for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, re-install the removed items using workers skilled in the trades involved.
 - 3. Clean surfaces to be painted in accordance with SSPC SP 1 to remove all oil and grease before mechanical cleaning. Neutralize welds with a chemical solvent which is compatible with the specified painting system.
 - 4. Mechanically clean and abrade all prepared surfaces in accordance with the specifications below.
 - a. Abrasive type and size must be selected to provide the required level of cleanliness while establishing a surface profile recommended by the paint manufacturer. Abrasive material must be new material, free of contaminants that would interfere with adhesion of the paint. Vacuum abraded surfaces immediately before primer application to remove residual dust. All mechanically cleaned surfaces must receive a coating of paint before flash rusting can occur, but no longer than 8 hours after cleaning. Re-clean surface if flash rusting occurs before paint application at no additional cost to VTA.
- D. Exterior Applications:
 - 1. After fabrication and immediately before shop painting, clean and prepare surfaces as described above.
 - 2. Abrasive blast all steel surfaces to be painted in accordance with SSPC SP 10.
 - 3. Re-wipe as necessary and vacuum all surfaces to remove dust immediately before paint application.
 - 4. Apply primer as specified herein.
- E. Primer: Apply 1 coat of zinc primer specified herein, 64 μm to 76 μm DFT, in accordance with applicable sections of SSPC PA 1 and SSPC PS 12.00.

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1. Inaccessible Surfaces: For surfaces which must be inaccessible after assembly or erection, apply a second coat of water acrylic primer, 64 µm to 76 µm DFT. The primer must conform to the materials specified in Section 09 91 00, Painting.
- F. Coordinate paint colors for speaker housings and grates, leaning rail brackets, and poster cabinets to match the adjacent shelter structure specified in Section 09 91 00, Painting.

2.04 GALVANIZING

- A. Steel and ferrous metal items exposed to moisture, gratings, and items so indicated on the Drawings, must be galvanized after fabrication by the hot-dip process in accordance with ASTM A123. Weight of the zinc coating must conform to the requirements specified under "Weight of Coating" in ASTM A123.
- B. Safeguarding against steel embrittlement must conform with the applicable requirements of ASTM A143.
- C. Safeguarding against warpage and distortion of steel members must conform with the applicable requirements of ASTM A384.
- D. Shop galvanized metalwork necessitating field welding which in any manner removes original galvanizing must be restored by field galvanizing repair in accordance with ASTM A780.
- E. Bolts and screws for attachment of galvanized items must be galvanized in accordance with ASTM A153.
- F. Prepare galvanized metal surfaces indicated to be painted in accordance with ASTM D2092.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which the miscellaneous metalwork will be installed. Correct conditions detrimental to the proper completion of the work. Do not proceed with the work until any unsatisfactory conditions identified have been rectified.

3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate the delivery of such items to the Worksite to avoid any delays due to lack of materials.

3.03 INSTALLATION

- A. Install metal fabrications and miscellaneous metalwork in accordance with the Drawings and the approved shop drawings, using mechanics and workers skilled and experienced in the installation of the type of work involved.
- B. Install metal fabrications and miscellaneous metal work with accessories furnished by the fabricator as required for complete and finished installations.

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- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metalwork items to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, wood screws and other connectors, as required.
- D. Cutting, Fitting and Placement:
1. Perform cutting, drilling and fitting required for the installation of the miscellaneous metal items. Set the work accurately in location, alignment and elevation, plumb, level, true and free from rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
 2. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of the exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Field Welding: Comply with AWS D1.1 for the procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.
- F. Install metalwork in accordance with approved shop drawings, true and horizontal, perpendicular, or at the required angle, as the case may be, level and square, with angles and edges parallel with related lines of the building or structure.
- G. Field welding, where required, must conform to the requirements of Section 05 05 60, Metal Welding.
- H. Where bases and bearing plates require grouting, conform to requirements of Section 03 62 00, Non- Shrink Grouting, and Section 05 12 35, Structural Steel as applicable.

3.04 SHEET METAL THICKER THAN 10 GAUGE

- A. Fabricate and install sheet metal work thicker than 10 gauge as part of the Work of this Section. Accurately cut and form with clean sharp corners and edges. Fit to other materials in a snug manner with proper fastenings. Drill or punch holes accurately. Conform welded joints to the requirements specified in the AWS D1.1 under "Workmanship." Supply, as a part of this Section, miscellaneous small parts or materials thinner than 10 gauge, or items specifically called for in this Section, when such supply is a normal and accepted part of the Work.
- B. Shop prime or galvanize fabricated work, as necessary or indicated. Match finish required with adjacent and/or adjoining work.

3.05 MISCELLANEOUS ANGLES, CLIPS, AND OTHER DEVICES

- A. Provide required miscellaneous clips, angles, lintels, and similar loose parts. Fabricate parts from standard structural sections or shapes, to sizes required. Wherever miscellaneous parts are exposed, grind edges, corners, and rough cuts smooth and free of snags. Shop paint all parts except those to be encased in concrete or masonry, or those which require other specific finishes.
- B. Steel Angle at Platform Edge: Comply with tolerances specified in Section 03 11 16, Architectural Cast- in-Place Concrete Forming.

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3.06 BIRD WIRE SYSTEM

- A. Install Bird Wire System where indicated. Refer to Section 10 81 13, Bird Control Devices.

3.07 GALVANIZING REPAIR

- A. Repair galvanized surfaces which have become damaged from welding, handling, or installation immediately after installation with galvanizing repair material in accordance with ASTM A780.

3.08 FIELD PAINTING

- A. After installation, prepare exposed painted surfaces, field welds, and other abraded or damaged primed surfaces as required, and touch up with an additional coat of the same primers herein before specified for shop painting. Finish field painting, where required, is specified in Section 09 91 00, Painting.

END OF SECTION 05 50 00

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SECTION 05 51 33

METAL LADDERS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for the fabrication and installation of metal ladders at location indicated below:

1. Elevator Shafts

1.02 RELATED SECTIONS

- A. Section 03 62 00, Non-Shrink Grouting
- B. Section 05 05 60, Metal Welding
- C. Section 05 12 35, Structural Steel
- D. Section 05 50 00, Metal Fabrications
- E. Section 09 91 00, Painting

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI)
- B. ASTM International (ASTM):
1. ASTM A27 Standard Specification for Steel Castings, Carbon, for General Application
 2. ASTM A47 Standard Specification for Ferritic Malleable Iron Castings
 3. ASTM A153 Standard Specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
 4. ASTM A307 Standard Specification for Carbon Steel Bolts, 60 000 PSI Tensile Strength
- C. California Building Code 2018.
- D. Occupational Safety and Health Administration (OSHA):
1. OSHA 3124 Standard Specification for Stairways and Ladders

1.04 SUBMITTALS

- A. General

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1. Submittals for architectural treatment must be made in accordance with the provisions in these technical specifications.
2. The Contractor must submit the following:
 - a. Manufacturer's Data: For manufactured or prefabricated items, submit manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products being provided and installed under the work of this Section. Indicate in the transmittal that copies of the installation instructions have been provided to the respective installing subcontractors.
 - b. Certification that ladder meets OSHA and ANSI 3124 standards.
3. All submittals must be provided to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

B. Shop Drawings:

1. Shop drawings for metal ladders must show details of members, including connections, sizes, spacing of bolts and welds. They must show the marking and position of each mounting fastener, member, erection plans and the limits of paint and galvanizing applications. Complete anchor bolts setting plans for the execution of the work must be submitted.
2. Calculations must show all stresses in members and connections, from dead, live and lateral loads in accordance with the requirements of the CBC current governing edition, and signed by a civil engineer licensed in the State of California.
3. Verify measurements at the elevator hoistways and take field dimensions for fitting and proper attachment to related work prior to producing shop drawings.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Metal Ladders must be measured by the each item.
- B. Payment: The contract price paid per each item for Metal Ladders must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Ladders complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Elevator access ladder must be Painted Steel and from the following approved manufacturers or VTA approved equal:
 1. O'Keefes Inc.
75 Williams Ave.
San Francisco, CA 94124
Tel: (415) 822-4222.
 2. Precision Ladders, LLC
5727 Superior Drive
Morristown, TN 37814
Tel: (800) 225-7814

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2.02 MATERIALS AND ACCESSORIES

- A. Steel: Fabricate from standard metal shapes and sizes as shown on the Contract Drawings. Members must conform to Section 05 50 00, Metal Fabrications, and these specifications.
- B. Primer Paint: Primer must be water-borne inorganic zinc primer as specified in Section 09 91 00, Painting. Where shop primed materials are to be finish painted and prime coat materials are by a different manufacturer than the finish coat materials, confirm compatibility of the primers with the manufacturer of the finish coat paints as specified in Section 09 91 00, Painting, for exterior metal.
- C. Concrete Inserts: Threaded or wedge type, galvanized ferrous castings, malleable iron ASTM A 47, or cast steel ASTM A 27. Provide bolts, washers, and shims as required, hot dip galvanized, ASTM A 153.
- D. Isolator for Metals Causing Electrolytic Action: Asphalt bitumen emulsion.
- E. Anchors, Bolts, Fastenings, etc.
 - 1. General: ASTM A307.
 - 2. Machine Bolts and Nuts: Other than those with self-locking screw heads, must be American National coarse thread series. Self-locking threads must be manufacturer's approved standard types. Nuts of the self-locking type may be used in lieu of upsetting the bolt threads as hereinafter specified. Bolts and nuts must be regular square head types.
 - 3. Washers: Round washers must conform to American Standard B27.2, Type B.
 - 4. Screws: Stainless Steel Phillips head, flush head or countersunk unless noted otherwise in this specification or on the Drawings.
- F. Ladders: Elevator access ladders must be aluminum with serrated square rungs. Rung spacing must be 12" on center. Ladder vertical supports must extend above top rung sufficiently to allow safe access from above ladder at elevator doorway. Ladder mounting must be coordinated with the elevator manufacturer, and must be per the ladder manufacturer's requirements.

2.03 FABRICATION

- A. Workmanship: Use materials of the composition, thicknesses and sizes shown, or if not shown, of the required size and thickness to provide adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use the type of materials shown or specified for the various components of work.
- B. Install anchors and other connecting members which occur in concrete in the concrete as the work progresses to avoid unnecessary cutting and drilling.
- C. Provide templates and patterns. Supervise proper location and installation of built-in items. Provide holes and connections for the work of other trades and make necessary connections thereto.
- D. As far as possible, work must be shop fitted and assembled, ready for erection. Shop and field connections must be riveted, welded or attached with screws, countersunk and finished flush where exposed.
- E. Provide positive insulation of metals from contact with masonry and different metals from contact with each other to prevent corrosion.

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- F. Form exposed work true to line and level, with accurate angles, surfaces and straight, sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.
- G. Weld corners and seams continuously and in accordance with the recommendations of AWS. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
- H. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible. Where exposed fasteners are used, they must be "Phillips", flathead and countersunk, screws or bolts, unless otherwise shown.
- I. Provide for anchorage of the type shown, coordinated with the supporting structure. Fabricate and space anchoring devices to provide adequate support for the intended use.
- J. Cut, reinforce, drill and tap miscellaneous metalwork items as indicated, to receive finish hardware or similar items of work.
- K. Metal work fabricator must carefully coordinate the dimensions and requirements of all fabricated metal work with the dimensions and requirements of all adjacent assemblies, supported by or abutting metal work. Fabricator must bring any discrepancies discovered to the attention of the VTA immediately.

2.04 CLEANING AND SHOP PAINTING

- A. Shop paint metal ladders, except for those members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise indicated.
- B. Reference Standards: Comply with the applicable provisions and recommendations of SSPC and AISC for shop painting of structural steel.
- C. General: Prepare and clean substrates in accordance with the paint manufacturer's written instructions, and as herein specified, for each particular substrate condition.
 - 1. Projections and irregular surfaces must be ground smooth or removed. Weld accumulations, spatter, and slag must be removed.
 - 2. Surfaces to be painted must be cleaned in accordance with SSPC-SP1 to remove all oil and grease prior to mechanical cleaning. Neutralize welds with a chemical solvent which is compatible with the specified painting system.
 - 3. Mechanically clean and abrade all prepared surfaces in accordance with the specifications below. Abrasive type and size must be selected to provide the required level of cleanliness while establishing a surface profile recommended by the paint manufacturer. Abrasive material must be new material, free of contaminants that would interfere with adhesion of the paint. Abraded surfaces must be vacuumed immediately prior to primer application to remove residual dust. All mechanically cleaned surfaces must receive a coating of paint within eight hours or before flash rusting can occur. If flash rusting occurs, the surface must be re-cleaned prior to paint application.
- D. Primers: All shop applied primers must be products of the manufacturer of the finish coat products.

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- E. Inaccessible Surfaces: For surfaces which must be inaccessible after assembly or erection, apply a second coat of water acrylic primer, at 2.0-3.0 mils DFT. The primer must conform with the materials specified in Section 09 91 00, Painting.

2.05 GALVANIZING

- A. Conform to galvanizing requirements as specified in section 05 50 00, Metal Fabrications.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which the ladders will be installed. Correct conditions detrimental to the proper completion of the work. Do not proceed with the work until any unsatisfactory conditions identified have been rectified.

3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate the delivery of such items to the Project site, so as to avoid any delays due to lack of materials.

3.03 INSTALLATION

- A. Install metal ladders and miscellaneous metalwork in accordance with the Drawings and the approved shop drawings, using mechanics and workers skilled and experienced in the installation of the type of work involved. Use accessories furnished by the fabricator as required for complete and finished installations.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing ladder to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, wood screws and other connectors, as required.
- C. Field Welding: Comply with AWS code for the procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work. Field welding, where required, must conform to the requirements of Section 05 05 60, Metal Welding.
- D. Install metalwork in accordance with approved shop drawings, true and horizontal, perpendicular, or at the required angle, as the case may be, level and square, with angles and edges parallel with related lines of the building or structure.
- E. Where bases and bearing plates require grouting, conform to requirements of Section 03 62 00, Non-shrink Grouting, and Section 05 12 35, Structural Steel, as applicable.

3.04 MISCELLANEOUS ANGLES, CLIPS, AND OTHER DEVICES

- A. Provide required miscellaneous clips, angles, lintels, and similar loose parts. Fabricate parts from standard structural sections or shapes, to sizes required. Wherever miscellaneous parts are exposed, grind edges, corners, and rough cuts smooth and free of snags. Shop paint all parts except those to be encased in concrete or masonry, or those which require other specific finishes.

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3.05 GALVANIZING REPAIR

- A. Galvanized surfaces which have become damaged from welding, handling, or installation must be repaired immediately after installation with galvanizing repair material in accordance with ASTM A780.

3.06 FIELD PAINTING

- A. After installation, prepare exposed painted surfaces, field welds, and other abraded or damaged primed surfaces as required, and touch up with an additional coat of the same primers herein before specified for shop painting. Finish field painting, where required, is specified in Section 09 91 00, Painting.

END OF SECTION 05 51 33

SECTION 05 52 00

METAL RAILINGS (STATIONS)

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for fabrication and installation of the following:
1. Metal Handrail
 2. Metal Guardrail
 3. Fence Screen
 3. Steel Pipe
 4. Steel Plate

1.02 RELATED SECTIONS

- A. Section 03 62 00, Non-shrink Grouting
- B. Section 05 05 60, Metal Welding
- C. Section 05 50 00, Metal Fabrications
- D. Section 09 91 00, Painting
- E. Section 26 50 00, Lighting
- F. Section 32 31 19, Decorative Metal Fences and Gates
- G. Section 32 31 26, Wire Fences and Gates

1.03 REFERENCED STANDARDS

- A. ASTM International:
1. ASTM A36 Standard Specification for Carbon Structural Steel
 2. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 3. ASTM A123 Standard Specification for Zing (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 4. ASTM A143 Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
 5. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 6. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
 7. ASTM A384 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
 8. ASTM A385 Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)

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9. ASTM A449 Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
10. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts
11. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
12. ASTM D6386 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

B. American Welding Society (AWS):

1. D1.1 Structural Welding Code – Steel

C. California Code of Regulations:

1. Table 16B Special Loads, California Building Code 2016.

D. National Association of Architectural Metal Manufacturers (NAAMM)

E. The Society for Protective coatings (SSPC) /National Association of corrosion Engineers (NACE):

1. SSPC-SP 1 Solvent Cleaning
2. SSPC-SP 3 Power Tool Cleaning
3. SSPC-SP 10/NACE No. 2 Near-White Blast Cleaning
4. SSPC-SP 11 Power Tool Cleaning to Bare Metal

1.04 SUBMITTALS

A. General

1. Submittals for Metal Railings must be made in accordance with the provisions in these technical specifications.
2. The Contractor must submit the following:
 - a. Product Data:
 - 1) For manufactured or prefabricated items, submit manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products being provided and installed under the Work of this Section. Indicate in the transmittal that copies of the installation instructions have been provided to the respective installing subcontractors.
 - 2) Submit manufacturers' product data of railing system and railing components, handrails, and handrail brackets. Include corrosion-inhibitive shop coat painting system.
 - b. Shop Drawings:
 - 1) Verify measurements at all locations and take field dimensions for fitting and proper attachment to related work before producing shop drawings.
 - 2) Submit shop drawings for the fabrication and erection of assemblies of each different Handrail and Guardrail section. Included must be plans, elevations, and details of sections and connections. Show accessories and anchorage items and mounting details to be incorporated into the work.
 - 3) Include settings drawings and templates for location and installation of miscellaneous metal items and anchorage devices.
 - 4) Submit loading calculations and certificate of compliance for guardrail loading requirements.

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3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked “No Exception Taken” or “Make Corrections Noted” and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Metal Handrail must be measured by the linear foot.
- B. Payment: The contract price paid per linear foot for Metal Handrail must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Handrail complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
- C. Measurement: Metal Guardrail must be measured by the linear foot
- D. Payment: The contract price paid per linear foot for Metal Guardrail must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Guardrail complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Metal Handrails: Refer to Section 05 50 00, Metal Fabrications, for Stainless Steel requirements.
 1. Stainless steel handrails: Provide terminal safety returns for all handrails. Handrail brackets must be stainless steel, wrought or welded, manufactured for the purpose, for anchorage to indicated substrate. Handrail brackets must comply with applicable code and loading requirements. Finish of brackets must match handrail finish. Include all fittings and components, sleeves, hardware, backing plates, and accessories as required for complete and finished handrail installations.
 2. Railing Corners: Provide one-quarter sphere components for rounding of 90- degree, outside railing corners. Sphere components must be welded into position, and the weldments must be ground and dressed smooth so as to be invisible in the finished work.
- B. Painted steel guardrails: Standard Steel Pipe, Code required Grade, of diameter and sizes indicated. Exterior metal Guardrails must be galvanized and painted. Guardrail brackets must be galvanized malleable iron, manufactured for the purpose, for anchorage to concrete walls and floors. Include all fittings and components, sleeves, hardware, backing plates, and accessories as required for complete and finished guardrail installations.
- C. Steel Pipe: Pipe for guardrails, pipe supports, and pipe sleeves must be seamless steel pipe, conforming to ASTM A53, Type S, Grade A, of diameters and sizes indicated. Special instructions must be given the pipe manufacturer to provide Architectural Handrail Grade pipe.
- D. Plate: Steel plate for anchor plates must be standard steel plate, conforming to ASTM A36, weldable quality.
- E. Stainless steel woven wire fabric:

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1. Type 1:
 - a. Single Weave
 - b. non-crimped woven wire
 - c. 1/8-inch thick 316 Stainless steel
 - d. one-inch square openings
 2. Type 2:
 - a. Double Weave
 - b. non-crimped woven wire
 - c. 1/8-inch thick 316 Stainless steel
 - d. see Architectural Drawings for pattern layout.
- F. Include all fittings and components, sleeves, hardware, backing plates, and accessories as required for complete and finished Guardrail installations.
- F. Provide terminal safety returns for all stair handrails.
- G. Loading Requirements: All guard railing more than 30 inch above grade must meet the requirements of Table 16-B Special Loads, of the California Building Code, item 9, for an occupant load of greater than 50. All guard railing must meet loading requirements for an occupant load of greater than 50, irrespective of assumed or calculated occupant loads.
- H. Non-shrink grout at post anchorages must conform to the provisions of Section 03 62 00, Non-shrink Grouting, and of these technical specifications.
- I. All materials must meet the requirements of Section 05 50 00, Metal Fabrications, and of these technical specifications.
- J. Finish:
 1. Paint:
 - a. Corrosion-inhibitive protective metal primer as herein specified under Cleaning and Painting.
 - b. Finish coats as herein specified under Cleaning and Painting.
 - c. Color as indicated in Contract Drawings.
- K. Component Sizes and Configurations: Sizes and configurations must be in accordance with the sizes and configurations shown on the Drawings, unless noted otherwise.
- L. Anchors, Fasteners, and Accessories: Provide all required anchors, fasteners, miscellaneous components, and accessories as required for complete and finished railing installations. Bolts and studs, nuts, and washers must conform to ASTM A307, ASTM A449, and ASTM A563, as applicable, and must be galvanized in accordance with ASTM A153.
 1. Expansion Bolts: Where anchors are not included in the concrete construction, provide galvanized expansion type anchors with matching galvanized steel bolts or studs with nuts, of sizes as indicated or required. Provide washers under all bolt heads and nuts. Expansion bolts require approval of the Engineer before they may be installed in post-tensioned slabs. Expansion bolts will not be permitted for use on concrete curbs or along the edge of concrete or a concrete joint.
- M. Welding Rod/Electrodes: Refer to Section 05 05 60, Metal Welding, for requirements.

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2.02 FABRICATION

- A. Metal handrails and guardrails must be fabricated by firms or shops experienced and skilled in the custom fabrication of architectural metal handrails and railings, and must meet the quality requirements of NAAMM's Pipe Railing Systems Manual.
- B. Bends in rails must be precision-formed to a smooth continuous radius by skilled workers. Work quality and finish must be true to detail. Butt joints must have internal pipe sleeve or dowel. Ends must be closed with similar materials, welded and ground smooth.
- C. Steel welded connections must be made in accordance with applicable requirements of Section 05 05 60, Metal Welding. Welding must be performed in the shop unless otherwise indicated. Welded joints of handrails and railings must be ground and dressed smooth to match adjacent surfaces and so that the shape and profile of the item welded is maintained.
- D. Metal handrails and railings must be prefabricated and preassembled in the factory or shop as far as practicable.

2.03 GALVANIZING

- A. Ferrous metal railings and related items on the exterior of the building, or as otherwise indicated, must be galvanized, after fabrication, by the hot-dip process in accordance with ASTM A123 and ASTM A385. Weight of zinc coating must conform to requirements specified under Weight of Coating in ASTM A123.
- B. Safeguarding against steel embrittlement must conform to applicable requirements of ASTM A143.
- C. Safeguarding against warpage and distortion of steel members must conform to applicable requirements of ASTM A384.
- D. Shop galvanized metalwork necessitating field welding which in any manner removes original galvanizing must be restored by galvanizing repair in accordance with ASTM A780.
- E. Bolts and screws for attachment of galvanized items must be galvanized in accordance with ASTM A153, or of compatible, non-corrodible material.

2.04 CLEANING AND PAINTING

- A. Cleaning and painting must conform to like requirements specified in Section 05 50 00, Metal Fabrications.
- B. All surfaces of metal handrails and railings must be cleaned and treated to assure maximum paint adherence, prior to application of the shop prime coat, in accordance with SSPC-SP 1, SSPC-SP 3, SSPC-SP 10/NACE No. 2, SSPC-SP 11 as applicable for the type of substrate, exposure, and application.
- C. Ferrous metalwork must be given a shop coat of rust-inhibitive metal primer as specified in Section 05 50 00, Metal Fabrications, or other approved rust-inhibitive metal primer standard with the railing manufacturer. All surfaces of handrails and railings must be spray-painted.
- D. Where galvanized surfaces are indicated to be painted, comply with cleaning and painting requirements of Section 05 50 00, Metal Fabrications.

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- E. Coordinate with Section 09 91 00 – Painting, for compatibility of the prime coat and finish coats of paint.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install metal handrails and guardrails as indicated and in accordance with the approved Shop Drawings, using workers skilled and experienced in the installation of the type of work involved. Conform to the installation requirements of NAAMM’s Pipe Railing Systems Manual, as applicable.
- B. Install metal handrails and guardrails with accessories furnished by the railing fabricator as required for complete and finished railing installations.
- C. Installation of handrails and guardrails must be in accordance with approved Shop Drawings, true and horizontal, perpendicular, or at the required angle, as the case may be, level and square, with angles and edges parallel with related lines of the building or structure.
- D. Field welding, where required, must conform to requirements of Section 05 05 60, Metal Welding.
- E. Where railing base plates require grouting, conform to requirements of Section 03 62 00, Non-Shrink Grout as applicable.

3.02 GALVANIZING REPAIR

- A. Galvanized surfaces which have become damaged from welding, handling, or installation must be repaired immediately after installation with galvanizing repair material in accordance with ASTM A780.

3.03 FIELD PAINTING

- A. After installation, exposed painted surfaces, field welds, and other abraded or damaged primed surfaces must be prepared as required and touched up with an additional coat of the same primers for ferrous and galvanized surfaces as hereinbefore specified for shop painting.
- B. Lightly sand and feather out such damaged surfaces so that paint touch-up becomes invisible. Spray-paint all touch-up work.
- C. Finish field painting is specified in Section 09 91 00, Painting.

END OF SECTION 05 52 00

SECTION 05 52 01

METAL RAILING (BRIDGE)

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:

1. Metal railings on Capitol Aerial Guideway

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 62 00, Non-Shrink Grouting
- D. Section 05 05 60, Metal Welding
- E. Section 05 12 35, Structural Steel
- F. Section 05 50 00, Metal Fabrications
- G. Section 05 17 00, Miscellaneous Metal
- H. Section 05 52 00, Metal Railings (Stations)
- I. Section 09 91 00, Painting

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
- | | | |
|----|-----------------|--|
| 1. | ASTM A36/A36M | Specification for Carbon Structural Steel |
| 2. | ASTM A53/A53M | Pipe, Steel, Black and Hot- Dipped, Zinc-Coated, Welded and Seamless |
| 3. | ASTM A780/A780M | Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
- B. National Association of Architectural Metal Manufacturers (NAAMM):
- | | | |
|----|------------------|---|
| 1. | NAAMM AMP 521-01 | Pipe Railing Systems Manual, Including Round Tube |
|----|------------------|---|

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1.04 SUBMITTALS

- A. General: Submittals for metal railing (bridge) must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.

- B. Shop Drawings: Submit detailed Shop Drawings of metal railings prior to fabrication, showing railing layout, sizes, bends and radii, locations of hardware, anchors, and accessories, and installation details. Include complete details for the fabrication and construction of the work, including construction methods, sequence and methods of shop and field assembly, and installation procedures
 - 1. Welds, both shop and field, must be indicated by standard welding symbols of AWS A2.4. Drawings must show the size, length, and type of each weld.
 - 2. Allow 25 days for review.

- C. Product Data: Submit manufacturers' product data of railing system and railing components, handrails, and handrail brackets. Include corrosion-inhibitive shop coat painting system.

- D. Mill Certificates:
 - 1. Provide Mill Certificates for each grade of steel for each heat to be used on project.
 - 2. Mill Certificates must include name of mill, date of rolling, date of shipping, ultimate tensile strength, yield strength, and percent of elongation.
 - 3. Mill Certificates must be furnished with each lot of material shipped to the Worksite and must be signed by the Contractor which will serve to certify that all structural steel materials installed comply with specified requirements.
 - 4. When Mill Certificates cannot be provided, hire a professional testing laboratory to verify compliance of each type of material to be used and provide laboratory test reports. The cost of testing must be paid for by the Contractor.

1.05 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.

- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.

- C. Contractor Quality Control:
 - 1. Welding: Welding quality control must be in accordance with the provisions of Section 05 05 60, Metal Welding.
 - 2. Grouting: Grouting quality control must be in accordance with the provisions of Section 03 62 00, Non-Shrink Grouting.

- D. VTA Quality Assurance:
 - 1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Conditions.

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2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.06 MEASUREMENT AND PAYMENT

- A. Measurement: Metal Railing (Bridge) must be measured by the linear foot.
 1. The payment quantity for Metal Railing (Bridge) is the length measured from end to end along the face of the railing, including intermediate posts.
- B. Payment: The contract price paid per linear foot for Metal Railing (Bridge) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Railing (Bridge) complete in place, including railing splices, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel Pipe: ASTM A53/A53M, Type S, Grade B. Hydrostatic testing does not apply.
- B. Steel Plates and Bars: ASTM A36/A36M, weldable quality.
- C. Welding Rod/Electrodes: Refer to Section 05 05 60, Metal Welding, for requirements.
- D. Non-Shrink Grout: Refer to Section 03 62 00, Non-Shrink Grouting, for requirements.
- E. Paint: Refer to Section 05 50 00, Metal Fabrications, and Section 09 91 00, Painting, for requirements.

2.02 FABRICATION

- A. Railings must present a smooth, uniform appearance in their final position, conforming closely to the horizontal and vertical lines shown or ordered.
- B. Butt joints must have internal pipe sleeves or dowels, unless shown otherwise in the plans.
- C. Free ends of horizontal pipe members must be closed with steel plate, welded and ground smooth to match the shape and profile of the horizontal pipe.
- D. Railings must conform to the curvature by means of a series of short chords, from center-to-center of rail posts. Joints must be matchmarked.
- E. Metal railings must be prefabricated and preassembled in the factory or shop as far as practicable.
- F. Steel welded connections must be made in accordance with applicable requirements of Section 05 05 60, Metal Welding. Welding must be performed in the shop unless otherwise indicated.
- G. Grind welds on exposed surfaces flush with the adjacent surfaces.

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- H. Carefully handle the materials such that no parts are bent, broken, abraded, or otherwise damaged. Do not use manufacturing, handling, or installation methods that damage or distort the members or damage the galvanizing.

2.03 GALVANIZING

- A. Metal railings and related items must be galvanized in accordance with Section 05 50 00, Metal Fabrications.
- B. After galvanizing, the railing elements must be free of fins, abrasions, rough or sharp edges, and other surface defects and must not be kinked, twisted, or bent. If straightening is necessary, use a method authorized by the VTA. Elements with kinks, twists, or bends may be rejected.
- C. Clean and regalvanize abraded or damaged galvanized surfaces of steel railing elements and posts. Clean and regalvanize ends of steel railing elements cut after galvanizing.

2.04 CLEANING AND PAINTING

- A. Where galvanized surfaces are indicated to be painted, comply with preparing, cleaning, and painting requirements of Section 05 50 00, Metal Fabrications.
- B. Coordinate with Section 09 91 00, Painting, for compatibility of the prime coat and finish coats of paint.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install metal railings as indicated and in accordance with the approved Shop Drawings, using workers skilled and experienced in the installation of the type of work involved. Conform with the installation requirements of NAAMM AMP 521-01, as applicable.
- B. Railings must present a smooth, uniform appearance in their final position, conforming closely to the horizontal and vertical lines shown or ordered.
- C. Installation of railings must be in accordance with approved Shop Drawings.
- D. Erect railings carefully and true to line and grade. Posts must be normal to the profile grade. Transverse to the profile grade, railings must be plumb within a tolerance not to exceed 0.02 foot in 10 feet. Adjacent rail elements must align with each other within 1/16 inch.
- E. Install metal railings with accessories furnished by the railing fabricator as required for complete and finished railing installations.
- F. Field welding, where required, must conform with requirements of Section 05 05 60, Metal Welding.
- G. Where railing post pockets require grouting, conform with requirements of Section 03 62 00, Non-Shrink Grouting.

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- H. Carefully handle the materials such that no parts are bent, broken, abraded, or otherwise damaged. Do not use manufacturing, handling, or installation methods that damage or distort the members or damage the galvanizing.

3.02 GALVANIZING REPAIR

- A. Galvanized surfaces which have become damaged from welding, handling, or installation must be repaired immediately after installation with galvanizing repair material in accordance with ASTM A780/A780M.

3.03 FIELD PAINTING

- A. Finish field painting is specified in Section 09 91 00, Painting.
- B. After installation, exposed painted surfaces, field welds, and other abraded or damaged primed surfaces must be prepared as required and touched up with two coats of matching and compatible paint.
- C. Lightly sand and feather out such damaged surfaces so that paint touch-up becomes invisible. Spray-paint all touch-up work.

END OF SECTION 05 52 01

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SECTION 05 55 16
METAL STAIR NOSING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes specifications for:
 - 1. Two-part Aluminum Stair Nosing

1.02 RELATED SECTIONS

- A. Section 03 11 00, Concrete Formwork
- B. Section 03 30 00, Cast-in-Place Concrete
- C. Section 03 35 00, Concrete Finishing
- D. Section 05 50 00, Metal Fabrications

1.03 REFERENCED STANDARDS

- A. American Disability Act (ADA) Barrier-free Code Design
- B. ASTM International (ASTM):
 - 1. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- C. American Welding Society (AWS)
- D. International Building Code (IBC)
- E. Occupational Safety and Health Association (OSHA):
- F. 2016 California building Code (CBC), Title 24, California Code of Regulations, Chapter 11B, Section 504
- G. UL:
 - 1. 1994 Luminous Egress Path Markings

1.04 SUBMITTALS

- A. General
 - 1. Submittals for architectural treatment must be made in accordance with the provisions in these Technical Specifications.

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2. The Contractor must submit the following:
 - a. Product Data: Submit manufacturer’s product literature describing products, material compliance and specified options.
 - 1) Product Data for stair nosings.
 - 2) Installation and maintenance instructions.
 - 3) Manufacturer’s recommendations for repair or reconditioning respective parts, products and materials during and beyond the life of all guarantees and warranties.
 - b. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, fabrication, and recommended installation instructions.
 - 1) Construction details, sizes of metal sections, thicknesses of metals, profiles, attachments, dimensions and field joints, method of support from structure, finishes, and work to be built-in or provided by other Sections.
 - 2) Welding: Indicate welded connections, both shop and field, using standard AWS welding symbols. Indicate net weld length.
 - c. Samples: Submit two (2) tread nosing six (6) inches long depicting exact colors of materials as specified herein.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked “No Exception Taken” or “Make Corrections Noted” and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Metal Stair Nosing must be measured by the linear foot.
- B. Payment: The contract price paid per linear foot for Metal Stair Nosing must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Stair Nosing complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Comply with the minimum requirements, unless otherwise noted or shown in the drawings, of the codes and regulations listed under the article entitled “References” of these specifications.
- B. All aluminum and aluminum alloy components must comply with the requirements of ASTM B221.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Exercise proper care in handling of Work so as not to injure finished surfaces. Protect Work from damage after it is in place.
- B. Store materials under cover in a dry and clean location off the ground.

1.08 WARRANTY

- A. Provide manufacturer’s standard warranty. Stair treads and nosings must be free from manufacturing defects in materials, fabrication, and installation for a minimum period of five (5) years from the date of acceptance by VTA.

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- B. Should a product fail to function in normal use within this period, manufacturer must furnish a new part at no charge.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Two-Part Ribbed Bar Abrasive Nosing, Model No: STTB-P3.375E as manufactured by Nystrom or VTA approved equal.
1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 2. Nystrom. Address: 9300 73rd Avenue N, Minneapolis, MN 55428; Phone: (800) 547-2635; Website: www.Nystrom.com

2.02 MATERIALS

- B. Provide Two Part Stair Nosing Extruded Units with replaceable tread (for ease of future replacement): One part, Sub-channel and removable plywood insert that is replaced with a screw down abrasive tread (installed after stairs are complete to minimize damage during construction). Tread must be full solid type abrasive designs. Second part must be Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Stair nosing must have full radius return and single piece with no joints. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Base nosing must be type 6063-T6 extruded aluminum.
 2. Finish: Natural Aluminum.
 3. Nosing type: Short Tipped Nose: 3-3/8-inches wide, with 1/2 –inch lip for poured concrete and steel pan applications.
 - a. Attachment Method: Cast-in, continuous extruded wing anchor.
 - b. Painted Undersides, to prevent adverse reaction between metal and concrete.
 4. Ribbed bar with abrasive filler strips no less than flush with the aluminum extrusion.
 - a. Abrasive Color: Yellow, UL 1994 listed photoluminescent.
 - b. Tread Abrasive: Anti-slip abrasive of grain aluminum oxide silicon carbonite granules in a UV protected, two part epoxy locked into extruded channels.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that preparation and affected dimensions are acceptable. Installer must not proceed until conditions are acceptable.
- B. Verify tolerances and correct improper conditions.

3.02 INSTALLATION

- A. Install stair treads and nosings in accordance with the governing regulations, the industry standards applicable to the work and the manufacturer's written instructions.

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- B. Align work plumb, level and where required, flush with adjacent surfaced and rigidly anchored to the substrate.

3.03 CLEANING

- A. Clean exposed surfaces as recommended by the manufacturer.

3.04 PROTECTION

- A. Cover during wet-type operation including painting and decorating.

END OF SECTION 05 55 16

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes the requirements for furnishing wood, nails, bolts, screws, framing anchors and other rough hardware, and other items needed, and perform rough carpentry for the construction shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
1. Wood Nailers, Backing, and Blocking
 2. Anchors and Fasteners
 3. Miscellaneous Rough Carpentry and related Rough Hardware

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions

1.03 REFERENCED STANDARDS

- A. American Plywood Association and The Engineered Wood Association (APA):
1. U.S. Product Standard PS-1 Structural Plywood
 2. Plywood Specification and Grade Guide
 3. APA grade trademark
- B. ASTM International (ASTM):
1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
- C. American Wood Preservers Association (AWPA):
1. AWPA C1 Al Timbers Products – Preservative Treatment by Pressure Process
 2. AWPA T1 Use Category System: Processing and Treatment Standard
- D. Federal Specifications (FS):
1. TT-W-550 Wood Preservative, Chromated Copper Arsenate Mixture
 2. TT-W-571 Wood Preservation: Treating Practices
- E. West Coast Lumber Inspection Bureau (WCLIB):
1. WCLIB No. 17 Standard Grading Rules
- F. National Fire Protection Association (NFPA):
1. NFPA 101, Section 10.2.3.4.1

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- G. Underwriters Laboratories (UL):
 - 1. UL Classification Marking – Fire Hazard

1.04 SUBMITTALS

- A. Submittals for Rough Carpentry must be made in accordance with the provisions in Section 6.6.2, Submittals, of the Special Conditions, and these technical specifications.
- B. Certification: Provide AWPA grade-stamped pressure-treated wood and plywood as specified herein, or submit certification by the fire-retardant pressure-treating plant that pressure-treated wood and plywood comply with the specified reference standards.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Rough Carpentry must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Rough Carpentry must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Rough Carpentry, complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Keep wood products under cover and dry. Protect against exposure to moisture and contact with damp or wet surfaces. Stack material in a manner that promotes air circulation.
- B. Deliver the materials to the job site and store, in a safe area, out of the way of traffic, and shored up off the ground surface.
- C. Identify framing lumber as to grades, and store each grade separately from other grades.
- D. Protect metals with adequate waterproof outer wrapping.
- E. Use extreme care in off loading of lumber to prevent damage, splitting, and breaking of materials.

1.07 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Wood Nailers, Backing, and Blocking
 - 1. Wood nailers or nailing strips, backing, and blocking must be “Construction” or “No. 1” grade Douglas fir as defined in WCLIB No. 17, of size and dimensions indicated or required. Moisture content must not exceed 19 percent at time of installation.
 - a. Fire Retardant Treatment: Wood nailers, backing, and blocking must be pressure-

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impregnated with an AWWPA C1 fire-retardant chemical suitable for the purpose. Each treated member must be stamped with the AWWPA approved trademark and, in addition, the Classification Marking of the UL Inc. for Fire Hazard Classification must be affixed to the back of each member. Wood nailers and blocking members must be precut to size and shape before being treated to preclude the need for field cutting and thus exposing untreated surfaces at cut ends. Any members that must still be cut in the field must be dipped, after cutting, in the same fire-retardant chemical that was used in the pressure treating process.

- b. Preservative Treatment: Where wood members are indicated or required to be treated with preservative material, provide pressure-treated “Construction” or “No. 1” grade Douglas fir, treated in accordance with FS TT-W-550 for preservative material (CCA) and FS TT-W-571 or AWWPA C1 for pressure treating.
- c. Treated members using copper must not contact galvanized materials.
- 2. Plywood must be Group 1 Species meeting requirements of U.S. Product Standard PS-1, of sizes and thicknesses indicated or required. Minimum thickness must be 5/8 inch. Each panel must carry the APA grade trademark. Plywood must be Exterior Grade or manufactured with Exterior Glue, with C-C or C-D (plugged) faces.
 - a. Fire-Retardant Treatment: Plywood must be fire-retardant treated in accordance with AWWPA C1 to have a flame spread rating of less than 25 (NFPA 101, Section 10.2.3.4.1) when tested in accordance with ASTM E84. Comply also with applicable requirements specified above for wood nailers and blocking.

B. Anchors and Fasteners

- 1. Wood nailers, backing, and blocking must be anchored to metal decking with self-drilling, self-tapping, tempered steel screws manufactured for the purpose of securing items to metal decking.
- 2. Wood and plywood backing and blocking must be secured to metal framing for gypsum board walls and partitions with self-drilling, self-tapping tempered steel drywall screws of type and size required for the installation.
- 3. Toggle bolts or screws may be employed to secure wood members to metal framing and substrates through drilled holes, provided the winged anchor is not visible in the finished work.
- 4. All anchors and fasteners must be stainless steel, galvanized, or specially treated to prevent corrosion as approved by the Engineer.
- 5. Galvanized anchors and fasteners must not be used with Treated members containing copper.

2.02 GRADE STAMPS

- A. Identify plywood as to species, grade, and glue type by the stamp of the American Plywood Association.
- B. Identify other materials of this Section by the appropriate stamp of the agency approved in advance by the Engineer.

2.03 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

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PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install wood nailers, backing, and blocking where indicated and where required for attachment and anchorage of other work.
- B. Coordinate location of wood members with other work involved. Provide wood nailers to be embedded in concrete for installation in formwork at the proper time.
- C. Attach wood members to substrates as required to support applied loading. Countersink bolt heads and nuts flush with surfaces, unless otherwise indicated.

3.02 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.03 DELIVERIES

- A. Stockpile materials sufficiently in advance of need to assure their availability in a timely manner for this Work.
- B. Make as many trips to the job site as are needed to deliver materials of this Section in a timely manner to ensure orderly progress of the Work.

3.04 COMPLIANCE

- A. Do not permit materials not complying with the provisions of this Section to be brought onto or to be stored at the job site.
- B. Promptly remove non-complying materials from the job site and replace with materials meeting the requirements of this Section.

3.05 WORKMANSHIP

- A. Produce joints which are tight, true, and well nailed, with members assembled in accordance with the Drawings and with pertinent codes and regulations.
- B. Selection of lumber pieces:
 - 1. Carefully select the members.
 - 2. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing, and will allow making of proper connections.
 - 3. Cut out and discard defects which render a piece unable to serve its intended function.
 - 4. Lumber may be rejected by the Engineer, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.
- C. Do not shim any framing component.

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3.06 GENERAL FRAMING

A. General:

1. In addition to framing operations normal to the fabrication and erection indicated on the Drawings, install wood blocking and backing required for the work of other trades.
2. Set horizontal and sloped members with crown up.
3. Do not notch, cut, or bore members for pipes, ducts, or conduits, or for other reasons except as shown on the Drawings or as specifically reviewed in advance by the Engineer.

B. Bearings:

1. Make bearings full unless otherwise indicated on the Drawings.
2. Finish bearing surfaces on which structural members are to rest so as to give sure and even support.
3. Where framing members slope, cut or notch the ends as required to give uniform bearing surface.

3.07 BLOCKING AND BRIDGING

- A. Install blocking as required to support items of finish and to cut off concealed draft openings, both vertical and horizontal, between ceiling and floor areas.

B. Bridging:

1. Install wood cross bridging (not less than 2 -inch x 3 -inch nominal), metal cross bridging of equal strength, or solid blocking between joists where the span exceeds 8 foot.
2. Provide maximum distance of 8 feet between a line of bridging and a bearing.
3. Cross bridging may be omitted for roof and ceiling joists where the omission is permitted by code, except where otherwise indicated on the Drawings.
4. Install solid blocking between joists at points of support and wherever sheathing is discontinuous. Blocking may be omitted where joists are supported on metal hangers.

3.08 ALIGNMENT

- A. On framing members to receive a finished surface, align the finish subsurface to vary not more than 1/8 – inch from the plan of surfaces of adjacent furring and framing members.

3.09 INSTALLATION OF PLYWOOD SHEATHING

A. Placement:

1. Place plywood with face grain perpendicular to supports and continuously over at least two supports, except where otherwise shown on the Drawings.
2. Center joints accurately over supports, unless otherwise shown on the Drawings.

- B. Protect plywood from moisture by use of waterproof coverings until the plywood in turn has been covered with the next succeeding component or finish.

3.10 FASTENING

A. Nailing:

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1. Use only common wire nails or spikes of the dimension shown on the Nailing Schedule, except where otherwise specifically noted on the Drawings.
2. For conditions not covered in the Nailing Schedule provide penetration into the piece receiving the point of not less than 1/2 the length of the nail or spike, provided, however, that 16d nails may be used to connect two pieces of 2" (nominal) thickness.
3. Nail without splitting wood.
4. Prebore as required.
5. Remove split members and replace with members complying with the specified requirements.

B. Bolting:

1. Drill holes 1/16" larger in diameter than the bolts being used.
2. Drill straight and true from one side only.
3. Do not bear bolt heads on wood, but use washers under head and nut where both bear on wood, and use washers under all nuts.

C. Screws:

1. For lag screws and wood screws, prebore holes same diameter as root of thread, enlarging holes to shank diameter for length of shank.

END OF SECTION 06 10 00

SECTION 06 16 53

MOISTURE-RESISTANT SHEATHING BOARD

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes the requirements for furnishing and installing Fiberglass-mat faced, moisture and mold resistant gypsum sheathing as indicated on the Drawings, as specified herein, and as needed for a complete and proper installation. Section includes requirements for:

1. Gypsum Sheathing
2. Accessories

1.02 RELATED SECTIONS

- A. Section 05 40 00, Cold-Formed Metal Framing
- B. Section 06 10 00, Rough Carpentry
- C. Section 07 90 00, Joint Protection
- D. Section 09 29 00, Gypsum Board

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM C11 Standard Terminology Relating to Gypsum and Related Building
 2. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products
 3. ASTM C475 Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
 4. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 5. ASTM C630 Standard Specification for Water-Resistant Gypsum Backing Board
 6. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board
 7. ASTM C954 Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inches to 0.112 inches in Thickness
 8. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
 9. ASTM C1047 Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
 10. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 11. ASTM C1280 Standard Specification for Application of Gypsum Sheathing
 12. ASTM C1396 Standard Specification for Gypsum Board
 13. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

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- 14. ASTM D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers
- 15. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- 16. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
- 17. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials
- 18. ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C
- 19. ASTM E497 Standard Practice for Installing Sound-Isolating Lightweight Partitions

B. Gypsum Association (GA): GA-253 Application of Gypsum Sheathing

1.04 SUBMITTALS

A. Product data:

- 1. Materials list of items proposed to be provided under this Section.
- 2. Manufacturers' specifications and other data needed to prove compliance with the specified requirements.
- 3. Manufacturers' recommended installation.

1.05 MEASUREMENT AND PAYMENT

A. Measurement: Moisture-Resistant Sheathing Board must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.

B. Payment: The lump sum payment for Moisture-Resistant Sheathing Board must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Moisture-Resistant Sheathing Board complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 REGULATORY REQUIREMENTS

A. In addition to the foregoing referenced standards, the regulatory requirements which govern the work of this Section include the following governing code.

- 1. California Code of Regulations (CCR), Title 24, Part 2, California Building Code, Chapters 25 and 25A, "Gypsum Board and Plaster."

1.07 DEFINITIONS

A. Words and terms used in this Section and not defined herein must be interpreted in accordance with the definitions given in ASTM C11.

1.08 QUALITY ASSURANCE

A. Installation and Finishing: Comply with applicable requirements of the California Building Code, Chapters 25 and 25A, and ASTM C840.

B. Installation of Sound-Retardant Partitions: Comply with applicable requirements of ASTM E497.

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1.09 JOBSITE CONDITIONS

- A. Maintain room temperature of not less than 40 degrees Fahrenheit during application of gypsum board, and 50 degrees Fahrenheit during application of joint treatment and for 48 hours thereafter. If temporary heat is provided, do not allow the temperature to exceed 95 degrees Fahrenheit.
- B. Maintain adequate ventilation in the working area during installation and finishing.

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers or bundles bearing the brand name, applicable standard designation, and the name of the manufacturer or supplier from whom the product is manufactured.
- B. Deliver materials to the site and store them in the work area if possible, so that materials will have a minimum period of 24-hours storage at the same temperature as the installation area.
- C. Store sheathing board in the horizontal position. When necessary to stack palettes, align blocking vertically to avoid distortion of boards. Keep materials dry, fully protected from weather and direct sunlight exposure.

1.11 WARRANTY

- A. Provide products that offer twelve months of coverage against in-place exposure damage (delamination, deterioration, and decay) commencing with the date of installation of the product in such structure.
- B. Manufacturer's Warranty:
 - 1. Five years against manufacturing defects from the date of purchase of the product for installation.
 - 2. Twelve (12) years against manufacturing defects when used as a substrate in architecturally specified EIFS.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Board Type and Thickness: Refer to indicated details and notes on the Contract Drawings for type and thickness of board. Where thickness is not indicated, provide 5/8-inch-thick board.
- B. Gypsum Sheathing: Fire-Rated Fiberglass-Mat Faced, Moisture and Mold Resistant Gypsum Sheathing: ASTM C1177, Type X:
 - 1. Thickness: 5/8-inch
 - 2. Weight 2.5 lb/sq.ft.
 - 3. Edges: Square
 - 4. Surfacing: Fiberglass mat on face, back, and long edges
 - 5. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 654 pounds per square foot, dry
 - 6. Flexural Strength, Parallel (ASTM C1177): 100 lbf, parallel

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7. Humidified Deflection (ASTM C1177): Not more than 1/8-inch
 8. Permeance (ASTM E96): Not less than 17 perms
 9. R-Value (ASTM C518): 0.67
 10. Mold Resistance (ASTM D3273): 10, in a test as manufactured
 11. Microbial Resistance (ASTM D6329, UL Environmental GREENGUARD three-week protocol): Will not support microbial growth
- C. Joint Compound and Tape: ASTM C475, joint tape, taping compound, and finishing compound. All-purposed compound may be substituted for taping compound and finishing compound.
- D. Accessories: ASTM C1047, galvanized steel. Provide metal corner bead for all external corners and angles and metal edge trim at all junctions of gypsum wallboard and walls of other materials and for all exposed edges.
- E. Screws: ASTM C1002, corrosion resistant treated and as applicable for type of metal framing, of required lengths.
- F. Sealant: Sealant for holes or penetrations in acoustical and damp-service partitions must conform to applicable requirements of Section 07 90 00, Joint Protection.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
1. Inspection: Verify that project conditions and substrates are acceptable, to the installer, to begin installation of work of this section.

3.02 INSTALLATION

- A. General: In accordance with GA-253, ASTM C12802 and the manufacturer's recommendations.
- B. Before applying sheathing board, verify that corners and framing are plumb, true, and solid. Apply no sheathing board until conduits, boxes, pipes, ducts, vents, supports, fixture frames, blocking and backing, and the like are in place and inspected, tested, and approved as required. All edges and ends of sheathing board must have solid bearing. Notify VTA in writing of all conditions detrimental to the timely completion of the work. Do not proceed with the work of this Section until all unsatisfactory conditions have been corrected.

3.04 PROTECTION

- A. Protect gypsum board installations from damage and deterioration until date of Substantial Completion.

END OF SECTION 06 16 53

SECTION 07 13 29

BUTYL RUBBER MEMBRANE WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
 - 1. Butyl rubber membrane waterproofing
 - 2. Asphalt panels (protective cover)
 - 3. Sealing compound

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 30 00, Cast-in-Place Concrete
- D. Section 03 35 00, Concrete Finishing

1.03 DEFINITIONS

- A. The terms “asphalt panel” and “protective cover” are used interchangeably.

1.04 REFERENCED STANDARDS

- A. American Railway Engineering and Maintenance of Way Association (AREMA):
 - 1. AREMA Manual for Railway Engineering, herein referred to as the "AREMA Manual", Chapter 8, Part 29, "Waterproofing"

1.05 SUBMITTALS

- A. General: Submittals for butyl rubber membrane waterproofing must be made in accordance with Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Working Drawings: Working drawings must show all details of the butyl rubber membrane waterproofing system including the asphalt panel protective cover. The details must be in accordance with the manufacturer's recommendations for each projection, opening, corner, splice, and termination including typical details at top of waterproofing membrane and asphalt panels at wing walls, retaining walls, or barrier slabs. The working drawings must include a list of all materials and a description of the procedures to be following during installation.

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- C. Product Data: Submit product data and manufacturer's installation instruction and recommendations for waterproofing membrane, primers, adhesives, protective cover, anti-bond paper, and other materials. Include detailed installation instructions for both vertical and horizontal applications.
- D. Certificates of Compliance: Submit certificates of compliance for the membrane and asphalt panels.
- E. Manufacturer's Certification: At completion of the installation, submit written certification, signed by the manufacturer or its authorized representative, that the materials used in the waterproofing work were in accordance with these Technical Specifications, and that they were installed in accordance with the material manufacturer's installation instructions and recommendations.

1.06 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
 - 1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 01 45 00, Quality Control.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify the Engineer at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. The Engineer may elect to observe these procedures. Provide samples and facilities for inspection to the Engineer without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by the Engineer.
 - 2. Qualifications of the Independent Testing Agency: Refer to Section 01 45 00, Quality Control.
 - 3. Membrane waterproofing system must be installed by an applicator/installer skilled and experienced in the type of work involved. Applicator must be approved by the manufacturer who furnishes the materials.
 - 4. The Contractor must make necessary arrangements with the manufacturer of the materials to be installed to provide on-site consultation and inspection service to assure the correct installation of the membrane waterproofing.
 - 5. The manufacturer's representative must be present at the time any phase of the work is performed. Membrane waterproofing must be applied only over substrate surfaces approved by the manufacturer's representative.
- D. VTA Quality Assurance:

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1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Provisions.
2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.07 WARRANTY

- A. In addition to the warranty requirements specified in Section 7, General Conditions, membrane waterproofing work must be guaranteed against leakage, defective materials and defective installation of the completed waterproofing work. Any such defects or leakage occurring during the period of the warranty must be promptly and completely corrected, including all affected work, at no additional cost to the VTA.
- B. Said warranty must be in effect for a period of five years from the date of Final Acceptance issued by the VTA. The warranty must be signed by the waterproofing applicator or installer and countersigned by the Contractor, and must be submitted to the VTA.

1.08 MEASUREMENT AND PAYMENT

- A. Measurement: Butyl Rubber Membrane Waterproofing must be measured by the square foot.
 1. The payment quantity for Butyl Rubber Membrane Waterproofing must be computed from measurements along the slopes of the actual areas placed.
- B. Payment: The contract price paid per square foot for Butyl Rubber Membrane Waterproofing must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Butyl Rubber Membrane Waterproofing complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
- C. Full compensation for providing and installing adhesives, tape, asphalt panels, splices, flashing, and accessories must be considered as included in the bid item for Butyl Rubber Membrane Waterproofing and no additional compensation will be allowed therefor.
- D. Full compensation for cleaning and preparing concrete surfaces and patching membrane must be considered as included in the bid item for Butyl Rubber Membrane Waterproofing and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Membrane: The waterproofing membrane must consist of butyl rubber secured with an authorized adhesive. You may substitute ethylene propylene diene monomer (EPDM) for the butyl rubber if it complies with the specifications for butyl rubber.
 1. The butyl rubber membrane must comply with the AREMA Manual for Railway Engineering, chapter 8, part 29, section 29.9.5.
 2. The butyl rubber membrane must be at least 0.060 inch thick.

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- B. Adhesive: The adhesive must comply with the AREMA Manual for Railway Engineering, chapter 8, part 29. Adhesive must be manufactured for use with the membrane material used, as recommended by the membrane manufacturer.
- C. Splicing Cement: The splicing cement must comply with the AREMA Manual for Railway Engineering, chapter 8, part 29.
- D. Butyl Gum Splicing Tape: The butyl gum splicing tape must comply with the AREMA Manual for Railway Engineering, chapter 8, part 29.
- E. Antibonding Paper: The antibonding paper must comply with the AREMA Manual for Railway Engineering, chapter 8, part 29.
- F. Fibered Aluminum Roof Coating: The fibered aluminum roof coating must comply with the AREMA Manual for Railway Engineering, chapter 8, part 29.
- G. Asphalt Panels: Asphalt panels must comply with the AREMA Manual for Railway Engineering, chapter 8, part 29, and must consist of a minimum of two layers of asphaltic panels applied with adhesive and sealing compound to a total thickness as shown in the plans.
 - 1. The individual asphalt panels must be at least 3/8 inch thick.
 - 2. The combined total thickness of all layers of asphaltic panels must be at least 3/4 inch.
 - 3. The installed asphalt panels must be at least 4 by 8 feet except as cut for closures.
 - 4. Ship and store the panels on smooth, flat surfaces.
- H. Sealing Compound: Sealing compound for joints and edges of asphalt panels must be compatible with the membrane, the adhesive used to fasten the membrane to the deck, the splicing cement, and the asphalt panels themselves.

PART 3 - EXECUTION

3.01 EXAMINATION AND CLEANING OF SUBSTRATE

- A. Finishing and curing of concrete surfaces to receive membrane waterproofing are specified in Section 03 35 00, Concrete Finishing.
- B. Verify that substrate surfaces are clean and dry, and that concrete is properly aged. The surface to be waterproofed must be dry when the membrane is applied.
- C. Verify that substrate and backing surfaces are smooth and rigid where membrane turns up.
- D. Vacuum-clean the concrete surfaces to receive the seal to clean them of dirt, dust, gravel, loose concrete particles, and other extraneous materials.
- E. Remove projections and fill depressions that could damage the membrane.
- F. Use rounded or chamfered edges on outside corners of the substrate and suitable fillets on inside corners of the substrate to prevent right-angle bends of the membrane.

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3.02 APPLICATION

- A. Do not apply the membrane when the atmospheric temperature is below 34 degrees Fahrenheit.
- B. Membrane waterproofing for vertical and horizontal surfaces must be applied in accordance with the manufacturer's latest specifications and installation instructions for membrane waterproofing.
- C. Do not apply the membrane waterproofing until you are prepared to place the asphalt panels within a short enough time such that the membrane is not damaged by workers, equipment, exposure to weathering, or any other cause. Repair or replace damaged membrane.
- D. Reinforce membrane at inside and outside corners and edges and around penetrations and projections in the substrate. Clamp membrane properly into floor drains.
- E. The horizontal surfaces of the finished waterproofing must be free from depressions and pockets. The membrane must be carefully turned into drainage fittings. Take special care to make the waterproofing effective at the following locations:
 - 1. Along the faces of the barrier slabs, wingwalls, and curbs
 - 2. At joints, offsets in ballast retainers, and other discontinuities
- F. Apply the membrane using the following procedure:
 - 1. Position and draw the membrane sheets tight without stretching.
 - 2. Roll one half of the membrane uniformly in a direction away from the starting edge or subsequent splice.
 - 3. Apply the adhesive to the exposed deck area with a squeegee at a rate of at least one gallon per 100 square feet of deck surface.
 - 4. Allow the adhesive to dry to a tack-free condition.
 - 5. Unroll and press the membrane firmly and uniformly in place, avoiding trapping of air.
 - 6. Repeat the same procedure for the remaining half of the membrane sheet, avoiding wrinkles and buckles. Position each succeeding sheet to fit the previously installed sheet and splice the sheets.
- G. Membrane Splices:
 - 1. Membrane splices must be tongue-and-groove type as shown in figure 8-29-3, no. 3, of the AREMA Manual for Railway Engineering, chapter 8, part 29.
 - 2. Splice the membrane sheets using the following procedure:
 - a. Clean all seam, lap, and splice areas with heptane, hexane, toluene, trichloroethylene, or white gasoline using a clean cloth, mop, or similar synthetic cleaning device.
 - b. Spread splicing cement continuously on the seam, lap, and splice areas at a uniform rate of at least one gallon per 75 square feet based on both mating surfaces.
 - c. After the cement has dried to a tack-free condition, apply the butyl gum splicing tape to the cemented area of the membrane, extending the tape to at least 1/8 inch beyond the edges of the splice and lap areas.
 - d. Roll or press the tape firmly into place to obtain full contact, avoiding bridging and wrinkles.
 - e. Reinforce corner splices with two continuous layers of rubber membrane over one layer of butyl tape.

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- H. Flash all projections, such as pipes, conduits, and sleeves, passing through the membrane waterproofing with prefabricated or field-fabricated boots, fitted coverings, or other devices as necessary to provide watertight construction. Use butyl gum tape between layers of rubber membrane.
- I. Patch holes in the membrane sheeting under the manufacturer's instructions with a minimum overlap of four inches.
- J. Clean adjacent surfaces of spillage and splatterings of adhesive materials.

3.03 ASPHALT PANELS INSTALLATION

- A. After the membrane waterproofing application on vertical surfaces has been inspected and accepted by VTA, install asphalt panels in accordance with the manufacturer's installation instructions and recommendations, and as specified herein
- B. If the panels are shipped with an inert material between the sheets to prevent sticking, remove the inert material before installation.
- C. Before placing the asphalt panels, thoroughly clean the surface of the applied membrane of dirt, dust, loose or unsound concrete, and other extraneous material.
- D. Lay the asphalt panels with two superimposed layers. Offset the joints in the second layer from the joints in the first layer by approximately one-half the width of the panel.
- E. Lay the asphalt panels in an adhesive coating using the following procedure:
 - 1. Apply the adhesive with a squeegee at a rate of at least one gallon per 100 square feet of deck surface.
 - 2. As you lay successive panels, thoroughly coat the edges and ends of adjacent asphalt panels already laid with a sealing compound.
 - 3. Lay the asphalt panels tightly against those previously laid such that the sealing compound completely fills the joints and squeezes out at the top.
 - 4. After all of the asphalt panels have been laid, fill any voids between the panels with sealing compound.
- F. Where an edge or protrusion of asphaltic panels is exposed to prolonged sunlight, coat the area with fibered aluminum roof coating.
- G. Asphalt panels damaged during construction operations and activities must be immediately repaired or replaced.

3.04 FIELD QUALITY CONTROL

- A. The Independent Testing Agency must perform the following inspections and testing:
 - 1. Verify that installed membrane is free from wrinkles, blisters, and exposed surfaces. Damaged or defective membrane must be corrected.
 - 2. Verify that waterproof membrane is free from defects or damage before covering or concealing the membrane with subsequent construction and finishes.
- B. The Contractor must retain a representative of the waterproofing system manufacturer to provide full time inspection of field installation of all elements of the waterproofing system.

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- C. The Independent Testing Agency and a representative of the waterproofing system manufacturer must inspect the waterproofing assembly and notify the VTA of defects. All defects must be corrected at the expense of the Contractor.

END OF SECTION 07 13 29

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SECTION 07 13 54

THERMOPLASTIC SHEET WATERPROOFING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for furnishing and installing Thermoplastic membrane Sheet Waterproofing at the elevator pits and sump pits at the Story Station.

1.02 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete
- B. Section 32 11 23, Aggregate Base Courses

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM D413 Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate
 2. ASTM D568 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Flexible Plastics in a Vertical Position
 4. ASTM D570 Standard Test Method for Water Absorption of Plastics
 5. ASTM D638 Standard Test Method for Tensile Properties of Plastics
 6. ASTM D751 Standard Test Methods for Coated Fabrics
 7. ASTM D1004 Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
 8. ASTM D1204 Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
 9. ASTM D2136 Standard Test Method for Coated Fabrics-Low Temperature Bend Test
 10. ASTM D4434 Standard Specification for Poly(Vinyl Chloride) Sheet Roofing
- B. General Services Administration (GSA), Public Building Service (PBS):
1. GSA-PBS 07115 Exposure to Fungi in soil

1.04 SUBMITTALS

- A. General
1. Submittals for architectural treatment must be made in accordance with the provisions in these technical specifications.
 2. The Contractor must submit the following:
 - a. Product Data: Submit manufacturer's product literature and detailed installation instructions for horizontal and vertical surfaces.
 - b. Samples: Submit samples of the membrane waterproofing being proposed for use on this project. Samples must be considered as examples of finished color and texture of the membrane waterproofing system only.

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- c. License Certificate: Submit a currently dated Applicator's License Certificate issued by the manufacturer. The certificate must verify the applicator's qualifications to properly install the membrane waterproofing systems specified herein, and must commit the manufacturer to the acceptance of the applicator.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.
4. Submit manufacturers product literature, ICC Evaluation Service approval report and installation guidelines along with the manufacturer's standard details.
5. Submit Sample warranty certificate from manufacturer.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Thermoplastic Membrane Sheet Waterproofing must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Thermoplastic Membrane Sheet Waterproofing must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Thermoplastic Membrane Sheet Waterproofing, waterproofing for elevator pits, complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Applicator Qualifications: Applicator must be approved to install the specified system if the thermoplastic system is not installed by the manufacturer. Applicator must have a minimum of (3) years' experience in the work of the type required by this manual. Applicator must have completed and passed the manufacturers training and guidelines.
- B. Product Manufacturer: Waterproofing system must have approval by ICC Evaluation Service or other nationally recognized approval agency.
- C. Materials: Obtain waterproofing products and accessories from a single manufacturer to assure material compatibility or as approved by manufacturer.
- D. Independent Inspection: VTA may make arrangements to retain and approved Inspection Company. The inspection company must provide full time inspection while all waterproofing work is underway. The inspection company must be approved by the manufacturer and had previously completed the manufacturer's inspection training. A report must be provided.
- E. Pre-Installation Conference: Conduct Conference at the project site to comply with the requirements of Division 01 of the specifications. Review requirements of substrate preparation, penetrations, waterstop installation, PVC waterstop locations, and all termination conditions.
- F. Seam sampling: At a minimum of three times per day sample seam. Sample seam strength by cutting a cross section a minimum of two inches wide from a completed and probed seam. Test sample must be tested by inspection company and documented on inspection report. Inspection company must consult with manufacturer on level of acceptability.

1.07 DELIVERY, STORAGE, AND HANDLING

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- A. Delivery: Materials must be delivered in their original packaging, clearly marked with manufacturers' name, brand and type of material. Store materials to avoid damage from other trades, weather damage, or UV over exposure.
- B. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture with canvas tarpaulins.
- C. Membrane rolls must be stored lying down on pallets and be fully protected from moisture with canvas tarpaulins.
- D. Adhesives must be stored at temperatures above 40 degrees F and be covered. Do not store at a temperature greater than 80 degrees.
- E. All flammable materials must be stored in a cool dry area away from sparks and open flames.
- F. Any materials which are determined damaged by the owner's representative are to be removed from the job site and replaced at no cost to VTA.

1.08 JOB CONDITIONS

- A. Proceed with waterproofing membrane installation only after substrate preparation is complete. Obtain acceptance from the VTA's representative and the membrane manufacturer's representative of substrate surfaces before proceeding with membrane installation. Waterproofing contractor is responsible to ensure substrate is adequately prepared.
- B. The substrate must be clean and smooth. Do not work in rain or snow. Severe temperatures, moisture and humidity may affect the installation and performance of products during construction. Consult with the manufacturers and comply with applicable recommendations of all materials of workmanship and handling.
- C. Ensure that blind side substrate is sound and dry. If water is seeping for blind side substrate, report this to VTA representative for correction before proceeding.
- D. The contractor is cautioned that certain membranes are incompatible with asphalt and oil based and plastic based cements. Avoid contact with asphalt and oil- based products with PVC membranes. Contact manufacturer when this occurs.
- E. Arrange work sequence to avoid damage to newly constructed waterproofing. Any damage which occurs to the waterproofing membrane and/or system is to be brought to the attention of the VTA's representative, inspection firm and membrane manufacturer.
- F. Prior to and during application, all dirt, debris, and dust must be removed from the surface either by vacuuming, sweeping, blowing with compressed air and/or similar methods.
- G. Liquid materials such as solvents and adhesives must be stored and used away from open flames, sparks and excessive heat.
- H. Contaminants, such as grease, fats, oils, and solvents, must not be allowed to come into direct contact with the waterproofing membrane.

1.09 SEQUENCING OF THE WORK

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- A. Work in conjunction with other trades by the timely performance of the work, including installation of protection layer(s), drainage panels, and insulation.
- B. Complete sections of the waterproofing membrane must be accepted by the inspection firm and manufacturer before proceeding with protection layers and/or backfill operations.

1.10 WARRANTIES

- A. Special Installer Warranty:
 - 1. The installer must provide a 2-year installer warranty. This warranty must insure against leaks in the waterproofing system caused by defects in the installation of the waterproofing system. The installer warranty must include defects in materials or workmanship. Upon notification of such defects or leaks with the warranty period the installer must make all repairs necessary to remedy the leaks in the waterproofing system.
- B. Manufacturers Warranty:
 - 1. Manufacturers standard five (5) year warranty.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Basis of Design: Concrete Primer: Hydro-Prufe® 80 mil Unreinforced Thermoplastic Sheeting and Accessories or VTA-approved equal.
 - 1. Manufacturer: HYDRO-GARD LLC, 18340 Yorba Linda Blvd., Suite 107, Box 304, Yorba Linda, CA 92886. Phone: (562) 944-7030.
 - 2. Proprietary Products: Use of manufacturer’s proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer’s material data that indicates compliance with the requirements of Part 1 of this Section.

2.02 WATERPROOFING MEMBRANE AND ACCESSORIES

- A. PVC Waterproofing Membrane.

Parameters	ASTM Test Method	Typical Physical Properties
Color		White / Grey
Overall thickness mm(inches), min.	D751	2.0 mm / .080
Tensile strength psi, min.	D638	1500 psi

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Elongation at break, min., %	D638	400 %
Seam strength, min., % of tensil strength	D751	75%
Tear resistance	D1004	10
Low temperature bend (-40 degrees F)	D2136	-40
Dimensional stability	D1204	.01
Water absorption	D570	3.0
Laminated Bond Strength	D413	24
Flammability	D568	SE
Accelerated Weather	D4434	No Cracking
Hydrostatic Head resistance	D751	555 feet

2.03 RELATED MATERIALS

- A. Sealants: As recommended by the manufacturer.
- B. All fasteners must be of the same type as the metal being secured. In general, all fasteners, anchors, nails, straps, must be of stainless steel. Fasteners are to be compatible with materials in contact with fasteners. All fasteners and anchors must have a minimum embedment of 1-1/4 inches and must be approved for such use by the fastener manufacturer. Fasteners for attachment of metal to wood expansion type fasteners. All fasteners must meet factory mutual standard 4470 for corrosion resistance.

PART 3 – EXECUTION

3.01 GENERAL

- A. The waterproofing contractor must coordinate the installation so that each area is made watertight at the end of each work period or onset of inclement weather whenever possible. Trapped water under the PVC waterproofing system must be removed prior to proceeding with the system.

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3.02 EXAMINATION

- A. Examine all surfaces, substrates and conditions to receive the waterproofing system. Confirm conditions are acceptable for the application of the PVC waterproofing system.
- B. Do not allow bitumen or oil in any form to contact the thermoplastic membrane or other system components. Ensure that foreign matter, debris is not in contact with PVC waterproofing membrane.
- C. Verify that all penetrations are in place and sealed with link seals or other suitable means approved by manufacturer.

3.03 SUBSTRATES AND SUBSTRATE PREPARATION

- A. The surface must provide a smooth and uniform profile free of debris, standing water, ice or rocks. Specific sub-grade preparation must be designed by a licensed and qualified Engineer.
- B. Under Slab Installation:
 - 1. For non-hydrostatic conditions: Over properly prepared Mud / Waste slab layout geotextile leveling layer. Ensure slab is dry and has no ponding water conditions. Dampness is acceptable. Overlap all adjoining sheets a minimum of 4-inches and secure overlaps with washer head nails or staples. Carry geotextile layer up lagged wall or up inside of bulk head form. Extend geotextile layer beyond forms for future tie-in.
 - 2. For hydrostatic conditions: Over properly prepared Mud / Waste slab layout HDPE layer over mud / waste slab. Ensure slab is dry and has no ponding water conditions. Dampness is acceptable. Ensure that light color side of sheet is facing down against mud / waste slab. Darker color geotextile should be facing up toward sky. Overlap all adjoining sheets a minimum of 4-inches and secure overlaps with washer head nails or staples. Fastening should be at a minimum of 24-inches on center or as needed to maintain position of sheet. Ensure sheets are staggered so end laps are a minimum of 12-inches apart. Continue installation and carry HDPE layer up forms or lagging to ensure a proper tie-in with wall system. It is recommended that HDPE layer is installed up vertically a minimum of 24-inches above rebar dowels coming out of the structural slab. When vertical bulkhead forms are used extend HDPE layer beyond forms a minimum of 24-inches to ensure enough tie-in and overlap is provided.
 - 3. Continue installation of HDPE layer up wall overlapping seams a minimum of 4-inches and secure laps with washer head nails at 24-inches on center. Install HDPE layer neatly and tight around tie-backs and other penetrations.
 - 4. Install PVC sheets over previous layer of geotextile leveling layer or HDPE layer under mat slab. Unroll and position PVC sheets so seams of PVC are staggered from seams of the underlayment. Let PVC sheets relax and overlap side laps 4-inches and end laps 4-inches. When wedge welding increase overlaps to 6-inches. Weld all laps with manufacturer approved automatic hot air welding equipment. Carry PVC sheets up forms or lagging to ensure a proper tie-in with the PVC sheets which will be installed on the wall. Ensure that PVC sheet does not cover up tie-in for the underlayment. Stay 12-inches below the underlayment tie-in and secure the terminating edge of the PVC with a fastening bar or other temporary fastening measure approved by manufacturer. PVC wall membrane will overlap termination bar by a minimum of 6-inches. When vertical bulkhead forms are used to segment horizontal mat pours extend PVC beyond forms a minimum of 12-inches to ensure enough tie-in and overlap is provided. Do not cover up tie-in of horizontal underlayment.

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3.04 PROTECTION LAYERS

- A. Vertical Protection Layer: Install protection material over PVC field membrane. Protection material can be spot adhered using a manufacturer approved adhesive. Mechanically fastening through PVC membrane is not allowed. Consult with manufacturer regarding product selection and installation requirements.

- B. Horizontal Protection Layer: When Matt slab is thicker than 24-inches and a double rebar cage is used it is recommended that the PVC membrane is covered with the 40 mil HDPE protection sheet. Loose lay 40 mil HDPE sheet over PVC membrane and overlap side and end laps 4-inches. Spot weld in place or tape seams to ensure placement is not disturbed. When protection layer on vertical wall is geotextile layer, ensure that geotextile layer overlaps HDPE protection material a minimum of 12-inches. When a concrete protection slab is not provided, and the matt slab will be poured directly over the PVC membrane, then cover the PVC membrane with either 40 mil HDPE or geotextile layer.

- C. When rebar is placed on or against PVC membrane or its protection layers, cement adobes must be used.

3.05 TERMINATION AT GRADE

- A. Terminate PVC membrane at grade once pile removal work has been completed. Ensure removal process has not caused any damage to the PVC membrane. If damaged, repair as needed.

3.06 COMPLETION

- A. Prior to demobilization from the site, the work must be reviewed by the contractor, inspection company and manufacturer representative. All defects noted, noncompliance with the specifications or the recommendations of membrane manufacturer must be itemized in a punch list. These items must be corrected immediately by the contractor prior to demobilization to the satisfaction of the membrane manufacturer.

END OF SECTION 07 13 54

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SECTION 07 16 00

CEMENTITIOUS AND REACTIVE WATERPROOFING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for furnishing and installing Cementitious Waterproofing Bondcoat.

1.02 RELATED SECTIONS

- A. Section 03 11 00, Concrete Formwork
- B. Section 03 30 00, Cast-in-Place Concrete
- C. Section 03 53 00, Concrete Topping
- D. Section 05 52 00, Metal Railing (Stations)
- E. Section 05 55 16, Metal Stair Nosing
- F. Section 32 17 26, Tactile Warning Surfacing

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C321 Standard Test Methods for Bond Strength of Chemical-Resistant Mortars
 - 2. ASTM C672 Standard Test Method for Scaling Resistance of Concrete Surfaces to Exposed to Deicing Chemicals
 - 4. ASTM D4541.02 Standard Test Method for Pull-off Strength
 - 5. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials

1.04 SUBMITTALS

- A. General
 - 1. Submittals for architectural treatment must be made in accordance with the provisions in these technical specifications.
 - 2. The Contractor must submit the following:
 - a. Product Data: Submit manufacturer's product literature and detailed installation instructions for horizontal and vertical surfaces.
 - b. Samples: Submit samples of the cementitious waterproofing bondcoat being proposed for use on this project. Samples must be considered as examples of finished colors and texture of the system only.
 - 3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked

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"No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Cementitious and Reactive Waterproofing must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Cementitious and Reactive Waterproofing must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Cementitious and Reactive Waterproofing complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Materials must be delivered in their original packaging, clearly marked with manufacturers' name, brand and type of material. Store materials to avoid damage from other trades, weather damage, and UV over exposure.
- B. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture with canvas tarpaulins.
- F. Any materials which are determined damaged by the owner's representative are to be removed from the job site and replaced at no cost to VTA.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Basecrete Cementitious Waterproofing Bondcoat as manufactured by Basecret Technologies LLC, Address: 7969 Moyer Ave., Sarasota FL 34240; Phone: (941)-312-5142; Website: basecreteusa.com, or VTA-approved equal.
 - 1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 - 2. Color:
 - a. At stair and landing: To match existing concrete.
 - b. At platform: Black

2.02 MATERIALS

- A. Two part system must not exceed 1/8-inch and must comply with:
 - 1. Impact Strength 19lbs/8.6kg
 - 2. Compressive Strength 7050 psi/48.61 MPa
 - 3. Tensile Strength 732 psi/5.05MPa
 - 4. Flexural Strength 2380 psi/16.41MPa
 - 5. Adhesive Strength
 - a. Concrete: 1372 psi/9.46MPa

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- b. Steel: 1144 psi/7.89MPa
- 6. Shearbond Adhesion 720 psi/4.96 MPa
- 7. Vapor transimission – ASTM E96
- 8. Bond Strength – ASTM C321
- 9. Freeze0Thaw – ASTM C672
- 10. Pull off Test – ASTM D4541.02

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine all surfaces, substrates and conditions to receive the Cementitious Waterproofing Bondcoat system. Confirm conditions are acceptable for the application.
- B. Ensure that foreign matter, standing water, and debris have been removed.

3.02 SUBSTRATES AND SUBSTRATE PREPARATION

- A. Inspect job site. Determine if any previous material used is compatible.
- B. Remove all previous material and any loose debris. Check and repair any cracks or voids with a compatible product. Once the site is clean and clear, pressure wash for final preparation. Protect adjacent areas to prevent material from going beyond designated site.

3.03 INSTALLATION

- A. Consult with manufacturer for recommended application methods.
- B. Apply two part system based on manufacturer's instructions with manufacturer representative in attendance.

END OF SECTION 07 16 00

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SECTION 07 22 00

ROOF AND DECK INSULATION

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes the requirements for furnishing and installing roof and Deck Insulation at the Story and Eastridge Stations and the following locations:
1. Signal/Communications Building
 2. Electrical Building
 3. Canopies
 4. Elevators
- B. Materials Include:
1. Roof insulation
 2. Adhesive
 3. Fasteners
 4. Roof Tape
 5. Asphalt
 6. Bituminous Plastic Cement
 7. Wood Stops, Blocking, and Insulation-Containment Members

1.02 RELATED SECTIONS

- A. Section 05 30 00, Metal Decking
- B. Section 07 61 13, Standing Seam Sheet Metal Roofing

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM C726 Standard Specification for Mineral Fiber Roof Insulation Board
 2. ASTM C728 Standard Specification for Perlite Thermal Insulation Board
 3. ASTM D312 Standard Specification for Asphalt Used in Roofing
 4. ASTM D2822 Standard Specification for Asphalt Roof Cement
 5. ASTM D3747 Standard Specification for Emulsified Asphalt Adhesive for Adhering Roof Insulation
 6. ASTM D4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free
- B. Federal Specifications (FS):
1. TT-W-550 Wood Preservative, Chromated Copper Arsenate Mixture
 2. TT-W-571 Wood Preservation: Treating Practices
- C. Underwriters Laboratories (UL):

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1. UL 580 Tests for Uplift Resistance of Roof Assemblies
2. UL 790 Tests for Fire Resistance of Roof Covering Materials

1.04 SUBMITTALS

A. General

1. Submittals for architectural treatment must be made in accordance with the provisions in these technical specifications.
2. Product Data: Submit manufacturer's product data of the roof deck insulation proposed for this work.

1.05 MEASUREMENT AND PAYMENT

A. Measurement: Roof and Deck Insulation must be measured by the square foot.

B. Payment: The contract price paid per square foot for Roof and Deck Insulation must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Roof and Deck Insulation complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

A. Insulation and roofing must meet Underwriters Laboratories requirements for Class A fire rating and Class I-90 wind uplift resistance in compliance with UL 790 and UL 580, respectively.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Roof Insulation: Roof deck insulation must be of polyisocyanurate foam core laminated to glass reinforced mat facer. Furnish in thickness required to provide minimum thermal resistance, R value of 9, or as required and sufficient to span the flute of metal decking. Insulation must be applied in at least two layers with staggered joints. Provide tapered roof insulation board where required for roof drainage. Tapered insulation can be of the same material as the deck insulation or a perlite-based material. Cover must be perlite board conforming to the requirements of ASTM C728. Roof insulation material and insulation must be compatible with the roofing system as recommended by the roofing materials manufacturer.

B. Adhesive: ASTM D3747.

C. Fasteners: Insulation board fasteners with appropriate stress-plate washers, manufactured specifically for securing insulation board to metal decking.

D. Roof Tape: Manufactured specifically for welding of tape over insulation joints, six inches wide.

E. Asphalt: ASTM D312, Type III.

F. Bituminous Plastic Cement: ASTM D2822 or ASTM D4586.

G. Wood Stops, Blocking, and Insulation-Containment Members: Pressure-treated "Construction" or "No.1" grade Douglas fir as specified in Section 06 10 00 – Rough Carpentry, treated with

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preservative in accordance with FS TT-W-550 for preservative material and FS TT-W-571 for pressure treating.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Coordinate roof insulation installation with the installation of roofing.
- B. Surfaces that insulation is to be applied must be smooth and dry, free from loose particles, and must be swept clean.
- C. Install insulation board in accordance with the insulation manufacturer's installation instructions and recommendations. Apply boards with adjacent ends staggered not less than 24 inches.
- D. Install perimeter wood containment members and stops with mechanical fasteners as indicated or required.
- E. Mop boards into place using hot steep asphalt applied in ribbons on six inch centers; press firmly into place. Cut boards to fit neatly around vent pipes, curbs, vertical surfaces, and other deck projections.
- F. Where required for additional holding power for holding boards in place, provide mechanical fasteners of type specified and installation method recommended by the fastener manufacturer.
- G. Apply roof tape in hot asphalt over all joints of insulation board in accordance with the insulation and tape manufacturer's taped joint system specifications and recommendations. Apply roof tape over joints between adjacent insulation boards and between wood blocking or insulation stops and insulation boards. Broom roof tape into asphalt.
- H. Lay no more boards than will be covered with completed roofing on the same day. Do not leave installed boards exposed to weather. Provide protection of insulation from rain and moisture.
- I. Provide water cut-offs at exposed edges of insulation at end of day's work and whenever rain is imminent. Extend cut-offs six inches on roof deck, carry up and over roof insulation, and extend six inches on top of roofing. Remove before continuing installation of insulation.

END OF SECTION 07 22 00

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SECTION 07 26 00

VAPOR RETARDERS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for furnishing and installing vapor barrier damp-proofing under all interior concrete slabs on grade:
1. Elevator Machine Rooms
 2. Electrical Rooms
 3. Storage Room
 4. Communications/Signal Building

1.02 RELATED SECTIONS

- A. Section 32 11 23, Aggregate Base Courses

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM D1593 Standard Specification for Non-rigid Vinyl Chloride Plastic Film and Sheeting

1.04 SUBMITTALS

- A. General
1. Submittals for architectural treatment must be made in accordance with the provisions in these technical specifications.
 2. The Contractor must submit the following:
 - a. Samples: Representative samples of polyvinyl chloride vapor barrier material, adhesive, and tape.
 3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Vapor Retarders must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Vapor Retarders must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Vapor Retarders for underslabs, for electrical/elevator machine room, Communications/Signal Building, and for Eastridge Platform complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

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PART 2 – PRODUCTS

2.01 VAPOR BARRIER SHEETING

- A. Polyvinylchloride plastic membrane sheeting meeting requirements of ASTM D1593, 10 mil thick.

2.02 ADHESIVE

- A. Synthetic rubber base cement, manufactured specifically for use with polyvinylchloride membrane material for cold application.

2.03 TAPE

- A. Pressure-sensitive neoprene or vinyl chloride rubber adhesive tape as recommended by the manufacturer of the vapor barrier material or a heavy-duty cloth masking tape, minimum 3 inches wide.

PART 3 – EXECUTION

3.01 LAYING

- A. Lay vapor barrier sheets directly over compacted aggregate drainage fill (between drainage fill and sand cushion) without damaging the sheets. Patch punctures and tears in vapor barrier sheets occurring during subsequent operations. Vapor barrier must be continuous between footings or foundation walls without voids.

3.02 LAPS

- A. Lap edges not less than 4-inches and ends not less than 6-inches, with all laps sealed continuously with adhesive and tape.

3.03 PERIMETER

- A. Turn up barrier a minimum of 2-inches or to within 1/2-inch of top of slab at edges and secure to wall foundations or footings with specified adhesive and tape.

3.04 PENETRATIONS

- A. Fit and seal vapor barrier tightly around pipes and conduits that penetrate the fill.

END OF SECTION 07 26 00

SECTION 07 41 13
METAL ROOF PANELS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for:
1. Interlocking-seamed, flat lock seam metal roof panels, with related metal trim and accessories.

1.02 RELATED SECTIONS

- A. Section 05 12 35 – Structural Steel for structural steel framing supporting metal panels.
- B. Section 05 30 00 – Metal Decking for continuous metal decking supporting metal panels.
- C. Section 05 40 00 – Cold-Formed Metal Framing for cold-formed metal framing supporting metal panels.
- D. Section 07 22 00 – Roof and Deck Insulation for thermal insulation installed under metal panels.
- E. Section 07 42 13 – Metal Wall Panels for factory-formed metal wall panels.
- F. Section 07 60 00 – Flashing and Sheet Metal for formed sheet metal copings, flashings, reglets, and roof drainage items in addition to items specified in this Section.

1.03 REFERENCED STANDARDS

- A. American Architectural Manufacturer's Association (AAMA):
1. AAMA 621 Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates
 2. AAMA 809.2 Voluntary Specification Non-Drying Sealants.
- B. American Society of Civil Engineers (ASCE):
1. ASCE 7 Minimum Design Loads for Buildings and Other Structures
- C. ASTM International (ASTM):
1. ASTM A653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 2. ASTM A755 Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 3. ASTM A792 Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

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4. ASTM A 980 Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled.
5. ASTM C645 Specification for Nonstructural Steel Framing Members.
6. ASTM C920 Specification for Elastomeric Joint Sealants.
7. ASTM D226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
8. ASTM D2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
9. ASTM D4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
10. ASTM E1592 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
11. ASTM E1980 Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

B. International Accreditation Service (IAS):

1. IAS AC 472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems, Part B

C. Underwriters Laboratories, Inc. (UL):

1. UL 580 - Tests for Uplift Resistance of Roof Assemblies

1.04 SUBMITTALS

A. Action Submittals

1. Product Data: Manufacturer's data sheets for specified products.
2. Shop Drawings: Show layouts of roof panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot showing edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, roof accessories, lightning arresting equipment, and special details. Make distinctions between factory and field assembled work.
 - a. Indicate points of supporting structure that must coordinate with roof panel system installation.
 - b. Include data indicating compliance with performance requirements.
 - c. Include structural data indicating compliance with requirements of authorities having jurisdiction.
3. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
4. Samples for Verification: Provide 12-inch- (305 mm-) long section of each metal panel profile. Provide color chip verifying color selection.

B. Informational Submittals

1. Product Test Reports: Indicating compliance of products with requirements, witnessed by a professional Engineer licensed in the State of California.
2. Qualification Information: For Installer firm and Installer's field supervisor.
3. IAS Accreditation Certificate: Indicating that manufacturer is accredited under provisions of IAS AC 472.
4. Buy American Certification: Manufacturers' letters of compliance acceptable to authorities having jurisdiction, indicating that products comply with requirements.
5. Manufacturer's Warranty: Sample copy of manufacturer's standard warranty.

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- C. Closeout Submittals
 - 1. Maintenance data.
 - 2. Manufacturer's Warranty: Executed copy of manufacturer's standard warranty.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Metal Roof Panels shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Metal Roof Panels shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Roof Panels complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Prior to erection of framing, conduct preinstallation meeting at site attended by Owner, Architect, manufacturer's technical representative, inspection agency and related trade contractors.
 - 1. Coordinate building framing in relation to metal panel system.
 - 2. Coordinate openings and penetrations of metal panel system.
 - 3. Coordinate work of Division 07 Sections "Roof Specialties" and "Roof Accessories" and openings and penetrations and manufacturer's accessories with installation of metal panels.

1.07 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal roof panel assembly and accessories from a single manufacturer providing fixed-base roll forming, and accredited under IAS AC 472 Part B.
- B. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum five years experience in manufacture of similar products in successful use in similar applications.
- C. Installer Qualifications: Experienced Installer certified by metal panel manufacturer with minimum of five years experience with successfully completed projects of a similar nature and scope.
 - 1. Installer's Field Supervisor: Experienced mechanic certified by metal panel manufacturer supervising work on site whenever work is underway.
- D. Buy American Compliance: Materials provided under work of this Section shall comply with the following requirements:
 - 1. Buy American Act of 1933 BAA-41 U.S.C §§ 10a – 10d.
 - 2. Buy American provisions of Section 1605 of the American Recovery and Reinvestment Act of 2009 (ARRA).

1.08 DELIVERY, STORAGE, AND HANDLING

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- A. Protect products of metal roof system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping.
 - 1. Deliver, unload, store, and erect metal roof system and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.
 - 2. Store in accordance with Manufacturer's written instructions. Provide wood collars for stacking and handling in the field.

1.09 COORDINATION

- A. Coordinate sizes, profiles, and locations of roof curbs and other roof-mounted equipment and roof penetrations, based upon sizes of actual selected equipment.

1.10 WARRANTY

- A. Special Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail in materials and workmanship within one year from date of Substantial Completion.
- B. Special Weathertightness Warranty: TBD.
- C. Special Panel Finish Warranty: TBD.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Fine Metal Roof Tech Custom Shingles as manufactured by Fine Metal Roof Tech - Metal Roof and Wall Systems; Salt Lake City, UT 84116; Email: sales@finemetalrooftech.com; Web: www.finemetalrooftech.com or VTA approved equal.
 - 1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 - 2. Metal roof shingles and metal wall panels must be single source manufacturer. No exceptions.

2.02 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof shingles system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.
- B. Structural Performance: Provide metal shingle assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated:
 - 1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on drawings.
 - 2. Wind Uplift Testing: Certify capacity of metal shingles by actual testing of proposed assembly per ASTM E 1592.

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- 3. Deflection Limits: Withstand inward and outward wind-load design pressures in accordance with applicable building code with maximum deflection of [TBD] of the span with no evidence of failure
- 4. Seismic Performance: Comply with ASCE 7, Section 9, Earthquake Loads.
- C. Wind Uplift Resistance: TBD.
- D. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the shingle to the other.
- E. Underlayment: TBD.

2.03 METAL ROOF SHINGLE

- A. Mechanically-seamed, Concealed Fastener, Metal Roof Shingles: Structural metal roof shingle consisting of formed metal sheet installed by mechanically interlocking edges of adjacent shingles, and attaching shingle to supports using concealed clips and fasteners in a weathertight installation.
 - 1. TBD.

2.04 METAL ROOF SHINGLE ACCESSORIES

- A. General: Provide complete metal roof shingle assembly incorporating trim, copings, fascia, gutters and downspouts, and miscellaneous flashings, in profiles as indicated. Provide required fasteners, closure strips, and thermal spacers as indicated in manufacturer's written instructions.
- B. Flashing and Trim: Match material, thickness, and finish of metal shingle face sheet.
- C. Shingle Clips: Stainless steel clips configured for concealment in shingle joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.
- D. Shingle Fasteners: Self-tapping screws, ring shank nails and other acceptable corrosion-resistant fasteners recommended by roof shingle manufacturer.
- E. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized zinc coating.
- F. Roof Accessories: Approved by metal roof shingle manufacturer. Refer to Section 07 72 00 "Roof Accessories" for requirements for curbs, equipment supports, roof hatches, heat and smoke vents, ventilators, and preformed flashing sleeves.

2.05 FABRICATION

- A. General: Provide factory fabricated and finished metal shingles and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Fabricate metal shingle joints configured to minimizing noise resulting from thermal movement.
- C. Form shingles in continuous lengths for full length of detailed runs, except where otherwise indicated on approved shop drawings.

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- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings. Form from materials matching metal shingle substrate and finish.

2.06 FINISHES

- A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. TBD.
- C. Interior Finish: 0.5 mil total dry film thickness consisting of primer coat and wash coat of manufacturer's standard light-colored acrylic or polyester backer finish.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine metal shingle system substrate and supports with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal shingle installation.
 - 1. Inspect metal shingle support substrate to determine if support components are installed as indicated on approved shop drawings. Confirm presence of acceptable supports at recommended spacing to match installation requirements of metal shingles.
 - 2. Shingle Support Tolerances: Confirm that shingle supports are within tolerances acceptable to metal shingle system manufacturer but not greater than the following:
 - a. 1/4-inch (6 mm) in 20 foot (6.1 m) in any direction.
 - b. 3/8-inch (9 mm) over any single roof plane.
- B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with insulated metal roof shingle system installation.

3.02 PREPARATION

- A. TBD.

3.03 METAL SHINGLE INSTALLATION

- A. Interlocking custom shingles: Install weathertight metal shingle system in accordance with manufacturer's written instructions, approved shop drawings, and project drawings. Install metal roof shingle in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions. Anchor shingles and other components securely in place. Provide for thermal and structural movement.
- B. Attach shingles to supports using clips, screws and fasteners recommended by manufacturer and indicated on approved shop drawings.
 - 1. Fasten diomond shingles to supports with concealed clips at each location indicated on approved shop drawings, with spacing and fasteners recommended by manufacturer.
 - 2. Provide weatherproof jacks for pipe and conduit penetrating metal shingles of types recommended by manufacturer.

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3. Dissimilar Materials: Where elements of metal shingle system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.

3.04 ACCESSORY INSTALLATION

- A. General: Install metal shingle trim, flashing, and accessories using recommended fasteners with positive anchorage to building, and with weather tight mounting. Provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal shingle assembly, including trim, copings, flashings, sealants, closure strips, and similar items.
 2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
 3. Provide concealed fasteners except where noted on approved shop drawings.
 4. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.
 5. Prepare joints per requirements.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an independent testing and inspecting agency acceptable to Owners representative to perform field tests and inspections and to prepare test reports.

3.06 CLEANING AND PROTECTION

- A. Remove temporary protective films immediately in accordance with metal roof shingle manufacturer's instructions. Clean finished surfaces as recommended by metal roof shingle manufacturer.
- B. Replace damaged shingles and accessories that cannot be repaired to the satisfaction of the Owners representative.

END OF SECTION 07 41 13

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SECTION 07 42 13
METAL WALL PANELS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for:
 - 1. Interlocking metal wall panel dry joint, pressure-equalized rainscreen or wall cladding system, with related metal trim and accessories.

1.02 RELATED SECTIONS

- A. Section 05 12 35, Structural Steel for structural steel framing supporting metal panels.
- B. Section 05 30 00, Metal Decking for continuous metal decking supporting metal panels.
- C. Section 05 40 00, Cold-Formed Metal Framing for cold-formed metal framing supporting metal panels.
- D. Section 07 22 00, Roof and Deck Insulation for thermal insulation installed under metal panels.
- E. Section 07 42 13, Metal Wall Panels for factory-formed metal wall panels.
- F. Section 07 60 00, Flashing and Sheet Metal for formed sheet metal copings, flashings, reglets, and roof drainage items in addition to items specified in this Section.

1.03 REFERENCED STANDARDS

- A. American Architectural Manufacturer's Association (AAMA):
 - 1. AAMA 621 Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates
 - 2. AAMA 508-07 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems
 - 3. AAMA 509-07 Voluntary Test and Classification Method of Drained and Back Ventilated Rain Screen Wall Cladding Systems
 - 3. AAMA 809.2 Voluntary Specification Non-Drying Sealants.
 - 3. AAMA
- B. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 Minimum Design Loads for Buildings and Other Structures
- C. ASTM International (ASTM):

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1. ASTM A653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A755 Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
3. ASTM A792 Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
4. ASTM A 980 Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled.
5. ASTM C645 Specification for Nonstructural Steel Framing Members.
6. ASTM C920 Specification for Elastomeric Joint Sealants.
7. ASTM D226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
8. ASTM D2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
9. ASTM D4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
10. ASTM E1592 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
11. ASTM E1980 Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

D. International Accreditation Service (IAS):

1. IAS AC 472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems, Part B

E. Underwriters Laboratories, Inc. (UL):

1. UL 580 - Tests for Uplift Resistance of Roof Assemblies

1.04 SUBMITTALS

A. Action Submittals

1. Product Data: Manufacturer's data sheets for specified products.
2. Shop Drawings: Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot showing edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, lightning arresting equipment, and special details. Make distinctions between factory and field assembled work.
 - a. Indicate points of supporting structure that must coordinate with metal panel system installation.
 - b. Include data indicating compliance with performance requirements.
 - c. Include structural data indicating compliance with requirements of authorities having jurisdiction.
3. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
4. Samples for Verification: Provide 12-inch- (305 mm-) long section of each metal panel profile. Provide color chip verifying color selection.

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B. Informational Submittals

1. Product Test Reports: Indicating compliance of products with requirements, witnessed by a professional Engineer licensed in the State of California.
2. Qualification Information: For Installer firm and Installer's field supervisor.
3. IAS Accreditation Certificate: Indicating that manufacturer is accredited under provisions of IAS AC 472.
4. Buy American Certification: Manufacturers' letters of compliance acceptable to authorities having jurisdiction, indicating that products comply with requirements.
5. Manufacturer's Warranty: Sample copy of manufacturer's standard warranty.

C. Closeout Submittals

1. Maintenance data.
2. Manufacturer's Warranty: Executed copy of manufacturer's standard warranty.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Metal Wall Panels shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Metal Wall Panels shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Metal Wall Panels complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Prior to erection of framing, conduct preinstallation meeting at site attended by Owner, Architect, manufacturer's technical representative, inspection agency and related trade contractors.
1. Coordinate building framing in relation to metal panel system.
 2. Coordinate openings and penetrations of metal panel system.
 3. Coordinate work of Division 07 Sections for application of weather resistive barrier over exterior sheathing substrate specified.

1.07 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal wall panel assembly and accessories from a single manufacturer providing fixed-base roll forming, and accredited under IAS AC 472 Part B.
- B. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum five years experience in manufacture of similar products in successful use in similar applications.
- C. Installer Qualifications: Experienced Installer certified by metal panel manufacturer with minimum of five years experience with successfully completed projects of a similar nature and scope.
1. Installer's Field Supervisor: Experienced mechanic certified by metal panel manufacturer supervising work on site whenever work is underway.

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- D. Buy American Compliance: Materials provided under work of this Section shall comply with the following requirements:
1. Buy American Act of 1933 BAA-41 U.S.C §§ 10a – 10d.
 2. Buy American provisions of Section 1605 of the American Recovery and Reinvestment Act of 2009 (ARRA).

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping.
1. Deliver, unload, store, and erect metal panel system and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.
 2. Store in accordance with Manufacturer's written instructions. Provide wood collars for stacking and handling in the field.

1.09 COORDINATION

- A. Coordinate sizes, profiles, and locations of openings, equipment, and wall penetrations based upon actual sizes.

1.10 WARRANTY

- A. Manufacturer Coating Performance Warranty for aluminum or galvalume materials: 25-year warranty against fading, color change, chalking, peeling, cracking, or delaminating of the coating system.
- B. Contractor: 10-year labor warranty for panel installation, including, flashings, fasteners and accessories to remain watertight and weatherproof.
1. Fluoropolymer Two-coat System:
 - a. Color fading in excess of ten Hunter units per ASTM D 2244.
 - b. Chalking in excess of No. eight rating per ASTM D 4214
 - c. Failure of adhesion, peeling, checking, or cracking.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Metal Wall Panels as manufactured by Fine Metal Roof Tech - Metal Roof and Wall Systems; Salt Lake City, UT 84116; Email: sales@finemetalrooftech.com; Web: www.finemetalrooftech.com or VTA approved equal.
1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 2. Metal roof shingles and metal wall panels must be single source manufacturer. No exceptions.

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2.02 PERFORMANCE REQUIREMENTS

- A. General: Provide metal wall panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.
- B. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated:
 - 1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on drawings.
 - 2. Wind Uplift Testing: Certify capacity of metal shingles by actual testing of proposed assembly per ASTM E 1592.
 - 3. Deflection Limits: Withstand inward and outward wind-load design pressures in accordance with applicable building code with maximum deflection, as indicated in the Contract Drawings, of the span with no evidence of failure
 - 4. Seismic Performance: Comply with ASCE 7, Section 9, Earthquake Loads.
- C. Wind Uplift Resistance: As indicated in the Contract Drawings.
- D. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the panel to the other.

2.03 METAL WALL PANELS

- A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50, Coating Class AZ55 (Grade 340, Coating Class AZM165) unpainted Galvalume Plus coating
 - 1. Nominal coated steel thickness: 22 gauge
 - 2.

2.04 METAL WALL PANEL ACCESSORIES

- A. General: Provide complete metal wall panel assembly incorporating trim, copings, and miscellaneous flashings, in profiles as indicated. Provide required fasteners, closure strips, and thermal spacers as indicated in manufacturer's written instructions.
- B. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.
- C. Panel Fasteners: Supply Fasteners and clips tested to meet provisions of this section, self-tapping screws, ring shank nails, and other acceptable corrosion-resistant fasteners recommended by panel manufacturer.
- D. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized zinc coating.
- E. Accessories: Approved by metal panel manufacturer. Refer to Section 07 60 00 – Flashing and Sheet Metal.

2.05 FABRICATION

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- A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Fabricate metal panel joints configured to minimizing noise resulting from thermal movement.
- C. Form panels in continuous lengths for full length of detailed runs, except where otherwise indicated on approved shop drawings.
- D. Wall Panel Flashing and Trim: Provide custom or standard metal flashing shapes to suit conditions for watertight installation.
- E. Cutting, bending, and fitting:
 - 1. Make all cuts square, true, and neat.
 - 2. Saw cutting panels, de burr, and clean edges before applying to the wall.

2.06 FINISHES

- A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. TBD.
- C. Interior Finish: 0.5 mil total dry film thickness consisting of primer coat and wash coat of manufacturer's standard light-colored acrylic or polyester backer finish.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine metal panel system substrate and supports with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal panel installation.
 - 1. Inspect metal panel support substrate to determine if support components are installed as indicated on approved shop drawings. Confirm presence of acceptable supports at recommended spacing to match installation requirements of metal panels.
 - 2. Panel Support Tolerances: Confirm that panel supports are within tolerances acceptable to metal panel system manufacturer but not greater than the following:
 - a. 1/4-inch (6 mm) in 20 foot (6.1 m) in any direction.
- B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with metal wall panel system installation.

3.02 PREPARATION

- A. TBD.

3.03 METAL PANEL INSTALLATION

- A. Wall Panels: Install weathertight metal panel system in accordance with manufacturer's written instructions, approved shop drawings, and project drawings. Install metal panels in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions.

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Anchor panels and other components securely in place. Provide for thermal and structural movement.

- B. Attach panels to supports using clips, screws and fasteners recommended by manufacturer and indicated on approved shop drawings.
 - 1. Fasten wall panels to supports with fasteners at each location indicated on approved shop drawings, with spacing and fasteners recommended by manufacturer.

3.04 ACCESSORY INSTALLATION

- A. General: Install metal panel trim, flashing, and accessories using recommended fasteners with positive anchorage to building, and with weather tight mounting. Provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.
 - 2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
 - 3. Provide concealed fasteners except where noted on approved shop drawings.
 - 4. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.
 - 5. Prepare joints per requirements.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an independent testing and inspecting agency acceptable to Owners representative to perform field tests and inspections and to prepare test reports.

3.06 CLEANING AND PROTECTION

- A. Remove temporary protective films immediately in accordance with metal panel manufacturer's instructions. Clean finished surfaces as recommended by metal panel manufacturer.
- B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Owners representative.

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SECTION 07 54 19

POLYVINYL CHLORIDE ROOFING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing:
 - 1. Adhered PVC membrane roofing system
 - 2. Cover board
 - 3. Roof insulation
 - 4. Vapor Retarder
 - 5. Base sheet
 - 6. Substrate board

1.02 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete
- B. 06 10 00, Rough Carpentry
- C. 07 60 00, Flashing and Sheet Metal
- D. 22 14 23, Storm Drainage Piping Specialties

1.03 REFERENCED STANDARDS

- A. County of Santa Clara Standard Specifications, May 2000 and Amended January 7, 2011, and Standard Details, September, 1997 and Amended December 21, 2010.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's data sheet for each product to be provided.
- B. Detail Drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:
 - 1. Base flashings and membrane terminations
 - 2. Tapered insulation, including slopes
 - 3. Crickets, saddles, and tapered edge strips, including slopes
 - 4. Insulation fastening and adhesive patterns
- C. Verification Samples: Provide for each product specified.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. Maintenance Data:

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- F. Guarantees: Provide manufacturer's current guarantee specimen.
- G. Prior to beginning the work of this section, roofing sub-contractor shall provide a copy of the final System Assembly Letter issued by the roofing manufacturer indicating that the products and system to be installed shall be eligible to receive the specified manufacturer's guarantee when installed by a certified roofing contractor in accordance with manufacturers requirements, inspected and approved by the roofing representative.
- H. Prior to roofing system installation, roofing sub-contractor shall provide a copy of the Guarantee Application Confirmation document issued by the roofing manufacturer indicating that the project has been reviewed for eligibility to receive the specified guarantee and registered.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Polyvinyl Chloride Roofing shall be measured by the square foot.
- B. Payment: The contract price paid per square foot for Polyvinyl Chloride Roofing shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Polyvinyl Chloride Roofing complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.06 DESIGN CRITERIA

- A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- C. Installer must comply with current code requirements based on authority having jurisdiction.
- D. Wind Uplift Performance: Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7.
 - 1. Field-of-Roof Uplift Pressure: TBD.
 - 2. Perimeter Uplift Pressure: TBD.
 - 3. Corner Uplift Pressure: TBD.
- E. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class [TBD]; ASTM E 108, for application and roof slopes indicated.

1.07 QUALITY ASSURANCE

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- A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive the specified manufacturer's guarantee.
- B. Manufacturer Qualifications: Qualified manufacturer that has UL listing for roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.
- D. Test Reports:
 - 1. Roof drain and leader test or submit plumber's verification.
 - 2. Core cut (if requested).
 - 3. Roof deck fastener pullout test.
- E. Source Limitations: Obtain all components from the single source roofing manufacturer guaranteeing the roofing system. All products used in the system must be labeled by the single source roofing manufacturer issuing the guarantee.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.09 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.10 GUARANTEE

- A. Provide manufacturer's system guarantee equal to Johns Manville's Peak Advantage No Dollar Limit Roofing System Guarantee.
 - 1. Single-Source special guarantee includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover board, substrate board, vapor retarder, manufacturer's edge metal products, and other single-source components of roofing system marketed by the manufacturer.
 - 2. Guarantee Period: 20 (twenty) years from date of substantial completion.

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- B. Installer's Guarantee: Submit roofing Installer's guarantee, including all components of roofing system for the following guarantee period:
 - 1. Guarantee Period: Two years from date of Substantial Completion.
- C. Existing Guarantees: Guarantees on existing building elements should not be affected by scope of work.
 - 1. Installer is responsible for coordinating with building owner's representative to verify compliance.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Johns Manville's PVC Roofing System as manufactured by Johns Manville P.O. Box 5108, Denver, CO 80217-5108, Phone: (303)-978-2000 and (877)-766-3295, Email: www.jm.com.
 - 1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material.

2.02 POLYVINYL-CHLORIDE ROOFING MEMBRANE – PVC

- A. PVC Sheet: ASTM D4434, Type III, fabric reinforced containing KEE Elvaloy. Basis of Design: JM PVC FB.
 - 1. Thickness: 80 mils.
 - 2. Fabric Fleece Backed
 - 3. Exposed Face Color: Grey ES.

2.03 AUXILIARY ROOFING MATERIALS – SINGLE PLY

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's internally reinforced or scrim reinforced, smooth backed membrane with same thickness and color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard water-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.
- D. Urethane Adhesive: Manufacturer's standard two component no VOC adhesive for fleece backed membranes
- E. Roofing Asphalt: ASTM D 312, Type IV.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer..

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- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, , cover strips, sealants, and other accessories.

2.04 AUXILLIARY ROOFING SYSTEM COMPONENTS

- A. Coping System: Manufacturer's factory fabricated coping consisting of a base piece and a snap-on cap. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee.
- B. Fascia System: Manufacturer's factory fabricated fascia consisting of a base piece and a snap-on cover. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee.
- C. Metal Edge System: Manufacturer's factory fabricated metal edge system used to terminate the roof at the perimeter of the structure. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee.

2.05 COVER BOARD

- A. Perlite Board: ASTM C 728, Type 3; composed of expanded perlite, cellulosic fibers, binders and waterproofing agents with top surface seal-coated.

2.06 ROOF INSULATION

- A. General: Preformed rigid roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

2.07 TAPERED INSULATION

- A. Tapered Insulation: ASTM C 1289, Type II, Class 2, Grade 3 (25 psi), provide factory-tapered insulation boards fabricated to slope of 1/4 -inch per 12 -inches (1:48), unless otherwise indicated.

2.08 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer.
- D. Urethane Adhesive: Manufacturer's two component polyurethane adhesive formulated to adhere insulation to substrate.

2.09 VAPOR RETARDER

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- A. Self-Adhered SBS Vapor Retarder: Tri-laminate woven polyethylene, nonslip UV protected top surface; suitable for application method specified.

2.10 BASE SHEET MATERIALS

- A. Base Sheet: ASTM D 4897, Type II, venting, non-perforated, heavyweight, asphalt-impregnated and -coated, glass-fiber base sheet with coarse granular surfacing or embossed venting channels on bottom surface.

2.11 SUBSTRATE BOARD

- A. Substrate Board: ASTM C 728, perlite board, 1 -inch (25 mm) thick, seal coated.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with the requirements affecting performance of roofing system.
 - 1. General:
 - a. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - b. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 2. Steel Decks:
 - a. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 30 00 – Steel Decking.
 - 3. Concrete Decks:
 - a. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 - b. Verify that concrete substrate is visibly dry and free of moisture.
 - 4. Lightweight Concrete Decks:
 - a. Verify that lightweight concrete substrate is visibly dry and free of moisture according to the lightweight insulating concrete manufacturer's approved method.
 - b. Verify that lightweight concrete has ability to provide minimum base sheet fastener pull-out resistance.
 - 1) Provide documentation of pull out resistance values using manufacturer's approved procedures.
 - 5. Ensure general rigidity and proper slope for drainage.
 - 6. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 -inch (1.6 mm) out of plane relative to adjoining deck.
- B. Unacceptable panels should be brought to the attention of the General Contractor and Project Owner's Representative and must be corrected prior to installation of roofing system.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

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- A. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.
- C. If applicable, prime surface of deck with asphalt primer at a rate recommended by roofing manufacturer and allow primer to dry.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 BASE-SHEET INSTALLATION

- A. Install one lapped base sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.
 - 1. Enhance fastening rate in perimeter and corner zones according to code requirements, wind uplift system approvals or manufacturer's guarantee requirements, whichever is more stringent
- B. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.05 VAPOR-RETARDER INSTALLATION

- A. Install polyethylene-sheet vapor retarder as a loosely laid single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 -inches (50 mm) and 6 -inches (150 mm), respectively.
 - 1. Seal side and end laps with tape or adhesive.
- B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
 - 1. Repair tears and voids in laps and lapped seams not completely sealed.
- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.06 INSULATION INSTALLATION

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- A. Coordinate installation of roof system components so insulation and cover board is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation boards with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4- inch (6 mm) with like material.
- E. Install 2 (two) or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6-inches (150 mm) in each direction.
- F. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- H. Preliminarily Fastened Insulation: Install insulation with fasteners at rate required by roofing system manufacturer or applicable authority, whichever is more stringent.
 - 1. Fasten top layer to resist uplift pressure at corners, perimeter, and field of roof.
- I. Adhered Insulation: Adhere each layer of insulation to substrate as follows:
 - 1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer's instruction.
 - 2. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.
- J. Proceed with installation only after unsatisfactory conditions have been corrected.

3.09 COVER BOARD INSTALLATION

- A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.
- C. Install cover board with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4-inch (6 mm) with cover board.
 - 1. Cut and fit cover board within 1/4-inch (6 mm) of nailers, projections, and penetrations.
- D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.
 - 1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- E. Adhered Cover Board: Adhere cover board to substrate as follows:

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1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer's instruction.
 2. Install to resist uplift pressure at corners, perimeter, and field of roof.
- F. Mechanically Fastened Cover Board: Install cover board and secure to deck using mechanical fasteners designed and sized for fastening specified cover board to deck type.
1. Fasten to resist uplift pressure at corners, perimeter, and field of roof.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.10 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.
- B. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.
- C. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.
1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation.
 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
 3. Remove and discard temporary seals before beginning work on adjoining roofing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.11 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing in accordance with membrane roofing system manufacturer's written instructions.
1. Unroll roofing membrane and allow to relax before installing.
 2. Install sheet in accordance with roofing system manufacturer's written instructions.
- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesive for fleece backed membranes: Apply water-based bonding adhesive to substrate at rate required by manufacturer and immediately install roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- D. Urethane Membrane Adhesive for fleece backed membranes: Apply Urethane Adhesive to substrate at rate required by manufacturer and install fleece-backed roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- E. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

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- F. Apply roofing membrane with side laps shingled with roof slope, where possible.
- G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - a. Remove and repair any unsatisfactory sections before proceeding with installation.
 - 3. Repair tears, voids, and incorrectly lapped seams in roofing membrane that do not meet requirements.
- H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- I. Install roofing membrane and auxiliary materials to tie in to existing roofing.
- J. Proceed with installation only after unsatisfactory conditions have been corrected.

3.12 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply solvent-based bonding adhesive at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners per manufacturer's installation instructions.
- D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's Registered Roof Observer (RRO) to inspect roofing installation on completion and submit report to owners representative.
 - 1. Notify Owners representative 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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3.14 PROTECTION AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

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SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing:
 - 1. Metal flashing and trim
 - 2. Gutters and downspouts
 - 3. Miscellaneous sheet metalwork

1.02 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete
- B. Section 05 30 00, Metal Decking
- C. Section 05 50 00, Metal Fabrications
- D. Section 07 41 13, Metal Roof Panels
- E. Section 07 54 19, Polyvinyl Chloride Roofing
- F. Section 07 61 13, Standing Seam Sheet Metal Roofing
- G. Section 07 90 00, Joint Protection
- H. Section 09 91 00, Painting

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM A36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 3. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 4. ASTM A924 Standard Specifications for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - 5. ASTM A986 Standard Specification for Chromium, Chromium-Nickel, and Silicon Alloy Steel Bars and Shapes for Corrosion and Heat-Resisting Service
 - 6. ASTM B29 Standard Specification for Refined Lead
 - 3. ASTM B32 Standard Specification for Solder Metal
- B. Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA):

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1. Architectural Sheet Metal Manual

1.04 SUBMITTALS

A. General

1. Submittals for Flashing and Sheet Metalwork, including gutters and downspouts, and installation details, must be made in accordance with the provisions in these technical specifications.
2. The Contractor must submit the following:
 - a. Product Data: Submit manufacturer's specifications, installation instructions and general recommendations for applications. Include manufacturer's certification and other data substantiating that the materials comply with the requirements. Indicate by copy of the transmittal form that the installer was provided copy of the manufacturer's instructions and recommendations.
 - b. Shop Drawings: Submit detailed shop drawings showing the manner of forming, jointing, and securing the metal to form flashings, trims and other shapes required for the Work of this Project. Show expansion joint details and waterproof connections to adjoining work and at obstructions and penetrations.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Flashing and Sheet Metal must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Flashing and Sheet Metal must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Flashing and Sheet Metal complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Work must conform to the requirements of the SMACNA Architectural Sheet Metal Manual.
- B. Except where otherwise indicated, comply with minimum thickness or gauge requirements as specified in SMACNA Architectural Sheet Metal Manual.
- C. Worksite Meetings: Before beginning Work of this Section, arrange a meeting to be attended by Contractor, manufacturer and installer of roofing and waterproofing materials, sheet metal, and roof accessories, and VTA. The purpose of the meeting will be to review the specific requirements of each discipline and the coordination required to satisfactorily install watertight roofing and waterproofing systems.

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PART 2 – PRODUCTS

2.01 MATERIALS

- A. Zinc Coated Sheet Steel: Commercial quality carbon steel, minimum of 0.20 percent copper content, complying with ASTM A653. Material must be hot dip galvanized in compliance with ASTM A653, Z275, mill phosphatized, and gauge as shown or specified herein.
- B. Stainless Steel: Stainless steel sheet for architectural applications, meeting the requirements of ASTM A240/A240M or ASTM A968/A968M, Type 304 or Type 316, with No. 4 finish.
- C. Sheet Copper: Standard cold-rolled copper sheet for building construction, conforming with ASTM B370, 16 oz., 20 oz., 24 oz., or 32 oz. per square foot as indicated or required. Where copper weights are not indicated, provide 16 oz. Gutters and downspouts shall be fabricated from 24 oz. copper. Cleats shall be 32 oz. copper.
- D. Copper Drainage Tube: Where downspouts are indicated as copper pipe or tube, provide DWV copper drainage tube conforming to ASTM B306. Provide for installation with standard copper, brass, or bronze fittings, as indicated, capable of being soldered. Coordinate with plumbing requirements specified under Division 22, Plumbing.
- E. Aluminum Sheet Metal: ASTM B209, 5005 or 3003-H14 aluminum alloy as appropriate, clear anodized or epoxy coated. Where aluminum sheet thickness is not indicated, provide 0.0201 inch thickness.
- F. Sheet Lead: Standard 0.062 inch thick lead sheet weighing 4 pounds per square foot, arsenical-antimonial and pig lead alloy meeting the requirements of ASTM B29. Use sheet lead or tubing for flashing of vent pipes and other penetrations of the roof.
- G. Solder for Steel, Lead and Copper: ASTM B32, 50 percent lead and 50 percent tin, used with muriatic acid flux.
- H. Miscellaneous Plate, Bar and Rod Stock: ASTM A36, or as otherwise specified.
- I. Building Paper: Rosin sized, unsaturated paper, weighing approximately 6 pounds per 100 square feet, or a water-repellent smooth building paper meeting requirements of FS UU-B-790, Type I, Grade A.
- J. Anchors and Fasteners: Anchors and Fasteners must be of materials compatible with the material being fastened. Types, gauges and lengths must be as required by applicable building codes and as required to support the materials being fastened adequately.
- K. Furnish neoprene washers where dissimilar metals occur to prevent galvanic action.
- L. Straps: Straps and miscellaneous fastenings, where required, shall be stainless steel, half-hard copper, or half-hard 70-30 brass of size indicated or required. Where not indicated, provide straps of 1/16 inch thick by 1 inch wide size.
- M. Sealant: Caulking or sealing compound shall be a silicone synthetic rubber elastomeric sealant which cures at normal temperature to a flexible firm rubber, tack free, in gun grade consistency. Sealant shall be specially designed for adhesion to the surfaces to which it will be applied, and shall meet or exceed the minimum requirements of FS TT-S-230 or FS TT-S-1543 or ASTM C920, as applicable.

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- N. Primer: Conform to the requirements for paint primer specified in Section 09 91 00, Painting, for exterior metal.
- O. Isolator: Asphaltic based emulsion or mastic.
- P. Hardware Cloth: 1/4 - inch by 1/4 - inch sheet mesh, galvanized after fabrication.
- Q. Insect Screen: 1/14 - inch by 1/16 - inch mesh (14/16), aluminum.

2.03 FABRICATION

- A. Standard Details: Except where otherwise shown or specified, all work must conform with the applicable details and recommendations of SMACNA Architectural Sheet Metal Manual.
- B. Workmanship: Workmanship must be of the highest quality available in the sheet metal industry in the locality of the Project. Finish molded or "broken" sheet metal members with true, straight and sharp, lines and angles, and where surfaces join, cope to an accurate fit, and securely solder, weld, or otherwise fasten. Hem exposed edges of sheet metal, approximately 1/2 - inch.
- C. Seams: Provide for expansion and contraction in sheet metal work. Form, fabricate and install material to finish watertight and weather tight throughout. Lock seam work must be flat and true to line, and sweated full of solder. Flat lock seams, and lap seams where soldered, must be at least 1/2 - inch wide. Lap seams not soldered must lap according to the pitch required, but in no case less than 3- inches. Standing seams are not acceptable unless specifically shown on the Drawings, or written approval is received from VTA.
- D. Joints: Join parts with concealed rivets or sheet metal screws, where necessary for strength or stiffness. Fabricate items in the maximum lengths possible for this Project, and hold joints to minimum in number. Grind and polish welded stainless steel joints to match the finish of the adjacent surfaces.
- E. Form and fabricate sheet metalwork as indicated and in accordance with the approved Shop Drawings and SMACNA Architectural Sheet Metal Manual. Properly reinforce sheet metalwork as required for strength and appearance.
- F. Finishes: All metals must be shop primed and painted. Galvanized sheet metal surfaces which will be concealed in the finished work shall be chemically treated or etched to assure maximum paint adherence and then shop painted with one coat of an approved galvanized primer.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Inspect all surfaces and materials to receive the Work of this Section. Do not proceed with the Work of this Section until all unsatisfactory conditions have been corrected. Surfaces must be clean and dry, immediately before installation of the materials.

3.02 COOPERATION

- A. Cooperate with the installers of other trades such as roofing and waterproofing, for the successful installation of a complete and functioning weather and water tight system.

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3.03 INSTALLATION - GENERAL

- A. Installation Standards: Install flashing and sheet metalwork as indicated and in accordance with the approved Shop Drawings and SMACNA Architectural Sheet Metal Manual.
- B. Flashing and Metal Trim: Provide flashing, counterflashing, cap flashing, metal trim, and any other fabricated items and miscellaneous sheet metalwork indicated or required to provide a complete and watertight installation.
- C. Gutters and Downspouts: Install gutters and downspouts as indicated and in accordance with the approved Shop Drawings and pertinent provisions of SMACNA Architectural Sheet Metal Manual.
- D. Work Quality:
 - 1. Sheet metalwork shall be finished straight and true, with miters and joints accurately fitted. Exposed work shall be free of dents and other defects. Corners shall be reinforced and seams made waterproof. Edges of sheet metal shall be hemmed.
 - 2. Provide for expansion and contraction in sheet metal assembly by means of expansion joints or other appropriate methods of SMACNA Architectural Sheet Metal Manual. Provide reinforcement as required.
 - 3. Isolate and protect dissimilar metals from contact with each other by applying specified isolation material to contact surfaces. Protect surfaces of sheet metal in contact with concrete, treated wood, or aluminum with a heavy coating of bituminous paint.
 - 4. Provide waterproof neoprene washers wherever required fasteners penetrate sheet metal. Exposed fasteners will not be permitted for any portion of this work.
- E. Caulking and Sealing: Caulk or seal joints and laps of sheet metalwork as indicated or required for a waterproof installation. Beads of sealant which will be concealed in the finished work shall be continuous with no voids of material. Interface and coordinate the caulking and sealing work of this Section with the work specified in Section 07 90 00 – Joint Protection.
- F. Flashing for Roof Penetrations:
 - 1. Flashing of roof penetrations shall be four pound lead. Flashing shall be accurately formed to conform with roofing contours and configurations and as required to assure a watertight installation. Flashing shall be built in as the roofing work progresses. Flash and burn lead against any penetrations through its surface.
 - 2. Except as indicated otherwise, plumbing and mechanical vent flashing shall be of four pound lead tubing. Flanges shall be minimum 18 inches square, and tubing shall be long enough to permit turning lead into the end of vent pipe.

3.04 METAL FLASHING

- A. Fabricate from galvanized steel of thicknesses shown and/or specified. Flashings include counter- flashing, slip joints, reglets, and all other parts whose function is to provide a watertight juncture between materials.
- B. Form shapes to the configurations shown or specified, with clean lines and hemmed edges. Solder all joints, where possible. Provide the flashing items required to be installed in conjunction with the work of other trades, within adequate time to not delay the progress of their work.

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3.05 PROTECTION

- A. Upon completion of installation of the Work of this Section, protect all sheet metal items from damage to the item and its finish. All damaged Work must be replaced at the discretion of VTA, at no additional cost to VTA.

END OF SECTION 07 60 00

SECTION 07 61 13

STANDING SEAM SHEET METAL ROOFING

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes requirements for furnishing and installing Sheet Metal Roofing for the Platform Canopies located at:
 - 1. Story Station Platform
 - 2. Eastridge Station Platform

1.02 RELATED SECTIONS

- A. Section 05 12 35, Structural Steel
- B. Section 05 30 00, Metal Decking
- C. Section 05 40 00, Cold-Forming Metal Framing
- D. Section 07 22 00, Roof and Deck Insulation
- E. Section 07 26 00, Vapor Retarders
- F. Section 07 60 00, Flashing and Sheet Metal
- G. Section 07 90 00, Joint Protection

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 2. ASTM A792 Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy- Coated by the Hot-Dip Process.
 - 3. ASTM E1592 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Differences.
 - 4. ASTM E1646 Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
 - 5. ASTM E1680 Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.
- B. American Institute of Steel Construction (AISC):
 - 1. *AISC Manual of Steel Construction*, American Institute of Steel Construction.
- C. American Iron and Steel Institute (AISI):

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- 1. AISI Cold-Formed Steel Design Manual, American Iron and Steel Institute.
- D. American Society of Civil Engineers (ASCE)
- E. California Building Standards Code (California Code of Regulations, Title 24) (CBC) 2016
- F. National Fire Protection Agency (NFPA)
- G. Underwriters Laboratories (UL):
 - 1. UL-580 Standard for Tests for Uplift Resistance of Roof Assemblies

1.04 SUBMITTALS

- A. General
 - 1. Submittals for Standing Seam Sheet Metal Roofing must be made in accordance with the provisions in these technical specifications.
 - 2. Product Data: Submit manufacturer's product data sheet and/or product design and installation manual.
 - 3. Shop Drawings: Submit panel shop drawings consisting of design and erection drawings, finish specifications, and other data necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection. Submit small scale layouts of panels and large scale details of edge conditions, joints, fastener and sealant placement, flashings, penetrations and curbs, and special details. Distinction must be made between factory and field assembled work. Drawings must be approved and field verification of all dimensions must occur prior to fabrication.
 - 4. Samples:
 - a. Panel: Two (2) required, full panel width by 12-inches long.
 - b. Anchor Clips: Two (2) required.
 - c. Fasteners: Two (2) of each type with a statement of intended use.
 - d. Sealants: One (1) sample of each type, with a statement of intended use.
 - 5. Warranties: Submit manufacturer's applicable sample warranties of products.
 - 6. Quality Assurance Submittals:
 - a. Calculations: Submit structural design calculations certified by a registered professional engineer to verify load carrying capacity of the panel system.
 - b. Test Reports: Submit certified test reports showing that the roof system has been tested and conforms to the specified performance testing requirements.
 - c. Certificates:
 - 1) A written statement from the manufacturer certifying conformance with the specified manufacturer's qualifications as stated in these specifications.
 - 2) A written statement from the installer certifying conformance with the specified installer qualifications as stated in these specifications.
 - 7. Closeout Submittals:
 - a. Manufacturer's maintenance instructions.
 - b. Warranty Documentaion

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Standing Seam Metal Roofing must be measured by the square foot.

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- B. Payment: The contract price paid per square foot for Standing Seam Metal Roofing must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Standing Seam Metal Roofing complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide structural standing seam metal roof system with a maximum. 1-high "vertical" seam side joint, snap-together seam, with factory applied sealant.
2. Attach roof panels to support substrate with concealed anchor clips designed to allow for thermal movement of the panels. There must be no exposed fasteners except at panel fixing line and flashing details or as indicated on approved panel drawings.
3. Provide metal roof panel system which has been manufactured and installed to withstand specified design loads and maintains performance requirements without defects, damage, or failure.

B. Performance Requirements:

1. Design Loads:
 - a. The structural standing seam metal roof system must be designed to safely resist the positive and negative wind loads as specified in the Contract Documents.

<u>Roof Area</u>	<u>(+) Wind</u>	<u>(-) Wind</u>
Main Roof	30 psf	30 psf
Ridge	30 psf	30 psf
Eave	30 psf	30 psf
Rake	30 psf	30 psf
Corners	30 psf	30 psf
 - b. The structural standing seam metal roof system must be designed to safely resist a 20 psf roof live load.
 - c. Roof systems that incorporate foam plastic insulation must be tested by the foam plastic manufacturer in accordance with NFPA-285.
2. Deflection Criteria: Roof panel deflection must be limited to L/240 for positive loading.

C. Performance Testing: Tests must have been conducted or witnessed by a recognized independent laboratory or independent professional Engineer.

1. Allowable uniform uplift load capacity must be determined in accordance with ASTM E1592.
 - a. The factor of safety against ultimate failure of panel, batten, or clip must be 1.65, with no increase due to wind.
 - b. Allowable uplift capacity for conditions of gage, span, or loading other than those tested may be determined by interpolation of the test results. Extrapolation of conditions outside the range of the tests is not acceptable.
2. Roof panel system must be tested for resistance to water penetration in accordance with ASTM E 1646, at a static pressure of 7.0 psf. There must be no uncontrolled water penetration through the panel side joints.
3. Roof panel system must be tested for resistance to air leakage in accordance with ASTM E1680, at a static air pressure of 4.0 psf. There must be no measurable leakage.
4. Roof panel system must be tested in accordance with UL Standard 580 and have a Class 90 rating.

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1.07 QUALITY ASSURANCE

A. Qualifications:

1. **Manufacturers Qualifications:** The manufacturer must have had at least fifteen (15) years in architectural metal roofing design and installation. The manufacturer must have a permanent, stationary, indoor, production facility.
2. **Installer Qualifications:**
 - a. The installer must have had a minimum of five (5) years experience in the installation of metal roofing.
 - b. The installer must be manufacturer certified.

- B. **Pre-installation Meeting:** Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. **Delivery:** Material must be delivered to the site in a dry and undamaged condition and unloaded per the manufacturer's instructions. The installer must inspect materials for damage and stains upon arrival at the site.

- B. **Storage:** Materials must be stored out of contact with the ground in weather tight coverings to keep them dry per the manufacturer's recommendations. Storage accommodations must provide good air circulation and protection from surface staining.

- C. **Handling:** Exercise care in unloading, storing, and handling of panels to prevent bending warping, twisting, or surface damage. Follow manufacturer's recommendations for material handling.

1.09 WARRANTY

A. **Manufacturer's Warranties:**

1. **Material Warranty:** The manufacturer must warrant that the material furnished will remain free from defects in material and workmanship for a period of two (2) years from date of shipment.
2. **Metal Substrate Warranty:** The manufacturer must warrant that the metal roof panel substrate will not rupture or perforate due to corrosion within a period of twenty (20) years from date of shipment.
3. **Finish Warranty:** The manufacturer must warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the roof panel paint finish for a period of twenty (20) years from date of shipment.
4. **Weather tight Warranty:**
 - a. **Premium Warranty:** The manufacturer must warrant against water penetration of the metal roof panel system, including panel side joint and trim conditions for a period of ten (10) years from date of substantial completion. During the first two (2) years of the warranty, the roofing contractor must be liable for all such costs and expenses of repair, refinishing, or replacement of the roofing system as covered by the warranty. Coverage must be limited to material and installation. Liability must be limited to repair of the metal panel roof system.

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PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Metal Tech-USA, 611 Highway 74 South, Suite 900, Peachtree City, GA 30269; Telephone: (770) 486-8825; Fax: (770) 631-7689; E-mail: info@metaltech-usa.com; website: www.metaltech-usa.com
1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.

2.02 MATERIALS

- A. Double-Lock Standing Seam Panels:
1. Aluminum; ASTM B209, Type 3003, 0.125-inch (3.1mm); 1.782 lb/ft squared
 2. Panel Width: 6-inches
 3. Panel Length: as stated in the Contract Drawings
 4. Seam Height; 1-inch
 5. Roof Slope: 6:12 minimum
 6. Installation Method: Solid deck with concealed clip fasteners and mechanically seamed panel joints.

2.03 FINISHES

- A. Paint Finishes: Coating systems must have been tested in accordance with ASTM standard test methods for factory color finish.
1. Polyvinylidene Fluoride (PVDF): Two-coat system consisting of a nominal 0.2 mil corrosion inhibitive primer on both sides with a 0.75 mil fluoropolymer exterior topcoat and 0.30 mil backer finish.
 2. Colors: As indicated in the Contract Documents.
- C. Texture: Panel finish must be smooth.

2.04 ACCESSORIES

- A. Fasteners: Use only high quality fasteners as recommended or approved by the roof system manufacturer. Follow fastener manufacturers' recommendations for fastener installation.
1. Screws: Self-drilling screws must be minimum #10 diameter. Self-tapping screws must be minimum #14 diameter.
 - a. Exposed self-drilling and self-tapping screws must have a zinc die-cast head with neoprene washer or be 300 series stainless steel with neoprene washer. All exposed fasteners must be painted to match panel color.
 - b. Concealed screws must be carbon steel with corrosion resistant coating or 300 series stainless steel as required.

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2. Rivets:

- a. Structural bulbed rivets must be min.3/16-inch diameter, standard dome head, aluminum rivet and mandrel, with a weather tight EPDM washer under the head. Min. 5/16-inch diameter, large flange head, aluminum rivet and mandrel, with a weather tight EPDM washer under the head is required at panel endlaps.
- b. Trim rivets must be min. 5/32-inch diameter, stainless steel body and stem with open end or aluminum body and stem with closed end.
- c. Rivets must be painted to match panel color.

B. Closures:

1. All panel end closures must be field-formed from metal closures, manufactured from the same material, color, and finish as the roofing.

C. Sealants: Use only high quality sealants as recommended or approved by the roof system manufacturer. Sealants must not contain oils, asbestos, or asphalts.

1. Non-Curing Butyl: One-part, non-skinning, non-drying, synthetic butyl elastomer. Use for metal-to-metal sealing or bedding of panel and flashing seams or joints.
2. Butyl Tape (Webbed Mastic): Extruded polymeric butyl tape, non-skinning and not easily displaced under compression. Use for critical sealing of panel ends, endlaps, penetrations, closures, and flashings.
3. Urethane: One-part moisture curing, gun grade polyurethane sealant. Used for sealing in all exposed conditions.

2.05 METAL FLASHING AND TRIM

- A. All flashing must be of the same material, gage, finish, color, and texture as the panels unless otherwise noted.
- B. Flashing design must conform to details submitted and approved by the Architect and, if required, the panel manufacturer.

2.06 UNDERLAYMENT

- A. Self-adhering and self-healing roofing underlayment as recommended by the manufacturer.

2.06 FABRICATION

- A. Where possible panels must be manufactured in continuous lengths, full length of panel runs.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. The installer must inspect the building to verify that the structure is ready for roofing installation.
 1. All supports must be in place with all bracing and connections tightened before work proceeds.
 2. Field-check dimensions and check support alignment with a taut string or wire; panel misalignment may induce "oil canning" and potentially restrict panel movement.

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- a. Panel/purlin erection tolerances:
 - 1) Maximum out-of-plane deviation must be limited to +/-3/16-inch from control.
 - 2) Maximum deviation of 1/8-inch between adjacent purlins or L/500 whichever is less.
3. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install metal roofing system in accordance with approved erection drawings and manufacturer's installation instructions.
- B. Install metal roofing system so that it is weather-tight, without waves, warps, buckles, fastening stress or distortion.
- C. Do not walk on panels until panels are fastened to substructure and seams are snapped together.
- D. Protect installed panels from abuse by other trades. The general contractor must be responsible for protecting the roofing from wet cement, plaster, and paint operations. The installer must provide walk boards in heavy traffic areas to prevent damage to the panels.

3.03 DAMAGED MATERIAL AND CLEANING

- A. Replace panels and other components of work which have been damaged beyond repair.
- B. To prevent rust staining, remove immediately from finished surfaces any filings caused by drilling or cutting.
- C. Wipe down each area after erection is complete for final acceptance.

END OF SECTION 07 61 13

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SECTION 07 84 00

FIRESTOPPING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes specifications for Firestopping to be installed at the following locations:
 - 1. Electrical Rooms
 - 2. Elevator Machine Rooms
 - 3. Communications/Signal Building

- B. This Section includes specifications for the following materials:
 - 1. Mineral fiber safing insulation.
 - 2. Silicone foam seal system.
 - 3. Gypsum fireproofing sealant.
 - 4. Fire stop sealant.

1.02 RELATED SECTIONS

- A. Division 22 – Plumbing, Division 26 – Electrical, and Division 27 – Communications for wall penetrations as indicated in the Contract Documents.

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C475 Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
 - 2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials
 - 3. ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems

- B. UL:
 - 1. Building Materials Directory
 - 2. Fire Resistance Directory

- C. Warnock Hersey (WH):
 - 1. Building Products Directory

1.04 SUBMITTALS

- A. General
 - 1. Submittals for Firestopping must be made in accordance with the provisions in these Technical Specifications.
 - 2. Shop Drawings: Submit details of firestopping and through-penetration firestopping for

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- indicated installations.
- 3. Product Data: Submit product data and installation instructions for indicated applications.
- 4. Record Documents: Indicated on record (“as-built”) documents locations of each type of firestopping in accordance with Section 01 78 39, Project Record Documents.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Firestopping must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Firestopping must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Firestopping complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 REGULATORY REQUIREMENTS

- A. In addition to the foregoing referenced standards, the regulatory requirements that govern the work of this Section include the following governing code:
 - 1. California Code of Regulations (CCR), Title 24, Part 2, California Building Code, Chapter 7, “Fire and Smoke Protection Features”.

1.07 QUALITY ASSURANCE

- A. Materials and installation must meet or exceed the following requirements:
 - 1. UL or WH Classification and Listing.
 - 2. One-hour and two-hour fire ratings when tested in accordance with ASTM E119.
 - 3. Class 1 (25 or less) flame-spread rating when tested in accordance with ASTM E814.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in the manufacturer's original unopened containers or packages with manufacturer's name, labels, product identification, lot numbers, and mixing and installation instructions, as applicable.
- B. Store materials in the original, unopened containers or packages, and under conditions recommended by the manufacturer.

1.09 SITE CONDITIONS

- A. Follow manufacturer's instructions for temperature, ventilation, and other conditions required for proper mixing and installing of foam seals and sealants.

PART 2 – PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Firestopping and fire-resistant penetration seals for floors, walls, ceilings, and roof where fire-rated walls, shafts, or assemblies are penetrated by plumbing, mechanical, and electrical features, or otherwise, as indicated or required.

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2.01 MATERIALS

- A. Requirements: Fire-stopping materials and fire-resistant penetration seals must conform to the following types, as applicable for the location.
1. Mineral Fiber: Loose or batt mineral-fiber safing insulation, meeting fire-rating and installation requirements indicated.
 2. Foam: One-part or two-part silicone foam, manufactured silicone penetrating seal system, meeting fire-rating and installation requirements indicated.
 - a. Color for exposed locations must be as selected by the Architect from manufacturer's standard colors.
 - b. Wherever seals are not exposed to view, provide manufacturer's standard color that has the best overall performance characteristics for the application indicated.
 - c. Associated adhesive sealant, damming materials, and solvent must be as recommended by the foam manufacturer.
 3. Gypsum Fireproofing Sealant: Trowelable gypsum compound meeting applicable requirements of ASTM C475 and ASTM E814 for one-hour or two-hour fire rating as indicated for the fire-rated assembly being penetrated.
- B. Fire Stop Sealant: Sealant for the sealing of joints packed with mineral fiber or safing insulation must be fire stop sealant manufactured for the purpose, meeting fire-rating and installation requirements indicated.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine penetrations and openings to be sealed to determine if conditions are satisfactory for the proper installation of fire-resistant materials and seals. If unsatisfactory conditions exist, do not commence work until such conditions have been corrected.
- B. Verify that items and apparatus penetrating openings are installed and completed before beginning the firestop installation.

3.02 LOCATIONS

- A. Provide firestopping and fire-resistant penetration seals wherever required to preserve fire ratings of building elements at plumbing, mechanical, electrical, and other penetrations.

3.01 INSTALLATION

- A. Install materials in clean, dry openings free of loose material and projections.
- B. Install materials in accordance with the respective manufacturer's installation instructions, and as required to provide a tight seal and preserve fire ratings at penetrations and openings.
- C. Inspect foam seals following 24-hour cure; add additional foam as required for tight seal; reinspect and add foam until installation is satisfactory.
- D. Install sealant in accordance with manufacturer's installation instructions.

3.01 CLEANING

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- A. Remove spilled and excess materials adjacent to penetrations without damaging adjacent surfaces.
- B. Leave finished work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.

END OF SECTION 07 84 00

SECTION 07 90 00

JOINT PROTECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes requirements for:

1. Sealants
2. Caulking
3. Primer
4. Sealant backing
5. Bond breaker

1.02 RELATED SECTIONS

- A. Section 07 95 50, Bridge Joint Seals and Assemblies
- B. Section 07 95 60, Bridge PTFE Spherical Bearings

1.03 REFERENCED STANDARDS

A. ASTM International (ASTM):

1. ASTM C717 Standard Terminology of Building Seals and Sealants
2. ASTM C790 Standard Guide for Use of Latex Sealants
3. ASTM C834 Specification for Latex Sealants
4. ASTM C920 Standard Specification for Elastomeric Joint Sealants
5. ASTM C962 Standard Guide for Use of Elastomeric Joint Sealants

B. Federal Specifications (FS):

1. TT-S-227 Sealing Compound: Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)
2. TT-S-230 Sealing Compound: Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)
3. TT-S-1543 Sealing Compound, Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures)

C. UL:

1. UL1479 Fire Tests of Through-Penetration Firestops

1.04 SUBMITTALS

A. General

1. Submittals for joint protection must be made in accordance with the provisions in these technical specifications.
2. The Contractor must submit the following:

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- a. Product Data: Submit manufacturer's specifications, recommendations and installation instructions for each type of sealant, caulking and associated miscellaneous material required. Include manufacturer's published data, letter of certification, or certified laboratory test report, indicating that each material complies with the requirements of the Contract Documents, and is intended for the uses and applications shown or specified. Indicate by copy of the letter of transmittal, that the installer has been provided a copy of the manufacturer's instructions.
 - b. Color Charts: Submit sealant and caulking color charts to VTA for selection of colors to be used at each location allowing 21 days prior to procurement, and following any required color or material selections of affected adjacent materials.
 - c. Samples: Submit samples of each color and type of sealant and caulking selected or specified. VTA's review will be for color and texture only. Compliance with other requirements is the exclusive responsibility of Contractor.
 - d. Manufacturer Approval: Provide a letter from the sealant manufacturer stating approval of the technical representative selected to supervise the application of the sealants, as well as the sealant applicator proposed to be used.
 - e. Certificate of Acceptability: Provide a certificate signed by the sealant manufacturer representative, indicating that they have reviewed the detailing for this Project, and the sealants specified for use, and identify any details or sealants specified that the manufacturer will not warrant for the use of their product. In the event there are any joints so identified as unacceptable, provide a proposed substitution material for consideration by VTA.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Joint Protection must be measured by the linear foot.
- B. Payment: The contract price paid per linear foot for Joint Protection must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Joint Protection complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 DEFINITIONS

- A. Sealant and caulking terms specified herein comply with the definitions of ASTM C717.

1.07 WARRANTY

- A. Upon completion of the work of this Section, submit a written warranty, signed by Contractor as well as the installer, covering the work for a period of 2 years. In addition, the warranty must stipulate that Contractor will provide all other work required for such repair or replacement, should failure occur, at no costs to VTA.
- B. Failure of the materials or workmanship must include leakage, hardening, cracking, crumbling, melting, shrinkage or running of the sealant or caulking, or the staining of adjacent materials.

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1.08 QUALITY ASSURANCE

- A. Qualifications: Application/installation of sealant and caulking materials must be by a licensed applicator skilled and experienced in the application/ installation of sealants and caulking compounds.
- B. Compatibility Tests: Primers and sealants must be tested by the manufacturer for compatibility and adherence with materials to which application is indicated. Submit test reports certifying compatibility at least 30 days before application.
- C. Field Samples and Mock-Ups:
 - 1. Provide sample application of sealants and caulking compounds at locations approved by the Engineer. Samples must represent primary types of materials, substrate surfaces, joint size, exposure, and other conditions to be encountered in the work. Preparation, priming, application, and curing must comply with manufacturer's recommendations for the actual conditions.
 - 2. Samples will be visually examined for staining, dirt pickup, shrinkage, color, work quality, and appearance. Cut and pull sealant from each sample joint to examine for internal bubbles or voids, adhesion, and compatibility with substrate.
 - 3. Schedule applications, with allowance for sufficient curing time, so that samples may be examined and necessary adjustments made at least one week before date scheduled for commencing installation of the work.

1.09 SITE CONDITIONS

- A. Do not proceed with installation of sealants and caulking compounds during inclement weather unless the installation complies with the manufacturer's instructions.
- B. Do not proceed with the installation of sealants under extreme temperature conditions that may cause joint openings to be near either maximum or minimum width, nor when high temperatures or high wind loads are forecast during the period required for initial or nominal cure of elastomeric sealants.
- C. Schedule installation and cure of elastomeric sealants during period of relatively low temperatures (but well within manufacturer's recommended range) so that subsequent tensile stresses upon cured sealants will be minimized.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Unless otherwise specifically approved by VTA, or called for on the Drawings, sealant products used must be commercial grade products, as manufactured by manufacturers as listed herein or VTA-approved equal.

2.02 MANUFACTURERS

- A. Various Sealants and caulking products as identified herein, and associated accessories must be provided by the following manufacturers (unless otherwise noted within these specifications), or VTA-approved equal:

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1. Dow Corning, 910 Auburn Court; Fremont, CA. 94538. Ph: (510) 490-9302; Fax: (510) 490-0650.
2. Morton Polymer Systems, 100N. Riverside Plaza; Chicago, IL 60606. Ph: (312) 807-3173; Fax: (312) 807-3435.
3. Sonneborn by ChemRex, 889 Valley Park Drive; Shakopee, MN 55379. Ph: (800) 433-9517; Fax: (800) 496-6067.

B. Products of the following Structural Sealant Manufacturers or VTA approved equal:

1. Product: Structural Glazing / Glazing sealant, model number 995: Dow Corning Corporation, Midland, MI 48686-0994. Ph: (989) 496-6000, FAX: (989) 496-4654.
2. Product: Structural Glazing / Glazing sealant, model number SSG4000: GE Sealants and Adhesives, 16325 Northcross Drive; Huntsville, NC 28078. Ph: (800) 332-3390, (800) 255-8886.
3. Product: Structural Glazing / Glazing sealant, model number 895, 896, or 985: Pecora Corporation, Dallas, TX 75243. Ph: (800) 233-9754, (214) 348-5313, Fax: (214) 348-5421.

2.03 MATERIALS

A. Sealants: Sealants must be designed for adhesion to the surfaces to which they will be applied, and must be non-staining, non-shrinking, and non-sagging, meeting the following requirements.

1. Exterior Sealant: Sealant for exterior locations must be a silicone or polyurethane elastomeric sealant, as appropriate for the substrate conditions, meeting requirements of ASTM C920, Type S or M, Grade NS, Class 25, and Use designation as required for the location and substrate.
 - a. Silicone Sealant: ASTM C920 and Fed. Spec. TT-S-230 or Fed. Spec. TT-S-1543, as applicable.
 - b. Polyurethane Sealant: ASTM C920 and Fed. Spec. TT-S-227 or Fed. Spec. TT-S-230, as applicable.
2. Interior Sealant: Sealant for general sealing of interior locations must be a single-component, gun-grade, paintable, water-base acrylic-latex, meeting requirements of ASTM C834.
3. Acoustical Sealant: Permanently plastic, paintable, synthetic polymer base sealant manufactured specifically for interior acoustical applications.
4. Sanitary Sealant: Single-component, primerless, flexible, mildew-resistant, silicone rubber, meeting requirements of Fed. Spec. TT-S-1543.
5. Fire-Resistant Sealant: Sealants used at penetrations of fire-rated walls and ceiling assemblies must be UL listed as meeting UL 1479.
6. Color:
 - a. For fully concealed joints, provide manufacturer's standard color of sealant or caulking compound that has best overall performance characteristics for application indicated.
 - b. For exposed joints, provide color indicated or, if color is not indicated, provide colors as selected by the Architect from manufacturer's standard colors, to match or blend with adjoining materials or to match adjacent joint material as applicable.

B. Primer: Primer, when required, must be a quick-drying, colorless, nonstaining sealer of type and consistency as recommended by the manufacturer of the sealant for the particular type of surfaces to be sealed.

C. Sealant Backing: Sealant backup or packing (backer rod) must be a non-absorbent premolded or preformed nonstaining resilient material, such as polyethylene foam rod, or neoprene, butyl, polyurethane, or other closed cell foams or extruded rod, compatible with the sealant used. Follow

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sealant manufacturer's recommendations for compatibility of backer rod with sealant used. Material must act as a bond breaker and must be circular in cross section.

- D. Bond Breaker: When required, pressure-sensitive polyethylene tape, teflon tape, or other plastic tape as recommended by the sealant manufacturer for the location, to prevent bond of sealant in heel of joint.

2.04 POLYURETHANE SEALANT

- A. Material must be a 2-part, moisture curing, gun grade polyurethane sealant, conforming to FS TT-S- 227, Type II, non-sag. Materials must be supplied in a ready-to-mix form. Compounds must be non-toxic and non-staining. Colors must be as selected by VTA, from manufacturer's standard colors. Polyurethane sealant must be used at all locations not specifically identified to receive another sealant type.

2.05 SILICONE SEALANT

- A. Material must be a one-part, low modulus silicone, non-sag sealant, conforming to FS TT-S-230, Type II, Class A. Material must be supplied in a ready-to-use form. Compounds must be non-staining and non-toxic. Sealants relying upon the release of acetic acid vapors for proper curing must only be applied at those locations where adequate ventilation (as defined by sealant manufacturer) of such vapors exists. Colors must be as selected by Engineer, from manufacturer's standard colors. Silicone sealant must be used at all glazing conditions.

2.06 PRIMERS AND BOND PREVENTATIVE MATERIALS

- A. Primer and bond preventative materials must be as recommended by the sealant or caulking manufacturer, for the intended use, exposure, and materials involved.

2.07 BACKSTOP MATERIAL

- A. Material must be glass fiber roping, closed cell neoprene, butyl polyurethane, vinyl, or polyethylene foams, free from oil or other staining elements. Oakum and other types of absorptive materials must not be used as backstop material for sealants or caulking.

2.08 CONTROL, SCORE, AND EXPANSION JOINT SEALANT

- A. Material must be a 2-part, moisture curing, liquid polysulfide polymers conforming to FS TT-S- 227, Type II, non-sag, or 2-part self-leveling polyurethane, Sonolastic manufactured by Sonneborn CO., Hayward, CA; Urethane Sealant (314) 55-922, black, manufactured by The Burke Co., San Mateo, CA, or VTA-approved equal. Sealant must meet requirements of ASTM C920, Type M. Materials must be supplied in a ready-to-mix form. Compounds must be non-toxic and non-staining. Colors must be as selected by VTA from manufacturer's standard colors.

2.09 STRUCTURAL SILICONE SEALANTS

- A. Silicone Structural Adhesive: One-component, self-priming, shelf-stable, neutral cure, elastomeric adhesive specifically formulated for silicone structural glazing, complying with the following requirements:

1. Tensile Strength: 150 psi
2. Durometer Shore A: 37 points
3. Modulus at 25% extension: 48 psi

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4. Joint movement: 50 percent +/-
5. Warranty period: 20 years
6. Color: Black
7. One part cure
8. Reversion resistant
9. UV Light resistant
10. All temperature gunnable
11. Neutral cure system

B. Reference Standards and Specifications for Structural Sealants:

1. TT-S-001543A
2. TT-S-00230C
3. ASTM C 920, Type S, Grade NS, Class 25, Use NT, G, A

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrate surfaces and joints to be sealed, and conditions under which work is to be performed, and correct conditions detrimental to proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: This Section is intended to be general in its scope as to where sealant is to be installed. Contractor must verify the conditions identified on the Drawings, and thoroughly familiarize himself with the extent of sealant work to be done. Only a complete, watertight and weather tight job will be considered acceptable. Sealants must be applied in accordance with the recommendations of the manufacturer, and under direct observation of the manufacturer's technical representative, by an applicator approved by the sealant manufacturer. The manufacturer must provide field technical assistance to ensure the proper cleaning of surfaces, and application of the materials.
- B. Surface Preparation: Surfaces must be clean, dry, and free from grease, oil, wax, lacquer, paint or other foreign material. Joints must be closed on three sides, and must be cleaned out to the depth indicated on the Drawings. Surface preparation of joints, application of primers, installation of sealant backing and bond breaker, and installation of sealant must be in accordance with the sealant manufacturers' installation instructions and recommendations and the requirements of ASTM C790 and ASTM C962, as applicable.
- C. Joint Dimensions:
1. Joints subject to foot or wheel traffic loading must be the full depth of the adjacent materials being sealed.
 2. Where joint depths exceed the requirements of the depth-width ratio specified herein, the inner portions must be filled with backstop filler until the required joint depth is provided.
- D. Seal joints continuously with sealant around openings in exterior walls, at control and expansion joints, and at other locations indicated or required for waterproofing the building or structure. Seal and caulk joints as indicated and as required to complete the building or structure, both exterior and interior.

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- E. Sealant must be placed before painting operations are started. Sealant in joints adjacent to painted work must be placed before final coat of paint is applied. Concrete, masonry, stucco, and other surfaces, if recommended by the sealant manufacturer, must be primed before applying sealant. Primer must be applied with a brush that will reach all parts of joints to be filled with sealant.
- F. Primer: Apply primer to surfaces indicated or recommended by the manufacturer. Primer must not be applied to surfaces which will be exposed after the completion of the work of the Project.
- G. Bond Preventative Material: Apply material at back or bottom of joints to be sealed, which have not received backstop material. Apply bond preventative material to full width and length of the joint cavity.
- H. Compounds: Apply sealants and caulking materials in accordance with the manufacturer's instructions, using equipment of the proper size to fit the joint widths. Force compound into the joints with sufficient pressure to fill the cavity solidly. Material must be smooth and free of air holes and wrinkles, and unless otherwise indicated, tooled and left sufficiently convex to result in a flush joint when fully cured.
- I. Curing: Cure sealants and caulking compounds in compliance with the manufacturer's instructions and recommendations, to achieve high early bond strength, internal cohesive strength, and surface durability.

3.03 FIELD QUALITY CONTROL

- A. Perform inspections necessary to assure proper preparation of locations and joints to receive sealants and caulking and to assure compliance with manufacturer's instructions for mixing, installation, curing, and protection.
- B. After curing of exterior joints exposed to weather, test for leaks by applying a stream of water perpendicular to the surface from a 1/2-inch or 5/8-inch hose at normal city water pressure. Test at least ten percent of the exposed joint system.
- C. Repair leaks and retest as directed.

3.04 SURFACE PREPARATION

- A. Joints and spaces to be sealed or caulked must be cleaned of dirt, dust, mortar, oil, and other deleterious substances that may impair bond or adversely affect the sealing or caulking work. Where necessary, degrease with an approved solvent or commercial degreasing agent. Surfaces must be dry before application of sealants or caulking compounds.
- B. Do not apply sealants to joint surfaces previously treated with sealer, curing compound, water repellent, or other coatings, unless a laboratory durability test of bond cohesion has been performed successfully demonstrating that bond will be durable. Test method must comply with procedures of the ASTM or FS applicable to the particular sealant.
- C. Do not apply paint and other coatings to surfaces adjoining joints until sealants have been installed and are nominally cured.
- D. If recommended by the manufacturer, remove paint and other coatings from surfaces to be sealed prior to sealant application. Remove coatings on metallic surfaces with a solvent that leaves no residue.

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- E. Joints must be cleaned out, full width and depth. Joints must be raked to proper depth, permitting use of sealant backing and sealant of indicated depth. Depth of joint in back of sealant must be filled with sealant backing as specified. Sealant must not be applied without sealant backing material, unless indicated otherwise on the Drawings.

- F. Joints must be enclosed on three sides. Where grooves for adequate sealing have not been provided, suitable grooves must be cleaned out to depth required or as indicated and cut or ground to minimum width of 1/4 inch without damage to adjoining work. Minor variations in width must not require correction. Damaged adjacent or connecting work resulting from cutting or grinding must be restored.

3.05 CURING AND PROTECTION

- A. Cure compounds and sealants in accordance with manufacturer's instructions to obtain maximum bond to surfaces, and cohesive strength and durability at earliest possible date.

- B. Provide for protection of sealants and caulking compounds during remainder of construction period, so that they will be without deterioration or damage at time of acceptance of the work.

3.06 CLEANING

- A. Confine compounds to joint areas indicated by use of masking tapes or other precautions to prevent spillage or migration onto adjoining surfaces. Remove excess compound or sealant promptly as work progresses and clean adjoining surfaces to eliminate evidence of spillage.

END OF SECTION 07 90 00

SECTION 07 95 00

EXPANSION CONTROL

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing Expansion Joint Assemblies at Station Platforms and Access Structures landings as indicated in the Contract Drawings.

1.02 RELATED SECTIONS

- A. Section 03 30 00, Cast-In-Place Concrete
- B. Section 05 50 00, Metal Fabrications
- C. Section 07 90 00, Joint Protection

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 2. ASTM D395 Standard Practice for Commercial Packaging
 3. ASTM D412 Standard Test Methods for Vulcanized rubber and Thermoplastic Elastomers – Tension
 4. ASTM D421 Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
 5. ASTM D570 Standard Test Method For Water Absorption of Plastic
 6. ASTM D624 Standard Test Method for Tear Strength of conventional Vulcanized Rubber and Thermoplastic Elastomers
 7. ASTM D695 Standard Test Method for compressive Properties of Rigid Plastics
 8. ASTM D1299 Standard Test Method for Shrinkage of Molded and Laminated Thermosetting Plastics at Elevated Temperature
 9. ASTM D2240 Standard Test Method for Rubber Property – Durometer Hardness
 10. ASTM F1637 Standard Practice for Safe Walking Surfaces
- B. International Organization for Standardization (ISO):
1. ISO 6361 Wrought Aluminum and Aluminum Alloy Sheets, Strips and Plates

1.04 SUBMITTALS

- A. General
1. Submittals for joint protection must be made in accordance with the provisions in these technical specifications.
 2. The Contractor must submit the following:
 - a. Product Data: Submit manufacturers' product data of vertical and horizontal

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- expansion-joint closures, assemblies, seals, and sealants for review. Include installation details.
 - b. Fire Rating Certification: Submit copies of UL Classification or Warnock Hersey Listing for fire-rated joint covers.
 - c. Drawings: Submit drawings indicating pertinent dimensions, general construction, blockout dimensions, product information, and structural joint opening dimensions.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Expansion Control shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Expansion Control shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Expansion Control complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in Manufacturer's original, intact, labeled containers and store under cover in a dry location until installed. Store off the ground in temperatures above 40°F, protect from weather and construction activities.

1.07 QUALITY ASSURANCE

- A. Pre-construction – the General Contractor, Engineer/Architect, Concrete Subcontractor, Manufacturer's Representative and Certified Contractor, will conduct a pre-construction meeting to discuss blockout construction, joint gap settings, concrete elevations, flatness (critical) and construction phasing. This meeting shall be held prior to any concrete placement at expansion joint blockouts and may be held in conjunction with the concrete pre-pour meeting.
- B. Expansion Joint Blockouts – vibrate all formwork then float and trowel concrete before final cure to remove all air pockets, voids and spalls. Adjust blockout depth to accommodate finished flooring material.
- C. Critical Joint Surface Areas - two feet on each side of the expansion joint opening shall be finish graded perpendicular to joint opening creating flush floor-to-floor transition. Elevations on each side of the joint must be identical.
- D. Pre-installation Inspection – the General Contractor, Engineer/Architect, Manufacturer's Representative and Certified Contractor, will conduct a pre-installation project site inspection. The General Contractor shall provide a field report that summarizes the project conditions and any remedial action necessary to correct field conditions (substrate, joint size, blockout, vertical offsets, etc.) that may affect expansion joint system performance.

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- E. Certification / Installation – a factory trained and “certified” contractor shall install the specified expansion joint system. The contractor shall provide proof of certification from manufacturer and proof of participation in manufacturer’s continuing education program.
- F. Warranty – the Manufacturer and Certified Contractor warrant to the Owner that the expansion joint system shall be free from manufacturing, material and installation defects for a period of one (1) year from the date of installation, based on specified movements and design conditions for normal use and subject to the terms and conditions of the manufacturer’s standard written limited warranty. No liability or responsibility is accepted due to defects in the concrete substrate.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: SSP Series, SNB Series, and DIH Series as listed below and as manufactured by MM Systems Corp., 50 MM Way, Pendergrass, GA, 30567 / Tel. 866.506.6929 / Fax. 706.824.7501 / Web www.mmsystemscorp.com or VTA approved equal.
 - 1. Proprietary Products: Use of manufacturer’s proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer’s material data that indicates compliance with the requirements of Part 1 of this Section.
 - a. Model Number:
 - 1) SSP-600
 - 2) SNB-1200
 - 3) SNB-C-1200
 - 4) SNB-C-600
 - 5) SNB-600
 - 6) DIH-200

2.02 DIH EXPANSION JOINT ASSEMBLIES

- A. Furnish pre-approved dual interlocking hinge expansion joint sealing system “DIH Series” as manufactured by MM Systems Corporation designed to meet seismic movement criteria, specified wheel loads, vertical displacement, lateral shear and pedestrian foot traffic as shown on the contract drawings.
- B. Expansion joint system shall consist of recessed structural aluminum base frame with integral dual hinged interlocking slide covers. Articulating interlocking slide covers shall incorporate vibration dampers that provide impact resistance and sound damping.
- C. Must accommodate pedestrian foot traffic with a slip resistant walking surface that complies with ASTM-F1637 Standard Practice for Safe Walking Surfaces and Accessible-Code Compliant (ADA Guideline) for static coefficient of friction for walking surfaces.
- D. Select the system size at each joint location based on the movement tables shown in the contract drawings or as defined by the structural engineer of record. The certified installation contractor must provide written confirmation that the model and size selected will accommodate expansion, contraction, vertical displacement and lateral shear throughout the full movement cycle.

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- E. Provide an independent third party analysis by a licensed structural engineer validating that the dual interlocking hinge expansion joint system meets the projects movement requirements and shall remain within the elastic range under specified service level loading conditions.
- F. Aluminum Structural Base Frames – from aluminum alloy 6005 -T5.
- G. Aluminum Hinged Slide Covers – from aluminum alloy 6005 -T5 with Accessible-Code Compliant sloped plates. Top surface shall provide a slip-resistant raised pattern profile. Slide covers shall have continuous cavities to receive integral high-density rubber damper that provides vibration and sound damping.
- H. Rubber Gutter – (per contract drawings) provide continuous 45-mil EPDM rubber attached to concrete with Microsealant Waterproofing Tape. Provide flexible down spout and drain tubes as required.
- I. Accessories – provide necessary assembly hardware required for complete installation.
- J. Blockout Infill – provide LokCrete[®] Elastomeric Concrete semi-flexible blockout infill material as manufactured by MM Systems Corporation. Elastomeric concrete shall be produced in an ISO2001 manufacturing facility consisting of polyurethane liquid components “A” and “B” and a specialty aggregate component “C”. LokCrete[®] cures exothermically and bonds to the concrete and aluminum expansion joint base frame.

Physical Properties of Elastomeric Concrete binder and aggregate mix after seven-day cure at room temperature:

<u>Property</u>	<u>Requirement</u>	<u>ASTM Method</u>
Compressive strength	2800 psi	D695
Resilience @ 5% deflection	95 percent	D695
Compressive stress, psi	800 psi min.	D695
Impact resistance, ft-lb, @ -20°F	No Cracks	Ball drop
Adhesion	Concrete Failure	D421
Ultimate Elongation	10 percent	D412
Water Absorption	3 percent	D570
Heat Shrinkage, max.	2 percent	D1299
Pot Life	15 minutes	(after mixing)

- K. Finishes:
 - 1. Aluminum Frames and Covers - top surface of aluminum base frame and dual hinged covers shall have slip-resistant raised V-pattern profile in standard mill finish.

2.03 SSP EXPANSION JOINT ASSEMBLIES

- A. Provide seismic expansion joint sealing system that meets the specified movement requirements and is capable of HS-20 loading and able to accommodate vehicular and pedestrian traffic.
- B. System shall consist of recessed extension plates that allow a seismic slide plate to remain flush with finished deck surface. Provide a seismic centering bar device with impact dampeners and displacement springs to allow the slide plate to displace and return to its natural position after a seismic occurrence. Include an integral waterstop that provides impact resistance and sound dampening.

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- C. The Certified Contractor must provide written confirmation, utilizing manufacturer’s product data, that the model and size selected will comply with and accommodate expansion, contraction, vertical displacement and lateral shear throughout the full movement cycle.
- D. Base Member - capable of HS-20 loading from aluminum alloy 6005 -T5.
- E. Extension Plates - 3/16-inch minimum plate thickness from aluminum alloy 6005 -T5.
- F. Aluminum Slide Plate (standard) - 3/8-inch minimum plate thickness from aluminum alloy 6005 -T5 with Accessible-Code Compliant beveled edges (12-inch opening requires ½-inch aluminum plate). Top surface shall provide non-slip V-groove finish. Underside of plate shall have continuous end cavities to receive integral high-density rubber waterstop that provides impact resistance and sound dampening.
- G. Seismic Centering Bar Device - shall have solid aluminum circular ball ends that lock and slide in the base member and rotate freely. Provide stainless steel hardware connected through rubber impact dampeners and single or dual heavy-duty displacement springs.
- H. Rubber Gutter - continuous fabric reinforced 60-mil EPDM rubber attached into an integral cavity in the base member. Provide flexible down spout and drain tubes as required. Fastener penetrations in the gutter are not allowed.
- I. Accessories - Provide necessary assembly hardware required for complete installation.
- J. Waterproofing (as required) – provide LokCrete[®] elastomeric concrete header material as manufactured by MM Systems Corporation. Elastomeric concrete shall be produced in an ISO2001 manufacturing facility consisting of polyurethane liquid components “A” and “B” and a specialty aggregate component “C”. LokCrete[®] cures exothermically and bonds to concrete, aluminum and steel.

Physical Properties of Elastomeric concrete binder after seven-day cure at room temperature:

<u>Property</u>	<u>Requirement</u>	<u>ASTM Method</u>
Tensile Strength	4750 psi	D412
Ultimate Elongation	10 percent	D412
Hardness, Shore D	78 +/- 5	D2240
Tear Resistance	200 pli / 35 kN/m	D624
Water Absorption	3 percent	D570
Heat Shrinkage, max.	2 percent	D1299
Compression Set	48 percent	D395
Pot Life	5 minutes	(after mixing)

Physical Properties of Elastomeric concrete binder & aggregate mix:

<u>Property</u>	<u>Requirement</u>	<u>ASTM Method</u>
Compressive strength	9200 psi	D695
Resilience @ 5% deflection	95 percent	D695
Compressive stress, psi	800 psi min.	D695
Impact resistance, ft-lb, @ -20°F	No Cracks	Ball drop
Adhesion	Concrete Failure	D421

- K. Finishes:

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1. Aluminum Slide Plates - top surface of aluminum slide plate shall have slip-resistant V-groove profile and standard mill finish. SSP-1200 Series shall have a slip-resistant raised profile and standard mill finish.
2. Recessed Extension Plates shall be standard mill finish.
3. Elastomeric Concrete Blockout Filler (as required) - shall be supplied in standard black or custom gray colors.

2.04 FABRICATION

- A. Metal Frames and Plates – shall be shipped in standard 10 ft. lengths and shall be cut to length at jobsite where required. All profiles shall be miter cut in the field to conform to directional changes unless otherwise contracted with expansion joint manufacturer.
- B. Aluminum Frames and Covers – shall be shipped in standard 10 ft. lengths and shall be cut to length at jobsite where required. All profiles shall be miter cut in the field to conform to directional changes unless otherwise contracted with expansion joint manufacturer.
- C. Rubber Gutter – shall be shipped in the longest practical continuous length in manufacturer’s standard shipping carton.
- D. Elastomeric Concrete Blockout Infill Material – Ship in manufacturer’s approved containers shrink wrapped on wooden pallets.
- E. Wall Mount (floor-to-wall condition) – aluminum ball and socket extrusions shall be shipped in standard 10 ft. lengths and shall be cut to length on jobsite where required.
- F. Wall Mount (slab-to-wall condition) – aluminum ball and socket extrusions shall be shipped in standard 10 ft. lengths and shall be cut to length on jobsite where required.

PART 3 – EXECUTION

3.01 PREPARATION

- A. The contractor must provide properly formed concrete expansion joint openings constructed to the exact dimensions and elevations shown on manufacturer’s standard system drawings or as shown on the contract drawings. Any edge or area in need of repair shall utilize structural concrete repair materials that provide a solid and square expansion joint opening. Deviations from these dimensions will not be allowed without the written consent.
- B. The contractor shall insure that the joint opening sidewall interfaces run parallel to each other for the entire length of the joint. Sidewalls should be plumb and interfaces must be continuously equidistant from each other across the joint width to accommodate the proper installation of the expansion joint system.
- C. Any concrete edge or area adjacent to the expansion joint opening in need of repair shall utilize structural concrete repair materials.
- D. Surface areas two feet on each side of the expansion joint opening shall be finish graded perpendicular to joint opening creating flush slab-to-slab transition. Elevations on each side shall be identical.

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- E. Install expansion joint system in strict accordance with the manufacturer's typical details and instructions along with the advice of their qualified representative. Refer to Manufacturers Installation Guide for detailed step-by-step installation instructions.

3.02 INSTALLATION

- A. The contractor must clean the concrete surface where the aluminum base frames are attached. Remove all contaminants by abrasive blasting immediately prior to installation of expansion joint system. Concrete form release agents, water repellents, laitance, surface dirt, rust, old sealants and other surface treatments and protective coatings must be removed from the concrete surface in order to obtain the proper concrete blockout infill bond.
- B. Areas adjacent to the joint must be masked to assure neat, clean joint lines. Remove masking after installation of expansion joint system.
- C. Do not install elastomeric concrete infill material until the concrete has been air-dried at temperatures at or above 45 degrees F. for at least 28 days minimum and the concrete must have a measured moisture content that is below 4 percent. The surface area must be completely dry prior to placement of the elastomeric bedding compound.
- D. Refer to Manufacturers Installation Guide for detailed step-by-step instructions on how to properly mix and install elastomeric concrete filler.

3.03 CLEANING AND PROTECTION

- A. Protect the system and its components during construction. Heavy construction vehicles will not be permitted to cross the expansion joint. Subsequent damage to the expansion joint system will be repaired at the general contractor's expense. After work is complete, clean exposed surfaces with a suitable cleaner that will not harm or attack the finish of the expansion joint system.

END OF SECTION 07 95 00

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SECTION 07 95 50

BRIDGE JOINT SEALS AND ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. Bridge deck joint seals
 2. Bridge joint seal assemblies
 3. Bridge joint seals between concrete structures
 4. Sliding joints
 5. Premolded expansion joint filler
 6. Expanded polystyrene
 7. Neoprene

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 15 13, Waterstops
- D. Section 03 30 00, Cast-in-Place Concrete
- E. Section 03 35 00, Concrete Finishing
- F. Section 03 41 00, Structural Precast Concrete
- G. Section 05 05 60, Metal Welding
- H. Section 05 12 35, Structural Steel
- I. Section 05 17 00, Miscellaneous Metal
- J. Section 07 95 00, Expansion Control

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM A572/A572M Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 2. ASTM C203 Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
 3. ASTM C542 Standard Specification for Lock-Strip Gaskets

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- | | | |
|-----|------------|---|
| 4. | ASTM D395 | Test Methods for Rubber Property – Compression Set |
| 5. | ASTM D412 | Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension |
| 6. | ASTM D412 | Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension |
| 7. | ASTM D471 | Standard Test Method for Rubber Property—Effect of Liquids |
| 8. | ASTM D573 | Standard Test Method for Rubber—Deterioration in an Air Oven |
| 9. | ASTM D746 | Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact |
| 10. | ASTM D1149 | Standard Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment |
| 11. | ASTM D1751 | Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) |
| 12. | ASTM D2240 | Test Method for Rubber Property – Durometer Hardness |
| 13. | ASTM D2628 | Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements |
- B. American Association of State Highway and Transportation Officials (AASHTO):
- | | | |
|----|-------------------|---|
| 1. | Designation M 300 | Standard Specification for Inorganic Zinc Rich Primer |
|----|-------------------|---|
- C. American Institute of Steel Construction (AISC)/The Society for Protective Coatings (SSPC):
- | | | |
|----|-----------------------|---|
| 1. | AISC 420-10/SSPC-QP 3 | Certification Standard for Shop Application of Complex Protective Coating Systems |
|----|-----------------------|---|
- D. American National Standards Institute (ANSI):
- | | | |
|----|-------------|-----------------|
| 1. | ANSI A135.4 | Basic Hardboard |
|----|-------------|-----------------|
- E. SAE International (SAE):
- | | | |
|----|------------|--|
| 1. | SAE AS8660 | Silicone Compound Nato Code Number S-736 |
|----|------------|--|
- F. The Society for Protective Coatings (SSPC):
- | | | |
|----|-----------|---|
| 1. | SSPC-QP 1 | Field Application to Complex Industrial and Marine Structures |
| 2. | SSPC-QP 2 | Field Removal of Hazardous Coatings |
- G. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:
- | | | |
|----|------------|---------------------------|
| 1. | Section 51 | Concrete Structures |
| 2. | Section 59 | Structural Steel Coatings |
- H. State of California, Department of Transportation (Caltrans):
- | | | |
|----|---------------------|--|
| 1. | California Test 435 | Method of Test for Machine Mixed, Two-Component, Type A Sealants |
| 2. | California Test 673 | Method of Test for Determining Movement Rating of Type B1 and B2 Preformed Elastomeric Joint Seals |

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1.04 SUBMITTALS

- A. General: Submittals for bridge joint seals and assemblies must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.
- B. Shop Drawings:
1. Shop Drawings for joint seal assemblies must show details of members, including connections, sizes, spacing of bolts and welds. They must show the marking and position of each member, erection plans and the limits of paint and galvanizing applications. A complete anchor bolt setting plan for the execution of the work must be submitted.
 2. Splice details for joint seals, where applicable.
 3. Alternative Joint Seal Assemblies with a Movement Rating of 4 inches or Less:
 - a. For alternative joint seal assemblies, submit 5 copies of shop drawings for each joint seal assembly to VTA.
 - b. After review, submit 6 to 12 copies, as requested by VTA, for final authorization and use during construction. Include details of the joint seal assembly and anchorage components, method of installation, blockout details, and additions or rearrangements of reinforcing steel.
 - c. If requested by VTA, submit supplemental calculations for each proposed alternative joint seal assembly.
 - d. Include in the shop drawings the thermal equation for setting the minimum joint opening at installation.
 - e. Shop drawings and calculations must be sealed and signed by an engineer who is currently registered as a civil engineer in the State of California.
 - f. Allow 25 days for VTA's review.
 - g. Submit one corrected copy to VTA for each joint seal assembly within 20 days of final authorization
 4. Joint Seal Assemblies with a Movement Rating Over 4 inches:
 - a. Submit shop drawings for each joint seal assembly to VTA.
 - b. If requested by VTA, submit supplemental calculations for each proposed alternative joint seal assembly.
 - c. Shop drawings and calculations must be sealed and signed by an engineer who is currently registered as a civil engineer in the State of California.
 - d. Allow 30 days for the VTA's review.
 - e. After review, submit 6 to 12 copies, as requested by VTA, for final authorization and use during construction. Include details of the joint seal assembly and anchorage components, method of installation, blockout details, and additions or rearrangements of reinforcing steel.
 - f. Submit one corrected copy to VTA for each joint seal assembly within 20 days of authorization.
- C. Certificates of Compliance: Certificates of compliance must be submitted for joint seal material.
1. Type A and AL Joint Seals: Submit a certificate of compliance and certified test report for each batch of sealant.
 2. Type B Joint Seals: Submit a certificate of compliance with certified test report for each lot of elastomeric joint seal and lubricant-adhesive. Test reports must include the seal movement rating, the manufacturer's minimum uncompressed width, and test results.

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3. For alternative joint seal assemblies, submit a certificate of compliance for each shipment of joint seal materials. The certificate must state that the materials and fabrication involved comply with these Technical Specifications and the data submitted in obtaining the authorization for the alternative joint seal assembly.
 4. For joint seal assemblies with a movement rating over four inches, submit a certificate of compliance for each shipment of joint seal assembly materials
- D. Laboratory Test Reports:
1. Laboratory test reports must show the name of testing agency, date of testing, types of tests performed and must be signed by a principal of the testing agency who is currently registered as a civil engineer in the State of California.
 2. Laboratory test reports must be submitted for joint seals to show compliance with appropriate ASTM Standards and these Technical Specifications.
 3. Test results for inorganic zinc coating adhesion test.
- E. Submit a work plan for cleaning expansion joints. Include details for preventing material, equipment, or debris from falling onto traffic or railroad property.
- F. Samples:
1. Type A and AL Joint Seals: At least 30 days before use, submit one-quart test samples of the following to the Independent Testing Agency for testing, as specified herein:
 - a. Both components from each batch of sealant
 - b. Manufacturer-required primers

1.05 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Conditions.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.

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2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Conditions.

D. VTA Quality Assurance:

1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements, of the Special Conditions.
2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.06 MEASUREMENT AND PAYMENT

A. Measurement:

1. Joint Seal of the various types listed on the Schedule of Quantities and Prices must be measured by the linear foot.
 - a. The payment quantity for Joint Seal must be measured from end to end along the centerline of the completed seal, including return sections and wall, curb, or barrier faces. Where individual seals are overlapped or are superimposed, each seal will be measured separately.
2. Joint Seal Assembly of the various types listed on the Schedule of Quantities and Prices must be measured by the linear foot.
 - a. The payment quantity for Joint Seal Assembly must be measured from end to end along the centerline of the completed seal, including return sections and wall, curb, or barrier faces.

B. Payment:

1. The contract price paid per linear foot for Joint Seal of the various types listed on the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing joint seals complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.
2. The contract price paid per linear foot for Joint Seal Assembly of the various types listed on the Schedule of Quantities and Prices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing joint seal assemblies complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.

C. Full compensation for saw cutting, cleaning, protecting, and repairing joints must be considered as included in the bid item for Joint Seals and Joint Seal Assemblies of the various types listed on the Schedule of Quantities and Prices and no additional compensation will be allowed therefor.

D. Full compensation for furnishing and placing expansion joint filler, expanded polystyrene, neoprene, hardboard, sliding joints, and grinding or grooving, as required, must be considered as included in the

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prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Premolded expansion joint filler must comply with ASTM D1751.
- B. Expanded Polystyrene:
 - 1. Expanded polystyrene must be commercially available polystyrene board with the following properties:
 - a. Flexural strength: 35 pounds per square inch minimum when tested under ASTM C203.
 - b. Compressive Yield Strength: 16 to 40 pounds per square inch at five percent compression.
 - 2. Face the surfaces of expanded polystyrene that concrete is placed against with 1/8-inch-thick hardboard complying with ANSI A135.4. You may use other facing materials that provide equivalent protection. Secure the hardboard using nails, waterproof adhesive, or other authorized means.
- C. Neoprene:
 - 1. Neoprene must be manufactured from a vulcanized elastomeric compound containing neoprene as the only elastomer and comply with the requirements shown in the following table:

Quality characteristic	Test method	Requirement
Tensile strength (min, psi)	ASTM D412	2,000
Ultimate elongation (min, percent)	ASTM D412	300
Compression set (max, percent, 22 hours at 70 degrees Celsius)	ASTM D395, Method B	30
Tear strength (min, kN/m)	ASTM D624, Die C	26
Hardness, Type A (points)	ASTM D2240	55 plus or minus 5
Ozone resistance (20 percent strain, 100 hours at 100 plus or minus 2.2 degrees Fahrenheit)	ASTM D1149 except 100 plus or minus 20 parts per 100,000,000	No cracks
Brittleness temperature at minus 40 degrees Celsius	ASTM D746, Section 9.1.2	Pass
Flame propagation	ASTM C542	Must not propagate flame
Change in volume (max, percent, IRM 903, immersed 70 hours at 100 degrees Celsius)	ASTM D471	80
Change in mass (max, percent, immersed 7 days at 70 degrees Celsius)	ASTM D471	15

- 2. After accelerated aging under ASTM D573 for 70 hours at 100 degrees Celsius, the elastomer must not show quality characteristic changes greater than those shown in the following table:

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Quality characteristic	Requirement
Tensile strength (percent)	-15
Elongation at break (percent)	-40
Hardness (points)	+10

D. Type A and AL Joint Seals:

1. Type A and AL joint seals consist of field-mixed silicone sealant placed in grooves in the concrete.
2. The sealant must be a two-component silicone type that withstands a plus-or-minus 50 percent movement.
3. The sealant must comply with the requirements shown in the following table:

Quality characteristic	Test method	Requirement
Modulus at 150 percent elongation (psi)	California Test 435	8–75
Recovery (inches, max)	California Test 435	21/32
Notch test	California Test 435	Notched or loss of bond, 1/4 inch max
Water resistance	California Test 435	Notched or loss of bond, 1/4 inch max
Ultraviolet exposure	California Test 435	No more than slight cracking or checking
Cone penetration (mm)	California Test 435	4.5–12.0

4. The sealant must be self-leveling and cure rapidly enough to not flow on grades up to 15 percent.
5. Do not use material that has expired unless it is retested and authorized.
6. Polyethylene foam or rod stock for retaining sealant must be commercial quality with a continuous, impervious glazed surface.

E. Type B Joint Seals:

1. Type B joint seals consist of preformed elastomeric joint seals placed in grooves in the concrete.
2. Preformed elastomeric joint seals must:
 - a. Comply with ASTM D2628.
 - b. Consist of a multi-channel, nonporous, homogeneous material furnished in a finished, extruded form.
 - c. Have a minimum seal depth at the contact surface of at least 95 percent of the minimum uncompressed seal width designated by the manufacturer.
 - d. Provide a movement rating of at least that shown in the plans when tested under California Test 673.
 - e. Have the top and bottom edges in continuous contact with the sides of the groove throughout the entire range of joint movement.
 - f. Be furnished full length for each joint with at most 1 shop splice in any 60-foot length.
3. For seals that would admit water or debris, fill each cell to a depth of three inches at the open ends with open-cell polyurethane foam or close the cells by other authorized means.
4. You may make one field splice per joint if authorized. Splice location and method must be authorized. Seals must be manufactured full length and then cut at the splice location and rematched before splicing.

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5. Shop and field splices must have no visible offset of exterior surfaces and no evidence of bond failure.
6. Combination lubricant-adhesive must comply with ASTM D4070.

F. Joint Seal Assemblies with a Movement Rating of 4 inches or Less:

1. Joint seal assemblies with a movement rating of 4 inches or less must consist of metal or metal and elastomeric assemblies placed in recesses over joints. Strip seal joint seal assemblies consist of a one-joint cell.
2. Metal parts must comply with the requirements specified for miscellaneous bridge metal in Section 05 17 00, Miscellaneous Metal.
3. Bolts, nuts, and washers must comply with ASTM F3125, Grade A325.
4. Sheet neoprene must comply with the specifications for neoprene specified herein. Fabricate sheet neoprene to fit the joint seal assembly accurately.
5. If authorized, you may use an alternative joint seal assembly if it conforms to the following requirements:
 - a. Quality of the alternative assembly and its suitability for the intended application are at least equal to that of the joint seal assembly shown in the plans. The factors to be considered include the ability of the assembly to resist the intrusion of foreign material and water throughout the full range of movement for the application and the ability to function without distress to any component.
 - b. Alternative joint seal assembly has had at least one year of proven satisfactory service under conditions similar to those described.
 - c. Alternative joint seal assemblies must have cast-in-place anchorage components for casting into the deck.
 - d. The anchorage components must include anchor studs spaced at a maximum of 4-1/2 inches. The studs must be at least 5/8 inch in diameter and eight inches long, except the studs may be six inches long in the overhang.
 - e. Instead of complying with the requirements specified for miscellaneous bridge metal in Section 05 17 00, Miscellaneous Metal, metal parts may comply with ASTM A572/A572M.
 - f. Elastomer must be neoprene complying with the requirements shown in Table 1 of ASTM D2628, except recovery and compression-deflection tests are not required, and the requirements shown in the following table:

Quality characteristic	Test method	Requirement
Hardness (points, Type A durometer)	ASTM D2240 (modified)	55–70
Compression set (percent, max, 70 hours at 100 degrees Celsius)	ASTM D395 (modified)	40

- g. The design loading must be the AASHTO LRFD Bridge Design Specifications Design Truck with 100 percent dynamic load allowance. The tire contact area must be ten inches measured normal to the longitudinal assembly axis by 20 inches wide. The assembly must provide a smooth-riding joint without slapping of components or tire rumble.
 - h. The movement rating of the assembly must be measured normal to the longitudinal axis of the assembly. Dimensions for positioning the assembly within the movement rating during installation must be measured normal to the longitudinal axis. Do not consider skew of the deck expansion joint.
 - i. The maximum depth and width of the recess must be such that the primary reinforcement providing the necessary strength of the structural members is outside

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the recess. The maximum depth at abutments and hinges is ten inches. The maximum width on each side of the expansion joint is 12 inches.

- j. Horizontal angle points and vertical corners at curbs must be premolded sections or standard sections of the assembly that have been miter cut or bent to fit.

G. Joint Seal Assemblies with a Movement Rating Over 4 inches:

1. Joint seal assemblies and seismic joints consist of metal or metal and elastomeric assemblies anchored or cast into a recess in the concrete over the joint.
2. Joint seal assemblies must consist of a metal frame system, supporting rails, and support bars with intervening neoprene glands.
3. Neoprene glands must comply with the requirements shown in Table 1 of ASTM D2628, except recovery and compression-deflection tests are not required, and the requirements shown in the following table:

Quality characteristic	Test method	Requirement
Hardness (points, Type A durometer)	ASTM D2240 (modified)	55–70
Compression set (percent, max, 70 hours at 100 °C)	ASTM D395 (modified)	40

4. Metal parts of the joint seal assembly must comply with the requirements for miscellaneous metal for bridges in Section 05 17 00, Miscellaneous Metal, or ASTM A572/A572M. Bolts, nuts, and washers must comply with the specifications for high strength steel fastener assemblies for miscellaneous metal for bridges in Section 05 17 00, Miscellaneous Metal.
5. Anchorage components must include anchor studs spaced at a maximum of 4-1/2 inches. Studs must be at least 5/8 inch in diameter and eight inches long, except the studs may be six inches long in the overhang.
6. Assemblies must be assembled completely at the fabrication site.

H. Sliding Joints:

1. Sliding joints consist of neoprene strips lubricated with silicone grease and covered with sheet metal.
2. Neoprene strips must comply with the specifications for neoprene specified herein.
3. Silicone grease must comply with SAE AS8660.
4. Sheet metal must be commercial-quality galvanized sheet steel, smooth and free of kinks, bends, or burrs. Joints must be butt joints sealed with plastic, duct-sealing tape.

- I. You may clean and paint metal surfaces of joint seal assemblies instead of galvanizing. Cleaning and painting must comply with the specifications for new structural steel in Section 59-2, "Painting Structural Steel," of the Caltrans Standard Specifications, except SSPC-QP 1, SSPC-QP 2, and AISC 420-10/SSPC-QP 3 certifications are not required. Finish coats are not required. Do not paint stainless steel or anchorages embedded in concrete.

2.02 DESIGN CRITERIA

A. Joint Seal Assemblies with a Movement Rating Over 4 inches:

1. If the assembly consists of more than one component, design the assembly such that the external components can be removed and reinstalled at any position within the larger half of the movement rating to allow for inspection of the internal components.

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2. Except for components in contact with the tires, the design loading must be the AASHTO LRFD Bridge Design Specifications Design Truck with 100 percent dynamic load allowance. Each component in contact with the tires must support a minimum of 80 percent of the AASHTO LRFD Bridge Design Specifications Design Truck with 100 percent dynamic load allowance. The tire contact area must be 10 inches measured normal to the longitudinal assembly axis by 20 inches wide. The assembly must provide a smooth-riding joint without slapping of components or tire rumble.
3. The maximum width of unsupported or yielding components or grooves in the roadway surface of the assembly must be 3 inches measured in the direction of vehicular traffic.
4. Assemblies must be capable of adjustment to the "a" dimension shown in the plans.
5. The assembly must have cast-in-place anchorage components that form a mechanical connection between the joint components and the concrete deck.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Construct open joints using a suitable material that you subsequently remove. Do not chip or break concrete corners when removing the material. Reinforcement must not extend across an open joint.
2. For filled joints, place premolded or expanded polystyrene joint filler in position before placing concrete. Fill holes and joints with mastic to prevent the passage of mortar or concrete.
3. Finish concrete edges at joints using an edger.
4. Sealed joints must be in planned position, resist the intrusion of foreign material and water, and provide bump-free passage of traffic.
5. The movement rating is measured normal to the longitudinal joint axis.
6. Use the seal type shown in the following table for the movement rating shown:

Movement Rating (MR)	Seal Type
MR less than or equal to 1 inch	Type A or B
1 inch < MR ≤ 2 inches	Type B
2 inches < MR ≤ 4 inches	Strip seal joint seal assembly
MR > 4 inches	Modular unit joint seal assembly or seismic joint

7. VTA may order you to install a joint seal larger than required by the movement rating. This work is change order work.
8. The joint opening at the time of placement must be that shown adjusted for temperature. Do not impair the joint clearance.
9. Cover or otherwise protect joints at all times before joint seals are installed. Do not allow debris or foreign material to enter joints.

B. Type A and AL Joint Seals:

1. Do not use sealant or adhesive that has skinned over or cannot be redispersed by hand stirring.
2. Abrasive blast clean joints and remove foreign material with high-pressure air immediately before installing seals. Protect waterstops during cleaning.
3. Joint surfaces must be surface dry when seals are placed.

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4. Place the sealant using equipment that mixes and extrudes the sealant into the joint. The equipment and the sealant placement must be as recommended by the sealant manufacturer.
 5. Do not use liquid components that have been exposed to air for more than 24 hours.
 6. Preparation For Type A Joint Seals:
 - a. For Type A joint seals, do not start cutting grooves until joint material is delivered to the Worksite.
 - b. Concrete saws for cutting grooves in the concrete must have diamond blades with a minimum thickness of 3/16 inch. Cut both sides of the groove simultaneously for a minimum first pass depth of two inches. The completed groove must have:
 - 1) Top width within 1/8 inch of the width shown or ordered
 - 2) Bottom width not varying from the top width by more than 1/16 inch for each 2 inches of depth
 - 3) Uniform width and depth
 - c. Saw cutting grooves is not required at the following locations:
 - 1) Joints armored with metal
 - 2) Joints in curbs, sidewalks, barriers, and railings, if grooves are formed to the required dimensions
 - d. Remove all material from the deck joint to the bottom of the saw cut. Remove foreign material from joints in curbs, sidewalks, barriers, railings, and deck slab overhangs.
 - e. Repair spalls, fractures, or voids in the grooved surface at least 64 hours before installing the joint seal. Bevel the lips of saw cuts by grinding.
 7. Preparation For Type AL Joint Seals:
 - a. For Type AL joint seals, remove expanded polystyrene and foreign material to the depth of the joint seal. Grind or edge the lip of the joint.
- C. Type B Joint Seals:
1. Prepare joints as specified for Type A joint seals, as specified in Article 3.01B.6 herein, except remove all material from the deck joint to the top of the waterstop or to the depth of the seal to be installed plus three inches.
 2. Thoroughly clean contact surfaces and the top surface of the seal to within 1/2 inch from either edge immediately before applying the lubricant-adhesive. Liberally apply the lubricant-adhesive to vertical groove surfaces and the sides of the joint seal under the manufacturer's instructions.
 3. Install joint seals full length for each joint using equipment that does not distort or damage the seal or the concrete. The top edges of the installed seal must be in a plane normal to the sides of the groove.
- D. Joint Seal Assemblies with a Movement Rating of 4 inches or Less:
1. Deck surfaces must comply with section 51-1.03F(5) of the Caltrans Standard Specifications before placing and anchoring joint seal assemblies. Pedestrian overcrossing deck surfaces must comply with the applicable requirements of Section 03 35 00, Concrete Finishing, before placing and anchoring joint seal assemblies.
 2. Preassemble metal parts of assemblies before installation to verify geometry.

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3. Except for primary reinforcement, continue reinforcement through the recess construction joint into the recess and engage anchorage components of the assembly.
4. Thoroughly clean joints immediately before installing sheet neoprene. Install sheet neoprene at such time that it will not be damaged by construction activities.
5. Place the assembly in the blocked-out recess in the concrete deck surface. The depth and width of the recess must allow the installation of the assembly anchorage components or anchorage bearing surface to the lines and grades shown.
6. For alternative joint seal assemblies, install elastomer under the manufacturer's instructions. Thoroughly clean the joint and blockout immediately before elastomer installation.

E. Joint Seal Assemblies with a Movement Rating Over 4 inches:

1. Measure dimensions for positioning the assembly during installation normal to the longitudinal axis of the assembly, disregarding the skew of the deck expansion joint.
2. Deck surfaces must comply with section 51-1.03F(5) of the Caltrans Standard Specifications before placing joint seal assemblies and anchorages.
3. Place each assembly into a blocked-out recess in the concrete deck surface. The depth and width of the recess must allow the installation of the assembly anchorage components or anchorage bearing surface to the lines and grades shown.
4. Except for primary reinforcement, continue reinforcement through the recess construction joint into the recess and engage anchorage components of the assembly.
5. Install each assembly with a watertight, continuous return six inches up into barriers at the low side of the deck. Neoprene glands must be continuous without field splices or joints.
6. Size the recess such that the primary reinforcement for structural members is outside the recess. The maximum recess depth at abutments and hinges is 14 inches. The maximum recess width on each side of the expansion joint is 18 inches.

F. Sliding Joints:

1. Apply a uniform film of silicone grease to the upper surface of the neoprene strip before placing the sheet metal.
2. Float the concrete surfaces where neoprene strips are placed to a level plane and finish with a steel trowel.
3. Do not allow grout or concrete seepage into the sliding joint during concrete placement.

3.02 FIELD QUALITY CONTROL

A. Contractor Quality Control:

1. The Independent Testing Agency must inspect the joints and blockouts for joint seals and joint seal assemblies prior to installation.
2. The Independent Testing Agency must inspect the installation of joint seals and joint seal assemblies.
3. Type A and AL Joint Seals:
 - a. The Independent Testing Agency must test sealants in accordance with California Test 435.
 - b. Label sealant containers or provide identification tickets for tanks of two-component material. Include the following:
 - 1) Material designation
 - 2) Lot number
 - 3) Manufacturer's name and instructions for use

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- 4) Dates of manufacture, packing, and expiration
4. Type B Joint Seals:
 - a. The Independent Testing Agency must select test samples of joint seal material and lubricant-adhesive at random from each lot of material. Test samples must be selected from stock at the Worksite or at a location acceptable to VTA and the manufacturer. Joint seal test samples must be at least three feet long.
 - b. Demonstrate the adequacy of installation procedures for Type B seals before starting installation activities.
 - c. The Independent Testing Agency must test for movement rating in accordance with California Test 673. Type B joint seals must conform to the materials and performance requirements specified in Article 2.01 herein.
5. Joint Seal Assemblies with a Movement Rating Over 4 inches:
 - a. Joint seal assemblies will not be authorized without evidence of one year of satisfactory service under similar conditions.
 - b. Vertical expansion joints in barriers must be accessible for inspection after recess concrete is placed.
 - c. A qualified representative of the assembly manufacturer must be present during the installation of the first assembly and available during remaining installations.
6. Welding Quality Control: Inspection of welding must be performed in accordance with the requirements of Section 05 05 60, Metal Welding.

END OF SECTION 07 95 50

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SECTION 07 95 60

BRIDGE PTFE SPHERICAL BEARINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work outlined in this Section includes the following items of work, as detailed in these Technical Specifications, as shown on the plans or reasonably implied therefrom and is not limited to the following items:
1. PTFE spherical bearings at Capitol Aerial Guideway

1.02 RELATED SECTIONS

- A. Section 6.6.2, Submittal, of the Special Conditions
- B. Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions
- C. Section 03 05 15, Portland Cement Concrete
- D. Section 03 11 00, Concrete Formwork
- E. Section 03 20 00, Concrete Reinforcing
- F. Section 03 30 00, Cast-in-Place Concrete
- G. Section 03 62 00, Non-Shrink Grouting
- H. Section 05 12 35, Structural Steel

1.03 REFERENCED STANDARDS

- A. American Society of Mechanical Engineers (ASME):
1. ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)
- B. ASTM International (ASTM):
1. ASTM A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 2. ASTM A709/A709M Specification for Structural Steel for Bridges
 3. ASTM D4441 Specification for Aqueous Dispersions of Polytetrafluoroethylene
- C. American Welding Society (AWS):
1. AWS D1.1/D1.1M Structural Welding Code – Steel (2015)
 2. AWS D1.5M/D1.5 Bridge Welding Code (2015)

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3. AWS D1.6/D1.6M Structural Welding Code – Stainless Steel (2017)

D. State of California, Department of Transportation (Caltrans), Standard Specifications 2018:

1. Section 51 Concrete Structures

1.04 DEFINITIONS

A. PTFE spherical bearings consist of PTFE and stainless steel bearing surfaces, stainless steel plates, and anchors. PTFE spherical bearings are either fixed type with spherical bearing surfaces, or expansion type with spherical and sliding bearing surfaces.

B. Load category: PTFE spherical bearings of differing vertical load capacity within a range defined as follows:

1. Bearings of 500 kips capacity or less
2. Bearings over 500 kips up to and including 2,000 kips capacity
3. Bearings over 2,000 kips capacity
4. Bearings in two different load categories that have vertical load capacities within 180 kips of each other are considered to be in one load category for proof testing.

1.05 SUBMITTALS

A. General: Submittals for bridge PTFE spherical bearings must be made in accordance with the provisions in Section 6.6.2, Submittal, of the Special Conditions, Section 7.43, Submittal of Shop Drawings, Product Data and Samples, of the General Conditions, and these Technical Specifications.

B. Submit proof that the bearing manufacturer has furnished PTFE spherical bearings that have had at least three years of satisfactory service for two projects with similar conditions to this project.

C. Shop Drawings:

1. Submit detailed Shop Drawings of PTFE spherical bearings prior to fabrication showing sizes, details of fabrication and construction, and locations of anchors and accessories.
2. Shop Drawings must include a description of the method of mechanical interlocking of PTFE fabric to the metallic substrate.
3. At locations other than hinges, Shop Drawings must include temporary support details for the bearing sole plate during concrete placement.
4. Allow 55 days for VTA review.

D. Certificates: Submit certificates of compliance for the materials used in PTFE bearings.

E. Test Reports: Submit test reports for proof-tested bearings signed by the personnel conducting the testing. Include bearing numbers of the tested bearings and the names of the personnel interpreting the test results.

1. If proof tests cannot be performed at the specified load, submit a testing plan listing additional physical tests to be performed. The tests must demonstrate that the requirements for proof testing at the specified load are satisfied.

F. Non-Shrink Grout: Submittals must be made in accordance with the requirements of Section 03 62 00, Non-Shrink Grouting.

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1.06 QUALITY CONTROL AND ASSURANCE

- A. Codes and Standards: Comply with all Federal, State and local codes and safety regulations.
- B. Inspection by VTA and Other Governing and Regulatory Authorities: Allow VTA and other governing and regulatory authorities to perform testing and inspection of materials and practices associated with construction within their jurisdiction on the Worksite during business hours for the purpose of ensuring that the Work is in compliance with the requirements of the plans, these Technical Specifications, and other local, state and federal laws and regulations.
- C. Contractor Quality Control:
 - 1. Sampling, Testing and Inspection:
 - a. Hire an Independent Testing Agency to perform sampling, testing, and inspections in accordance with the provisions herein and Section 6.26, Quality Assurance and Quality Control Requirements.
 - b. Wherever it is specified herein that sampling, testing, or inspection must be performed by the Contractor, it must be understood to mean that said sampling, testing, or inspection must be performed by the Independent Testing Agency.
 - c. Cooperate with and notify VTA at least 48 hours in advance of sampling, tests and inspections, being performed by the Independent Testing Agency. VTA may elect to observe these procedures. Provide samples and facilities for inspection to VTA without extra charge if requested.
 - d. The Independent Testing Agency must collect samples of materials for testing in accordance with the provisions outlined herein and as directed by VTA.
 - 2. Qualifications of the Independent Testing Agency: Refer to Section 6.26, Quality Assurance and Quality Control Requirements.
- D. VTA Quality Assurance:
 - 1. VTA will monitor the implementation of the Contractor's quality control programs through observation, inspection, sampling and testing in accordance with Section 6.26, Quality Assurance and Quality Control Requirements.
 - 2. Failure of VTA to detect work or material which is defective or contrary to these Technical Specifications must not prevent later rejection when such work or material is discovered, nor must it obligate VTA for final acceptance.

1.07 MEASUREMENT AND PAYMENT

- A. Measurement: PTFE Spherical Bearings must be measured by the individual unit (each).
 - 1. A PTFE spherical bearing with more than one PTFE surface must be considered to be one bearing.
- B. Payment: The contract price paid per individual unit (each) for PTFE Spherical Bearings must include full compensation for furnishing all labor, materials, tools, and incidentals, and for doing all Work involved in constructing PTFE spherical bearings, complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefor.

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- C. Full compensation for furnishing PTFE spherical bearing samples and proof testing said samples must be considered as included in the bid item for PTFE Spherical Bearings and no additional compensation will be allowed therefor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. PTFE spherical bearings must be self-lubricating.
- B. PTFE spherical bearings must have an initial static coefficient of friction of at most 0.06.
- C. PTFE surfaces must be unfilled fabric made from virgin PTFE oriented multifilament and other fibers. Filament resin must comply with ASTM D4441.
- D. At the highest point of substrate and after compression, the PTFE fabric must have a thickness from 1/16 to 1/8 inch.
- E. Steel plates must comply with ASTM A709/A709M.
- F. Stainless steel plates must comply with ASTM A240/A240M, Type 304, and be at least 1/8 inch thick.
- G. Surfaces of flat stainless steel that mate with PTFE surfacing must have a minimum no. 8 mirror finish. Surfaces of curved stainless steel that mate with PTFE surfacing must have a finish of less than 16 microinches root mean square. Determine the finish under ASME B46.1.
- H. Welding must comply with AWS D1.1/D1.1M except welding of stainless steel must comply with AWS D1.6/D1.6M.
- I. Stud connectors must comply with Section 05 12 35, Structural Steel.
- J. Non-shrink grout placed under masonry plates or bearing assemblies or in anchor bolt sleeves or canisters must comply with the requirements in Section 03 62 00, Non-Shrink Grouting.

2.02 FABRICATION

- A. Flat stainless steel surfaces must be a weld overlay on structural steel plate or a solid or sheet stainless steel.
- B. Curved stainless steel surfaces must be solid stainless steel except curved stainless steel surfaces over six inches thick may be a weld overlay on structural steel plate.
- C. If a weld overlay is used for stainless steel surfacing, attach the overlay by submerged arc welding using Type 309L electrodes. The completed overlay must have a 3/32-inch minimum thickness after fabrication.
- D. If stainless steel sheets are used for stainless steel surfacing, attach the sheets by perimeter arc welding using Type 309L electrodes. After welding, the stainless steel surface must be smooth and without waves.

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- E. Plate radius dimensional tolerances are from 0.000 to minus 0.010 inch for convex plates and from plus 0.010 to 0.000 inch for concave plates.
- F. Use full-size convex and concave metal templates for the spherical surfaces of each bearing radius.
- G. PTFE fabric backing material on bearing surfaces must be epoxy bonded and mechanically interlocked to the steel substrate. Bonding must be performed under controlled factory conditions. The mechanical interlock on the spherical concave surface must be integrally machined into the steel substrate. Welded retention grids are not allowed on the concave surface. Except for the selvage, oversaw or recess edges such that no cut fabric edges are exposed.
- H. During fabrication, the maximum temperature of bonded PTFE surfaces must be 300 degrees Fahrenheit.
- I. After bonding to the substrate, the PTFE surface must be smooth and free from bubbles.
- J. Assemble PTFE spherical bearings at the fabrication site.
- K. The PTFE and stainless steel interfaces must be in full bearing after completing assembly.
- L. Use at least four steel straps bolted to threaded holes in the masonry and sole plates to secure each bearing assembly as a unit for shipment. Steel straps must not be welded and must be adequate to use for lifting the bearing assembly. Bearings must be shipped as a unit and remain intact when uncrated and installed.

2.03 SOURCE QUALITY CONTROL AND ASSURANCE

- A. The bearing manufacturer must have furnished PTFE spherical bearings that have had at least three years of satisfactory service for two projects with similar conditions to this project.
- B. A qualified representative of the bearing manufacturer must be present during installation of the first bearing and be available during remaining installations.
- C. Templates for the spherical surfaces must be available for inspection.
- D. Proof Testing:
 - 1. The Independent Testing Agency must proof test the PTFE spherical bearings in the presence of the VTA as follows:
 - a. Test fixed-type bearings for compression.
 - b. Test expansion-type bearings for compression and initial static coefficient of friction.
 - c. Proof test one bearing from each lot of production bearings. A lot of bearings is 25 bearings, or fraction thereof, of the same type within a load category.
 - 2. The Engineer will select random test samples from each lot of production bearings. Notify VTA at least seven days before starting proof testing.
 - 3. If proof tests cannot be performed at the specified load, perform the additional physical tests described in the testing plan in the presence of VTA. The tests must demonstrate that the requirements for proof testing at the specified load are satisfied.
 - 4. Before proof testing, the test bearings must be conditioned for 12 hours at 75 degrees Fahrenheit, plus or minus 5 degrees Fahrenheit. Clean the bearing surfaces before testing.
 - 5. For compression testing of PTFE spherical bearings:

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- a. Rotate the bearings at the design rotation or 0.02 radians, whichever is greater, and hold for one hour at a load of 1.5 times the maximum vertical load capacity. You may rotate the bearing by inserting a beveled plate between the bearing and the restraining surface before loading.
 - b. Maintain the bearing in a rotated position during testing.
6. For coefficient of friction testing of PTFE spherical bearings:
- a. Continuously load the bearing to the minimum dead load for 12 hours before testing. Maintain the dead load during testing.
 - b. Measure the initial static coefficient of friction on the first movement of the bearing.
 - c. Measure the initial static and dynamic coefficients of friction at a sliding speed of not more than one inch per minute. The initial static friction must not exceed that specified.
 - d. Cycle the test bearings for a minimum of 100 movements. Each movement must consist of at least one inch of relative movement at a sliding speed of not more than 12 inches per minute. After cycling, measure the initial static and dynamic coefficients of friction at a sliding speed of not more than one inch per minute. The initial static friction must not exceed that specified.
7. Proof-tested bearings must not show any signs of the following:
- a. Bond failure of bearing surfaces
 - b. Separation or lift-off of plates from each other or from PTFE surfaces
 - c. Excessive transfer of PTFE to the stainless steel surface
 - d. Other defects
8. If a proof-tested bearing fails to comply with the above requirements, proof test all the remaining bearings in the lot.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Prepare concrete surfaces to receive PTFE spherical bearings in accordance with the following requirements:
1. Set bearing assemblies level. VTA provides adjustments to horizontal positions of bearing assemblies due to temperature. Attain full bearing on the concrete under bearing assemblies.
 2. Immediately before setting bearing assemblies or masonry plates on ground concrete surfaces, thoroughly clean and apply caulking to all contact surfaces.
 3. During welding, protect bearings and bearing surfaces using authorized methods.
 4. The embedded end of each anchor bolt must terminate with a head or a nut and washer. Anchor bolts must allow true positioning of bearing assemblies.
 5. Installing and constructing non-shrink grout pads under masonry plates or in anchor bolt sleeves or canisters must be done after girder erection and before placing deck concrete.
 6. If anchor bolts are installed in pipe sleeves or metal canisters, fill the pipes or canisters completely with non-shrink grout, in accordance with Section 03 62 00, Non-Shrink Grouting.
- B. The Engineer must be present during the dismantling of each bearing assembly at the Worksite.

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- C. Temporarily support PTFE bearing sole plates during concrete placement. Temporary supports must prevent rotation or displacement of the bearings. Temporary supports must not inhibit the function of the PTFE bearings after concrete is placed or restrict movement at bridge joints due to temperature changes and prestress shortening. Materials for temporary supports must comply with the requirements for form fasteners in Section 51-1.03C(2)(a) of the Caltrans Standard Specifications.
- D. Replace or resurface damaged bearings and bearings with scratched mating surfaces. Resurfacing must be performed at the bearing manufacturer's plant.

3.02 PROTECTION

- A. Protect bearing surfaces from contamination and weather damage.

END OF SECTION 07 95 60

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SECTION 08 10 00
DOORS AND FRAMES

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for furnishing and installing metal doors and frames at:
 - 1. Story and Eastridge Communications/Signal Buildings and Stations
 - 2. Story Station Access Structures
- B. For Elevator Door requirements, refer to Section 14 24 00, Hydraulic Elevators.

1.02 RELATED SECTIONS

- A. Section 05 50 00, Metal Fabrications
- B. 08 70 00, Door Hardware
- C. 09 91 00, Painting

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI):
 - 1. ANSI A250.11 Recommended Erection Instructions for Steel Frames
 - 2. ANSI A250.8 Recommended Specifications for Steel Doors and Frames
- B. Steel Door Institute (SDI):
 - 1. SDI 108 Recommended Selection and Usage Guide for Standard Steel Doors
 - 2. SDI 110 Standard Steel Doors and Frames for Modular Masonry Construction
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 80 Standards for Fire Doors and Other Opening Protectives
- D. State of California Energy Commission:
 - 1. 116(a) Air Infiltration Requirements, California Energy Efficiency Standards for Residential and Nonresidential Buildings

1.04 SUBMITTALS

- A. General
 - 1. Submittals for Doors and Frames must be made in accordance with the provisions in these technical specifications.
 - 2. The Contractor must submit the following:

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- a. Product Data: Submit manufacturer's specifications and installation instructions for all types of doors and frames specified herein.
 - b. Shop Drawings: Submit shop drawings for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements for hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items. Provide a schedule of doors and frames using the same reference numbers for details and openings as those shown on the Drawings.
 - c. Fire Rating Labels: Submit manufacturer's certification for all fire rated door and frame assemblies, certifying that each assembly has been constructed in conformance with materials and methods having current approved fire ratings.
 - d. Certificate of Compliance: Provide a written certification from the manufacturer of the doors and frames, certifying conformance with the applicable requirements of the State of California Energy Requirements, relative to air infiltration.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Doors and Frames must be measured by each assembly.
- B. Payment: The contract price paid per each assembly for Doors and Frames must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Doors and Frames complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Store doors and frames under cover on the Worksite, on wood blocking, in a fashion that will keep the units raised off of the floor or ground. Avoid creating a humidity chamber by using a plastic or canvas shelter; ventilate the area covered.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Pressed steel frames for doors and other openings, must be combination buck, frame and trim type. Doors and frames must be fabricated from cold rolled, hot rolled, pickled and oiled steel, and galvanized with a minimum coating of .0778 psf of surface, or electrolytically zinc-coated. Exterior metal surfaces must be thoroughly cleaned and given a dip or spray shop coat of rust inhibiting primer after fabrication. Doors and frames must be treated chemically to provide paint adhesion.
- B. Frames:
 1. Welded Frames: Headers and jambs must be secured at the corners by internal welding of faces, or by welded splice plates. Joints at jambs and headers must be further secured at the rabbet either by welding or by mechanical interlock. Faces of frames at junction of

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head and jamb must present neat, hairline joints. Frames must be strapped together for shipment, in pairs, with the head of one frame inverted, for bracing during shipment. An alternate acceptable method must be to provide temporary steel spreaders securely fastened to the bottom of each frame.

2. **Material Thickness:** The thickness of the sheet steel used in fabrication of frames must be 16 gage, except where thicker metal is required for labeled fire door assemblies.
3. **Mullions and Transom Bars:** Mullions and transom bars must be tubular construction and must joint with heads and jambs and be butt welded thereto.
4. **Jamb Anchors:** Frames must be provided with a minimum of 3 anchors per jamb, of the type required by the wall construction to which attached. Anchors must be of steel, not less than 18 gage thick.
5. **Glazing Beads:** Glazing beads must be furnished with frames at glazed openings and other locations where fixed glazing is indicated in pressed steel frames. Frames must be prepared for the type of glazing beads required to receive the glass, metal panel, gasketing, and accessories indicated. Beads must be mitered at corners, may be either the screw-on or snap-on type, and must be placed on the non-security side of the opening.
6. **Provide Fire Rated Frames** meeting or exceeding required door fire ratings as listed in door schedules, and in accordance with NFPA 80.

C. **Doors:**

1. **Clearance:** Single swing doors must have not more than 1/8 inch clearance at heads and jambs, 1/4 inch clearance at meeting edges of pairs of doors, and 3/4 inch at bottoms. All dimensions are nominal and subject to recognized manufacturer's tolerances. The lock edges of doors must be so designed as to provide proper operating clearance.
2. **Door Classification:** Doors must be Grade Level 3, Model 1, per SDI 108 standards, in sizes as shown or specified herein. Provide doors and frames for modular masonry construction per SDI 110 standards.
3. **Internal Construction:** The internal construction of the doors must conform to one of the following methods, in accordance with the manufacturer's standard practice.
 - a. Vertical and/or horizontal steel, rigidly formed members welded to the face panels. Panels with metal reinforcing must have sound deadening applied to the inside to eliminate metallic sound incident to normal door operation.
 - b. Honeycomb, polyurethane, or solid structural mineral core bonded to the inside of both faces of the door.
 - c. Other methods of reinforcing may be used, provided they achieve the same degree of flatness, rigidity and strength as the methods listed above.
4. **Hollow Steel Construction:** 1-3/4 inch thick doors must have face sheets formed from one sheet of steel. No seams must occur on the faces of the door or its edges. The top and bottom of all doors must be closed with a recessed channel and closure or must receive a flush end closure treatment.
5. **Provide Fire Rated Doors** as listed in door schedules, and in accordance with NFPA 80.

2.02 FABRICATION

- A. Fabrication of doors and frames, and their related items, must be in conformance with ANSI A250.8.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the manufacturer's instructions, approved shop drawings and ANSI A250.11.

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B. Placing of Frames:

1. Except for frames located at in-place concrete or masonry and at drywall partitions, place frames before construction of the enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
2. Protect inside (concealed) faces of door frames using a fibered asphalt emulsion coating. Apply over shop primer to an approximate thickness of 3 mm, and allow to dry before handling.
3. Install fire rated frames in accordance with NFPA 80.

C. Door Installation:

1. Fit hollow metal doors accurately in their respective frames, within the clearances specified in ANSI A250.8.
2. Place fire rated doors with clearances as specified in NFPA 80.

D. Hardware and Finishing: Unless otherwise noted, hardware must be provided under Section 08 70 00, Door Hardware. For finish painting requirements, refer to Section 09 91 00, Painting.

END OF SECTION 08 10 00

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for:
 - 1. Aluminum Windows
 - 2. Accessories

1.02 RELATED SECTIONS

- A. Section 05 40 00, Cold-Formed Metal Framing
- B. Section 06 10 00, Rough Carpentry
- C. Section 07 42 13, Metal Wall Panels
- D. Section 07 90 00, Joint Protection
- E. Section 08 80 00, Glazing

1.03 REFERENCED STANDARDS

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 1503.1 Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections
- B. Aluminum Association (AA):
 - 1. AA-M12C22 Standard for Aluminum Finishes
 - 2. AA515 Standard for Aluminum Composition
- C. ASTM International (ASTM):
 - 1. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - 2. ASTM C1172 Standard Specification for Laminated Architectural Flat Glass
 - 3. ASTM D2000 Standard Classification System for Rubber Products in Automotive Applications
 - 4. ASTM E283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
 - 5. ASTM E331 Standard Test Method for Water Penetration of Exterior Window, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
 - 6. ASTM E547 Standard Test Method for Water Penetration of Exterior Windows,

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Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference

- D. California Association of Window Manufacturers (CAWM):
 - 1. CAWM 301-90 Forced Entry Resistance Tests for Windows
- E. NAFS-North American Fenestration Standard/Specification for windows, doors, and skylights (AAMA/WDMA/CSA 101/I.S.2/A440-08)
 - 1. AAMA/NWWDA 101/I.S. 2 - Voluntary Specification, Performance Requirements and Test Procedures for Air Leakage Resistance, Water Penetration Resistance, Structural Loading, Forced Entry Resistance.
 - 2. F-AW55, C-AW80, AP-AW80 Test methods within AAMA/ NWWDA 101/I.S. 2.
- F. California Building Code (CBC): Latest Edition.

1.04 SUBMITTALS

- A. Shop Drawings: Show materials, sizes and shapes of members, details of fabrication and installation, and finish hardware.
- B. Product Data: Submit window manufacturer's product data, including illustrative photos (catalog cuts) of the windows, operating and locking hardware.
- C. Samples: 3 feet by 4 feet sample of operable unit, of materials, finish and color specified; sample must include glazing and hardware.
- D. Test Reports: Test reports from AAMA accredited laboratories certifying specified performance. Furnish with specified certification.
- E. Certification: AAMA Notice of Certification stating that the tested window meets or exceeds referenced criteria for ANSI/AAMA 101 window type specified.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Aluminum Windows must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Aluminum Windows must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Aluminum Windows complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.06 SYSTEM DESCRIPTION

- A. General: In addition to requirements shown or specified, comply with:
 - 1. Applicable provisions of AAMA Windows and Sliding Glass Doors Manual for design, materials, fabrication and installation of component parts.

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- B. Design Requirements: Arcadia T200 Series (thermal) Heavy Commercial Fixed, Casement, Awning and Hopper Windows 2-inch depth. Hinged compression sealed aluminum windows. Suitable for outside or inside glazing.
- C. Performance Requirements: Each assembly must be tested by a recognized testing laboratory or agency in accordance with specified test methods.
 - 1. Conformance to F-AW55, C-AW80, AP-AW80 specifications in AAMA/NWWDA 101/I.S. 2/A440-8.
 - a. Air Infiltration: Accordance with ASTM E 283 at a static air pressure difference of 6.24 psf. Air infiltration must not exceed .30 cfm per square foot.
 - b. Water Resistance: Accordance with ASTM E 331/ASTM E 547 at a static air pressure difference of 12 psf. No water leakage.
 - c. Uniform Load Structural: Aluminum window systems comply with AAMA/WDMA/CSA 101/I.S.2/A440-08, Voluntary specifications for aluminum windows. Guidelines for specified AW rated product.
 - d. Component testing: Accordance with procedures described in AAMA/NWWDA 101/I.S. 2/A440-08.
 - e. Forced Entry Resistance: All windows must conform to CAWM 301-90.
 - f. Condensation Resistance Test: (CRF) when tested in accordance with AAMA 1503.1-88, the condensation resistance factor must not be less than 51.
 - g. Thermal Transmittance Test: Accordance with AAMA 1503.1-88, (U-Value) not more than .59 BTU/hr/sf/°F.
 - h. Thermal Movements: Allow thermal movement resulting from the following maximum change (range) in ambient temperature.
 - 1) 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.07 QUALITY ASSURANCE

- A. Single Source Responsibility:
 - 1. Obtain entrances, storefronts, ribbon walls, window walls, curtain walls, window systems, and finish through one source from a single manufacturer.
- B. Provide test reports from AAMA accredited laboratories certifying the performances as specified in these specifications.
- C. Test Units:
 - 1. Air, water, and structural test unit sizes and configuration must conform with requirements of AAMA 101.
 - 2. Thermal test unit sizes must be 4 feet by 6 feet. Unit must consist of a single typical vent.
- D. Test Procedures and Performance: Windows must conform to AAMA 101 requirements for the window types specified. In addition, windows must meet the following performance requirements:
 - 1. Air Infiltration Test:
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E283 at static air pressuredifference of 6.24 pounds per square foot.
 - b. Air infiltration must not exceed 10 cubic feet per minute per foot of perimeter crack length.
 - 2. Water Resistance Test:
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E331 at static air pressuredifference of 7.50 pounds per square foot.
 - b. There must be no uncontrolled water leakage.

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3. Uniform Load Structural Test:
 - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E330 at a static air pressure difference of 80 pounds per square foot positive pressure and 80 pounds per square foot negative pressure.
 - b. At conclusion of the test, there must be no glass breakage, permanent damage to fasteners, hardware parts, support arms, or actuating mechanisms, nor any other damage that would cause the window to be inoperable or otherwise defective.
 4. Condensation Resistance Test (CRF):
 - a. With window sash and ventilators closed and locked, test unit in accordance with AAMA 1503.1.
 - b. Condensation resistance factor must be not less than 51.
 5. Thermal Transmittance Test (Conductive U-value):
 - a. With window sash and ventilators closed and locked, test unit in accordance with AAMA 1503.1.
 - b. Conductive thermal transmittance (U-value) must be not more than 60 BTU per hour per degree F per square foot.
- E. Drainage: Window design must enable water entering or occurring within the system to drain to the exterior.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Do not allow windows or components to come in contact with mud, uncured concrete, materials that with the presence of moisture could cause staining of finish, and other materials that could damage windows or their finish.

1.09 WARRANTY

- A. Warranted against failure and/or deterioration of metals due to manufacturing process for a period of two (2) years.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Arcadia T200 Series, Heavy Commercial Thermal Fixed (F-Aw55 Grade), Outside Set as manufactured by Arcadia, Inc. Provide basis of design product, or approved equal.
 1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 2. Manufacturer: Arcadia, Inc., 2301 E Vernon, Vernon, CA. Phone: 323-269-7300.

2.02 MATERIALS

- A. Extruded aluminum profiles 6063-T6 alloy and temper (ASTM B221 G.S. 10A-T6).
- B. All framing members .125 minimum wall thickness.
- C. Weatherstrip EPDM bulb type conforming to ASTM D2000 AA515 and must be keyed into extruded grooves.

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- D. Back glazing two-sided adhesive, 15 lbs./ft.³ density, polyethylene tape. Glazing wedges must be EPDM or Santoprene.
- E. Thermal barrier material poured-in-place two part polyurethane.
- F. Safety Glazing: Laminated Tempered Glass: Made up of two panes of fully tempered (FT), Type I, Class 1, glass of thicknesses indicated, with special 0.060-inch vinyl interlayer, meeting requirements of ASTM C1172 and CBC.
 - 1. Tint color: 19-Crystal Gray by Viracon.
- G. Anchoring Devices and Fasteners: Aluminum or stainless steel when exposed, cadmium- or zinc-plated steel when concealed.
- H. Electrolytic Bituminous Isolation Coating: Asphalt- or Coal-tar pitch-based paint or varnish of heavy or thick consistency, or 1/16-inch thick neoprene or butyl tape.
- I. Sealants: Refer to Contract Specifications Section 07 90 00 – Joint Protection, for requirements.

2.03 FINISH

- A. An Architectural Class II or I anodic coating conforming with AA-M12C22A31/AA-M12C22A41.
 - 1. Anodize finish color shall be Arcadia Colornodic AC-2 (#11 Clear).

2.04 FABRICATION

- A. Frame components mitered, reinforced extruded corner key, hydraulically crimped, and “cold welded”.
- B. All ventilator extensions tubular, each corner mitered, reinforced extruded corner key, hydraulically crimped, and “cold welded”.
- C. All corners weather sealed with an elastomeric sealant.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine conditions and verify substrate conditions are acceptable for product installation.

3.02 INSTALLATION

- A. Install in accordance with approved shop drawings and manufacturers installation instructions.

3.03 FIELD QUALITY CONTROL

- A. Contractor’s responsibility to make all necessary final adjustments to attain normal operation of each window and its mechanical hardware.

END OF SECTION 08 51 13

SECTION 08 71 00

DOOR HARDWARE

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing the following:
 - 1. Door Hardware, including electric hardware
 - 2. Gate Hardware
 - 3. Digital keypad access control devices
 - 4. Hold-open closers with smoke detectors
 - 5. Wall or floor-mounted electromagnetic hold-open devices
 - 6. Power supplies for electric hardware
 - 7. Low-energy door operators plus sensors and actuators
 - 8. Thresholds, gasketing and weather-stripping
 - 9. Door silencers

1.02 RELATED SECTIONS

- A. Section 08 10 00 – Doors and Frames

1.03 REFERENCED STANDARDS

- A. 2019 California Building Code, CCR, Title 24
- B. BHMA – Builders’ Hardware Manufacturers Association
- C. CCR – California Code of Regulations, Title 24, Part 2, California State Accessibility Standards
- D. DHI – Door and Hardware Institute
- E. NFPA - National Fire Protection Association
 - 1. NFPA 80 - Fire Doors and Other Opening Protectives
 - 2. NFPA 105 - Smoke and Draft Control Door Assemblies
- F. UL - Underwriters Laboratories.
 - 1. UL 10C - Fire Tests of Door Assemblies
 - 2. UL 305 - Panic Hardware
- G. WHI - Warnock Hersey Incorporated
- H. SDI - Steel Door Institute

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1.04 SUBMITTALS

- A. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- B. Submit six (6) copies of schedule organized vertically into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
1. Include a Cover Sheet with;
 - a. Job Name, location, telephone number.
 - b. Architects name, location and telephone number.
 - c. Contractors name, location, telephone number and job number.
 - d. Suppliers name, location, telephone number and job number.
 - e. Hardware consultant's name, location and telephone number.
 2. Job Index information included;
 - a. Numerical door number index including; door number, hardware heading number and page number.
 - b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
 - c. Manufacturers' names and abbreviations for all materials.
 - d. Explanation of abbreviations, symbols, and codes used in the schedule.
 - e. Mounting locations for hardware.
 - f. Clarification statements or questions.
 - g. Catalog cuts and manufacturer's technical data and instructions.
 3. Vertical schedule format sample:

Heading Number 1 (Hardware group or set number – HW -1)					
			(a) 1 Single Door #1 - Exterior from Corridor 101	(b) 90°	(c) RH
			(d) 3' 0"x7' 0" x 1-3/4" x (e) 20 Minute (f) WD x HM		
(g) 1	(h)	(i) ea	(j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS	(m) 626	(n) IVE
2	6AA	1 ea	Lockset - ND50PD x RHO x RH x 10-025 x JTMS	626	SCH

- (a) - Single or pair with opening number and location.
- (b) - Degree of opening
- (c) - Hand of door(s)
- (d) - Door and frame dimensions and door thickness.
- (e) - Label requirements if any.
- (f) - Door by frame material.
- (g) - (Optional) Hardware item line #.
- (h) - Keyset Symbol.
- (i) - Quantity.
- (j) - Product description.
- (k) - Product Number.

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- (l) - Fastenings and other pertinent information.
- (m) - Hardware finish codes per ANSI A156.18.
- (n) - Manufacture abbreviation

- D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.
- E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.
- F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Door Hardware shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Door Hardware shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Door Hardware complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.06 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Responsible for detailing, scheduling and ordering of finish hardware.
 - 2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing.
 - 3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.

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- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
 - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items must be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- F. Product packaging to be labeled in compliance with CA Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986.

1.08 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.09 WARRANTY

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
 - 1. Locksets: Ten (10) years.
 - 2. Electronic: One (1) year.
 - 3. Closers: Thirty (30) years – "Mammoth" Series (3) years.
 - 4. Exit devices: Three (3) years.
 - 5. All other hardware: Two (2) years.

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1.10 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least one week prior to beginning work of this section.
- B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key District Personnel, and Project Inspector.
- C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owners keying standards.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: as listed, or VTA approved equal.
 - 1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.

<u>Item</u>	<u>Manufacturer</u>	<u>Acceptable Substitutes</u>
Hinges	Ives	Hager, Stanley, McKinney
Locks, Latches & Cylinders	Schlage	Or Approved Equal
Exit Devices	Von Duprin	Or Approved Equal
Closers	LCN	Or Approved Equal
Push, Pulls & Protection Plates	Ives	Trimco, BBW, DCI
Flush Bolts	Ives	Trimco, BBW, DCI
Dust Proof Strikes	Ives	Trimco, BBW, DCI
Coordinators	Ives	Trimco, BBW, DCI
Stops	Ives	Trimco, BBW, DCI
Overhead Stops	Glynn-Johnson	Or Approved Equal
Thresholds	Zero	Pemko, National Guard
Seals & Bottoms	Zero	Pemko, National Guard

2.02 MATERIALS

- A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
 - 1. Hinges shall be sized in accordance with the following:
 - a. Height:
 - 1) Doors up to 42-inches wide: 4-1/2-inches.
 - 2) Doors 43-inches to 48-inches wide: 5 inches
 - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.

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- c. Number of Hinges: Furnish 3 hinges per leaf to 7-feet 5-inches in height. Add one for each additional 2-feet in height.
 2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.
- B. Floor Closers: Shall be equipped with compression springs, cam and roller operating mechanism and a one piece spindle-cam for maximum operating performance and longevity.
- C. Pivots: High strength forgings and castings with precision bearings for smooth operation. Positive locking vertical adjustment mechanism to allow installer to precisely position the door and balance the load.
- D. Continuous Hinges: As manufactured by Ives, an Allegion Company. UL rated as required.
- E. Heavy Duty Cylindrical Locks and Latches: Falcon "T" Series as scheduled with "Quantum" design, fastened with through-bolts and threaded chassis hubs.
1. Chassis: cylindrical design, corrosion-resistant plated cold-formed steel, through-bolted.
 2. Backset: 2-3/4-inch typically, more or less as needed to accommodate frame, door or other hardware.
 3. Lever Trim: accessible design, independent operation, minimum 2-inch clearance from lever mid-point to face of door.
 4. Certifications:
 - a. ANSI A156.2, 1994, Series 4000, Grade 1.
 - b. UL listed for B, 1-1/2 label and lesser class single doors up to 4feet by 8feet.
 5. Furnish at Common Area Doors.
- F. Deadlocks: Rotating cylinder trim rings of attack-resistant design. Mounting plates and actuator shields of plated cold-rolled steel. Mounting screws of 1/4-inch diameter steel and protected by drill-resistant ball bearings. Steel alloy deadbolt with hardened steel roller. Strike alloy deadbolt with reinforcer and two 3-inch long screws. ANSI A156.5, 2001 Grade 1 certified.
- G. Exit devices: Von Duprin as scheduled.
1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
 2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
 3. Mechanism case shall have an average thickness of .140-inch.
 4. Compression spring engineering.
 5. Non-handed basic device design with center case interchangeable with all functions.
 6. All devices shall have quiet return fluid dampeners.
 7. All latchbolts shall be deadlocking with 3/4-inch throw and have a self-lubricating coating to reduce friction and wear.
 8. Device shall bear UL label for fire and or panic as may be required.
 9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
 10. Lever Trim: "Breakaway" design, forged brass or bronze escutcheon with a minimum of .130-inch thickness, match lockset lever design.
 11. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.
 12. Furnish glass bead kits for vision lites where required.
 13. All Exit Devices to be sex-bolted to the doors.
 14. Panic Hardware shall comply with CBC Section 11B.404.2.7 and shall be mounted between 34-inch and 44-inch above the finished floor surface.

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- a. Provide exit devices UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4, and UL listed for Panic Exterior Fire Exit Hardware maximum opening force of 15 pounds according to the California Building Code section 11B-404.2.9.

H. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.

1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 1 1/16-inch and piston diameter of 1-inch to ensure longevity and durability under all closer applications.
3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16-inch steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
4. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.
5. Closers must be installed to permit doors to swing 180 degrees.
6. All closers must utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
7. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
8. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Per 11B-404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.

I. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.

1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
2. Provide dust proof strikes at openings using bottom bolts.

J. Door Stops:

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).

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3. Overhead stops must be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
- K. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.
- L. Thresholds: As Scheduled and per details.
1. Thresholds shall not exceed 1/2-inch in height, with a beveled surface of 1:2 maximum slope.
 2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection.
 3. Use 1/4-inch fasteners, red-head flat-head sleeve anchors (SS/FHSL).
 4. Thresholds must comply with CBC Section 11B-404.2.5/
- M. Seals: Provide silicone gasket at all rated and exterior doors.
1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
 2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.
 3. Smoke & Draft Control Doors, Provide UL10C Classified complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.
- N. Door Shoes & Door Top Caps: Provide door shoes at all exterior doors and top caps at all exterior out-swing doors.
- O. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.03 KEYING

- A. Furnish a Proprietary Schlage masterkey system as directed by the owner or architect. Key system to be designated and combined by the Schlage Master Key Department even if pinned by the Authorized Key Center, Authorized Security Center or a local authorized commercial dealer.
- B. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of Allegion or an Authorized Key Center or Authorized Security Center. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.
- C. Furnish all cylinders in the Small Format Interchangeable Core (SFIC) keyway to match the Schlage keyway. (Choose AB, DB, EB, FB, GB, HB, JB, KB, LB, MB keyways). All keyways match the corresponding Best™ keyway. These cylinders are supplied uncombined to be pinned by the Authorized Key Center, Authorized Security or authorized commercial dealer.
- D. Furnish construction keying for doors requiring locking during construction.

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1. For SFIC systems provide 80-035 Small Format Construction Cores in either “BRN” or “GRN” combination for all locks that need to be locked during construction and M204-152 Disposable Cores for all cylinders not required to be locked.
 2. For SFIC systems provide ten 48-310 Const. Keys in either “BRN” or “GRN” combination to match cores in number 1 above.
 3. For SFIC systems provide two 48-311 Control Keys in either “BRN” or “GRN” combination to match cores in number 1 above. (const.)
 4. For SFIC systems provide two control keys for installing the permanent cores (either 48-311 for non-patented keyways or 49-356 for patented keyways such as “Everest -B” family).
- E. Furnish all keys with visual key control.
1. Stamp key “Do Not Duplicate”.
 2. Stamp (BHMA) key symbol on key.
- F. Furnish all cylinders with visual key control.
1. Stamp (BHMA) key symbol on side of cylinder (CKC).
- G. Furnish mechanical keys as follows:
1. Furnish 2 cut change keys for each different change key code.
 2. Furnish 1 uncut key blank for each change key code.
 3. Furnish 6 cut masterkeys for each different masterkey set.
 4. Furnish 3 uncut key blanks for each masterkey set.
 5. Furnish 2 cut control keys cut to the top masterkey for permanent I/C cylinders.
 6. Furnish 1 cut control key cut to each SKD combination.
- H. Furnish Schlage Padlocks and the cylinders to tie them into the masterkey system for gates, storage boxes, utility valve security, roof hatches and roll-up doors keyed as directed in the keying schedule.
1. Furnish KS43D2200 padlock for use with non-I/C Schlage cylinders. Furnish 47-413 (conventional) or 47-743-XP (PrimusXP) with above.
 2. Furnish KS43G3200 padlock for use with FSIC Schlage cylinders. Furnish 23-030 (Classic / Everest) or 20-740 (PrimusXP) with above.
 3. Furnish KS41D1200 padlock for use with SFIC Schlage cylinders. Furnish 80-037 (Everest-B) with above.
- I. Furnish one Schlage cabinet lock for each cabinet door or drawer so designated on the drawings or keying schedule to match the masterkey system.
1. Furnish CL100PB for use with non-I/C Schlage cylinders.
 2. Furnish CL77R for use with FSIC Schlage cylinders.
 3. Furnish CL721G for use with SFIC Schlage cylinders.
- 2.04 FINISHES**
- A. Generally to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.

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- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

2.05 FASTENERS

- A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
- B. Screws for butt hinges shall be flathead, countersunk, full-thread type.
- C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
- D. Provide expansion anchors for attaching hardware items to concrete or masonry.
- E. All exposed fasteners shall have a phillips head.
- F. Finish of exposed screws to match surface finish of hardware or other adjacent work.
- G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.
- C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) 2016 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34-inch and 44-inch AFF.

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- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.
- G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.
- H. Hardware Installer shall coordinate with security contractor to route cable to connect electrified locks, panic hardware and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.
- I. Hardware Installer must also be present with the security contractor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closers to insure proper and secure operation.
- J. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for in the Electrical Section.
- K. Conductors shall be minimum 18 gage stranded, multicolored. A minimum 12-inch loop of conductors shall be coiled in the interface junction box. Each conductor must be permanently marked with its function.
- L. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacturer's technical documentation.

3.03 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surface soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace

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hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.04 **HARDWARE LOCATIONS**

- A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.05 **FIELD QUALITY CONTROL**

- A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.06 **SCHEDULE**

- A. The items listed in the following schedule must conform to the requirements of the foregoing specifications.

- B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.

Manufacturers Abbreviations (Mfr.)

ADA	=	Adams Rite Mfg.	Aluminum Door Hardware
FAL	=	Falcon	Locks, Latches & Cylinders
GLY	=	Glynn-Johnson Corporation	Overhead Door Stops
IVE	=	Ives	Hinges, Pivots, Bolts, Coordinators, Dust ProofStrikes, Push Pull & Kick Plates, Door Stops & Silencers
JOH	=	L.E. Johnson	Sliding Door Hardware
LCN	=	LCN	Door Closers
SCE	=	Schlage Electronics	Electronic Door Components
SCH	=	Schlage Lock Company	Locks, Latches & Cylinders
TRI	=	Trimco	Signs
VON	=	Von Duprin	Exit Devices
ZER	=	Zero International	Thresholds, Gasketing & Weather-stripping

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HARDWARE GROUP NO. 01

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	T581GD7 DAN	626	FAL
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	SET	SEALS	5050B	BRN	NGP
1	EA	DOOR SWEEP	100VA	AL	NGP
1	EA	THRESHOLD	PER DETAIL		NGP

HARDWARE GROUP NO. 02

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	T581GD7 DAN	626	FAL
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	SET	SEALS	5050B	BRN	NGP
1	EA	DOOR SWEEP	100VA	AL	NGP
1	EA	THRESHOLD	PER DETAIL		NGP

HARDWARE GROUP NO. 03

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	PASSAGE SET	T101 DAN	626	FAL
1	EA	CLOSER	MAMMOTH-180	630	LOX
1	EA	FLOOR STOP	FS18S	BLK	IVE

HARDWARE GROUP NO. 04

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	STOREROOM LOCK	T581GD7 DAN	626	FAL
1	EA	CLOSER	MAMMOTH-180	630	LOX
1	EA	FLOOR STOP	FS18S	BLK	IVE

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HARDWARE GROUP NO. 05

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MULLION	BY GATE MANUFACTURER		
2	EA	ELEC PANIC HARDWARE	RX-AX-98-EO-ALK-EMERG EXIT RSS-WH 9-VOLT BATTERY WITH HARDWIRED OPTION	626	VON
1	EA	MORTISE CYLINDER	C987	626	FAL
1	EA	SFIC CORE	C607	626	FAL
2	EA	CLOSER	MAMMOTH-180	630	LOX
2	EA	FLOOR STOP	FS18S	BLK	IVE

HARDWARE GROUP NO. 06

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MULLION	BY GATE MANUFACTURER		
1	EA	PANIC HARDWARE	AX-98-EO-WH	626	VON
1	EA	PANIC HARDWARE	AX-98-L-BE-06-WH	626	VON
2	EA	CLOSER	MAMMOTH-180	630	LOX
2	EA	FLOOR STOP	FS18S	BLK	IVE

HARDWARE GROUP NO. 07

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	FIRE EXIT HARDWARE	9847-EO-F	626	VON
1	EA	FIRE EXIT HARDWARE	9847-L-NL-F-06	626	VON
1	EA	RIM HOUSING	C953	626	FAL
1	EA	SFIC CORE	C607	626	FAL
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	SET	SEALS	5050B	BRN	NGP
1	SET	ASTRAGAL	137NA	CL	NGP
1	EA	DOOR SWEEP	100VA	AL	NGP
1	EA	THRESHOLD	PER DETAIL		NGP

HARDWARE GROUP NO. 08

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	BY GATE MANUFACTURER		
2	EA	CANE BOLT	524P23SPU HOLD DOWN	630	CRO
2	EA	PADLOCK L/CYL-SFIC	KS41F1200	625	SCH
1	EA	SFIC CORE	C607	626	FAL

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HARDWARE GROUP NO. 09

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	FIRE EXIT HARDWARE	9847-EO-F	626	VON
1	EA	FIRE EXIT HARDWARE	9847-L-NL-F-06	626	VON
1	EA	RIM HOUSING	C953	626	FAL
1	EA	SFIC CORE	C607	626	FAL
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	SET	SEALS	5050B	BRN	NGP
1	SET	ASTRAGAL	137NA	CL	NGP
1	EA	DOOR SWEEP	100VA	AL	NGP
1	EA	THRESHOLD	PER DETAIL		NGP

END OF SECTION 08 71 00

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SECTION 08 80 00

GLAZING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing glass and glazing required for:
 - 1. Graphics Display Cases
 - 2. Kiosks
 - 3. Station Shelter Wind Screens Modules and Panels
 - 4. Aluminum Windows
 - 5. Glass Canopy at Elevator

1.02 RELATED SECTIONS

- A. Section 07 90 00 – Joint Protection
- B. Section 08 51 13 – Aluminum Windows
- C. Section 09 96 23 – Graffiti Resistant Coatings
- D. Section 10 73 16.36 – Glass Supported Glass Awnings

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI):
 - 1. ANSI Z97.1 Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test
- B. ASTM International (ASTM):
 - 1. ASTM C1172 Standard Specification for Laminated Architectural Flat Glass
 - 2. ASTM C1036 Standard Specification for Flat Glass
 - 3. ASTM C1048 Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
- C. Consumer Products Safety Commission (CPSC):
 - 1. Safety Standard for Architectural Glazing Materials
- D. California Building Code (CBC):
 - 1. CBC California Building Code 2018
- E. Glass Association of North America (GANA):
 - 1. FF-P-110 Key Operated, heavy Duty Commercial Padlocks

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F. National Fire Protection Association (NFPA):

1. Glazing Manual

1.04 SUBMITTALS

A. General

1. Submittals for Glazing must be made in accordance with the provisions in these technical specifications.
2. The Contractor must submit the following:
 - a. Product Data: Submit manufacturer's specifications and installation instructions for all glass and glazing materials to be used on the Project.
 - b. Samples:
 - 1) Submit manufacturer's color chart to VTA. Submit 12 inch x 12 inch sample of each type of glazing to be used on the Project.
 - 2) Provide color samples of tinted obscure glazing and clear obscure glazing proposed for use. Submit samples representing the color as identified herein.
 - c. Certification: Submit certification that the glazing materials to be furnished and installed conform to all applicable requirements of CBC.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Glazing, of the various types shown in the Bid Form, must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Glazing, of the various types shown in the Bid Form, must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Glazing complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Codes and Standards: Any glazing material furnished and installed in architectural products covered by CPSC Safety Standard for Architectural Glazing Materials (42 FR 1428; 16 CFR Part 1201) must meet requirements of those Standards. All other glazing must conform to CBC.
- B. Labeling of Glazing Materials: In addition to the requirements of CPSC and UBC, the following specific labeling is required:
 1. Safety Glass: Comply with ANSI Z97.1, with label on each piece of glass.

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1.07 WARRANTY

- A. Upon completion of the work of this Section, submit a written warranty, signed by Contractor, as well as installer, covering the work for a period of 2 years. In addition, the warranty must stipulate that Contractor will provide all other work required for such repair or replacement, should failure occur, at no cost to VTA.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Glass must comply with the applicable requirements of ASTM C1036.
- B. Safety Glazing: Laminated Tempered Glass: Made up of two panes of fully tempered (FT), Type I, Class 1, glass of thicknesses indicated, with special 0.060-inch vinyl interlayer, meeting requirements of ASTM C1172 at:
 - 1. Poster Cabinets: 1/4 inch thick.
 - 2. Graphics Panel: 1/2 inch thick.
 - 3. Windscreens: 1/4-inch thick.
 - 4. Aluminum Windows: Two pieces of 1/4-inch thick each, see Section 08 51 13 Aluminum Windows and Contract Drawings for assembly.
 - 5. Glass Awning: 3/4-inch thick.
- C. Setting Blocks: Neoprene, 70 to 90 durometer hardness, with proven compatibility with the sealants to be used.
- D. Spacers: Neoprene, 40 to 50 durometer hardness, with proven compatibility with the sealants to be used.
- E. Sealants and Accessories: As specified in Section 07 90 00 – Joint Protection.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Obtain field dimensions of each opening that is to receive glass and cut each light to provide the optimal bite on, and clearance from, the sash or frame.
- B. Clean the surfaces that are to receive glass and glazing materials. Surfaces must be free of dirt, corrosion, residue, and any other substance that may impair adhesion of glazing materials.
- C. Seal porous glazing channels or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive glazing compound.
- D. Do not perform glazing when ambient temperature is below 40 degrees Fahrenheit or during damp or rainy weather.

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3.02 FABRICATION

- A. Standards for Fabrication: Comply with the applicable requirements of FGMA Glazing Manual, except as may otherwise be shown or specified, and except as may be specifically recommended by the manufacturer of the glass or glazing material.

3.03 INSTALLATION

- A. General: Watertight and airtight installation of each piece of glazing exposed to the weather is required. Each installation must withstand normal temperature changes, wind loading, and impact loading with no failure of any kind, including loss or breakage of glazing, failure of sealants or gasketing to remain air- and water-tight, deterioration of glazing materials or other defects in the materials or their application.
- B. Standards for Installation: Comply with the applicable requirements of FGMA Glazing Manual, except as may otherwise be shown or specified, and except as may be specifically recommended by the manufacturer of the glazing or glazing material.
- C. Inspection of Materials: Immediately before installation of glazing, inspect all edges for flares, chips or irregularities, and faces for scratches or surface disfigurements. Materials with such blemishes must be rejected and not installed on this Project.
- D. Appearance: Unify appearance of each series of lites of glazing by setting each piece to match those adjacent, as nearly as possible. Inspect each piece and set with the pattern, draw and bow oriented in the same direction as those adjacent.
- E. Clean all members to receive glazing, immediately before installation of the glazing.

3.04 FINISH AND CLEANING

- A. Remove and replace all glazing which is broken or has become scratched, chipped, abraded, cracked or damaged in any way during the construction process.
- B. Maintain glazing in a reasonably clean condition during construction, so that it will not be damaged by corrosive action and will not contribute (by wash-off) to the deterioration of the glazing materials and/or other work.
- C. Not more than four (4) days before Final Inspection of the Project, wash and polish all glazing in compliance with the recommendations of the glazing manufacture.

END OF SECTION 08 80 00

SECTION 08 90 00

LOUVERS AND VENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for the metal louvers, dampers, vents and other related materials at:
 - 1. Eastridge Station Communications/Signal Building
 - 2. Story Station Communications/Signal Building, Utility Rooms and Access Structures
 - 3. Elevator Hoistway, Elevator Machine Rooms and
 - 4. Janitor's Room

- B. Furnish and install louvers, bird screens, blank-off panels, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.

- C. The louvers to be furnished include the following:
 - 1. Formed metal louvers
 - 2. Thin line louvers
 - 3. Steel louvers
 - 4. Aluminum louvers
 - 2. Bird Screens

1.02 RELATED SECTIONS

- A. Section 07 60 00, Flashing and Sheet Metal

- B. Section 07 90 00, Joint Protection

- C. Section 08 80 00, Glazing

- D. Section 09 91 00, Painting

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 2. ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate
 - 3. ASTM B211 Standard Specification for Aluminum Alloy Extruded Bars, Rods, and Wire
 - 4. ASTM B221 Standard Specification for Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - 5. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound

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- B. Federal Specifications (FS):
 - 1. TT-P-86 Paint, Red-Lead-Base, Ready-Mixed
- C. Air Movement and Control Association International, Inc:
 - 1. AMCA Standard 500-L-2007 Laboratory Methods of Testing Louvers for Rating
 - 2. AMCA Publication 501 Application Manual for Air Louvers
- D. The Aluminum Association Incorporated:
 - 1. Aluminum Standards and Data
 - 2. Specifications and Guidelines for Aluminum Structures
- E. American Society of Civil Engineers:
 - 1. Minimum Design Loads for Buildings and Other Structures
- F. Architectural Aluminum Manufacturers Association:
 - 1. AAMA 800 Voluntary Specifications and Test Methods for Sealants
 - 2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels
 - 3. AAMA TIR A9 Metal Curtain Wall Fasteners
 - 4. AAMA 2605-2005 Superior Performing Organic Coatings on Aluminum Extrusions and Panels

1.04 SUBMITTALS

- A. General
 - 1. Submittals for Louvers and Vents must be made in accordance with the provisions in these technical specifications.
 - 2. The Contractor must submit the following:
 - a. Product Data: Submit manufacturer's specifications and installation instructions. Indicate by transmittal that a copy of each instruction has been forwarded to installer. Submitted product data must include but not be limited to:
 - 1) Air flow and water entrainment performance test results.
 - 2) Material types and thickness.
 - b. Shop Drawings: Submit shop drawings showing details of fabrication and erection of louvers and vents, including:
 - 1) Elevations, sections and specific details for each louver.
 - 2) Anchorage details and connections to all component parts.
 - 3) Signed and sealed structural calculations.
 - c. Samples: Submit samples of each louver type, style and finish.
 - 1) Submit 3 to 4 brush samples of stainless steel for final selection by VTA.
 - d. Submit color chips for approval. Submit manufacturer's product literature and detailed installation instructions for horizontal and vertical surfaces.

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3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Louvers and Vents must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Louvers and Vents must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Louvers and Vents complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.
- B. Aluminum Sheet: ASTM B209M, Alloy 1100, 3003 or 5005.
- C. Galvanized Sheet Steel: ASTM A653/A653M, commercial quality, gage as shown.
- D. Primer: Red lead, FS TT-P-86, Type III.
- E. Nails and Fasteners: Manufacturer's standard, compatible with the fabricated item.
- F. Thin Line Fire Damper: Where louvers are located within 10 feet of an exit discharge system or means of egress system, and as shown on the Drawings, use a 4 inches deep louver model ELS 837 as manufactured by RUSKIN or VTA approved equal, with a thin line fire damper model IBDT as manufactured by RUSKIN or VTA approved equal, to provide a minimum three quarter hour fire protection rating. Prepare and paint entire assembly per specifications.

2.02 MANUFACTURERS

- A. The louvers and related materials herein specified and indicated on the Drawings must be products of the following manufacturer's, or VTA approved equal.
 1. Construction Specialties, Inc., 49 Meeker Avenue, Cranford, New Jersey 07016, Ph: (800) 631-7379 / (888) 895-8955.
 2. The AIROLITE Company, P.O. Box 666, Marietta, Ohio 45750, Ph: (614) 373-7676, Fax: (614) 373-6666, Fax-On-Demand: (614) 376-9966.
 3. Greenheck, 400 Ross Avenue, Schofield, WI 54476-0410, Ph: (715) 359-6171, Fax: (715) 355-2399, Web site: <http://www.greenheck.com>.
 4. Industrial Louvers, Inc., 511 South 7th Street, Delano, MN 55328, Ph: (763) 972-2981, Fax: (763) 972-2911.
 5. Ruskin Manufacturing, 3900 Dr. Greaves Rd., Kansas City, MO 64030, Ph: (816) 761-7476, Fax: (816) 761-1936.

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2.03 FABRICATION

- A. Provide louver models as described herein, bird screens, blank-off panels, structural supports and accessories as specified and/or shown on the Drawings. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.
- B. Louvers must be mechanically assembled using stainless steel or aluminum fasteners.
- C. Include supports, anchorage, and accessories required for complete assembly.
- D. Formed metal louvers. Formed metal louvers must be manufactures standard metal frames, formed and shaped as shown on the Drawings. Provide manufacturer's standard louver frame and blade depths as nominally defined on the Drawings. Except where identified as thin line louvers on the Drawings, all louvers must be standard formed steel louvers.
1. Fabricate from galvanized steel sheet to sizes and shapes shown on the Drawings. Form blades to shape shown, with exposed edges hemmed at least 1/2 inch. Provide vertical legs, at least 1/2 inch high, at front and rear (inner) edges. If blade shape is inverted "Y" or inverted "Vee," this return is not required, but hem cut edges. Blades must be not thinner than 20 gage, or as otherwise noted.
 2. Fabricate frames from not thinner than 18 gage material. Miter at exposed corners of trim. Provide removable trim at inner face, if inner face is exposed. Lap joints and solder or weld. Dress finish surfaces smooth. Secure blades to side frames with continuous end member fastened with concealed screws, welding or soldering. For blades longer than 30 inches, provide center divider/support.
 3. Provide removable bird screen on inner face of louver. Screen must have metal frame holding the mesh securely. Secure with screws or clips.
 4. Color & Finish: Stainless steel louvers must be natural color and provided with a brush finish. Submit 3 to 4 brush samples of stainless steel for final selection by VTA.
- E. Thin line louvers: Thin line louvers must be manufacturer's standard narrow profile stainless steel frames and blades formed and shaped as shown on the Drawings.
1. Fabricate from stainless steel sheet to sizes and shapes shown on the Drawings. Form blades to shape shown, with exposed edges hemmed at least 1/2 inch. Provide vertical legs, at least 1/2 inch high, at front and rear (inner) edges. If blade shape is inverted "Y" or inverted "Vee," this return is not required, but hem cut edges. Blades must be not thinner than 20 gage, or as otherwise noted.
 2. Fabricate frames from not thinner than 18 gage material. Miter at exposed corners of trim. Provide removable trim at inner face, if inner face is exposed. Lap joints and solder or weld. Dress finish surfaces smooth. Secure blades to side frames with continuous end member fastened with concealed screws, welding or soldering. For blades longer than 30 inches, provide center divider/support.
 3. Provide removable bird screen on inner face of louver. Screen must have metal frame holding the mesh securely. Secure with screws or clips.
 4. Color & Finish: Stainless steel louvers must be brush finish. Submit four brush samples of stainless steel for final selection by VTA.
- F. Bird Screens: Fabricate with an extruded aluminum frame of Type 6063-T5 alloy. Miter at exposed corners. Provide with removable, replaceable mesh insert. Secure to base frame with screws, exposed portions of frame or trim. Provide mesh inserts of No. 2 (1/2 inch mesh), fabricated from

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16 gage diameter wire and providing 80 percent free area. Finishes: mesh, mill finish; exposed portions of frame: caustic etched and lacquer finished.

- G. Provide fire dampers at louvers as required by local codes.

2.04 PAINTED FINISH FORMED METAL LOUVERS

- A. Preparatory Work: Grind welds smooth and flush, and polish exposed weld marks to match adjacent material. Pre-treat surfaces to receive paint coating with manufacturer's recommended material or process.
- B. Coating Process: Neutralize and wash surfaces and apply prime paint to surfaces, to yield a dry film thickness of 2 mils. Apply a second coat of prime paint to those surfaces which will be in direct contact with concrete or mortar. Apply a baked enamel finish to a uniform dry film thickness of 2 mils.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Check site dimensions affecting this work. Ensure openings affecting this work are properly prepared and that flashings are correctly located to divert moisture to the exterior.

3.02 INSTALLATION

- A. Install louvers, dampers, and vents as shown on the accepted shop drawings, following the procedures defined in the manufacturer's recommended installation instructions
- B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.
- C. Anchor louvers, dampers, and vents to the building substructure as indicated on architectural drawings.
- D. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
- E. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
- F. Set units level, plumb and true to line, with uniform joints.

3.03 PROTECTION

- A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.04 ADJUSTING AND CLEANING

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- A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers, dampers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the VTA, remove damaged materials and replace with new materials.
 - 1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating

END OF SECTION 08 90 00

SECTION 09 28 13

CEMENTITIOUS BACKING BOARD

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes the requirements for furnishing and installing Cementitious Backing Board as indicated on the Drawings, as specified herein, and as needed for a complete and proper installation. Section includes requirements for:

1. Cement Board
2. Accessories

1.02 RELATED SECTIONS

- A. Section 05 40 00, Cold-Formed Metal Framing
- B. Section 06 10 00, Rough Carpentry
- C. Section 09 29 00, Gypsum Board
- D. Section 09 30 00, Tile

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI):

1. A108.11 Standard for Interior Installation of Cementitious Backer Units
2. A118.1 Standard Specification for Dry-Set Portland Cement Mortar
3. A118.4 Standard Specification for Latex-Portland Cement Mortar
4. A118.9 Standard Test Methods and Specifications for Cementitious Backer Units
5. A136.1 Standard Specification for Organic Adhesives for Installation of Ceramic Tile

- B. ASTM International (ASTM):

1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products
2. ASTM C1002 Standard Specification for Steel Drill screws for the Application of Gypsum Panel Products or Metal Plaster Bases
3. ASTM C1325 Standard Specification for Fiber-Mat Reinforced Non-Asbestos Cement Interior Substrate Sheets
4. ASTM D2394 Standard Test Methods for Simulated Service Testing of Wood and Wood-Based Finish Flooring

1.04 SUBMITTALS

- A. Product data:

1. Materials list of items proposed to be provided under this Section.

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2. Manufacturers' specifications and other data needed to prove compliance with the specified requirements.
3. Manufacturers' recommended installation and product data.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Cementitious Backing Board must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Cementitious Backing Board must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Cementitious Backing Board complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Have materials shipped in manufacturer's original packages showing manufacturer's name and product brand name.
- B. Storage and Protection: Store materials inside and protected from damage by the elements. Protect ends, edges, and faces of cement boards from damage.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Cement Board:
 1. Backer Board: Cementitious, water durable, board; surfaced with fiberglass reinforcing mesh on front and back; long edges wrapped; and complying with ANSI A118.9 and ASTM C1325.
 - a. Thickness: 1/2-inch or 5/8-inch.
 - b. Edges: Tapered.
 - c. Compressive Strength: Not less than 2250 pounds per square inch when tested in accordance with ASTM D 2394.
 - d. Water absorption: Not greater than eight percent when tested for 24 hours in accordance with ASTM C473.
 2. Bendable Backer Board: Cementitious, water durable, board; surfaced with fiberglass reinforcing mesh on front and back; long edges wrapped; and complying with ANSI A118.9.
 - a. Thickness: 1/2-inch.
 - b. Edges: Tapered.
 - c. Compressive Strength: Not less than 2250 pounds per square inch when tested in accordance with ASTM D2394.
 - d. Water Absorption: Not greater than eight percent when tested for 24 hours in accordance with ASTM C473.
 3. Underlayment: Cementitious, water durable, board; surfaced with fiberglass reinforcing mesh on front and back; long edges wrapped; and complying with ANSI A118.9 and ASTM C1325.
 - a. Thickness: 1/4-inch.
 - b. Edges: Tapered.
 - c. Compressive Strength: Not less than 2250 pounds per square inch when tested in accordance with ASTM D2394.

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- d. Water Absorption: Not greater than eight percent when tested for 24 hours in accordance with ASTM C473.
- 4. Fasteners:
 - a. Screws: For wood and 22 gauges or lighter steel framing: Hi-Lo thread screws (No. 8) wafer head, corrosion-resistant, 1-1/4-inch or 1-5/8-inch long, and complying with ASTM C1002.
 - b. Screws: For 20 gauges or heavier: Drill point screws (No.8) wafer head, corrosion-resistant, 1-1/4-inch or 1-5/8-inch long, and complying with ASTM C1002.
- 5. Joint Treatment:
 - a. Tape: Alkali-resistant fiberglass mesh tape intended for use with cement board.
- 6. Bonding Materials:
 - a. Mortar: Dry-set Portland cement mortar in accordance with ANSI A118.1.
 - b. Mortar: Latex-Portland cement mortar in accordance with ANSI A118.4.
 - c. Adhesive: Organic adhesive in accordance with ANSI A136.1, Type 1.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: In accordance with the following reference standards and manufacturer's recommendations: ANSI A108.11.
- B. Before applying board, verify that corners and framing are plumb, true, and solid. Apply no board until conduits, boxes, pipes, ducts, vents, supports, fixture frames, blocking and backing, and the like are in place and inspected, tested, and approved as required. All edges and ends of board must have solid bearing. Notify VTA in writing of all conditions detrimental to the timely completion of the work. Do not proceed with the work of this Section until all unsatisfactory conditions have been corrected.

END OF SECTION 09 28 13

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SECTION 09 29 00

GYPSUM BOARD

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes the requirements for furnishing and installing gypsum wallboard as indicated on the Drawings, as specified herein, and as needed for a complete and proper installation. Section includes requirements for:
1. Gypsum wall board
 2. Fire-rated board
 3. Water-resistant (W/R) backing board
 4. Joint compound and tape
 5. Accessories
 6. Screws
 7. Sealant

1.02 DESCRIPTION

- A. When a fire resistance rating is indicated for a gypsum board assembly, details of construction must be in accordance with reports of fire tests of assemblies which have met the requirements of the indicated fire rating.
- B. Details of construction not specified herein must conform to applicable requirements of ASTM C840.

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM C11 Standard Terminology Relating to Gypsum and Related Building
 2. ASTM C475 Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
 3. ASTM C630 Standard Specification for Water-Resistant Gypsum Backing Board
 4. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board
 5. ASTM C954 Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inches to 0.112 inches in Thickness
 6. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
 7. ASTM C1047 Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
 8. ASTM C1396 Standard Specification for Gypsum Board
 9. ASTM E497 Standard Practice for Installing Sound-Isolating Lightweight Partitions

1.04 SUBMITTALS

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- A. Product data:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturers' specifications and other data needed to prove compliance with the specified requirements.
 - 3. Manufacturers' recommended installation.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Gypsum Board must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Gypsum Board must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Gypsum Board complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 REGULATORY REQUIREMENTS

- A. In addition to the foregoing referenced standards, the regulatory requirements which govern the work of this Section include the following governing code.
 - 1. California Code of Regulations (CCR), Title 24, Part 2, California Building Code, Chapters 25 and 25A, "Gypsum Board and Plaster."

1.07 DEFINITIONS

- A. Words and terms used in this Section and not defined herein must be interpreted in accordance with the definitions given in ASTM C11.

1.08 QUALITY ASSURANCE

- A. Installation and Finishing: Comply with applicable requirements of the California Building Code, Chapters 25 and 25A, and ASTM C840.
- B. Installation of Sound-Retardant Partitions: Comply with applicable requirements of ASTM E497.

1.09 JOBSITE CONDITIONS

- A. Maintain room temperature of not less than 40 degrees Fahrenheit during application of gypsum board, and 50 degrees Fahrenheit during application of joint treatment and for 48 hours thereafter. If temporary heat is provided, do not allow the temperature to exceed 95 degrees Fahrenheit.
- B. Maintain adequate ventilation in the working area during installation and finishing.

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers or bundles bearing the brand name, applicable standard designation, and the name of the manufacturer or supplier from whom the product is manufactured.

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- B. Deliver materials to the site and store them in the work area if possible, so that materials will have a minimum period of 24-hours storage at the same temperature as the installation area.
- C. Store gypsum board in the horizontal position. When necessary to stack palettes, align blocking vertically to avoid distortion of boards. Deep materials dry, fully protected from weather and direct sunlight exposure.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Board Type and Thickness: Refer to indicated details and notes on the Contract Drawings for type and thickness of board. Where thickness is not indicated, provide 5/8-inch-thick board.
- B. Gypsum Wallboard: ASTM C36, furnished with tapered longitudinal edges and in lengths which will result in a minimum footage of joints.
 - 1. Provide foil-backed gypsum wallboard for interior facing of exterior walls where gypsum wallboard is scheduled for the interior finish and for gypsum wallboard furred over concrete or masonry.
- C. Fire-Rated Board: Provide Type X board for assemblies indicated to have a fire- resistance rating.
- D. Water-Resistant (W/R) Backing Board: ASTM C630, 5/8-inch thick. Provide Type X water-resistant gypsum backing board where water-resistant gypsum board walls and ceilings are indicated to have a fire-resistance rating.
- E. Joint Compound and Tape: ASTM C475, joint tape, taping compound, and finishing compound. All-purposed compound may be substituted for taping compound and finishing compound.
- F. Accessories: ASTM C1047, galvanized steel. Provide metal corner bead for all external corners and angles and metal edge trim at all junctions of gypsum wallboard and walls of other materials and for all exposed edges.
- G. Screws: ASTM C954 or ASTM C1002, as applicable for type of metal framing, of required lengths.
- H. Sealant: Sealant for holes or penetrations in acoustical and damp-service partitions must conform to applicable requirements of Section 07 90 00 – Joint Protection.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Apply gypsum wallboard in accordance with applicable requirements of ASTM C840.
- B. Before applying gypsum board, verify that corners and framing are plumb, true, and solid. Apply no gypsum board until conduits, boxes, pipes, ducts, vents, supports, fixture frames, blocking and backing, and the like are in place and inspected, tested, and approved as required. All edges and ends of gypsum board must have solid bearing. Notify VTA in writing of all conditions detrimental to the timely completion of the work. Do not proceed with the work of this Section until all unsatisfactory conditions have been corrected.

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- C. Apply wallboard over metal framing and furring with self-drilling, self-tapping screws installed with an electric screw-gun equipped with adjustable screw depth control. Drive screw heads slightly below the surface of the wallboard, taking care to avoid breaking the paper face or fracturing the gypsum core. Space screws a maximum of 12 inches on center in the field of boards and eight inches on center staggered along the abutting edges for walls, and seven inches on center along abutting edges for ceilings. Do not drive screws closer than 3/8 inch from edges and ends.
- D. Apply wallboard first to ceilings and then to walls, using maximum practical lengths to minimize end joints. End joints will not be permitted on walls or partitions less than 16 feet in height. Wallboard must be applied vertically to walls. Joints on opposite sides of the same wall or partition must occur on different studs. Boards must be installed in moderate contact, not forced in place.
- E. In two-ply gypsum board construction, apply the base ply perpendicular to framing members and the face ply parallel to framing members. Laminate face-ply to base-ply with adhesive or all-purpose compound. Fasten with a sufficient number of screws to hold the board in place until the laminating adhesive or compound has set, but not less than 12-inch spacing on ceilings and 16-inch spacing on walls. Joints in the face ply must be offset from joints in the base ply by not less than 16 inches.
- F. Provide metal corner bead at all vertical and horizontal external corners and angles. Provide metal edge trim at all junctions of gypsum wallboard and walls of other materials or where there are exposed edges.
- G. At acoustical or sound walls, penetrations of walls must have a minimum clearance of 1/4 inch along their perimeters at wallboard, which must be filled with sealant. Fill all voids completely with sealant. Install wallboard 1/4 inch to 3/8 inch above floor and fill resultant space with sealant. Achieve maximum sound insulation through careful installation work in jointing, sealing, taping, and staggering of joints.
- H. Gypsum wallboard surfaces must have a maximum variation of 1/8 inch in eight feet when a straightedge is laid on the surface in any direction.

3.02 TAPING AND FINISHING

- A. Tape and finish all joints, corners, metal accessories, screw heads, damaged or abraded surfaces, and cutouts for the work of other trades in accordance with ASTM C840 and the drywall materials manufacturer's instructions and recommendations.
- B. Joints, wall and ceiling angles, and inside vertical corners must be reinforced with tape embedded in taping compound and finished with not less than two applications of finishing compound, allowing each application to dry thoroughly and sanding between coats as required. Dimples at screws heads and other imperfections must be similarly treated.
- C. External corners, edges, and ends with metal beads and edge trim must have the flanges completely spackled and feathered off smooth from the nose.
- D. Final application of finishing compound and sanding must leave gypsum wallboard surfaces uniformly smooth and in proper condition to receive a painted finish.
- E. Type X gypsum backing board must be fire-taped as required.

END OF SECTION 09 29 00

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SECTION 09 30 00

TILING

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes requirements for:
 - 1. Tile
 - 2. Setting bed and adhesive
 - 3. Grout
 - 4. Reinforcement
 - 5. Cleavage membrane
 - 6. Anti-fracture membrane
 - 7. Sealant
 - 8. Cementitious backer board
 - 9. Cementitious backer board accessories

1.02 RELATED SECTIONS

- A. Section 09 28 13, Cementitious Backing Board
- B. Section 10 28 00, Janitorial Accessories

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI):
 - 1. ANSI A108.1 Installation of Ceramic Tile with Portland Cement Mortar
 - 2. ANSI A108.4 Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive
 - 3. ANSI A108.5 Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
 - 4. ANSI A108.6 Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy
 - 5. ANSI A108.10 Installation of Grout in Tilework
 - 6. ANSI A108.11 Interior Installation of Cementitious Backer Units
 - 7. ANSI A118.1 Specifications for Dry-Set Portland Cement Mortar
 - 8. ANSI A118.3 Specifications for Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive
 - 9. ANSI A118.4 Specifications for Latex-Portland Cement Mortar
 - 10. ANSI A118.6 Specifications for Ceramic Tile Grouts
 - 11. ANSI 118.9 Cementitious Backer Units
 - 12. ANSI 118.10 Waterproof Membranes for Thinset Tile and Stone
 - 13. ANSI A136.1 Organic Adhesives for Installation of Ceramic Tile
 - 14. ANSI A137.1 Ceramic Tile
- B. ASTM International (ASTM):

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1. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes
2. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
3. ASTM C150 Standard Specification for Portland Cement
4. ASTM C482 Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement
5. ASTM C627 Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
6. ASTM C920 Standard Specification for Elastomeric Joint Sealants
7. ASTM C1325 Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Interior Substrate Sheets
8. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
9. ASTM D2178 Standard Specification for Asphalt Glass Used in Roofing and Waterproofing

C. Tile Council of North America (TCNA):

1. TCNA Handbook for Ceramic, Glass, and Stone Tile Installation

1.04 SUBMITTALS

- A. General:
- B. Shop Drawings: Submit fully detailed Shop Drawings, showing tile layouts, dimensions, bedding and joint details, and connections to adjoining work.
- C. Product Data: Submit manufacturer's specifications, catalog cuts, color range of tile, data sheets, installation instructions, and maintenance instructions. Include certifications and other data to show compliance with Contract requirements.
- D. Samples: Submit samples of each type, class, finish, and color of tile and grout, not less than 12 inches square, on plywood backing, with grouted joints as indicated. Include at least one complete grouted tile intersection. Samples shall show full range of color and texture. Samples shall match the Architect's control samples. Samples require approval of the Architect before they may be used in the work.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Tiling shall be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Tiling shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Tiling complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA, and no additional compensation will be allowed therefore.

1.06 QUALITY ASSURANCE

- A. Master Grade Certificates: Furnish a Master Grade Certificate as specified in ANSI A137.1 for each type of tile, signed by the manufacturer and the Trade Subcontractor, certifying to the grade, type and quantity of tile, together with satisfactory information for identification of the containers to which they apply.

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- B. Control Samples: Tile shall match the Architect's control samples in all respects. Control samples require the Architect's approval before they may be used as a standard.
- C. Single Source Responsibility: Obtain each material required for any one type and color of tilework from a single source to minimize variations in appearance and quality.
- D. Installation Standards: Comply with TCNA Handbook for Ceramic, Glass, and Stone Tile Installation and the herein referenced standards for all tile installations.

1.07 PRODUCT DELIVERY AND STORAGE

- A. Deliver materials, other than bulk materials, in manufacturer's unopened containers, fully identified with name, brand, type, grade, class, size, color, and pattern. Store materials above ground and protect from weather and damage. Store in accordance with the respective manufacturer's instructions.

1.08 JOB CONDITIONS

- A. Examine substrates and adjoining construction, and the conditions under which tilework is to be installed. Do not proceed with tilework until conditions detrimental to the proper and timely completion of this work have been corrected.
- B. Allowable Variations in Substrate Levels:
 - 1. For Full Mortar Setting Bed Floors: plus or minus 1/4 inch in ten feet in any direction and 3/8 inch total maximum variation from levels indicated.
 - 2. For Full Mortar Setting Bed Walls: plus or minus 1/8 inch in 8 feet in any direction and 1/4 inch total maximum variation from indicated planes.
 - 3. For Thin-Set Tilework: Substrate shall conform to the allowable variations in finished work as specified in Article entitled "Installation Standards" herein. Where floor drains occur, substrate shall have minimum slope of 1/8 inch per foot to drain.
- C. Set tile and grout tile joints when ambient temperature is above 50 degrees F. Do not set or grout tile when ambient temperature is above 90 degrees F.

1.09 MAINTENANCE MATERIALS

- A. Upon completion of the Work, deliver to the Owner an additional two percent of total of each tile size, pattern, and color used on the job, for use in future repair and maintenance work. Furnish boxes of whole tiles, sealed and properly identified. Include trim shapes.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Crossville 8-inch by 8-inch CS-Cross-Slate field tile (A825/.10808CS) Porcelain stone, Color: Cove base 6-inch by 8-inch, (A825/.10608CBS), Cove base Corner right, Cove base Corner left, and inside Cove base Corner Pieces porcelain stone trim, Color: Cross-Colors Mingles Mercury as manufactured by Crossville. Provide basis of design product, or approved equal.
 - 1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used

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to the exclusion of equivalent products of other manufacturers. Equivalent products shall meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.

2. Crossville, Inc., 349 Sweeney Drive, Crossville, TN 38555, Phone: (931)-484-2110. Website: crossvilleinc.com.

2.02 MATERIALS

- A. Tile: ANSI A137.1, Standard grade. Tile types, sizes, colors, and finishes shall be as indicated.
 1. Porcelain stone Wall Tile, Floor Tile, Base Tile, and Trim pieces: Machine-made natural clay-type ceramic wall tile of sizes, thickness, colors, and textures indicated, matching the Architect's control samples for the location.
 - a. Crossville square tile, Color: Cross-Colors Mingles Mercury, 8-inches by 8-inches, for floor, and wall.
 - 1) Cove Base: 6-inches by 8-inches, Color: Cross-Colors Mingles Mercury.
 2. Trim: Include matching stops, returns, trimmers, caps, and special shapes required to produce complete, neatly finished installation. Provide cove base at intersection of floors and walls. Color: Cross-Colors Mingles Mercury.
- B. Setting Bed and Adhesive Materials:
 1. Full-Thick Portland Cement Mortar Setting Bed:
 - a. Portland Cement: ASTM C150, Type I.
 - b. Lime: ASTM C207, Type S.
 - c. Sand: ASTM C144.
 - d. Water: Clean and potable.
 - e. Proportions: In accordance with ANSI A108.1.
 - f. Bond Coat: ANSI A118.1 dry-set portland cement mortar or ANSI A118.4 latex portland cement mortar skim coat.
 2. Thinset, Dry-Set Portland Cement Mortar: ANSI A118.1.
 3. Thinset, Latex-Portland Cement Mortar: ANSI A118.4.
 4. Epoxy Adhesive: ANSI A118.3.
 5. Water-Resistant Organic Adhesive: ANSIA136.1. Water-resistant organic adhesive only shall be used for the application of wall tile over Water-resistant gypsum board backing surfaces.
- C. Grout: ANSI A118.6, color Ardex Silver Shimmer-19. If indicated colors are not available from manufacturer's standard colors, custom colors shall be provided. If colors are not indicated, colors shall be as selected by the Architect from manufacturer's standard colors.
- D. Reinforcement: 2-inch by 2-inch mesh, 16 gage galvanized steel wire fabric.
- E. Cleavage Membrane: ASTM D2178, asphalt-impregnated glass felt, Type III - standard ply sheet, with overlap of 4 inches minimum.
- F. Anti-Fracture Membrane: 40 mil (1mm) thick reinforced peel-and-stick sheet membrane specifically designed to use under ceramic tile, porcelain, and natural stone as a stress relieving material in conjunction with thin-set methods. Membrane shall have the flexibility and strength to

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withstand structural and natural concrete shrinkage cracks up to 1/4-inch (6.4 mm) without transferring the stress load to the finished tile topping. Anti-fracture membrane shall consist of fabric reinforcement laminated to a tacky aggressive adhesive membrane on the bottom providing for superior adhesion to concrete substrates. Top fabric shall provide a bonding surface for latex modified thinset mortars and thinset tile adhesives. Provide accessory materials as required and recommended by the membrane manufacturer for a complete installation. Provide materials in compliance with ANSI 118.10, ASTM C482, ASTM C627, and ASTM D412.

- G. Sealant: Mildew-resistant urethane or silicone sealant conforming with applicable requirements of ASTM C920. Provide Grade P for joints in horizontal surfaces and Grade NS for joints in vertical surfaces. Provide for M and G uses. Sealant may be Type S or Type M as appropriate. Color shall match color of grouted joints. Include proper backer rod where indicated or required.
- H. Cementitious Backer Board: ASTM C1325 or ANSI A118.9 for use as backing for tile.
- I. Cementitious Backer Board Accessories:
 - 1. Two-inch wide glass fiber mesh tape for use over cementitious backer board in ceramic tile installation.
 - 2. Fasteners shall be non-corrosive and non-oxidizing.

PART 3 – EXECUTION

3.01 EXAMINATION OF SUBSTRATE SURFACES

- A. Examine subfloor and substrate surfaces to receive tile. Subfloor and substrate surfaces shall be firm, dry, clean, and free from defects or irregularities that may impair bond or jeopardize the quality of the work, and no tile work shall be performed over affected areas until suitable corrections have been made.
- B. Verify that work of other trades, in or behind the tile, is installed before proceeding with tile work.
- C. Confirm that metal stud spacing and gage comply with ceramic tile installation requirements.

3.02 PREPARATION

- A. Etch concrete and concrete block substrate with ten percent solution of muriatic acid as required to remove curing compounds or other substances that may interfere with proper bond of specified mortar for tile. Rinse clean with water to remove traces of acid.
- B. Seal around all openings in floors and walls, at junctions of floors and walls, and in corners and joints with sealant before installing tile.
- C. Install cementitious backer board in accordance with ANSI 108.11. Space horizontal and vertical joints and corners 1/8 inch and fill solid with dry-set or latex-portland cement mortar. Maximum variation in backing surface shall be 1/4 inch in 10 feet. Cementitious backer board shall be taped and finished smooth using glass fiber mesh tape embedded in a skim coat of mortar over joints and corners. Where waterproof membrane occurs, coordinate installation of cementitious backer board and waterproof membrane.

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3.03 FIELD QUALITY CONTROL

- A. Comply with the TCNA Handbook for Ceramic, Glass, and Stone Tile Installation methods specified in the Contract Specifications.
- B. Comply also with ANSI A108.1, A108.4, A108.5, A108.6, and A108.10 as applicable for the indicated installation.
- C. Comply with manufacturer's instructions and recommendations for special requirements not covered by referenced standards.

3.04 INSTALLATION

- A. Lay out tilework in patterns indicated using field tile and trim shapes as indicated or required. Center tile fields in both directions in each space or on each wall area, and adjust to minimize tile cutting. Provide uniform joint widths of 1/16 inch, unless otherwise indicated.
- B. Cut field tile, not trim shapes, unless otherwise indicated.
 - 1. Avoid cutting tile but, if necessary, use a power-operated abrasive saw. Finish cut edges of tile with a carborundum stone to match the uncut edges.
 - 2. Tiles which are cut to permit the passage of another element through the finished surface are to fit it neatly around such penetration, not less than 3/8 inch nor more than 1/2 inch from such penetration. Make templates as required. Use power operated wetsaws, bandsaws, and core drills as required.
- C. Tile floors shall be in true planes, sloped a minimum of 1/8 inch per foot to floor drains. Waves or depressions in floors will not be accepted. Tile walls shall be in true planes, plumb and level. Tile joints in floors and walls shall line up. Tileout of line or out of plane will not be accepted.
- D. Extend tilework into recesses and under equipment and fixtures in the spaces indicated or scheduled to receive tile. Form a complete covering without interruptions. Terminate work neatly at obstructions, edges, and corners, without disruption of pattern or joint alignments.
- E. Provide expansion joints in tilework where indicated. Provide sealant and backer rod as required. Joints shall coincide with building expansion joints where they occur, and shall penetrate the tile setting bed completely.
- F. Install cleavage membrane over concrete or masonry surfaces where indicated or required in compliance with membrane manufacturer's recommendations.
- G. Install anti-fracture membrane over concrete or masonry surfaces where indicated or required in compliance with membrane manufacturer's recommendations.
- H. Install metal reinforcement in full-thick mortar setting bed for floor tile where indicated or required.

3.05 FIELD QUALITY CONTROL

- A. Comply with applicable requirements of ANSI A108.10. Force a maximum of grout into all joints. Grouted joints shall be full and integral with setting bed. Before grout sets, strike or tool the joints of

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cushion-edge tile to depth of cushion, filling all gaps or skips, and with square-edge tile, fill joints flush with their surface, tooling joints smooth and dense.

- B. The finished work shall not exceed the following deviations from level and plumb, and from elevations, locations, slopes, and alignments indicated:
1. Floors: 1/8 inch in 8 feet in any direction; plus or minus 1/8 inch at any location; 1/32 inch offset at any location.
 2. Walls: 1/8 inch in 8 feet in any direction; plus or minus 1/8 inch at any location; 1/32 inch offset at any location.
 3. Joints: Nominal 1/16-inch standard joint width, plus or minus 1/32-inch variation at any location; 1/16 inch in 8 feet for deviation from the plumb, and for other variations in alignment of joints.
- C. Provide quality control checks of completed tilework by tapping (or sounding) tile surfaces with a soft wood or rubber mallet to detect individual tiles which are not properly bedded or bonded.

3.06 CLEANING

- A. After grout has set, sponge and wash tiles thoroughly and then polish with clean, dry cloths. Use no acids or abrasive soaps on tile, except as approved by the tile manufacturer. Tile having stains or discoloration that are not removable with soap and clean water shall be replaced.
- B. In addition to the initial cleaning procedure required, and not more than two days before final acceptance of this work, provide a final cleaning and polishing of ceramic tilework as recommended by the tile manufacturer.

3.07 PROTECTION OF COMPLETED WORK

- A. Close spaces in which tile is being set to traffic and other work; keep closed until firmly set. Protect from damage until Contract acceptance by the Owner. Before traffic is permitted on tile floors, cover floors with nonstaining building paper. Lay board walkways on floors that are to be used as passageways by workers. Remove cracked, broken or damaged tile; replace with new tile.

END OF SECTION 09 30 00

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SECTION 09 61 36

STATIC RESISTANT FLOORING TREATMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes requirements for:
1. Static Dissipative floor coating system for interior concrete slabs.

1.02 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete

1.03 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI):
1. ANSI-ESD STM7.1-2013 ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items – Floor Materials – Resistive Characterization of Materials
 2. ANSI/ESD S20.20 – 2014 Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
 3. ANSI/ESD STM97.2 Floor Materials and Footwear – Voltage Measurement in Combination with a Person
 4. ANSI/ESD TR53-01-15 ESD Association Technical Report for the Protection of Electrostatic Discharge Susceptible Items – Compliance Verification of ESD Protective Equipment and Materials
- B. ASTM International (ASTM):
1. ASTM D968 Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
 2. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

1.04 SUBMITTALS

- A. General
1. Submittals for Static resistant Flooring Treatment must be made in accordance with the provisions in these technical specifications.
 2. Product Data: Submit manufacturer's product data including physical properties, electrical properties and application instructions.

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1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Static Resistant Flooring Treatment must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Static Resistant Flooring Treatment must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Static Resistant Flooring Treatment complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Applicators Qualifications: Ensure applicators qualifications by one of the following:
 - 1. Use applicator experienced in application of similar materials for a minimum of five years on projects of similar size and complexity. Submit list of completed projects including project name and location, name of Architect, name of material manufacturer and approximate quantity of materials applied.
 - 2. Submit letter of approval from manufacturer stating applicator is qualified to apply the specified materials.
- B. Applicators Personnel: Employ persons trained for application of specific materials.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging with labels clearly identifying product name, manufacturer, batch or dye lot numbers and SDS sheets.
- B. Storage: Store materials in accordance with manufacturer's instructions. Keep containers sealed until ready for use.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.08 ENVIRONMENTAL CONDITIONS

- A. Ensure environment is fully enclosed; weather tight, well lighted and air temperatures at time of installation are between 60 and 80 degrees F.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Heavy Duty Static Control Topical Concrete Sealant with ESD Floor Finish.
 - 1. Electrical Resistance per ANSI-ESD STM7.1-2013, >1.0E04, <1.0E09.
 - 2. Color: Translucent.

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2.02 MANUFACTURER

- A. Basis of Design: System must be ElectraSeal Anti Static ESD Concrete Floor Sealer and ElectraGlaze top coat as manufactured by United SCP Incorporated, 4301 32nd Street West, Ste. B-20, Brandon, FL 34205. Phone (719) 676-3928, or VTA approved equal.
1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrate to receive static control coating system. Notify Engineer if substrate is unacceptable. Do not begin preparation or application until conditions are acceptable.
- B. Pre-application Product Testing: Mask off a 36-inch by 36-inch test area. Apply two thin coats of. Follow with one thin top coat. Allow the coating(s) to cure for at least 24 hours. Pre-test material bond strength to substrate per manufacturers product instructions. Test Electrical conductivity to ANSI-ESD STM7.1-2013 - Point to Point Electrical Resistance, flooring. Contact manufacturer should results exceed >1.0E09.
- C. Test vapor emission of concrete slab per calcium chloride test method ASTM F-1869. Should concrete vapor emissions results exceed 9 lbs. per 1,000 SF/24 hour period contact United SCP prior to proceeding with installation.
- D. Ensure new concrete has the following properties:
1. Maximum water/cement ratio of 0.45.
 2. Cured 60 days at a minimum of 60 degrees F.
 3. Minimum compressive strength of 3,500 PSI.
 4. Minimum tensile strength of 200 PSI.

3.02 SURFACE PREPARATION

- A. Prepare substrates in accordance with manufacturer's instructions.
- B. Ensure substrate is clean, free of dirt, oil, grease, wax and other compounds which may inhibit bonding of flooring treatment to substrate.
- C. Repair cracked and eroded concrete in accordance with manufacturer's instructions. Remove and repair unsound substrates.

3.03 APPLICATION

- A. Mask all encumbrances such as existing wall base and columns prior to application of coatings in accordance with manufacturer's instructions.

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- B. Install electrical grounding foil in accordance with manufacturer's recommended grounding methods. Use one strap per each 2,000 square feet of flooring material.
- C. Ensure that concrete or other substrate is visibly dry.
- D. Do not add thinners to any component of the conductive floor coating system.
- E. Apply 1st coat to prepared concrete per manufacturers recommended guidelines. Do not over apply - apply a thin even coat. Allow to cure for at least 1 hour prior to proceeding.
- F. Apply 2nd coat per manufacturers recommended guidelines. Do not over apply - apply a thin even coat. Allow to cure at least 1 hour prior to proceeding.
- G. Apply one thin top coat per manufacturer's instructions. Allow coatings 1 hour to dry before subjecting to foot traffic and 24 hours prior to subjecting to moderate forklift traffic.

3.04 TESTING

- A. Allow the coated floor to cure 7 to 10 days and test the flooring to compliance with ANSI/ESD S20.20-2014 per test method ANSI-ESD STM7.1-2013 (electrical resistance point to point and electrical resistance to ground).

3.05 PROTECTION

- A. Protect floor coating system while curing (minimum 48 hours) and especially during move in of heavy equipment.

END OF SECTION 09 61 36

SECTION 09 67 70

ELEVATOR SPRAY-ON FLOORING

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes requirements for:
1. Spray floor system requirements
 2. Spray application
 3. Performance characteristics
 4. Installation procedures

1.02 RELATED SECTIONS

- A. Section 14 24 00, Hydraulic Elevators

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
1. ASTM D4541 Standard Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion Testers
 2. ASTM D412 Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomer
 3. ASTM D2240 Standard Test Method for Shore D Hardness
 4. ASTM E84 Standard Test method for Surface Burning Characteristics of Building Materials

1.04 SUBMITTALS

- A. General
1. Submittals for Elevator Spray-on Flooring must be made in accordance with the provisions in these technical specifications.
 2. Product Data: Submit manufacturer's product data including a list of the materials used, physical properties, and application instructions. Submit the corresponding Material Safety Data Sheets (MSDS) for the various compounds to be used, including solvents, primer coat, membrane coat, top coat, accent speckles, and non- skid sealer.
 3. Contractor must submit color swatches for approval. Color: slate gray.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Elevator Spray-On Flooring must be measured by the square foot.

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- B. Payment: The contract price paid per square foot for Elevator Spray-On Flooring must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Elevator Spray-On Flooring complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. The Contractor must keep adequate and current production records including information relating to the control consistency and quality of the spray coat flooring material.
- B. The intended minimum service life for the installed spray coated floor is expected to be 10 years. Contractor must warranty the new floor from defects in material quality and craftsmanship for 3 years after the date of installation.
- C. The Contractor must keep records of the work done; records shall document elevator number, production number, date of production, temperature of the spray, pressure, quantity of spray used, and any information pertinent to the Work performed.
- D. Installer must be experienced in the application of polyurea spray and have a minimum of 50,000 gallons of spray application experience in high profile public access areas and shall be certified by the manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging with labels clearly identifying product name, manufacturer, batch or dye lot numbers and SDS sheets.
- B. Storage: Store materials in accordance with manufacturer's instructions. Keep containers sealed until ready for use.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.08 SITE CONDITIONS

- A. The substrate to receive application work shall be clean and dry of any moisture and contaminants that could affect the performance of the flooring material.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: System must be Precidium 550D Polyurea as manufactured by Quantum Chemical, 15 Riel Drive, St. Albert, Canada T8N 3Z2. Phone (780) 458-3355, Email: www.quantumchemical.com, or VTA approved equal.
1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.

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2.02 PRODUCT REQUIREMENTS

- A. Spray-on Flooring: Precidium 550D-FR, or VTA approved equal, high performance, polyuria elastomer, two-part compound mixed in a 1 to 1 ratio resin under conditions specified by the manufacturer, Quantum Technical Services Ltd. (Quantum) and with the specialized equipment and controls, specified by the manufacturer. Product must be applied as a spray to a properly prepared surface. Product must have the following performance characteristics:
 - 1. Flame resistance meeting ASTM E84
 - 2. Zero Volatile Organic Compound (VOC)
 - 3. 24 hour curing time
- B. Primer: compatible product as recommended by manufacturer
- C. Sealer: compatible product as recommended by manufacturer
- D. Final finish on floor must have no less than a 0.6 coefficient of friction for both wet and dry conditions.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The installer must be certified by the manufacturer and use the best practices, methods and techniques and the appropriate equipment in the performance of the Work.
- B. The installer must be responsible for the safety of its working crew, and shall provide its personnel safety protection equipment as required by the federal, state, and local regulatory agencies.
- C. The spray coat flooring material application must be performed in a safe manner and shall be in compliance with the environmental, federal, state and local agency safety regulations.
- D. The sprayed-on material must be built up to achieve flush transition with the elevator cab sill.
- E. Apply primer coat 3 mils thick over flooring substrate in accordance with the manufacturer's details.
- F. Apply spray-on flooring to a total thickness of 80 to 100 mils. Hot plural spray applied only. Maintain an even distance from surface providing a uniform application with an overlap from one pass to the next.
- G. Top coat must be applied to a thickness of 6 to 8 mils.
- H. Multicolor accent details must be applied to a thickness of 6 to 8 mils.
- I. Apply sealer 100 grit no longer than 6 hours after installation at manufacturer's recommended coverage rates of 5 to 9 mils. If longer than 6 hours, refer to manufacturer's recoat instructions.

3.02 SURFACE PREPARATION

- A. Prepare substrates in accordance with manufacturer's instructions.

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- B. Ensure substrate is clean, free of dirt, oil, grease, wax and other compounds which may inhibit bonding of flooring treatment to substrate.

- C. Contractor must be fully responsible for the controlling of over-spray and work environment during the application. Follow manufacturer's recommendations for field spray applied finishes. Protect adjacent surfaces and in-place construction during field applied spray application. Contractor must control over-spray and protect adjacent properties including buildings, structures, vehicles, and landscape furnishings during application in the field.

3.03 PROTECTION

- A. Protect floor coating system while curing (minimum 48 hours) and especially during move in of heavy equipment.

END OF SECTION 09 67 70

SECTION 09 91 00

PAINTING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and applying factory and field finish painting work as indicated.
- B. The work includes the painting and finishing of exposed items and surfaces throughout the Contract including but not limited to; steel components of the pedestrian overcrossing, metal railings, fences, gates, guardrails, and handrails except as otherwise indicated. Surface preparation, priming, and coats of paint specified are in addition to shop priming and surface treatment specified under other sections of these technical specifications.
- C. The term "paint" as used herein means all coating systems materials, and includes primers, emulsions, acrylics, enamels, stain, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.
- D. Paint exposed surfaces whether or not colors are designated in any Schedule, except where the natural finish of the material is specifically indicated as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas.
- E. The paint systems specified list the basic painting systems. Deviations within the system, such as the use of two finish coats instead of undercoat and finish, will be permitted only where such procedure is recommended by the paint manufacturer and approved by VTA.
- F. All painting specified herein, whether shop applied or field applied, must be spray applied unless otherwise approved in writing by VTA.

1.02 RELATED SECTIONS

- A. Section 05 12 35, Structural Steel
- B. Section 05 17 00, Miscellaneous Metal

1.03 WORK NOT INCLUDED

- A. The following categories of work are not included as part of the field-applied finish work, or are included in other sections of these technical specifications:
 - 1. Shop-fabricated or factory- built mechanical and electrical equipment or accessories, are not included in these specifications.
 - 2. Pre-Finished items: Field finish does not include painting when factory-finishing is specified for items such as finished mechanical and electrical equipment, including light fixtures and distribution cabinets. Field touch-up is required, however, in all cases when the factory finish is damaged.
 - 3. Finished Metal Surfaces: Anodized aluminum, stainless steel, and similar finished materials will not require finish painting unless otherwise indicated or scheduled.

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4. Operating Parts and Labels:
 - a. Moving parts or operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, and motor and fan shafts will not require finish painting unless otherwise indicated.
 - b. Do not paint over code-required labels, such as UL and FM, or equipment identification, performance rating, name, or nomenclature plates.

1.04 REFERENCED STANDARDS

A. ASTM International (ASTM):

1. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
2. ASTM D4258 Standard Practice for Surface Cleaning Concrete for Coating
3. ASTM D4259 Standard Practice for Abrading Concrete
4. ASTM D4262 Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
5. ASTM D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

B. Steel Structures Painting Council (SSPC):

1. PA1 Shop, Field, and Maintenance Painting
2. Paint 23 Latex Primers for Steel Surfaces
3. Paint 24 Latex Semi-Gloss Exterior Topcoats
4. PS 18.01 Three-Coat Latex Painting System
5. SP 1 Solvent Cleaning
6. SP 2 Hand Tool Cleaning
7. SP 3 Power Tool Cleaning
8. SP 6 Commercial Blasts Cleaning

1.05 SUBMITTALS

A. General

1. Submittals for Painting must be made in accordance with the provisions in these technical specifications.
2. The Contractor must submit the following:
 - a. Schedules: Submit a list of paint materials proposed for use, identifying each material by manufacturer's name, product name and number, including primers, thinners, and coloring agents, together with the manufacturer's catalog data fully describing each material as to contents, recommended usage, and preparation and application methods. Identify surfaces to receive each paint material. Deviations from the approved schedule will not be accepted.
 - b. Color and Gloss Samples:
 - 1) Using materials conforming to the requirements of the Contract Documents prepare and submit 9 inch x 12 inch samples of each color and paint finish.
 - 2) For paint systems to be applied on concrete and masonry, provide 4 inch x 4 inch samples of masonry for each type of finish and color, defining filler, prime and finish coats.
 - c. Site Sample Panels: Fully paint, stain or otherwise finish 1 complete surface area on the Project, for each finish material and color scheme called for in the Contract

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Documents, and obtain the approval of VTA, for conformance to the color and finish. All subsequent work on the Project must be of the same or higher standard of quality as the approved area.

3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.06 MEASUREMENT AND PAYMENT

- A. Measurement: Painting must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Painting must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Painting complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.
- C. Refer to Section 05 12 35, Structural Steel for Measurement and Payment for cleaning and painting of structural steel.
- D. Refer to Section 05 17 00, Miscellaneous Metal for measurement and payment for cleaning and painting of structural steel.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint materials to the Worksite in their original, unopened containers bearing the following information: manufacturer and material, stock number and date of manufacture, contents by volume for major pigments and vehicle constituents, thinning and application instructions, color name and number. Materials which are potentially hazardous to human life must be noticeably labeled, identifying the potential hazard and emergency treatment procedures.
- B. Store paint materials and equipment in a separate enclosed facility provided specifically for such storage. The storage facility must conform to requirements of applicable jurisdictional agencies. Do not store materials or equipment in any portion of any buildings or enclosures being constructed as a part of the work of this Project. Storage environment must comply with manufacturer's specifications.
- C. Perform allowable field mixing, cleaning of painting equipment, and other related work in the separate paint storage facility.

1.08 PROJECT CONDITIONS

- A. Contractor must comply with manufacturer's recommendations for environmental conditions under which paint and paint systems must be applied. Paint products must not be applied while the surface to receive the material is subject to rain, fog, mist or extreme humidity, or surface temperatures less than recommended by manufacturer. Ensure proper ventilation during interior painting operations.
- B. Remove from the Worksite daily empty containers, rags, and other debris of the Work of this Section.

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- C. Contractor must be fully responsible for the controlling of over-spray and work environment during the application of all field applied paints. Follow manufacturer's recommendations for field spray applied finishes. Protect adjacent surfaces and in-place construction during field applied spray painting. Do not spray-apply paint in moderate or high wind conditions. Contractor must control over-spray and protect adjacent properties including buildings, structures, vehicles, and landscape furnishings while applying paint in the field.

1.09 QUALITY ASSURANCE

- A. Regulatory Requirements: Paint products and solvents shall comply with the latest regulations of the Bay Area Air Quality Management District regarding regulations governing permissible content of volatile organic compounds (VOC).
- B. Quality Standards:
1. Preparation and painting work shall conform to the recommended practices and quality standards of the "Painting and Decorating Craftsman's Manual and Textbook," latest edition, published by the Painting and Decorating Contractors of America.
 2. Preparation and painting of steel surfaces shall conform to the quality standards of the SSPC Steel Structures Painting Manual, Volume 2.
 3. Paints, enamels, stains, lacquers, and varnishes shall be applied in accordance with the manufacturers' latest specifications, instructions, and recommendations.
- C. Paint Coordination:
1. Coordinate and interface the work of this Section with the various Sections specifying factory-applied finishes.
 2. Coordinate the work of this Section with the work specified under Mechanical and Electrical, for color-coding and painting of mechanical and electrical equipment, piping, conduit, ducts, and panels.
 3. Provide finish coats that are fully compatible with the prime paints used. Field-applied primers shall be supplied by the same manufacturer as the intermediate (if any) and finish coats used. Review other Sections of these Specifications in which prime paints are specified to ensure compatibility of the coating system for each of the various substrates. Provide barrier coats over incompatible primers or remove and reprime as required.
- D. Paint Manufacturer's Review: Before purchasing paint materials, review the proposed paint systems, materials, and substrates with qualified representatives of the proposed paint products manufacturer. Obtain manufacturer's concurrence of the proposed paint systems, or any recommended changes thereto, before providing product data, samples, and mock-ups as specified herein.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Provide undercoat paint produced by the same manufacturer as the finish coats. Use thinners approved by the paint manufacturer, and use only to recommended limits.
- B. Use primers and undercoaters that are suitable for each surface to be covered and that are compatible with the finish coat required.

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- C. Use products of the same manufacturer for succeeding coats where shop primed materials are to be finish painted and prime coat materials are by a different manufacturer than the finish coat materials. Confirm compatibility of the primers with the manufacturer of the finish coat paints.
- D. Materials necessary to complete the painting are herein specified and generically listed. Except for specialty items or as otherwise specified, materials for any one system must be by one manufacturer.
- E. Materials for undercoats and finish coats of paint must be ready-mixed and must not be changed, except for thinning of undercoats (when required), reinforcing or coloring, any of which must be in accordance with the recommendations of the manufacturer.
- F. Minimum dry film thicknesses (MDFT), in mils, and the number of coats required to obtain that thickness must be in conformance with the recommendations of the paint manufacturer of each system.
 - 1. Equivalent materials from the architectural product line of other manufacturers will be acceptable, subject to approval of VTA.

2.02 COLORS AND FINISHES

- A. Use representative colors when preparing samples for review by VTA. Final acceptance of colors will be from samples applied on the job.
- B. Color Pigments: Pure, non-fading, applicable types to suit the substrates and service indicated.
- C. Color Mixing: To the maximum extent possible, mixing of paint materials to obtain the required color, finish and consistency must be done by the manufacturer of the paint materials.

PART 3 – EXECUTION

3.01 CONDITION OF SUBSTRATE

- A. Examine the areas and conditions under which painting work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film
- C. Application of first coat of finish must constitute acceptance of surface conditions and responsibility for ultimate finish.

3.02 SURFACE PREPARATION

- A. General: Prepare and clean substrates in accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.
 - 1. Projections and irregular surfaces must be ground smooth or removed. Weld accumulations, spatter, and slag must be removed.
 - 2. Remove accessories, cover plates and similar items in place and not to be painted, or provide suitable protection from surface preparation and painting operations. Remove such items if necessary for the complete painting of the items and adjacent surfaces. Following

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completion of painting of each space or area, re-install the removed items using workers skilled in the trades involved.

3. Surfaces to be painted must be cleaned in accordance with SSPC SP 1 to remove all oil and grease before mechanical cleaning. Neutralize welds with a chemical solvent which is compatible with the specific painting system.
4. If mildew is present, remove mildew by washing and sterilizing the substrate as recommended by the coating manufacturer.
5. For metals or cementitious materials, clean and prepare substrates per manufacturer's recommendations for interior substrates of the appropriate composition.

B. Ferrous Metals:

1. Shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal items, hollow metal work, and similar items. Where primer finish is damaged during construction assembly, and other various sections do not address repair and touch-up, this section must apply.
2. Clean thoroughly, remove corrosive deposits and rust by scraping or other suitable means and allow to dry. Dust thoroughly to get surface clean. When corrosion is not severe, dull all glossy areas with sandpaper or a liquid deglossing compound. Wipe clean. Spot prime all bare ferrous metals with a rust inhibitive primer.
3. Mechanically clean and abrade all prepared surfaces in accordance with SSPC SP 6, Commercial Blast Cleaning. Hold-back areas on shop primed components must be cleaned in accordance with SSPC SP 6, SSPC SP 2, or SSPC SP 3 as applicable. Abrasive type and size must be selected to provide the required level of cleanliness while establishing a surface profile recommended by the paint manufacturer. Abrasive material must be new material, free of contaminants that would interfere with adhesion of the paint. Abraded surfaces must be vacuumed immediately before paint application to remove residual dust. All mechanically cleaned surfaces must receive a coating of paint within 8 hours or before flash rusting can occur. If flash rusting occurs, the surface must be re-cleaned before paint application.
4. Before applying succeeding coats, primers and undercoats must be integral and must perform the function for which they were specified. Properly prepare and touch-up scratches, abrasions, or other imperfections, and remove foreign matter before proceeding with the following coat.

C. Shop Primed Metals:

1. Before application of field coats on shop primed metal surfaces, remove oil, grease, welding flux residues, and other contaminants harmful to painting in accordance with SSPC SP 1. After solvent cleaning, prepare bare metal surfaces by removing stratified rust (rust scale), loose mill scale, loose or non-adherent rust, and detrimental welding deposits by methods specified in SSPC SP 3.
2. Touch-up primed metal surfaces using the same prime paint as originally applied or a prime paint determined to be compatible with existing coat and specified finish coats.

D. Galvanized Metals:

1. Repair damaged galvanized surfaces in accordance with ASTM A780.

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2. Clean unpainted galvanized steel surfaces of oil, grease, and other contaminants in accordance with SSPC SP 1, and paint in accordance with manufacturer's recommendations. Take particular care to prevent the contamination of the cleaned surfaces with salt, acids, alkali, or other corrosive chemicals before prime coating and between subsequent coats of paint.
3. Galvanized surfaces which have not been allowed to sufficiently weather may require surface roughening to provide adequate adhesion of the paint. Spot clean areas of rust in accordance with SSPC SP 2 or SSPC SP 3 as required.
4. Test galvanized surfaces for passivators or stabilizers. If passivators are found on the galvanized surface, remove all passivators per manufacturer recommendations and per procedures determined by the Steel Structures Painting Council. Repair damaged galvanizing prior to painting.

E. Concrete, Concrete Masonry and other Cementitious Materials:

1. Prepare cementitious surfaces of concrete, concrete block, and cement plaster to be painted by removing efflorescence, parting membrane, chalk, dust, dirt, grease, wax, and oils in accordance with ASTM D4258 and ASTM D4259.
2. Determine the moisture content of the surfaces to be painted by performing ASTM D4262 and ASTM D4263 tests respectively. If the surfaces do not meet the manufacturer's recommendations for these conditions, remedial action must be performed to correct this condition before application of paint. Do not paint over surfaces where moisture is present.
3. If mildew is present on surfaces to be painted, remove all mildew and sterilize surface per paint manufacturer recommendations prior to applying paint. Let surface dry thoroughly before painting.
4. Determine the alkalinity of the surfaces to be painted by performing appropriate tests. Use only a compatible coating for that alkalinity.

3.03 MATERIALS PREPARATION

- A. Prepare painting materials in accordance with the manufacturer's directions.
- B. Store materials not in actual use in tightly covered containers within the temperature range recommended by the manufacturer. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.
- C. Stir materials before application to produce mixture of uniform density, and as required during the application of the materials. Do not stir film which may form on the surface into the material. Remove the film and, if necessary, strain the material before using.
- D. Tint each undercoat a different shade to facilitate identification of each coat where multiple coats of the same material are to be applied. Provide a code number to identify material tinted by the manufacturer.

3.04 APPLICATION

- A. General:

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1. Apply paint in accordance with the manufacturer's instructions. Use applicators and techniques best suited for the substrate and type of material being applied. Use no brushes, rollers, carpet, velvet back, or high pile sheep's wool. Spray equipment must be as recommended by the paint manufacturer for the material and texture required.
2. Spread materials evenly and smoothly without runs, sags, or other defects. Make edges of paint adjoining other materials or colors sharp and clean, without overlapping. Allow sufficient time between coats to ensure proper drying.
3. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has dried sufficiently to meet the manufacturer's re-coat requirements. Sand between each enamel coat application with fine sandpaper or steel wool, or rub surfaces with pumice stone where required to produce an even, smooth surface in accordance with the coating manufacturer's instruction.
4. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color, and appearance. Ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a film thickness equivalent to that of flat surfaces.
5. Paint surfaces behind moveable equipment and furniture the same as similar exposed surfaces.
6. Paint the back sides of access panels, removable or hinged covers to match the exposed surfaces.

B. Mechanical and Electrical Work: Painting of mechanical and electrical work must be limited to those items designated in those appropriate specifications sections.

C. Dry Film Thickness:

1. Apply as many coats of paint as necessary to obtain the required minimum dry film thickness (MDFT) in conjunction with each paint system but not fewer than the number of coats recommended by the paint manufacturer to obtain that thickness.
2. Use the more stringent requirements where the paint manufacturer's instructions differ from these technical specifications.
3. The specified film thickness must be a minimum of the profile depth of the coating, when dry, as measured from the face of the surface to be coated.
4. Measure film thickness by non-destructive methods, in accordance with the manufacturer's recommendation:
 - a. Magnetic surface by use of Elcometer thickness gauge.
 - b. Nonmagnetic surfaces by a pit gauge or micrometer.
5. Final painted surface must provide a uniform finish and color after drying regardless of how many additional DFT mils are required, above and beyond the most stringent DFT required by this specification, to achieve the level of finish and color quality specified herein.

D. Scheduling Painting:

1. Apply the first coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
2. Allow sufficient time between successive coats to permit proper drying. Do not re-coat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and the application of another coat of paint does not cause lifting or loss of adhesion of

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the undercoat.

- E. Prime Coat: Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- F. Brush Application: No brush application must be accepted on this project without the prior written consent of VTA. If VTA permits brush applications, Contractor must brush out and work brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, wavy edges or other surface imperfections will not be acceptable. Neatly draw gloss and color break lines.
- G. Mechanical Applicators: Use mechanical methods for paint application unless specifically not permitted by governing ordinances.
- H. Completed Work: Match accepted sample for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.05 PAINT SYSTEM SCHEDULE

- A. The surfaces scheduled to receive paint or stain coatings must receive the paint systems indicated in the following schedule:
 - 1. Basis of Design: Sherwin Williams paint systems as manufactured by Sherwin Williams.
 - a. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 - 2. Exterior Surfaces (Field Applied):
 - a. Ferrous Metals: Manufacturer - Sherwin Williams
 - 1) Preparation: SSPC-SPC6 (Commercial Blast) with 2 mil angular profile
 - 2) First coat: Apply one coat Zinc Clad 4100 Organic Zinc Primer, 3-5 mils DFT
 - 3) Second coat: Apply one coat Macropoxy 646 Fast Cure, 5-10 mils DFT
 - 4) Finish Coat: Apply one coat Hi-Solids Polyurethane 250, 3-5 mils DFT
 - 5) Anti-Graffiti: Apply one coat 2K Waterbased Urethane Anti-Graffiti Coating, 2-4 mils DFT

Note: If Zinc primer is shop applied, field repairs can be done with Zinc Clad 4100, 3-5 mils DFT.
 - b. Galvanized Metals: Manufacturer - Sherwin Williams
 - 1) Preparation: SSPC-SPC16 (Brush-Off Blast) with 1 mil angular profile
 - 2) First coat: Apply one coat Macropoxy 646 Fast Cure, 4-6 mils DFT
 - 4) Finish Coat: Apply one coat Hi-Solids Polyurethane 250, 3-5 mils DFT
 - 5) Anti-Graffiti: Apply one coat 2K Waterbased Urethane Anti-Graffiti Coating, 2-4 mils DFT
 - c. Cementitious Surfaces: Refer to Drawings for extents of cementitious surfaces to receive paint coatings. Manufacturer's recommended DFT must take precedence only when it exceeds these minimum requirements. Manufacturer - Sherwin Williams

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- 1) First coat: Apply one coat Corobond 100, 4-6 mils DFT
 - 2) Second coat: 2K Waterbased Urethane Anti-Graffiti Coating, 2-4 mils DFT
 - 3) Finish Coat: 2K Waterbased Urethane Anti-Graffiti Coating, 2-4 mils DFT
3. Interior:
- a. Cementitious Surfaces: Refer to Drawings for extents of cementitious surfaces to receive paint coatings. Manufacturer's recommended DFT must take precedence only when it exceeds these minimum requirements. Manufacturer - Sherwin Williams
 - 1) First coat: Apply one coat Corobond 100, 4-6 mils DFT
 - 2) Second coat: 2K Waterbased Urethane Anti-Graffiti Coating, 2-4 mils DFT
 - 3) Finish Coat: 2K Waterbased Urethane Anti-Graffiti Coating, 2-4 mils DFT
 - b. Plaster, Gypsum Board, and Hardboard: Manufacturer's recommended DFT must take precedence only when it exceeds these minimum requirements.
 - 1) First coat: PrepaRite® ProBlock Primer, 1.4 mils DFT
 - 2) Second coat: Apply one coat Pro Industrial Catalyzed Waterbased Epoxy, 2-4.9 mils DFT
 - 3) Finish Coat: Apply one coat 2K Waterbased Urethane Anti-Graffiti Coating, 2-4 mils DFT
- B. Structural Paint System:
1. Exterior Surfaces (Shop Applied):
 - a. Ferrous Metals: Manufacturer - Sherwin Williams
 - 1) Preparation: SSPC-SPC6 (Commercial Blast) with 2 mil angular profile
 - 2) First coat: Apply one coat Zinc Clad 4100 Organic Zinc Primer, 3-5 mils DFT
 - 3) Second coat: Apply one coat Macropoxy 646 Fast Cure, 5-10 mils DFT
 - 4) Finish Coat: Apply one coat Hi-Solids Polyurethane 250, 3-5 mils DFT
 - 5) Anti-Graffiti: Apply one coat 2K Waterbased Urethane Anti-Graffiti Coating, 2-4 mils DFT

3.06 ADJUST AND CLEAN

- A. Touch up and restore finish where damaged. Touch up abraded, stained, or otherwise disfigured portion or refinish as necessary to produce an acceptable job.
- B. Remove spilled, splashed, or splattered paint from finish surface and floors not intended to be painted or previously painted.
- C. Do not mar surface finish of items being cleaned.
- D. Leave paint storage spaces clean and in condition required for equivalent spaces in the Contract.
- E. Barricades: Maintain barricades and wet paint signs for the duration of need.

3.07 FIELD QUALITY CONTROL

- A. VTA reserves the right to invoke the following testing procedure at any time, and any number of times during the period of painting.

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1. VTA will sample the paint being used. Samples of materials delivered to the site will be taken, identified, and sealed, and certified in the presence of Contractor.
 2. VTA will perform appropriate tests for the following characteristics in accordance with the specified manufacturer's standards: abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, re-coating, skinning, color retention, alkali resistance, and quantitative materials analysis.
 3. Contractor will allow VTA access to all areas for testing upon request in a timely manner.
- B. VTA will periodically examine the painted surface after each application, for visual acceptance of appearance of the paint finish. Painted surfaces showing signs of cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, wavy edges, or other surface imperfections will not be acceptable and Contractor must remove the paint finishes from the rejected surfaces and re-apply finishes until deemed acceptable by VTA, at no additional cost to VTA.

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SECTION 09 96 23

GRAFFITI RESISTANT COATINGS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing all labor, materials, equipment and services necessary for and incidental to satisfactory completion of high performance, two component, hydrophobic polyurethane anti-graffiti coatings and sacrificial film coatings for glazing. Anti-graffiti coatings must be applied to all exposed concrete, colored or painted concrete, stamped or formed; masonry walls, ceiling, and column surfaces; all metal shelter columns and surfaces, top rail of guardrails and handrails, fencing, and other exposed surfaces as specified or otherwise directed by VTA. Sacrificial film must be applied to all glazing.

1.02 RELATED SECTIONS

- A. Section 03 11 16 – Architectural Cast-in-Place Concrete Forming
- B. Section 03 35 00 – Concrete Finishing
- C. Section 08 80 00 – Glazing
- D. Section 09 91 00 – Painting
- E. Section 10 73 16 – Canopies

1.03 SUBMITTALS

- A. General
1. Submittals for architectural treatment must be made in accordance with the provisions in these technical specifications.
 2. The Contractor must submit the following:
 - a. Product Data: Submit product data files and manufacturer's preparation and installation instructions.
 - b. Samples: Provide nine square feet field sample of the specified treatment on prepared substrate or finishes as specified for VTA's observance prior to the start of work specified herein. Said samples must be furnished at no cost to VTA. Finished surfaces of the actual work must meet the standards of the acceptable samples.
 - c. Maintenance Materials: Contractor must purchase and provide to VTA, upon completion of the Work specified herein, proper quantities, but no less than 5 gallons or the equivalent thereof, of new unopened manufacturer recommended cleaning supplies for the purpose of maintaining the treated surfaces. Installer must also provide manuals and initial guidance for the maintenance requirements of the application.
 - d. Certificate: Submit certification that the applicator and his personnel is approved by the manufacturer as appropriately trained and experienced in the use and application of the products to be used as specified herein.

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- e. Warranty: Submit manufacturer's 10 year warranty to VTA per paragraph TBD.
- 3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.04 MEASUREMENT AND PAYMENT

- A. Measurement: Graffiti Resistant Coatings must be measured by the square foot.
- B. Payment: The contract price paid per square foot for Graffiti Resistant Coatings must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Graffiti Resistant Coatings complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.05 QUALITY CONTROL

- A. The application specified herein is a specially formulated clear, non-sacrificial, high performance, water-borne anti-graffiti coating with added chemical and abrasion resistance for painted surfaces, and extremely porous cementitious surfaces in areas susceptible to a high frequency of graffiti vandalism.
- B. Provide Manufacturer's ten year limited warranty to VTA. All anti-graffiti coating is to be done by manufacturer's certified applicator.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all required products in original, unbroken containers bearing labels which identify the container contents, manufacturer and storage instructions.
- B. If on-site, store specified materials in an enclosed, lockable, well ventilated room or space providing protection against contamination from the elements, and adjacent construction and other sources.

1.07 PROJECT CONDITIONS

- A. The Contractor must comply with manufacturer's recommendations for environmental conditions under which coating systems must be applied. Products must not be applied while the surface to receive the material is subject to rain, fog, mist or extreme humidity, or surface temperatures less than recommended by manufacturer.
- B. Remove from the job site daily empty containers, rags, and other debris of the work of this Section.

PART 2 – PRODUCTS

2.01 ANTI-GRAFFITI COATING

- A. Basis of Design: 2K WATERBASED URETHANE ANTI-GRAFFITI COATING as manufactured by Sherwin Williams, a clear, non-sacrificial, high performance, two component, hydrophobic polyurethane for painted surfaces, signs and extremely porous cementitious surfaces in areas susceptible to a high frequency of graffiti vandalism, or approved equal.

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1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 2. Vertical surfaces: Minimum ten (10) vertical feet from any walking or standing area beginning at base of vertical surface.
 3. As stated in the Contract Drawings.
- B. Basis of Design: 3M Anti-Graffiti Film AG4 as manufactured by 3M, a clear, sacrificial, high performance, anti-graffiti film coating for glazed surfaces in areas susceptible to a high frequency of graffiti vandalism, or approved equal.
1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.

PART 3 – EXECUTION

3.01 CONDITION OF SUBSTRATE

- A. Examine the areas and conditions under which coating work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Immediately notify VTA, in writing, of all conditions detrimental to the acceptable quality and timely completion of the Work.
- B. Do not apply coating over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable coating film.
- C. Application of first coat of finish must constitute acceptance of surface conditions and responsibility for ultimate finish

3.02 SURFACE PREPARATION

- A. Verify that all necessary materials and equipment required for satisfactory application are on-site and in good working order. Reliance on other affected trades for necessary materials and equipment is prohibited.
- B. Caulk all fencing and other penetrations on horizontal concrete surfaces for concrete set items where penetrations are not protected by flange caps.
- C. Thoroughly inspect all surfaces, substrates and project conditions affecting the work specified herein. Report any surface or condition discovered which might prohibit a satisfactory application to VTA. Do not work on or about questionable surfaces or conditions as per manufacturer's instructions until responsible trades thereof complete satisfactory correction. Start of the work specified herein confirms unconditional acceptance of all affected surfaces, substrates and project conditions encountered by responsible trades. Start of application means the Contractor has accepted the existing substrate conditions.

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3.03 APPLICATION

- A. Apply anti-graffiti coating in strict accordance with the manufacturer's printed instructions. Apply only to clean, dry surfaces when ambient temperature is above 4 degrees C. Allow Anti-graffiti coating seven full days to cure prior to applying graffiti remover or any other solvents. Use only manufacturer approved products to remove graffiti from treated surfaces.
- B. Surfaces to receive anti-graffiti coating must be clean of all dust, efflorescence and any other foreign matter.
- C. Coverage to be per manufacturer's recommendations for the surface type and conditions.
- D. Allow new cementitious surfaces to cure for 28 days and painted surfaces to cure as specified by paint manufacturer, prior to the application of anti-graffiti coating. Coordinate the application of anti-graffiti coating with the application of sealants and paint as required to ensure complete and adequate coverage and protection. If pH test has been conducted and the substrate is neutral, application may be made.
- E. Remove graffiti, if any that occurs during construction, prior to final acceptance by VTA. As warranty is requested, the applicator and his personnel must be certified, in writing, by the manufacturer as appropriately trained and adequately experienced in the use and application of the products and systems specified herein on the surfaces scheduled to receive the same.

3.04 CLEAN-UP

- A. Periodically during the application phases of the work, remove from the site excess materials, unused equipment, trash and debris which may otherwise cause obstructions and hazardous conditions affecting the work. Maintain the work areas in a clean, safe working condition at all times.
- B. At completion of the Work specified herein, thoroughly clean all finished surfaces, floors, and walls and leave the affected areas ready for use by VTA. Leave no discernible marks or scars.
- C. Clean applicators, roller covers and spray rigs per manufacturer recommendations. Do not allow any wastewater not meeting local water treatment plant requirements to enter the wastewater or stormwater systems. Dispose of any wastewater in accordance with local codes and regulations.

3.05 SAFETY

- A. Conform with the manufacturer's printed instructions and manufacturer's Materials Safety Data Sheet (MSDS).
- B. VTA reserves the right to order the removal from the site of any equipment and/or construction practice which, in their sole opinion, may contribute to a hazardous condition or an unsafe installation procedure. Systems, equipment or procedures so discharged from the site must not be reused on the work in any form.

3.06 ADJUST AND CLEAN

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- A. Touch up and restore finish where damaged. Touch up abraded, stained, or otherwise disfigured portion or refinish as necessary to produce an acceptable job.
- B. Remove spilled, splashed, or splattered coating from finish surface and floors not intended to be coated.
- C. Do not mar surface finish of items being cleaned.
- D. Leave coating storage spaces clean and in condition required for equivalent spaces in the Contract.
- E. Barricades: Maintain barricades and wet paint signs for the duration of need.

3.07 FIELD QUALITY ASSURANCE

- A. VTA reserves the right to invoke the following testing procedure at any time, and any number of times during the period of coating.
 - 1. VTA may sample the coating being used. Samples of materials delivered to the site will be taken, identified, and sealed, and certified in the presence of Contractor.
 - 2. VTA will perform appropriate tests for the following characteristics in to confirm the specified manufacturer's standards: abrasion resistance, apparent reflectivity, flexibility, wash ability, absorption, accelerated weathering, dry opacity, accelerated yellowness, re-coating, skinning, color retention, alkali resistance, and quantitative materials analysis.

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SECTION 10 12 00

DISPLAY CASES

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for furnishing and installing Information Graphics Display Cases at LRT Station platform shelters.
- B. Post mounted, directories complete with components by single manufacturer at exterior locations indicated on the Plans. Furnish component options specified below.
- C. Display Cabinets provided under this section are intended to include flexible designated units indicating direction and information from single manufacturer using minimum of standard components housed in enclosure for changing or components behind tamper-resistant glazing cover.

1.02 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete
- B. Section 03 53 00, Concrete Topping
- C. Section 05 50 00, Metal Fabrications
- D. Section 09 91 00, Painting
- E. Section 32 33 00, Site Furnishings

1.03 REFERENCED STANDARDS

- A. Aluminum Association (AA)
- B. ASTM International (ASTM):
 - 1. ASTM B112 Standard Specification for Aluminum-Base Alloys in Ingot Form for Sand Die Castings (6063-T5 aluminum alloy)
 - 2. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Extruded aluminum alloy frame)

1.04 SUBMITTALS

- A. General
 - 1. Submittals for Display Cases must be made in accordance with the provisions in these technical specifications.
 - 2. The Contractor must submit the following:
 - a. Product Data:
 - 1) Manufacturers signed statement regarding compliance with installation requirements. Manufacturer is required to inspect installation and to

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- certify that installation is in compliance with manufacturer requirements.
 - 2) Manufacturer's product literature indicating units and designs selected.
 - b. Shop drawings:
 - 1) Indicate materials, sizes, configurations, and applicable substrate mountings provided in other sections.
 - 2) Include requirements for anchors or mounting mechanisms for cabinets furnished in this section.
 - c. Samples:
 - 1) Door extrusion in shape and finish specified complete with glazing material specified; minimum 6 inches by 6 inches corner section.
 - d. Submit warranty form completely filled in and properly signed by manufacturer.
 - e. Submit maintenance data and cleaning requirements for exterior surfaces.
 - f. Submit all cabinet keys in accordance with specification requirements prior to final payment.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Display Cases must be measured by each assembly.
- B. Payment: The contract price paid per each assembly for Display Cases must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Display Cases complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Work required under this section from manufacturers regularly engaged in work of this magnitude and scope for minimum of five years.
- B. Warranty: Provide manufacturer's five year warranty for graphics display cases and poster cabinets to be free from defects in materials and workmanship for a period of five years from date of installation and acceptance by VTA.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Acceptance at site: Coordinate delivery of work to Project site under this section for immediate installation.
- B. Handling materials and equipment: Handle cabinets in careful manner in order not to damage or mar surfaces or adjacent finish surfaces.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate:

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1. Installation with adjacent finish materials not destroying adjacent surfaces.
2. Coordinate with other sections to cast-in or built-in anchors and mounting hardware in work specified in other sections.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Products or comparable products that meet or exceed all provisions of this specification or VTA approved equal.
 1. The Tablet & Ticket Co., 1120 Atlantic Drive, West Chicago, IL 60185. Phone (630) 231-6611 or (800) 438-4959; Fax (630) 231-0211; model 800IDF Series.
 2. APCO Signs, 388 Grant Street, SE, Atlanta, GA 30312-2227. Phone (404) 688-9000; Fax (404) 577-3847; model 'Visuline 2300 post mounted cabinet.
 3. Nelson Harkins, 5301 N. Kedzie Avenue, Chicago, IL 60625. Phone (773) 478-6243; Fax (773) 478-8227; model 248 series.
 4. Other manufacturer's products are acceptable if approved by VTA. All substitutions must be in strict compliance with these specified requirements.
- B. Mounting: Post Mounted with custom non burial mounting plates.
- C. Product: Post mounted double faced, top illuminated display case, 2 side piano hinged doors with glazing of clear tempered glass and key locks on each side, background removable vinyl impregnated cork board on exterior substrate, both sides, unit to have a routed aluminum header above the door with text as detailed and specified, both sides. Units to be mounted on posts with base plate mounting.
- D. Type: Configuration: Map and cork bulletin board.
- E. Cabinet size: per drawings.
- F. Heights: Post mounted per drawings.
- G. Design units with selected components below.

2.02 COMPONENTS

- A. Housing:
 1. Fabricated ASTM B221-90, 6063-T5 extruded aluminum alloy frame surrounding solid backing plate.
 2. Color: Custom painted finish per specifications section 09 91 00 - Painting.
 3. Post finish: To match main frame.
- B. Doors:
 1. Frame materials: ASTM B221-90, 6063-T5 aluminum alloy, corners precision hairline mitered.
 2. Glazing: 1/4 inch tempered laminated.
 3. Hinges: Continuous piano hinges at outer edges of each door.

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4. Furnish: standard key lock with two keys.
5. Finish and color: per specifications section 09 91 00 - Painting.

C. Posts:

1. Material: ASTM B112-90, 6063-T5 aluminum alloy, 0.125 inch thickness minimum. Provide required structural reinforcement within each post.
2. Profile: per drawings.
3. Finish: Match housing finish and color.

2.03 FABRICATION

A. Shop assembly:

1. Fabricate units to configurations indicated on reviewed shop drawings. Internally reinforce units in accord with reviewed shop drawings.
2. Furnish copy in units headers; copy indicated in reviewed shop drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verification of conditions:

1. Examine areas to receive display cabinets; verify for correct location of cast-in anchors installed under other sections.
2. Notify Engineer in writing of unacceptable substrate or improper location of anchors.
3. Beginning work indicates acceptance of substrate.

3.02 INSTALLATION

- A. Install directories in locations indicated in accord with reviewed shop drawings. Square, plumb, and level units; install related trim pieces.

3.03 CLEANING

- A. Clean exposed surfaces not more than 48 hours prior to Date of Substantial Completion in accord with manufacturer's instructions.

END OF SECTION 10 12 00

SECTION 10 14 00

SIGNAGE

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes Requirements for fabricating and installing project signage:

Project sign types are:

1. Sign Type 1: Station Identification Pylon
2. Sign Type 2: Station Identification on Aerial Guideway
3. Sign Type 10: Destination Platform
4. Sign Type 18: Accessible Signage
5. Sign Type 19: Fence Mounted - Informational
6. Sign Type 20: Canopy Mounted - Informational
7. Sign Type 21: Canopy Mounted - Directional
8. Sign Type 22: ADA Braille - Room Identification
9. Sign Type 23: Overhead - Identification
10. Sign Type 24: ADA Braille - Elevator Identification
11. Sign Type 25: Double Post – Station Identification
12. Sign Type 26: Fence Mounted – Station Identification
13. Sign Type 31: Kiosk Station – Station Identification

- B. Contractor's Responsibilities:

1. Provide all services, labor, materials, and product required to fabricate and install project signage and graphic items detailed, noted and specified in the Contract Documents.
2. Obtain and pay for required permits and taxes.
3. Visit site to inspect existing conditions and verify dimensions that are related to fabrication and installation of project signage.
4. Thoroughly review contract documents, checking conditions and dimensions shown. Contractor shall immediately notify Owner's Representative of any discrepancies in Contract Documents or field dimensions and conditions.

- C. Order of Precedence:

1. Written dimensions on the drawings shall have precedence over scaled dimensions.
2. Specifications shall take precedence in quality over information noted on the drawings.

1.02 RELATED SECTIONS

- A. Division XX – TBD
- B. Section 03 31 00 –Concrete Structures
- C. Section 05 50 00 – Metal Fabrications
- D. Section 26 50 00 – Lighting

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- E. Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 51
- F. Green Seal Standard GS-11
- G. South Coast Air Quality Management District (SCAQMD) Rule #1168

1.03 REFERENCED STANDARDS

Not part of this submittal.

1.04 SUBMITTALS

- A. General
 - 1. Submittals for architectural treatment shall be made in accordance with the provisions in Section 01 33 00 – Submittal Procedures, 01 33 23 – Shop Drawings, Product Data, and Samples, and these technical specifications.
 - 2. Contractor shall submit the following shop drawings, working drawings, calculations and product data:
 - a. Shop Drawings: Provide complete shop drawings, drawn to scale, detailing interior construction, placement of lighting, electrical equipment, method of service, access and full-size details affecting exterior appearance. Submit one complete set in reproducible form to Owner's Representative for review and approval prior to fabrication.
 - b. Engineering Drawings: Provide complete structural design drawings, drawn to scale, showing engineering details and calculations for sign structures, concrete footings, bases, rebar and building attachments as required for compliance with local codes. Submit one complete set in reproducible form to Owner's Representative for review and approval prior to fabrication.
 - c. Lettering Patterns: Submit two full-size lettering patterns of sign messages, symbols or other graphic elements related to sign fabrication for approval by Owner's Representative.
 - d. Vinyl Copy: Submit two mounted, one-line samples of each size, color, type style and font on pre-spaced tapes for approval by Owner's Representative.
 - e. Screen Processed Copy: Submit two blueline prints of film positives for approval by the Owner's Representative.
 - 3. Technical Specifications: Submit technical specifications of paint, coatings and other finish materials. Include actual samples of these finishes. Submit two copies for approval by Owner's Representative.
 - 4. Material Data:
 - a. Submit material cost data for all materials required to construct the work in place. The material cost shall reflect the actual cost of material without mark-up.
 - b. Provide manufacturer's information/data sheet or a letter from the manufacturer indicating the location of manufacture, amount of recycled content (post consumer and industrial percentage in the product, and the location of raw material harvest if within 500 miles of the project site.
 - c. Submit manufacturer's descriptive technical data and material safety data sheet for all adhesives and sealants indicating the volatile organic compound level in grams/liter.

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5. Samples:
 - a. Paint Color Samples: Submit samples of paint for review of color, sheen and texture, on 4" x 6" aluminum sheets to simulate actual finish. Contractor shall resubmit each sample as requested until required color, sheen and texture is achieved. Submit two copies each for review by Owner's Representative.
 - b. Hardware Samples: Submit samples of hardware such as hinges, locks and fasteners that will be exposed to view. Submit two copies each for review by Owner's Representative.
 - c. Concrete Finish Samples: Submit sample of concrete finish for pre-cast or cast-in place exterior signs and sign bases. Submit two copies to Owner's Representative for review.

6. Prototypes: Submit complete, finished prototypes to Owner's Representative for review as requested. Subsequent fabrication of contract work shall conform with the accepted prototypes, which may be used on the job. Submit one sample each of the following:
 - a. Sign Type 1: Provide color ID line and Zinc Plaque
 - b. Sign Type 10: One complete sign including copy application
 - i. Sign Type 19: One complete sign including copy application
 - j. Sign Type 22: One complete sign including copy application
 - k. Sign Type 26: One complete sign including copy application

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Signage shall be measured by each assembly.
- B. Payment: The contract price paid per each assembly for each assembly shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing each assembly complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Suppliers: Obtain all products from approved suppliers as identified in Part 2 of this Section.
- B. Installer: Installation shall be performed by installer specialized and experienced in work similar to that required for this project.
- C. Subcontractors: Subject to same submittal, work experience and supervision requirements as the contractor.
- D. Regulatory Requirements: Products shall meet requirements of all applicable codes pertaining to signage, including, but not limited to:
 1. Americans With Disabilities Act Accessibility Guidelines (ADAAG) and local amendments and modifications.
 2. California Title 24.
 3. Engineering codes and requirements.

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- E. Materials: Materials used in the execution of this work shall be new and of the highest quality available to meet the specific requirements noted in Part 2 of this Section.

1.07 RIGHTS AND GUARANTEE

- A. Design Rights: Contractor is hereby granted limited right to the designs as shown and specified herein for the sole purpose of completing contractual obligations to fabricate and install project signage. Contractor may not manufacture, reproduce or exhibit these designs, or modify them for any other purpose with prior written consent.
- B. Project Warranty: Contractor shall guarantee his work for a period of one year from the date of acceptance or in accordance with the provisions of Division 1, whichever is greater.
- C. Manufacturer's Warranty: Submit manufacturer's standard warranty document executed by authorized company official.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Signage Systems shall be by the following or VTA approved equal.
1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products shall meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 2. Acrylic Polyurethane: Matthews Paint Company.
 3. Adhesives: General Electric, Dow Corning.
 4. Exterior Architectural Flood Lighting: KIM Lighting, Gardco.
 5. Polycarbonate Sheet: General Electric, Lexan.
 6. Porcelain Enameling: Fireform, Enameltec, Winsor.
 7. Screen-Printing Inks: Warnow's Decal Du-Well Enamel.
 8. Film Graphics: 3M Scotchcal, 3M Digital Media & Scotchlite Film, Calon II.

2.02 MATERIALS

- A. Aluminum: Provide angles, extrusions, channels, shapes, tubes and panel flat, aluminum plate or sheets of thickness required to prevent oil-canning.
1. Provide alloy 5005-h34 for anodized finishes.
 2. Provide alloy 3003-h14, mill finish, for painted finishes.
- B. Structural Steel and Aluminum: Provide structural steel and aluminum shapes, channels and extrusions of wall thickness and alloy temper required to meet or exceed engineering requirements and satisfy applicable codes.
- C. Steel Tubing: Provide material conforming to specifications for electric resistance welded carbon and alloy steel mechanical tubing ASTM A513. Remove scale before finishing. Provide wall thickness to meet structural requirements.

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- D. Electrical Wiring and Equipment: Provide electrical materials such as ballasts, transformers, lamps, sockets, neon units, connectors and other equipment required to complete fabrication Equipment shall be new and approved by FMG Architects.
- E. Exterior Illumination: Provide ground sign lighters, size as required to provide even illumination of sign face. All connections shall be housed within a weatherproof, watertight, code-approved junction box, buried flush to the existing grade. Use KIM lighting AFL 1 horizontal flood or approved equal.
- F. Labels: Provide code-required labels to be located inconspicuously away from primary message faces of the sign. No other labels to be affixed to sign.
- G. Hardware: Provide incidental hardware necessary for the proper functioning of the signs, including:
1. Hinges: Provide stainless steel hinges for hinged access panels. Finish to match adjacent surface.
 2. Locks: Provide pin tumbler locks for access panels. Finish to match adjacent surface.
 3. Fasteners: Provide flat head stainless steel fasteners, painted to match adjacent surfaces, wherever exposed fasteners may be required. Exposed fasteners shall be permitted only where specifically stated in the individual sign specifications and drawings. Provide stainless steel fasteners for assembling ferrous to non-ferrous metal.
- H. Acrylic Plastic: Provide acrylic of thickness indicated on the drawings, but not less than 1/8 inch thick, unless otherwise specified. Cement used to fabricate plastic parts shall be #4 cement as manufactured by industrial polychemical or equal. Plastics shall be of uniform color and translucence as supplied by manufacturer.
- I. Polycarbonate Sheet: Provide Lexan as manufactured by General Electric, or Tuffak as manufactured by Rohm and Haas, of thickness indicated on drawings.
- J. Porcelain Enamel: Provide pan formed, porcelain enameled sign panels with 1/2 inch/1 inch/1.5 inch/2 inch flanged returns, unless otherwise noted. Exterior sign surfaces of steel shall match 4 mils porcelain enamel finish specified herein under the corresponding part of this Section, unless noted otherwise on drawings.
- K. Tactile (ADA) Signs: Provide Etched Zinc sign panels. Back-up substrate material shall consist of 1/8 inch black acrylic. Laminate together with industrial tape/adhesive as required.
- L. Paint: Provide two component acrylic polyurethane with low volatile organic compounds and ultraviolet (UV) inhibitors.
1. All interior paint must comply with volatile organic compound and chemical component limits of Green Seal Standard GS-11.
- M. Vinyl Material: Provide high performance vinyl products guaranteed for a minimum of seven years of durability for exterior applications. Application of vinyl films shall meet manufacturer's specifications and recommendations.
1. Opaque Vinyl Graphics: Provide machine-cut vinyl graphics as shown on drawings. Graphics and copy shall be pre-spaced on 3M film application.
 2. Reflective Graphics: Provide reflective letters and machine-cut vinyl graphics as shown

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- on drawings. Graphics shall be pre-spaced on 3M film application.
3. For digitally printed direct graphics: Provide UV solvent inks guarantee for a least seven years.

2.03 FABRICATION METHODS

A. Exercise highest level of care during fabrication and installation, including:

1. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes and details of construction.
2. Preassemble signs in the shop to the greatest extent possible to minimize field assembly.
3. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
4. Conceal fasteners if possible; otherwise, located fasteners to appear inconspicuous.
5. Form panels to required size and shape as shown on drawings. Comply with requirements for design, dimensions, finish, color and details of construction.
6. Coordinate dimensions and attachment methods to produce message panels with closely fitted joints. Align edges and surfaces with one another in the relationship indicated.

B. Aluminum:

1. **Welded Construction:** Provide sign cabinets or structures of welded construction with joints filled and finished smooth, unless otherwise noted on the drawings. Exposed fasteners may not be used, except for access panels, which shall be attached with stainless steel flat head screws painted to match adjacent metal.
2. **Seamless Construction:** Provide signs cabinets of seamless welded construction with edges break formed, and joints welded, ground and finished smooth. Exposed fasteners may not be used, except for access panels, which shall be attached with stainless steel flat head screws painted to match adjacent metal.
3. **Structural Reinforcements:** Provide sign enclosures or cabinets reinforced with interior structural metal framing as required.
4. **Oil-Canning:** Adhere panels to structural framing with industrial adhesive or by providing additional welded structural support as required to prevent oil canning.
5. **Multi-panel Surfaces:** Run grain in the same direction where aluminum and or stainless steel multi-panel surfaces are used.
6. **Electrolysis:** Prevent corrosive action due to electrolysis by separating ferrous and non-ferrous metals with neoprene or vinyl spacers, or by using stainless steel fasteners.

C. Sign Cabinet/Porcelain Enamel Finish:

1. **Enclosures:** Provide sign enclosures constructed of porcelain enameled sheets, panels, and parts as shown on drawings. Porcelain enamel shall be applied in accordance with Porcelain Enamel Institute's PEI:ALS 105 "Porcelain Enamel Use." Contractor shall use mechanical fasteners throughout for assembly. No exposed fasteners shall be used, except for access panels, to be attached with stainless steel flat head screws painted to match adjacent metal.
2. **Panel Construction/Honeycomb Core:** Face sheets shall be fabricated in one piece from 1/16 inch aluminum porcelain enameling sheet of Alclad alloy 6061-H12 with an alloy 1230 cladding of approximately 5% on both sides. Porcelain enamel shall be applied in accordance with PEI:ALS 105(69).
 - a. Thickness of core material shall be as noted on the drawings, and shall be phenolic impregnated paper honeycomb. Core material shall meet Federal Specification MIL-D-

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- b. 5272 for resistance to fungus.
The cell size shall be 1/2 inch, weight of Kraft paper 80lb and impregnated 18 percent by weight minimum.
 - c. Back sheet to be fabricated in one piece from sheet steel to thickness as required. Surface shall be treated with an amorphous chromate conversion coating conforming to requirements of the Federal Specification MIC-C-5541B.
 - d. Laminating adhesive shall produce a permanent oil and water resistant bond. Adhesives shall be of the thermo-setting type. Bonding of panels shall be prepared in heated flat platen press of sufficient size to contain the entire panel at one time with capabilities of 10 lbs per 1 in ch squared over the entire platen area. Face and back panels shall be cleaned prior to laminating, in tanks of sufficient size to accommodate the complete panel.
 - e. Adhesively bonded panels shall have an exterior face of such flatness that, when measured at normal room temperature of 70-80 degrees Fahrenheit, the maximum wave slope of the surface at any point, measured from the nominal plane of the surface, shall not exceed 1%. Flatness will be considered satisfactory if tolerance requirement is met with readings taken in sun or shade. Wave slope shall be computed in the following manner:
 - 1) Measure the distance between high points (Dimension A). Place a straight edge across the points and measure the depth of slope (Dimension B). Divide one half of A into B to determine percentage of wave slope.
 - f. Manufacturer shall furnish certification as to prior testing of the adhesive laminate according to test methods ASTM E-72-68 and ASTM C-273-61 performed by an independent testing laboratory.
 - g. The tensile strength of honeycomb laminate construction shall have a minimum of TBD. Test to be performed in accordance with ASTM C297-61 and ASTM C381-61.
 - h. Weep holes of 8 inch in diameter are to be drilled in the perimeter frame at bottom of each panel. Holes to be spaced approximately 3 inch in from either end and in the center of each panel.
- D. Very High Bond (VHB) 3M Tape: Apply VHB tape as specified and recommended by manufacturer for sign fabrication applications.
- 1. Pretreat all surfaces prior to the application of VHB tape, removing all oil and foreign matter, and lightly sand bonding surfaces prior to tape application.
 - 2. Prior to removal of the carrier tape, burnish the tape to the first applied surface to activate adhesive properties.
 - 3. Reburnish bonded areas and clamp elements together for time specified by manufacturer.
- E. Laminating Duraply: Clean all surfaces of free foreign matter. Apply industrial strength waterproof adhesive per manufacturer's instructions and clamp until dry. Panels to be permanently bonded and free of warpage.
- F. Acrylic Signs: Finish all exposed edges of plexiglass smooth with a polished or painted finish as noted on the drawings. Exposed lamination seams shall not be permitted.
- G. Exposed Concrete Signs and Bases: Shape, dimension and form concrete bases as detailed and noted on the drawings. Provide steel reinforcing rods in quantities, size and placement as required. Provide wood forms built with metal form liner to produce flat exposed surfaces and smooth edges.
- H. Concrete Footings: Provide concrete mixed and poured in accordance with engineering specifications. Provide 16 gauge, galvanized iron metal forms for exposed concrete that is free of air pockets, pits, exposed aggregate or other imperfections, unless otherwise noted. Exposed tops of concrete footings shall be finished with 6" wide mow-strip surround, sloping away from sign structure toward finished grade.

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2.04 FINISHING

- A. Painted Finish: Prepare surfaces to be painted in accordance with the manufacturer's specifications and recommendations. Pre-treatment of paint finished surfaces to include:
1. Ensure that all surfaces are free of tooling marks, scratches, dings, dents, bondo, joint fillers or foreign matter.
 2. Thoroughly sand surfaces to be paint finished as required, using dual action sander with 320 grit paper prior to application of primer and finish coats.
 3. Provide sufficient primer coats to achieve a smooth uniform surface.
 4. Spray paint all surfaces as required, following paint manufacturer's recommendations concerning thinning, application and drying time.
 5. Provide primer coats and top coats of two component acrylic polyurethane with low volatile organic compounds.
 6. Provide finish paint containing ultraviolet UV inhibitors and antioxidants as required for highest degree of color and finish retention.
 7. Provide satin gloss finish unless otherwise specified.
- B. Powder-Coated Finish: Prepare surfaces to be powder-coated in accordance with manufacturer's specifications and recommendations. Pre-treatment of powder coat finished surfaces shall include:
1. Provide satin gloss finish, free of blemishes, pitting or any foreign matter.
 2. Provide acid-etch degreasing bath, followed by a clean water rinse.
 3. Provide iron phosphate adhesion bath, followed by clean water rinse.
 4. Provide non-chromate acidulated seal bath.
 5. Provide drying cycle lasting no less than 10 minutes at 300 to 400 degrees Fahrenheit, or as recommended by manufacturer.
 6. Electrostatically apply powdered paint at 75 to 90KV or as recommended by manufacturer.
 7. Provide thermal setting cycle timed for twenty minutes at a temperature of 400 degrees Fahrenheit or as recommended by manufacturer.
 8. Painted Finish on Tactile (ADA) Signs: Provide tactile sign panels with background painted with acrylic enamel or acrylic polyurethane with eggshell matte finish. Tactile graphics shall be off- contact screen printed with acrylic enamel formulated for screen process, or thermal foil-stamped in colors matching those noted on the drawings. Copy shall have crisp and clean edges. Braille dots shall be finished to match color of sign background surface.
- C. Porcelain Enamel Finish: Provide porcelain panels specifically prepared for enameling, using a metal immersion treatment with all pretreatment processes performed in tanks of sufficient size to accommodate the complete panel. Pretreatment and finish processing shall include:
1. Provide de-oxidizing and alkaline chromate solutions.
 2. Provide porcelain enameled coverage on face side to a minimum of 4 mils in thickness.
 3. Provide uniform coverage of porcelain enamel through use of aeromatic spray equipment conforming to current PEI:ALS 105(69).
 4. Provide porcelain enameled finish with gloss reading of 50 to 70 units when measured at an angle of 45 degrees with a photovoltmeter.
- D. Clear Coated Metal Surfaces: Provide pretreatment and protective clear coat finish to all polished or brushed metal surfaces. Pretreatment and finish processing shall include the following:
1. Thoroughly clean metal to be free of all buffing compound and all foreign matter.
 2. Provide tarnish-retarding pre-treatment using Matthews Paint Co. #74-737 "Braco Pretreatment"

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- or approved equal.
3. Provide clear, colorless adhesive using Matthews Paint Co. #74-793 “Spray Bond” or approved equal. Applications shall be followed with 30 minute drying cycle.
4. Provide final clear coat finish of #282-260 “Braco Clear”, catalyzed with #283-800 “Catalyst” and reduced with #285-100 “Exempt Reducer” by Matthews Paint Co. or approved equal.
5. Provide clear coat finish to cast letters, including backs of all letters, as well as front and sides.

2.05 COPY APPLICATION

- A. General Requirements: Provide Adobe Type I Postscript Font available from Adobe Systems for all copy applications except as otherwise noted on drawings. Typestyle shown on drawings are for information only.
1. Provide typestyle available with digitally direct print using a flatbed printer or provide digitally printed media 3M film and clear matte overlamine, as indicated on the drawings.
 2. Ensure that size and placement of copy comply with dimensions for letter height, line spacing and placement as either noted on drawings, in digital files, or final approved lettering patterns.
 3. Ensure that baselines of all copy is straight and parallel with top or bottom of sign structure unless otherwise noted.
 4. Ensure that edges of letter forms are true and smooth with straight and curved portions representing the specified project typestyle exactly.
 5. Ensure that corners of letter forms and numerals are true to form. Rounded letter forms shall extend slightly below the normal baseline per respective typestyle characteristics. All letter forms shall be free of imperfections, ticks and distortion of straight lines and curves.
- B. Tactile ADA Signs: Execute tactile ADA signs with typestyle and symbols indicated on the drawings. Include grade II Braille translations. Letter forms shall be crisp and free of imperfection.
1. Symbols, copy and grade 2 Braille shall be processed from photo- mechanically produced film positives.
 2. Characters on signs shall be raised 1/32 inch minimum and shall be Sans Serif uppercase characters accompanied by Grade 2 Braille (see item 6 below).
 3. Raised characters shall be a minimum of 5/8 inch and a maximum of 2 inch high.
 4. Contrast between character, symbols and their background must be 70% minimum and have a non-glare finish. 1117B.5.2
 5. Characters on signs shall have a width-to-height ratio of between 3:5 and 1:1 and a stroke width-to-height ratio of between 1:5 and 1:10. 1117B.5.3
 - a. All letters must be measured in uppercase. After choosing a typestyle to test, begin by printing the letters I, X, and O at 1 inch high. Place the template’s 1:1 square over the X or the O, whichever is narrower. If the character is not wider than 1 inch, nor narrower than the 3:5 rectangle, the proportions are correct. Use the 1:5 rectangle to determine if the stroke of the I is too broad, and the 1:10 rectangle to see if it is too narrow. If all the tests are passed, the typestyle is compliant with proportion code.
 6. California (Contracted) Grade 2 Braille shall be used wherever Braille is required in other portions of these standards. Dots shall be 0.1 inch on centers in each cell with 0.20 inch space between cells, measured from the second column of dots in the first cell to the first column of dots in the second cell. Dots should be raised a minimum of 0.025 inch above the background. 1117B.5.6
 7. Provide rounded or domed California Braille dots, each distinct and separate. Dots with straight sides and flat tops are not readable for many Braille users.
 8. Raised characters shall use silkscreen tipped process, using a high quality inks.
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- D. Vinyl Copy Applications: Prepare surfaces for vinyl sheet and copy applications in accordance with manufacturer's specifications and recommendations. Surfaces shall be perfectly smooth and free of dust, grease, wax or other foreign matter prior to application.
- G. Porcelain Panel Copy: Provide screen printed copy on porcelain panels unless otherwise specified. Screen printed copy shall be fired to create permanent graphics application. Letter forms shall be neat, clean and crisp following the project letterstyle and colors as noted.
- H. ADA Signs: Provide tactile copy and symbols for ADA room identification signs that is raised-in-relief 1/32 inch above sign background surface. Copy shall be tipped to colors as indicated on the drawings. Letter forms shall be crisp and clear and free from imperfection.
- I. Digitally Printed Graphics: Prepare substrates in accordance with manufacturer's specifications and recommendations. Surfaces shall be perfectly smooth and free of dust, grease, wax or other foreign matter prior to application.

PART 3 – EXECUTION

Not part of this submittal.

END OF SECTION 10 14 00

SECTION 10 14 53
ROADSIDE SIGNAGE

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the requirements for furnishing and installing roadside signs and marker panels.
- B. This Section also includes the requirements for relocating existing roadside signs.

1.02 RELATED SECTIONS

- A. Section 01 55 24 Construction Area Signs
- B. Section 34 41 13 Traffic Signals

1.03 REFERENCED STANDARDS

- A. California Manual on Uniform Traffic Control Devices (CA MUTCD)
- B. California Sign Specifications
- C. Federal Highway Administration (FHWA):
 - 1. Standard Highway Signs and Markings
- D. State of California, Department of Transportation (Caltrans), Standard Specifications:
 - 1. Section 15 Existing Highway Facilities
 - 2. Section 82 Signs and Markings
 - 3. Section 84 Markings
- E. City of San Jose Standard Specifications:
 - 1. Section 56 Signs
 - 2. Section 82 Markers and Delineators

1.04 SUBMITTALS

- A. Submit certificates of compliance for signs.

1.05 MEASUREMENT AND PAYMENT

- A. The contract unit price paid per each for Roadside Sign on Sign Post(s) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing roadside signs, complete in place, including concrete footing, sign posts and furnishing and installing sign panels, as shown on the plans, as specified in these technical specifications, and as directed by the VTA.

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- B. The contract unit price paid per each for Roadside Signs (Strap and Saddle Bracket Method shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing roadside signs by the strap and saddle bracket method, complete in place, including furnishing and installing sign panels, as shown on the plans, as specified in these technical specifications, and as directed by the VTA.

- C. The contract unit price paid per each for Remove Roadside Sign shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in removing roadside signs as shown on the Plans, as specified in these technical specifications, and as directed by VTA.

PART 2 – PRODUCTS

2.01 SIGN PANELS

- A. New roadside signs shall conform to the requirements of Section 82-2, “Sign Panels,” of the Caltrans Standard Specifications.

2.02 OTHER SIGN MATERIALS

- A. Sign posts shall conform to the requirements of Section 82-3, “Roadside Signs,” of the Caltrans Standard Specifications.

PART 3 – EXECUTION

3.01 PREPARATION, ERECTION, AND INSTALLATION

- A. Locate existing facilities, pothole, and maintain existing utilities as specified in Section 31 00 00, Earthwork, and as indicated on the Plans.

3.02 REMOVE ROADSIDE SIGNS

- A. Existing roadside signs, where shown on the Plans to be removed, shall be completely removed including foundations as shown on the Plans, as specified in the Standard Specifications and these technical specifications, and as directed by VTA.

- B. Holes and depressions caused by the removal of work shall be backfilled with suitable native material or as specified in Section 15-1.02, “Preservation of Property,” of the Standard Specifications and as directed by VTA.

END OF SECTION 10 14 53

SECTION 10 28 00

JANITORIAL ACCESSORIES

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes specifications for:
 - 1. Mop and Broom Holder
 - 2. Shelf Unit

1.02 RELATED SECTIONS

- A. Section 05 40 00, Cold Formed Metal Framing
- B. Section 06 10 00, Rough Carpentry
- C. 09 29 00, Gypsum Board
- D. 09 30 00, Tiling

1.03 REFERENCED STANDARDS

- A. American Iron and Steel Institute (AIAI):
 - 1. Type 304 and Stainless Steel

1.04 SUBMITTALS

- A. General
 - 1. Submittals for Janitorial Accessories must be made in accordance with the provisions in these technical specifications.
 - 2. Contractor must submit the following shop drawings, working drawings, and product data:
 - a. Submit manufacturer's data, cleaning and maintenance instructions, accompanied by any drawings required to clearly define mounting or installation details or instructions. Provide a schedule indicating items to be provided for each room or space. Data shall identify metal gauges, finishes, and special mounting conditions.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Janitorial Accessories must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Janitorial Accessories must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in

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constructing Janitorial Accessories complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Worksite in their original factory containers, together with required mounting or fastening materials. Protect from damage due to physical impact or exposure to moisture, humidity or other corrosive exposure, in accordance with the manufacturer's instructions..

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Basis of Design: Utility Shelf with Mop/Broom Holders and Rag Hooks model B-239 as manufactured by Bobrick or VTA approved equal.
Basis of Design: Stainless Steel Wire Shelf model 1872S as manufactured by Eagle Group or VTA approved equal.
1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.
 - a. Bobrick, 6901 Tujunga Avenue, North Hollywood, California, 91605-6213, Phone; (818)-982-9600, Website www.bobrick.com
 - b. EAGLE GROUP, 100 Industrial Boulevard, Clayton, DE 19938-8903 USA, Phone: 302-653-3000, Fax: 302-653-2065, www.eaglegrp.com

2.02 MOP AND BROOM HOLDER

- A. Product description: Utility shelf with mop/broom holders and rag hooks shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Shelf shall be 18 gauge (1.2mm), 8" (205mm) deep with 3/4" (19mm) return edges, and shall have front edge hemmed for safety.
1. Mounting Base and Shelf — 18-8, type-304, 18-gauge (1.2mm) stainless steel with satin finish. All-welded construction. Shelf is 8" (205mm) deep with 3/4" (19mm) return edge on all three sides. Front edge is hemmed for safety.
 2. Shelf Support Brackets — 18-8, type-304, 16-gauge (1.6mm) stainless steel with satin finish. Welded to mounting base and shelf.
 3. Mop/Broom Holders — Spring-loaded rubber cams with anti-slip coating. Plated steel retainers.
 4. Hooks — 18-8, type-304, 12-gauge (2.8mm) stainless steel with satin finish. Each hook attached to mounting strip with two rivets.

2.03 SHELF

- A. Wire shelf with mat wires welded to a four-truss assembly on front and back, and three-truss assembly on each end.
1. Dimensions: 18-inch depth, 72-inch width, 74-inch height, four shelves.
 2. 600 pound capacity.
 3. Stainless Steel finish.
 4. Brackets to securely fasten shelving unit to wall.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Check areas to receive surface mounted units for unevenness, irregularities, and spacing of plumbing fixtures and partitions for acceptable installation.
- B. Notify VTA in writing of conditions detrimental to the timely completion of the work. Do not proceed with the work of this Section until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Drill holes to the correct size and at the locations required to yield a concealed fastened installation.
- B. Securely mount accessories into substantial backing, plumb and align.
- C. Provide theft resistant fasteners for accessory mountings exposed to view.

3.03 ADJUSTING AND CLEANING

- A. Adjust operating accessories for proper operation.
- B. Clean and polish exposed surfaces of accessories.
- C. Touch-up, repair or replace damaged products until Substantial Completion.

END OF SECTION 10 28 00

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SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing fire extinguishers.

1.02 RELATED SECTIONS

- A. Section 05 40 00, Cold Formed Metal Framing
- B. Section 06 10 00, Rough Carpentry

1.03 REFERENCED STANDARDS

- A. Underwriters Laboratory (UL):
1. 711 Rating and Fire Testing of Fire Extinguishers

1.04 SUBMITTALS

- A. General
1. Submittals for Fire Extinguishers must be made in accordance with the provisions in these technical specifications.
2. The Contractor must submit the following:
- a. Product Data: Submit details and manufacturer's product data of fire extinguishers, including installation details.
 - b. Letter of Acceptance: Submit local Fire Marshal's letter of acceptance of the fire extinguisher class type to be installed.
 - c. Warranty: Submit Warranty for fire extinguisher to be free of defects in materials and workmanship for a period of 1 year.
3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Fire Extinguishers must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Fire Extinguishers must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Fire Extinguishers complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

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PART 2 – PRODUCTS

2.01 MATERIALS

- A. Multi-Purpose Dry Chemical Extinguishers: Provide nominal twenty-pound capacity extinguishers as indicated, rated as follows, unless otherwise noted:
 - 1. Twenty Pounds: UL Rating of 20A-120B:C. All locations, except where carbon dioxide extinguishers are required.
- B. Carbon Dioxide Extinguishers: Provide nominal 20-pound capacity extinguishers as indicated, rated as follows:
 - 1. Twenty Pounds: UL Rating of 10-B:C. One for each electrical room and communications room.
- C. Mounting Brackets: When extinguishers are indicated to be wall mounted without cabinets, provide manufacturer's mounting brackets for sturdy, top and bottom support, properly sized for type and size of extinguisher, and to resist lateral forces from a design seismic event.
- D. Fire Extinguisher must be warranted against material, manufacturer, and workmanship defects for a period of one year from acceptance of project from contractor.
- E. Fire Extinguisher must be clearly labeled and match the type approved by the local Fire Marshal.
- F. Package, handle, deliver and store at the Worksite in a manner that will avoid damage. Damaged equipment will be rejected.
- G. Fire extinguishers must meet UL Standard 711 Rating and Fire Testing of Fire.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Fire extinguishers must be wall mounted as shown on the Drawings. Provide mounting brackets and accessories as required for a complete fire extinguisher system ready for use. Provide additional blocking or supports within the wall framing as required to sufficiently mount fire extinguisher securely.
- B. Install fire extinguishers at heights to comply with applicable requirements of regulating authorities. Check extinguishers for proper charge operation. Remove and replace any damaged or defective equipment.

END OF SECTION 10 44 16

SECTION 10 73 16.36
GLASS SUPPORTED GLASS AWNINGS

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes specifications for furnishing and installing Elevator Canopies located at:

1. Story Station

1.02 RELATED SECTIONS

A. Section 08 80 00, Glazing

1.03 REFERENCED STANDARDS

A. American Architectural Manufacturers Association (AAMA):

1. AAMA 501.4 Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Inter-Story Drifts
2. AAMA 501.6 Recommended Dynamic Test Method For Determining The Seismic Drift Causing Glass Fallout From A Wall System

B. American Society of Civil Engineers (ASCE):

1. ASCE 7 Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers

C. ASTM International:

1. ASTM A 666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
2. ASTM A743 Standard Specification for Castings, Iron Chromium, Iron Chromium Nickel, Corrosion Resistant, for General Applications
3. ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
4. ASTM F 593 Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs

1.04 SUBMITTALS

A. General

1. Submittals for Glass Supported Glass Awnings must be made in accordance with the provisions in these technical specifications.
2. Contractor must submit the following shop drawings, working drawings, and product data:

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- a. Shop Drawings: Plans, sections, elevations, and details with point support fittings identified by manufacturer's part numbers, dimensions, materials, finishes, connections, method of anchorage to structure and glass thickness and type.
- b. Manufacturer's Qualification Statement.
- c. Test Reports: Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on glass supported glass awnings point load fittings are acceptable. Test reports include tests performed in accord with ASTM E330, AAMA501.4, and AAMA 501.6
- e. Manufacturers instructions and product data.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Glass Supported Glass Awnings must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Glass Supported Glass Awnings must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Glass Supported Glass Awnings complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.06 QUALITY ASSURANCE

- A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience.
- D. Provide point support fittings from a single source.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Basis of Design: Spider Fittings and Accessories as designed by C.R. Laurence Co, Inc., 2200 E. 55th St., Los Angeles, CA 90058-3488; Tel: (800) 421-6144 or (323) 588-1281 Ext. 7770; Fax: (866) 921-0532 or (323) 581-6522; Email: archmetals@cr Laurence.com or VTA approved equal.
 1. Proprietary Products: Use of manufacturer's proprietary product names to designate materials and finishes is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Equivalent products must meet or exceed the requirements of these specifications. Furnish manufacturer's material data that indicates compliance with the requirements of Part 1 of this Section.

2.02 POINT SUPPORT FITTINGS

- A. Fittings are stainless steel 316 Alloy; in brushed (BS suffix) finish. Heavy Duty Spider Fittings must accommodate glass thickness from 3/4-inch. Glass must be tempered laminated glass.

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- B. Austenitic Stainless Steel castings: ASTM A743; 316 Alloy, Grade CF 8 or CF 8M.
- C. Fasteners: Stainless Steel bolts: ASTM F593; 316 Alloy.

2.03 SPIDER FITTING FOR STRUCTURAL GLASS

- A. Heavy Duty Spider Fittings: Post Mount:
 - 1. Double Arm "V" Fitting used to attach a single glass panel to a structural end post, or two in-line glass panels to a structural center:
 - a. Model number: PMH2VBS
 - 2. 4-Way Arm Fitting used to attach 2 in-line glass panels to a structural center post:
 - a. Model number: PMH4BS
 - 3. Head Combination Glass Attachment Fitting:
 - a. Model number: HSF14BS
 - 4. Fin Top/Bottom Shoe Fitting for 3/4 inch glass:
 - a. Model number: FTF12BS; 12 inch fin
 - 5. Fin Suspension Fittings:
 - a. Model number: FSU12BS

2.04 GLASS ATTACHMENTS

- A. Rigid Cap fittings:
 - 1. Model number: RCF12BS
 - 2. Model number: RCF12PS
- B. Rigid Combination fasteners:
 - 1. Model number: RRF10BS
 - 2. Model number: RRF10PS
- C. Countersunk fittings:
 - 1. Model number: SPP0BS – brushed finish
- D. Swivel fittings:
 - 1. Model number: SCF34BS
 - 2. Model number: SCF34BS
 - 3. Model number: SCAP34BS
- E. Combination Swivel fittings:
 - 1. Model number: RSF10BS
 - 2. Model number: HSF14BS

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.

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3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved shop drawings, and engineering calculations.
- B. Point support fittings to be mounted to structural post.
- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

3.03 TOLERANCES

- A. Maximum Variation From True Position: [+/- 1/8 inch] maximum in 12-foot.- 0-inch runs, non-cumulative.
- B. Maximum Offset From True Alignment Between Adjacent Members Butting or In-Line: +/- 1/32-inch.

END OF SECTION 10 73 16.36

SECTION 10 73 16

CANOPIES

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing and installing the metal eyebrow canopy at Elevator.
- B. This Section includes requirements for furnishing and installing the TVM, Shelter Canopies. Each shelter canopy includes all fixed and attached components such as roofing, beams, ceiling finish, gutters, shelter speaker housings, wind screens with poster cabinets and glazing.
- C. Design of all canopies must be in accordance with applicable building codes and ordinances and certified by a professional engineer currently registered in the State of California.

1.02 RELATED SECTIONS

- A. Section 03 23 00, Reinforcing Steel
- B. Section 03 30 00, Cast-in-Place Concrete
- C. Section 05 05 60, Metal Welding
- D. Section 05 12 35, Structural Steel
- E. Section 05 50 00, Metal Fabrications
- F. Section 07 60 00, Flashing and Sheet Metal
- G. Section 07 61 13, Standing Seam Metal Roofing
- H. Section 07 90 00, Joint Protection
- I. Section 08 80 00, Glazing
- J. Section 09 91 00, Painting
- K. Section 09 96 23, Graffiti Resistant Coatings
- L. Section 10 12 00, Display Cases
- M. Section 22 14 13, Facility Storm Drainage Piping
- N. Section 26 50 00, Lighting
- O. Section 27 42 19, Public Address and Passenger Information Monitors

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- P. Section 28 20 00, Video Surveillance (CCTV)
- Q. Section 31 63 29, Drilled Concrete Piers and Shaft

1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.04 SUBMITTALS

- A. General
 - 1. Submittals for Canopies must be made in accordance with the provisions in these technical specifications.
 - 2. The Contractor must submit the following:
 - a. Product Data: Submit manufacturer's specifications and installation instructions. Indicate by transmittal that a copy of each instruction has been forwarded to installer.
 - b. Manufacturer's Drawings: Submit manufacturer's drawings showing details of fabrication and erection, including anchorage, accessories, and finishes. Drawings must be stamped by a structural engineer licensed in the State of California.
 - c. Samples: Submit a sample of deck panel and fascia trim representing materials and finish of canopy to be installed.
 - d. Color Chart: Submit manufacturer's color chart of standard colors for selection of final finished color by VTA.
 - e. Warranty: Submit warranty.
 - f. Certification for manufacturer experience: Submit letter certifying manufacturer's experience.
 - g. Certification for installer experience: Submit letter certifying installer's experience per paragraph.
 - h. Shop Drawings: Submit shop drawings for each shelter canopy type, showing details of fabrication and erection, including anchorage, accessories and finishes.
 - 3. All submittals must be made to VTA for review. The Contractor must not order materials, begin fabrication, or begin construction of work related to the submittal, until the submittal has been reviewed and stamped by VTA with a shop drawing stamp marked "No Exception Taken" or "Make Corrections Noted" and returned to the Contractor by VTA.

1.05 MEASUREMENT AND PAYMENT

- A. Measurement: Canopy Components (of the various types shown in the Bid Form) must be measured by the each assembly.
- B. Payment: The contract price paid per each assembly for Canopy Components (of the various types shown in the Bid Form) must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Canopy components complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

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PART 2 – PRODUCTS

2.01 MATERIALS

- A. Roof deck and trim must be pre-painted, hot-dipped galvanized steel conforming to ASTM A653, Grade 340. Galvanizing must conform to ASTM A653. Paint must be factory applied and uniform.
- B. Roof beams must conform to ASTM A653, Grade 340. Galvanizing must conform to ASTM A653.
- C. Nails and/or Fasteners: Manufacturer's standard, compatible with the fabricated item.

2.02 PAINTED FINISH

- A. Preparatory Work: Grind welds smooth and flush, and polish exposed weld marks to match adjacent material. Pre-treat surfaces to receive paint coating.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Inspect conditions of related work and verify dimensions and determine that there are no irregularities which would interfere with the satisfactory installation of the units. Notify VTA in writing of any conditions detrimental to the timely completion of the Work. Do not proceed with the work of this Section until unsatisfactory conditions have been corrected.

3.02 INSPECTION

- A. Verify that the canopy has been fabricated and installed straight and true.

3.03 INSTALLATION

- A. Install canopy in accordance with manufacturer's shop drawings and specifications.
- B. Install pre-engineered metal canopy as shown on the accepted shop drawings, following the procedures defined in the manufacturer's recommended installation instructions.

3.04 TOLERANCES

- A. Maximum variation from plan, elevation or location indicated on the Plans: 1/8-inch.
- B. Maximum variation in offset from true alignment between adjacent members, butting or in line: 1/8-inch.

3.05 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under the provisions of the General and Special Conditions of this Contract

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3.06 ADJUSTING AND CLEANING

- A. Clean up site and remove any debris or excess materials created during installation of the canopy.

3.07 PROTECTION

- A. Protect finished installation from damage during the completion of related work and until the project is substantially complete. Contractor must be responsible for repairing any damages occurring to the canopy.

END OF SECTION 10 73 16

SECTION 10 81 13
BIRD CONTROL DEVICES

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes requirements for furnishing and installing Bird Spike Strips located:
 - 1. All exposed piping in public areas
 - 2. As indicated in the Contract Drawings

1.02 RELATED SECTIONS

- A. Section 07 60 00, Flashing and Sheet Metal

1.03 SUBMITTALS

- A. General: Submittals for Bird Control Devices must be made in accordance with the provisions in these Technical Specifications.
- B. Shop Drawings: Submit detailed Shop Drawings of the bird control devices including installation, hardware, and accessories.
- C. Product Data:
 - 1. Manufacturer's product data and installation instructions.
 - 2. Catalog cuts, marked to indicate applicable requirements.
- D. Samples: Submit two samples for each product used.
 - 1. Bird control strips: minimum 6 inch sample.

1.04 MEASUREMENT AND PAYMENT

- A. Measurement: Bird Control Devices must be measured by the lump sum price as listed in the Schedule of Quantities and Prices.
- B. Payment: The lump sum payment for Bird Control Devices must include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all Work involved in constructing Bird Control Devices complete in place, as shown on the drawings, as specified in these Technical Specifications, and as directed by the VTA.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original unopened packaging with legible manufacturer's identification.
- B. Store delivered products in clean, safe, dry area.
- C. Protect products from damage before, during, and after the installation.

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1.06 QUALITY ASSURANCE

- A. Single Source Responsibility: Furnish products from one manufacturer for entire project.
- B. Obtain all technical information from the manufacturer.
- C. Installer must visit the site to gather all information of existing site conditions.

1.07 PRODUCT CONDITIONS

- A. Coordination: Coordinate installation with other work, existing conditions, and within on-site tolerances. Provide hardware and accessories as necessary for the proper installation and function.
- B. Visit site and field measure prior to fabrication and delivery of materials.

1.08 WARRANTY

- A. Provide manufacturer's guarantee as follows:
 - 1. Bird wire system: Five years.
 - 2. Bird spike strips: Five years.
 - 3. Bird Slope System: Minimum two year guarantee against U.V. breakdown.

PART 2 – PRODUCTS

2.01 BIRD SPIKE STRIPS

- A. Material: Ultraviolet (UV) stabilized polycarbonate, heat and weather resistant form -200 to +300 degrees Fahrenheit, one piece construction, minimum 3 inch width, minimum 4 inch height, minimum 40 spikes per foot in linear array with no gap center spike, non-staggered design, and flexible for wrapping around rounded surface (e.g. light fixture).
- B. Mounting: adhesive as recommended by manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the area and delivered products and verify that:
 - 1. Dimensions are correct to the delivered products.
 - 2. Adjacent or adjoining surfaces are clean, dry, reasonably smooth, and free from defects.
 - 3. There is absence of other conditions that will adversely affect installation.
- B. Do not start work until unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Prior to installation, clear surface of bird dropping, nesting material or other debris. Remove or repair articles that may damage after installation, including overhanging foliage, brush, and loose parts of the structure. Use appropriate disinfectant to prepare surface.

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3.03 INSTALLATION

- A. Install bird control devices in accordance with manufacturer's recommendation and reviewed Shop Drawings.
- B. Bird Control Strip: Install bird control where noted, leaving no gaps for perching.

3.04 PROTECTION

- A. Protect work from damage to surface, profile and shape.

END OF SECTION 10 81 13

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