LAGUNA NIGUEL TO SAN JUAN CAPISTRANO PASSING SIDING

IFB 7-2018

Volume 2

CONTRACT TECHNICAL SPECIFICATIONS

August 10, 2018

(PAGE INTENTIONALLY LEFT BLANK)

OCTA
LAGUNA NIGUEL TO SAN JUAN CAPISTRANO PASSING SIDING PROJECT

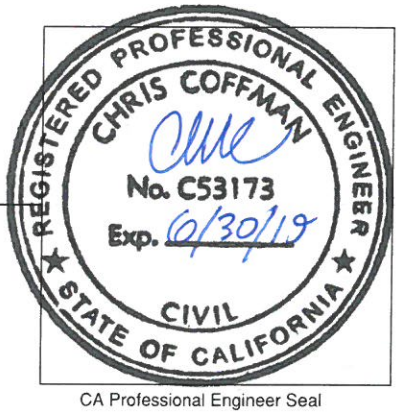
CONTRACT TECHNICAL SPECIFICATIONS

The specifications provided herein have been prepared by or under the direction of the following Registered Persons:

CIVIL AND TRACK

8/2/18

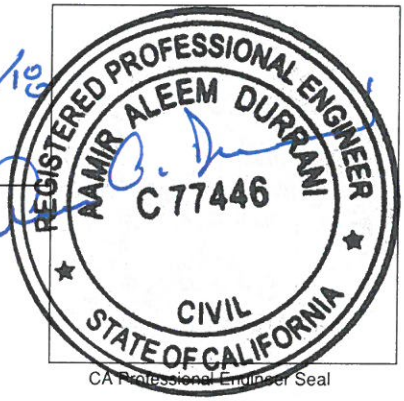
CHRIS COFFMAN



CA Professional Engineer Seal

STRUCTURES

8/3/18

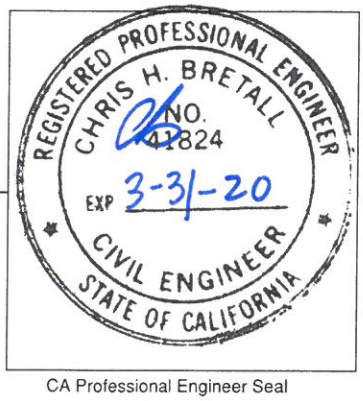


CA Professional Engineer Seal

ROADWAY

8/3/18

CHRIS BRETALL



CA Professional Engineer Seal

(PAGE INTENTIONALLY LEFT BLANK)

OCTA LAGUNA NIGUEL TO SAN JUAN CAPISTRANO PASSING SIDING PROJECT CONTRACT SPECIFICATIONS TABLE OF CONTENTS

SECTION NO.	TITLE	PAGES
DIVISION 01 – GENERAL REQUIREMENTS		
01 11 13	Work Covered by the Contract Documents	10
01 11 15	Definition of Terms and Reference Standards	14
01 11 16	Work by SCRRA	4
01 14 00	Work Restrictions	14
01 14 16	Coordination With SCRRA	6
01 14 19	Coordination with Utilities	14
01 21 00	Allowances	4
01 22 00	Unit Prices	2
01 22 05	Lump Sum Prices	1
01 24 13	Value Engineering Change Proposals (VECP)	4
01 25 00	Substitution Procedures	6
01 26 14	Request for Information	4
01 29 73	Schedule of Values	4
01 31 00	Project Management and Coordination	6
01 31 99	Period of Performance	4
01 32 17	Construction Project Schedule	16
01 32 33	Photographic Documentation	6
01 33 00	Submittal Procedures	18
01 35 15	Maintenance and Protection of Railroad Traffic	2
01 35 23	Site Safety Requirements	6
01 35 44	Environmental Safety and Health Program	6
01 40 00	Quality Requirements	10
01 43 23	Contractor Qualifications and Requirements	14
01 55 26	Maintenance and Protection of Traffic	4
01 56 37	Worksite Security Requirements	4
01 56 38	Bird Protection	2
01 56 39	Temporary Tree and Plant Protection	8
01 57 19	Temporary Environmental Controls	6
01 60 00	Product Requirements	6
01 64 00	SCRRA Furnished Material and Equipment	2
01 71 13	Mobilization, Demobilization, and Controls	16
01 71 23	Field Engineering	4
01 74 19	Construction Waste Management and Disposal	4
01 77 00	Substantial Completion	6
01 77 19	Project Closeout	4
01 78 23	Operation and Maintenance Data	4
01 78 36	Warranties and Guarantees	6
01 78 39	Project Record Documents	4
Division 03 – Concrete		
03 21 00	Reinforcing Steel	14
03 31 00	Structural Concrete	25
03 40 00	Precast Concrete	8

OCTA LAGUNA NIGUEL TO SAN JUAN CAPISTRANO PASSING SIDING PROJECT CONTRACT SPECIFICATIONS TABLE OF CONTENTS

SECTION NO.	TITLE	PAGES
Division 05 - Metals		
05 52 00	Hand Rails and Railing	6
05 53 00	Metal Grating	6
05 55 00	Miscellaneous Metals	6
Division 09 – Finishes		
09 90 00	Painting and Coatings	6
09 96 23	Graffiti-Resistant Coating	4
Division 10 – Specialties		
10 14 53	Roadway Signs	12
10 14 55	Railroad Signage	6
Division 26 – Electrical		
26 06 00	Grounding and Bonding	10
Division 31 - Earthwork		
31 11 00	Site Clearing	6
31 11 50	Demolition, Cutting and Patching	10
31 20 00	Earthwork	26
31 32 32	Lightweight Cellular Concrete	6
31 50 00	Excavation Support	10
Division 32 – Exterior Improvements		
32 12 00	Hot Mix Asphalt (HMA) Pavement	8
32 16 00	Curbs, Gutters, and Sidewalks	4
32 17 23	Pavement Markings	4
32 31 13	Chain Link Fencing and Gates	8
32 31 16	Welded Wire Fencing and Gates	4
32 32 16	Gravity Block Retaining Walls	6
32 32 21	Prefabricated Modular Block (PMB) Retaining Walls	14
32 32 43	Permanent Soldier Pile Wall	8
32 91 00	Soil Erosion, Sediment Control, Top Soiling and Seeding	22
Division 33 – Utilities		
33 42 00	Culvert and Drainage Pipe	18
33 46 00	Underdrains	6
Division 34 – Transportation		
Track Materials		
34 11 10	Continuous Welded Rail (CWR)	26
34 11 15	Other Track Materials (OTM)	8
34 11 23	Special Trackwork	8
34 11 26	Ballast	8
34 11 27	Sub-Ballast and Aggregate Base	4
34 11 33	Concrete Railroad Ties	30
34 11 34	Wood Railroad Ties	14
34 11 36	Elastic Rail Fasteners	8

OCTA LAGUNA NIGUEL TO SAN JUAN CAPISTRANO PASSING SIDING PROJECT CONTRACT SPECIFICATIONS TABLE OF CONTENTS

SECTION NO.	TITLE	PAGES
34 11 40	Precast Concrete Grade Crossing Panels	6
Railroad Signals		
34 42 18	Conduit and Pull Boxes	8
Highway-Rail Grade Crossings		
34 71 50	Highway-Rail Grade Crossings	10
Track Construction		
34 72 00	Trackwork	24
34 72 20	Track Shifting, Relocation and Resurfacing	8
34 72 30	Field Welding Rail	8
Railroad Bridges		
34 80 11	Stone Revetment (Riprap)	10

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 03 21 00

REINFORCING STEEL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Reinforcing steel bar requirements for concrete construction.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 03 31 00 – Structural Concrete

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. SP 66, ACI Detailing Manual.

2. 318, Building Code Requirements for Structural Concrete.

B. ASTM International (ASTM):

1. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

2. A497, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.

3. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

4. A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

C. American Welding Society (AWS):

1. D1.4, Structural Welding Code - Reinforcing Steel.

D. Concrete Reinforcing Steel Institute (CRSI):

1. Manual of Standard Practice.

E. Current California Department of Transportation Standard Specifications 2010.

F. American Railway Engineering and Maintenance-of-Way Association (AREMA)

1. Chapter 8 – Concrete Structures and Foundations.

1.03 SUBMITTALS

A. Shop Drawings:

1. See Division 01 for requirements for the mechanics and administration of the submittal process.

2. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

c. Mill certificates for all reinforcing.

d. Manufacturer and type of proprietary rebar mechanical splices.

e. Manufacturer and type of rebar adhesive anchor including installation instructions.

3. “Buy America” Certificate of Compliance

4. Qualifications of welding operators, including Qualification Certificates conforming to AWS D1.4.

5. Provide Task Hazard Safety Analysis and required safety plan as part of the Site Specific Health and Safety Plan

6. Welding processes and procedures.

7. Rebar number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and rebar supports.

8. Sufficient rebar details to permit installation of reinforcing.

9. Rebar details in accordance with ACI SP 66.

10. Locations where proprietary rebar mechanical splices are required or proposed for use.

11. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Plans.

a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Plans but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Welding operators, processes and procedures shall be qualified in accordance with AWS D1.4.

2. Welding operators must have been qualified during the previous 12 months prior to commencement of welding.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Support and store all reinforcing above ground.

B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the Shop Drawing mark numbers.

C. Handling of Epoxy-Coated Rebar:

1. Use padded or nonmetallic slings and padded straps to protect coated reinforcement from damage.

2. Handle bundled bars to prevent sagging that could damage the coating.

3. Do not drop or drag rebars.

4. Store on wooden cribbing.

5. Coated rebars subject to rejection by Engineer if rebar coating has been damaged. The rebars may be used for repair if approved by Engineer.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURES

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Rebar adhesive anchors:

a. HIT-HY150 System by HILTI FASTENING SYSTEMS, INC.

b. Epcon Adhesive Anchoring System by ITW Ramset/Red Head.

c. Power-Fast by Powers Fastening, Inc.

d. Or substantially equivalent product approved in writing by OCTA.

2. Rebar mechanical splices:

a. Lenton Rebar Splicing by Erico, Inc.

b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.

c. Bar-Grip Systems by Barsplice Products, Inc.

d. Or substantially equivalent product approved in writing by OCTA.

B. Submit request for substitution in accordance with Division 01.

2.02 MATERIALS

A. Reinforcing Bars: ASTM A615, grade 60, deformed.

B. Reinforcing Bars to be Welded: ASTM A706.

C. Welded Wire Reinforcement: ASTM A185 or ASTM A497.

D. Smooth Dowel Bars: ASTM A615, grade 60 with metal end cap to allow longitudinal movement equal to joint width plus 1 inch.

E. Epoxy-Coated Rebars: ASTM A775 and ASTM A615, Grade 60, meeting Annex A1 for epoxy coating.

F. Epoxy-Coated Rebar Patching Material:

1. Compatible with the coating material.

2. Inert in concrete.

3. Meet requirements of Annex A1 of ASTM A775.

4. Obtained from the manufacturer of the epoxy resin that was used to originally coat the rebars.

G. Proprietary Rebar Mechanical Splices: To develop in tension and compression a minimum of 125 percent of the yield strength of the rebars being spliced.

H. Welding Electrodes:

1. E90 meeting requirements of AWS D1.4.

I. Rebar Adhesive Anchors:

1. Manufactured for the specific purpose of embedding and developing 125 percent of the yield strength of rebars in hardened concrete.

2.03 ACCESSORIES

A. Metal Chairs, Runners, Bolsters, Spacers, Hangers, and Other Rebar Supports:

1. Plastic-coated tips in contact with forms.

2. Plastic coating meeting requirements of CRSI Manual of Standard Practice.

B. Protective plastic caps at mechanical splices.

2.04 FABRICATION

A. Tolerances:

1. Sheared lengths: +1 inch.

2. Overall dimensions of stirrups, ties and spirals: +1/2 inches.

3. All other bends: +0 inch, -1/2 inches.

B. Minimum diameter of bends measured on the inside of the rebar to be as indicated in ACI 318 Paragraph 7.2.

C. Ship rebars to jobsite with attached plastic or metal tags.

1. Place on each tag the mark number of the rebar corresponding to the mark number indicated on the Shop Drawing.

2. Mark numbers on tags to be so placed that the numbers cannot be removed.

3. For epoxy-coated rebars, use only plastic tags secured to rebars by nylon or plastic ties.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Tolerances:

1. Rebar placement:

a. Clear distance to formed surfaces: +1/4 inches.

b. Minimum spacing between bars: -1/4 inches.

c. Top bars in slabs and beams:

1) Members 8 inches deep or less: +1/4 inches.

2) Members between 8 inches and 2 feet deep: -1/4 inches, +1/2 inches.

3) Members more than 2 feet deep: -1/4 inches, +1 inches.

d. Crosswise of members: Spaced evenly within +1 inches.

e. Lengthwise of members: +2 inches.

2. Minimum clear distances between rebars:

a. Beams, walls and slabs: Distance equal to rebar diameter or 1 inch, whichever is greater.

b. Columns: Distance equal to 1-1/2 times the rebar diameter or 1-1/2 inches, whichever is greater.

c. Beam and slab rebars shall be threaded through the column vertical rebars without displacing the column vertical rebars and still maintaining the clear distances required for the beam and slab rebars.

B. Minimum concrete protective covering for reinforcement: As shown on Plans.

C. Minimum concrete protective covering for reinforcement, unless indicated otherwise on Plans:

1. Three (3) inches for concrete cast against earth, 2 inches all other locations.

D. Unless indicated otherwise on Plans, provide splice lengths for reinforcing as follows:

1. For rebars: Class B splice meeting the requirements of Paragraph 12.15 of ACI 318.

2. For welded wire reinforcement:

a. Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than one (1) spacing of cross wires plus 2 inches, nor less than 1.5 x development length nor less than 6 inches.

b. Development length shall be as required for the yield strength of the welded wire reinforcement in accordance with Paragraph 12.8 of ACI 318.

3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.

a. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Plans.

E. Reinforcing Steel Splices:

1. Splices of reinforcing bars shall consist of lap splices, service splices, or ultimate butt splices.

2. Splicing of reinforcing bars will not be permitted at a location designated on the plans as a "No-Splice Zone."

3. At the option of the Contractor, reinforcing bars may be continuous at locations where splices are shown on the plans.

4. The location of splices, except where shown on the plans, shall be determined by the Contractor using available commercial lengths where practicable.

5. Unless otherwise shown on the plans, splices in adjacent reinforcing bars at any particular section shall be staggered.

   a. The minimum distance between staggered lap splices or mechanical lap splices shall be the same as the length required for a lap splice in the largest bar.

   b. The minimum distance between staggered butt splices shall be 2 feet, measured between the midpoints of the splices along a line which is centered between the axes of the adjacent bars.

6. Lap Splicing Requirements:

   a. Splices made by lapping shall consist of placing reinforcing bars in contact and wiring them together, maintaining the alignment of the bars and the minimum clearances.

   b. Should the Contractor elect to use a butt welded or mechanical splice at a location not designated on the plans as requiring a service or ultimate butt splice, this splice shall conform to the testing requirements for service splice.

   c. Reinforcing bars shall not be spliced by lapping at locations where the concrete section is not sufficient to provide a minimum clear distance of 2 inches between the splice and the nearest adjacent bar.

   d. The clearance to the surface of the concrete specified on the Plans shall not be reduced.

7. Service Splicing and Ultimate Butt Splicing Requirements:

   a. Service splices and ultimate butt splices shall be either butt welded or mechanical splices, shall be used at the locations shown on the plans, and shall conform to the requirements of these Specifications and the Plans.

8. Mechanical Splices:

   a. Mechanical splices shall not be used for any reinforcing steel in the “Ultimate Splice Zone” as indicated on the Plans.

   b. Any mechanical splices proposed by the Contractor shall be submitted for review and approval by the Engineer prior to reinforcing steel fabrication.

   c. Only mechanical splices prequalified by the Transportation Laboratory of the California Department of Transportation shall be allowed.

   d. Submittal of proposed mechanical splices shall include:

      1) The type or series identification of the splice material including tracking information for traceability.

      2) The bar grade and size number to be spliced.

      3) A copy of the manufacturer's product literature giving complete data on the splice material and installation procedures.

      4) A statement that the splicing systems and materials used in conformance with the manufacturer's installation procedures will develop the required tensile strengths, based on the nominal bar area, and will conform to the total slip requirements and the other requirements in the California Department of Transportation Standard Specifications.

      5) A statement that the splice material conforms to the type of mechanical splice in the California Department of Transportation current prequalified list.

9. Butt Welded Splices:

   a. Except for resistance butt welds, butt welded splices of reinforcing bars shall be complete joint penetration butt welds conforming to the requirements in AWS D 1.4, and these Specifications.

   b. Welders and welding procedures shall be qualified in conformance with the requirements in AWS D 1.4.

   c. Only the joint details and dimensions as shown in Figure 3.2, "Direct Butt Joints," of AWS D 1.4, shall be used for making complete joint penetration butt welds of bar reinforcement.

      1) Split pipe backing shall not be used.

d. Butt welds shall be made with multiple weld passes using a stringer bead without an appreciable weaving motion.

1) The maximum stringer bead width shall be 2.5 times the diameter of the electrode and slagging shall be performed between each weld pass.

2) Weld reinforcement shall not exceed 0.16 inches in convexity.

e. Electrodes used for welding shall meet the minimum Charpy V-notch impact requirement of 27°J at -4 degrees.

f. All bars to be welded shall conform to the requirements of ASTM A706.

g. In the event that any of the specified preheat, interpass, and post weld cooling temperatures are not met, all weld and heat affected zone metal shall be removed and the splice rewelded.

h. Welding shall be protected from air currents, drafts, and precipitation to prevent loss of heat or loss of arc shielding.

1) The method of protecting the welding area from loss of heat or loss of arc shielding shall be subject to approval by the Engineer.

i. Reinforcing bars shall not be direct butt spliced by thermite welding.

j. Procedures to be used in making welded splices in reinforcing bars, and welders employed to make splices in reinforcing bars, shall be qualified by tests performed by the Contractor on sample splices of the type to be used, before making splices to be used in the work.

10. Resistance Butt Welding:

a. Shop produced resistance butt welds shall be produced by a fabricator who is approved by the Transportation Laboratory of the California Department of Transportation.

b. Before manufacturing hoops using resistance butt welding, the Contractor shall submit to the Engineer the manufacturer's Quality Control (QC) manual for the fabrication of hoops.

1) As a minimum, the QC manual shall include the following:

a) The pre-production procedures for the qualification of material and equipment.

b) The methods and frequencies for performing QC procedures during production.

c) The calibration procedures and calibration frequency for all equipment.

d) The Welding Procedure Specification (WPS) for resistance welding.

e) The method for identifying and tracking lots.

11. Service Splice and Ultimate Butt Splice Testing Requirement:

a. Testing and reporting of test results for Service and Ultimate Butt Splices shall conform to the California Department of Transportation Standard Specification, Section 52 Reinforcement.

F. Placing Rebars:

1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.

2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM Specification that governs for the rebar supplied.

3. Rebar support:

a. Uncoated rebar:

1) Support rebars and fasten together to prevent displacement by construction loads or placing of concrete.

a) Locate and support reinforcement with bar supports to maintain minimum concrete cover.

b) Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

2) On ground, provide supporting concrete blocks to support reinforcing steel.

3) Over formwork, provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other rebar support.

a) Only tips in contact with the forms need to be plastic coated.

b. Coated rebar:

1) Support coated rebars and fasten together to prevent displacement.

2) Use plastic or nylon ties to hold rebars rigidly in place.

3) Support rebars by use of plastic or plastic-coated chairs, runners, bolsters, spacers, hangers and rebar supports as required.

4. Support rebars over cardboard void forms by means of concrete supports which will not puncture or damage the void forms during construction nor impair the strength of the concrete members in any way.

5. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, rebars in the upper layers shall be placed directly above rebars in the bottom layer with clear distance between layers to be 1 inches.

   a. Place spacer rebars at 3 feet maximum centers to maintain the required 1 inches clear distance between layers.

6. Extend reinforcement to within 2 inches of concrete perimeter edges.

   a. If perimeter edge is formed by earth, extend reinforcement to within 3 inches of the edge.

7. To assure proper placement, furnish templates for all column/pier vertical bars and dowels.

8. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer.

   a. Do not bend reinforcing by means of heat.

9. Do not tack weld reinforcing.

10. Embed rebars into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:

    a. Drill hole in concrete with diameter and depth as required to develop 125 percent of the yield strength of the bar according to manufacturer's requirements.

    b. Clean holes per manufacturer's recommendations.

    c. Place adhesive in drilled hole.

    d. Insert rebar into hole and adhesive in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Reinforcement Congestion and Interferences:

1. Notify Engineer whenever the specified clearances between rebars cannot be met.

2. Do not place any concrete until the Engineer submits a solution to rebar congestion problem.

3. Rebars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.

4. If rebars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of rebars.

5. No cutting of rebars shall be done without written approval of Engineer.

B. Inspection of Epoxy-Coated Rebars:

1. Coated rebars will be inspected on the jobsite for handling defects, coating abrasion, coating thickness and continuity of coating.

2. Engineer may defer final inspection of rebar coating integrity and repairs until the rebars have been erected and all handling is completed.

3. Repair coated areas as directed by Engineer.

   a. Do not place concrete until all repairs to coatings have been completed.

C. Patching of Epoxy-Coated Rebar:

1. Patching and repair to be performed in accordance with the instructions of patching material manufacturer.

2. Patching material to provide a minimum film thickness of 5 mils over the bare area.

   a. Thickness of area adjacent to patched area not to exceed 15 mils.

3. Areas to be patched to be clean and free of surface contaminants.

   a. Treat areas in accordance with patching material manufacturer's instructions before oxidation occurs.

4. Total surface area covered by patching material not to exceed 2 percent of total surface area of the rebar.

5. Rebar welds and adjacent bare rebar areas to also be patched after welding is completed.

D. Employ a testing laboratory to perform and report following:

1. Review and approve Contractor proposed welding procedures and processes for conformance with AWS D1.4.

2. Qualify welders in accord with AWS D1.4.

3. Test three (3) samples of each bar size and each type of weld in accord with AWS D1.4.

a. The tensile strength of each test shall be not less than 125 percent of the required yield strength of the rebar tested.

4. Conduct nondestructive field tests (radiographic or magnetic particle) on not less than one (1) random sample for each 10 welds.

a. In addition if any welds are found defective, test five (5) previous welds performed by same welder.

5. Visually inspect each weld for presence of cracks, undercuts, inadequate size and other visible defects.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. Reinforcing Steel shall be considered incidental structural concrete or other Contract work items requiring reinforcing steel. No separate measurement or payment will be made for reinforcing steel,

B. Furnishing all tie wires, blocks, chairs and other supporting devices shall be considered incidental and no separate payment will be made therefore.

C. Furnishing and testing sample splices, radiographic examinations performed by the Contractor and furnishing access facilities for inspection and non-destructive testing by the Engineer shall be considered incidental and no additional compensation will be allowed therefore.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 03 31 00

STRUCTURAL CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cast-in-place concrete and grout.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 03 21 00 – Reinforcing Steel.

1.02 REFERENCES

A. American Railway Engineering and Maintenance-of-Way Association (AREMA)

1. Chapter 8 – Concrete Structures and Foundations

B. American Concrete Institute (ACI):

1. 116R, Cement and Concrete Terminology.

2. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

3. 212.3R, Chemical Admixtures for Concrete.

4. 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.

5. 304.2R, Placing Concrete by Pumping Methods.

6. 305R, Hot Weather Concreting.

7. 306R, Cold Weather Concreting.

8. 318, Building Code Requirements for Structural Concrete.

9. 347R, Recommended Practice for Concrete Formwork.

C. ASTM International (ASTM):

1. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.

2. C33, Standard Specification for Concrete Aggregates.

3. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

4. C94, Standard Specification for Ready-Mixed Concrete.

5. C138, Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

6. C143, Standard Test Method for Slump of Hydraulic Cement Concrete.

7. C150, Standard Specification for Portland Cement.

8. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.

9. C172, Standard Practice for Sampling Freshly Mixed Concrete.

10. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

11. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

12. C260, Standard Specification for Air-Entraining Admixtures for Concrete.

13. C289, Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).

14. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

15. C494, Standard Specification for Chemical Admixtures for Concrete.

16. C578, standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

17. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

18. C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Testing Agency Evaluation.

19. C1240, Standard Specification for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout.

20. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

21. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

22. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

23. E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.

D. Corps of Engineers (COE):

1. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Nonshrink).

E. Standard Specifications for Public Works Construction, SSPWC 2012 Edition.

1.03 DEFINITIONS

A. Per ACI 116R except as modified herein:

1. Concrete fill: Non-structural concrete.

2. Concrete Testing Agency: Testing agency employed to perform materials evaluation, design of concrete mixes or testing of concrete placed during construction.

3. Exposed concrete: Exposed to view after construction is complete.

4. Indicated: Indicated by Contract Documents.

5. Nonexposed concrete: Not exposed to view after construction is complete.

6. Required: Required by Contract Documents.

7. Specified strength: Specified compressive strength at 28 days.

8. Submitted: Submitted to Engineer.

1.04 SUBMITTALS

A. Testing Laboratory Certification

1. Testing Laboratory Certifications

B. Shop Drawings:

1. See Division 01 for requirements for the mechanics and administration of the submittal process.

2. Concrete mix designs proposed for use.

    a. Concrete mix design submittal to include the following information:

        1) Sieve analysis and source of fine and coarse aggregates.

        2) Test for aggregate organic impurities.

        3) Test for deleterious aggregate per ASTM C289.

        4) Proportioning of all materials.

        5) Type of cement with mill certificate for cement.

        6) Type of fly ash with certificate of conformance to Specification requirements.

        7) Slump.

        8) Air content.

        9) Brand, type, ACI or ASTM designation, and quantity of each admixture proposed for use.

        10) 28-day cylinder compressive test results of trial mixes per ACI 318 and as indicated herein.

        11) Shrinkage test results.

        12) Standard deviation value for concrete production facility.

3. Product technical data including:

    a. Acknowledgement that products submitted meet requirements of standards referenced.

    b. Manufacturer's installation instructions.

    c. Manufacturers and types:

        1) Joint fillers.

        2) Curing agents.

        3) Bonding and patching mortar.

        4) Construction joint bonding adhesive.

        5) Non-shrink grout with cure/seal compound.

4. Reinforcing steel:

    a. Per Specification Section 03 21 00.

1.05 QUALITY ASSURANCE

A. Quality Assurance:

1. Concrete testing agency:

    a. Contractor must employ at its own expense the services of a California certified testing laboratory to:

        1) Perform materials evaluation.

        2) Design concrete mixes.

    b. Concrete testing agency to meet requirements of ASTM E329.

2. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.

    a. Approval of concrete mix design by Engineer does not relieve Contractor of his responsibility to provide concrete that meets the requirements of this Specification.

3. Adjust concrete mix designs when material characteristics, job conditions, weather, strength test results or other circumstances warrant.

    a. Do not use revised concrete mixes until submitted to and approved by Engineer.

4. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon.

B. Qualifications:

1. Ready mixed concrete batch plant certified by National Ready Mixed Concrete Association (NRMCA).

2. Formwork, shoring and reshoring for slabs and beams except where cast on ground to be designed by a professional engineer currently registered in the state where the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage of Material:

1. Cement and fly ash:

a. Store in moistureproof, weathertight enclosures.

b. Do not use if caked or lumpy.

2. Aggregate:

a. Store to prevent segregation and contamination with other sizes or foreign materials.

b. Obtain samples for testing from aggregates at point of batching.

c. Do not use frozen or partially frozen aggregates.

d. Do not use bottom 6 inches of stockpiles in contact with ground.

e. Allow sand to drain until moisture content is uniform prior to use.

3. Admixtures:

a. Protect from contamination, evaporation, freezing, or damage.

b. Maintain within temperature range recommended by manufacturer.

c. Completely mix solutions and suspensions prior to use.

4. Reinforcing steel: Support and store all rebars above ground.

B. Delivery:

1. Concrete:

a. Prepare a delivery ticket for each load for ready-mixed concrete.

b. Truck operator shall hand ticket to Engineer at the time of delivery.

c. Ticket to show:

1) Mix identification mark.

2) Quantity delivered.

3) Amount of each material in batch.

4) Outdoor temp in the shade.

5) Time at which cement was added.

6) Numerical sequence of the delivery.

7) Amount of water added.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:

1. Nonshrink, nonmetallic grout:

   a. Sika "SikaGrout 212."

   b. Euclid Chemial "NS Grout."

   c. BASF Admixtures, Inc. "Masterflow 713."

   d. Or substantially equivalent product approved in writing by OCTA

2. Epoxy grout:

   a. BASF Admixtures, Inc. "Brutem MPG."

   b. Euclid Chemical Company, "E3-G."

   c. Fosroc, "Conbextra EPHF".

   d. Or substantially equivalent product approved in writing by OCTA

3. Expansion joint fillers:

   a. Permaglaze Co.

   b. Rubatex Corp.

   c. Williams Products, Inc.

   d. Or substantially equivalent product approved in writing by OCTA

4. Form coating:

   a. Richmond "Rich Cote."

   b. Industrial Lubricants "Nox-Crete Form Coating."

   c. Euclid Chemical "Eucoslip VOX."

   d. Or substantially equivalent product approved in writing by OCTA

5. Prefabricated forms:

   a. Simplex "Industrial Steel Frame Forms."

b. Symons "Steel Ply."

c. Universal "Uniform."

d. Or substantially equivalent product approved in writing by OCTA

6. Bonding agent:

a. Euclid Chemical Co.

b. BASF Admixtures, Inc.

c. L & M Construction Chemicals Inc.

d. Or substantially equivalent product approved in writing by OCTA

7. Calcium nitrate:

a. Grace Concrete Products.

1) DCI.

2) DCI'S.

b. Euclid Chemical Company.

1) Eucon BCN.

2) Eucon CIA.

c. Or substantially equivalent product approved in writing by OCTA

8. Microsilica (Silica Fume):

a. Grace Concrete Products "Force 10,000 D".

b. Euclid Chemical Company "Eucon MSA".

c. Or substantially equivalent product approved in writing by OCTA

B. Submit request for substitutions in accordance with Division 01.

2.02 MATERIALS

A. Portland Cement: Conform to ASTM C150 Type II, III or V.

B. Fly Ash:

1. ASTM C618, Class F or Class C.

2. Non-Staining.

a. Hardened concrete containing fly ash to be uniform light gray color.

3. Maximum loss on ignition: 4 percent.

4. Compatible with other concrete ingredients.

5. Obtain proposed fly ash from a source approved by the State Highway Department in the State of California for use in concrete for bridges. A list of pre-approved products may be obtained from the following website: http://www.dot.ca.gov/hq/esc/approved_products_list/

C. Admixtures:

1. Air entraining admixtures: ASTM C260.

2. Water reducing, retarding, and accelerating admixtures:

a. ASTM C494 Type A through E.

b. Conform to provisions of ACI 212.3R.

c. Do not use retarding or accelerating admixtures unless specifically approved in writing by Engineer and at no cost to OCTA.

d. Follow manufacturer's instructions.

e. Use chloride free admixtures only.

3. Maximum total water soluble chloride ion content contributed from all ingredients of concrete including water, aggregates, cementitious materials and admixtures by weight percent of cement:

a. 0.10 all concrete.

4. Do not use calcium chloride.

5. Pozzolanic admixtures: ASTM C618.

6. Calcium nitrate: ASTM C494 Type C.

7. Microsilica: ASTM C1240.

8. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in the mix design.

D. Water: Potable, clean, free of oils, acids and organic matter.

E. Aggregates:

1. Normal weight concrete: ASTM C33, except as modified below.

2. Fine aggregate:

   a. Clean natural sand.

   b. No manufactured or artificial sand.

3. Coarse aggregate:

   a. Crushed rock, natural gravel, or other inert granular material.

   b. Maximum amount of clay or shale particles: 1 percent.

4. Gradation of coarse aggregate:

   a. Lean concrete and concrete topping: Size #7 or #8.

   b. All other concrete: Size #57 or #67.

F. Concrete Grout:

1. Nonshrink nonmetallic grout:

   a. Nonmetallic, noncorrosive, nonstaining, premixed with only water to be added.

   b. Grout to produce a positive but controlled expansion.

   c. Mass expansion not to be created by gas liberation.

   d. Minimum compressive strength of non-shrink grout at 28 days: 6500 psi.

   e. In accordance with COE CRD-C621.

2. Epoxy grout:

   a. 3-component epoxy resin system.

      1) Two liquid epoxy components.

      2) One inert aggregate filler component.

   b. Each component packaged separately for mixing at jobsite.

   c. Minimum compressive strength of epoxy grout shall be as specified in the Plans.

G. Forms:

1. Prefabricated or job built.

2. Wood forms:

   a. New 5/8 or 3/4 inches 5-ply structural plywood of concrete form grade.

   b. Built-in-place or prefabricated type panel.

   c. 4 x 8 feet sheets for built-in-place type except where smaller pieces will cover entire area.

   d. When approved, plywood may be reused.

3. Metal forms:

   a. Metal forms excluding aluminum may be used.

   b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.

4. Chamfer strips: Clear white pine, surface against concrete planed.

5. Form ties:

   a. Removable end, permanently embedded body type with cones on outer ends not requiring auxiliary spreaders.

   b. Cone diameter: 3/4 inches minimum to 1 inch maximum.

   c. Embedded portion 1-1/2” minimum back from concrete face.

   d. If not provided with threaded ends, constructed for breaking off ends without damage to concrete.

   e. Provide ties with built-in waterstops at all walls that will be in contact with process liquid during plant operation.

6. Form release: Nonstaining and shall not prevent bonding of future finishes to concrete surface.

H. Membrane Curing Compound:

1. ASTM C309, Type I-D.

2. Resin based, dissipates upon exposure to UV light.

3. Curing compound shall not prevent bonding of any future coverings, coatings or finishes.

4. Curing compounds used in water treatment plant construction to be nontoxic and taste and odor free.

I. Bonding Agent:

1. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.

2. Euclid Chemical Co. "Flex-Con."

3. BASF Admixtures, Inc. "Acryl-Set."

4. L & M Construction Chemicals "Everbond."

5. Thoro System Products "Acryl 60."

6. Or substantially equivalent product approved in writing by OCTA

J. Expansion Joint Filler:

1. In contact with water or sewage:

a. Closed cell neoprene.

b. ASTM D1056, Class SC (oil resistant and medium swell) of 2 to 5 psi compression deflection (Grade SCE41).

2. Exterior walking surfaces:

a. Asphalt expansion joint filler.

b. ASTM D994.

3. Other use:

a. Fiber expansion joint filler.

b. ASTM D1751.

K. Bead Board

1. The bead board panels shall be a minimum of two (2) inch thick, four (4) feet wide, and 8 feet long and shall meet the requirements of ASTM C578.

2. Bead board coat: A suitable and compatible bonding material for permanently adhering.

2.03 CONCRETE MIXES

A. General:

1. All concrete to be ready mixed concrete conforming to ASTM C94.

2. Provide concrete of specified quality capable of being placed without segregation and, when cured, of developing all properties required.

3. All concrete to be normal weight concrete.

B. Strength:

1. Provide specified strength and type of concrete for each use in structure(s) as follows:

Type of Construction	Concrete Class*	Maximum Slump (Inches)
Street Surface Improvements		
Concrete Pavement (not integral with curb)	565-C-3250	4”
Curb, Integral Curb and Pavement, Gutter, Walk, Alley Aprons, Extruded Curb & Gutter	565-C-3250	4”
Sewer and Storm Drainage Facilities		
Pipe Collars, Beam Support for Pipe, Pre-Cast Manhole Components, Catch Basins, Sidewalk Culverts	565-C-3250	4”
Pipe Bedding and Encasement, Anchors and Thrust Blocks, Wall Support for Pipe	520-C-2500	4”
Tunnel and Trench Backfill	520-C-2500	4”
Reinforced Structures		
Bridges, Buildings, Retaining Walls	650-CW-4000	4”
Cast-In-Place Piles	650-CW-4000	4”
Channel and Boxes	650-CW-4000	4”
Walls and Deck	650-CW-4000	4”
Miscellaneous		

Street Light and Traffic Signal Foundations, Survey Monuments	565-C-3250	4”
Fence and Guard Post Foundations	565-C-3250	4”
Coarse Masonry Grout	610-E-2000G	10”

*Refer to SSPWC Section 201 for designation.

C. Air Entrainment:

1. Provide air entrainment in all concrete resulting in a total air content percent by volume as follows:

MAX AGGREGATE SIZE	TOTAL AIR CONTENT PERCENT
1 inch or 3/4 inches	5 to 7

2. Air content to be measured in accordance with ASTM C231, ASTM C173, or ASTM C138.

D. Slump - 4 inches maximum, 1 inch minimum:

1. Measured at point of discharge of the concrete into the concrete construction member.

2. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.

3. Pumped concrete:

a. Provide additional water at batch plant to allow for slump loss due to pumping.

b. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified above.

4. Determine slump per ASTM C143.

E. Selection of Proportions:

1. General:

a. Proportion ingredients to:

1) Produce proper workability, durability, strength, and other required properties.

2) Prevent segregation and collection of excessive free water on surface.

2. Minimum cement contents and maximum water cement ratios for concrete to be as follows:

SPECIFIED STRENGTH	MINIMUM CEMENT, LB/CY MAXIMUM AGGREGATE SIZE 1/2”	3/4”	1”	MAXIMUM WATER CEMENT RATIO BY WEIGHT
4000	650	650	650	0.45

3. Substitution of fly ash: Maximum of 25 percent by weight of cement at rate of 1 lb fly ash for 1 lb of cement.

4. Sand cement grout:

a. Three parts sand.

b. One part Portland cement.

c. Entrained air: Six percent plus or minus one percent.

d. Sufficient water for required workability.

e. Minimum 28-day compressive strength: 3,000 psi.

5. Normal weight concrete:

a. Proportion mixture to provide desired characteristics using one of methods described below:

1) Method 1 (Trial Mix): Per ACI 318, Chapter 5, except as modified herein.

a) Air content within range specified above.

b) Record and report temperature of trial mixes.

c) Proportion trial mixes per ACI 211.1.

2) Method 2 (Field Experience): Per ACI 318, Chapter 5, except as modified herein:

a) Field test records must be acceptable to Engineer to use this method.

b) Test records shall represent materials, proportions and conditions similar to those specified.

6. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of Paragraph 5.3 of ACI 318 using the standard deviation of the proposed concrete production facility as described in Paragraph 5.3.1 of ACI 318.

F. Allowable Shrinkage: 0.048 percent per ASTM C157.

G. For Brackish or Salt Water Locations:

1. Calcium nitrate shall be added at a quantity of 5 gal per cubic yard.

a. Calcium nitrite solution shall contain 30 percent solids and shall provide 15 lbs per cubic yard chloride protection.

b. Mix shall also include 7 percent, by weight of cement microsilica.

2. Proposed admixture alternates must be approved by the OCTA prior to their use.

a. Any proposed substitution shall include:

1) Documentation as to the corrosion protection mechanism.

2) Test data documenting the stated level of protection offered.

3) Documentation that the proposed alternate meets a service life of 100 years as calculated using Fick's Second Law of Physics.

b. All models shall use a reference diffusion coefficient of 2.81.

3. The Contractor may perform trial mixes prior to the delivery in order to adjust the desired air content, set time, and slump.

PART 3 - EXECUTION

3.01 FORMING AND PLACING CONCRETE

A. Formwork:

1. Contractor is responsible for design and erection of formwork.

2. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.

a. Allowable tolerances: As recommended in ACI 347R.

3. Chamfer strips: Place ¾" chamfer strips in forms to produce ¾" wide beveled edges on permanently exposed corners of members.

4. Clean and adjust forms prior to concrete placement.

5. Tighten forms to prevent mortar leakage.

6. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.

B. Construction, Expansion, and Contraction Joints:

1. Provide at locations indicated.

2. Locate construction joints in beams and girders as shown in the Plans.

3. Install construction joints perpendicular to main reinforcement with all reinforcement continued across construction joints.

4. At least 48 hours shall elapse between placing of adjoining concrete construction.

5. Thoroughly clean and remove all laitance and loose and foreign particles from construction joints.

6. Before new concrete is placed, existing concrete surfaces must be roughened to ¼" amplitude and coat all construction joints with an approved bonding adhesive used and applied in accordance with manufacturer's instructions.

C. Embedments:

1. Set and build in anchorage devices and other embedded items required for other work that is attached to, or supported by concrete.

2. Use setting diagrams, templates and instructions for locating and setting.

3. Secure waterstops in correct position using hog rings or grommets spaced along the length of the waterstop and wire tie to adjacent reinforcing steel.

D. Placing Concrete:

1. Place concrete in compliance with ACI 304R and ACI 304.2R.

2. Place in a continuous operation within planned joints or sections.

3. Begin placement when work of other trades affecting concrete is completed.

4. Place concrete by methods which prevent aggregate segregation.

5. Do not allow concrete to free fall more than 4 feet.

6. Where free fall of concrete will exceed 4 feet, place concrete by means of tremie pipe or chute.

E. Consolidation: Consolidate all concrete using mechanical vibrators supplemented with hand rodding and tamping, so that concrete is worked around reinforcement and embedded items into all parts of forms.

F. Protection:

1. Protect concrete from physical damage or reduced strength due to weather extremes.

2. In cold weather comply with ACI 306R except as modified herein.

a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars coated with frost, ice or snow.

b. Minimum concrete temperature at the time of mixing:

OUTDOOR TEMPERATURE AT PLACEMENT (IN SHADE)	CONCRETE TEMPERATURE AT MIXING
Below 30˚ F	70˚ F
Between 30˚-45˚ F	60˚ F
Above 45˚ F	50˚ F

c. Do not place heated concrete that is warmer than 80 DegF.

d. If freezing temperatures are expected during curing, maintain the concrete temperature at or above 50˚ F for 7 days or 70˚ F for 3 days.

e. Do not allow concrete to cool suddenly.

3. In hot weather comply with ACI 305R except as modified herein.

a. At air temperature of 90˚ F and above, keep concrete as cool as possible during placement and curing.

b. Do not allow concrete temperature to exceed 90˚ F at placement.

c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.

d. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs/sf/hr as determined from ACI 305R, Figure 2.1.5.

G. Curing:

1. Begin curing concrete as soon as free water has disappeared from exposed surfaces.

2. Cure concrete by use of moisture retaining cover, burlap kept continuously wet or by membrane curing compound.

3. Provide protection as required to prevent damage to concrete and to prevent moisture loss from concrete during curing period.

4. Provide curing for minimum of 7 days.

5. Form materials left in place may be considered as curing materials for surfaces in contact with the form materials except in periods of hot weather.

6. In hot weather follow curing procedures outlined in ACI 305R.

7. In cold weather follow curing procedures outlined in ACI 306R.

8. If forms are removed before 7 days have elapsed, finish curing of formed surfaces by one of above methods for the remainder of the curing period.

9. Curing vertical surfaces with a curing compound:

a. Cover vertical surfaces with a minimum of two coats of the curing compound.

b. Allow the preceding coat to completely dry prior to applying the next coat.

c. Apply the first coat of curing compound immediately after form removal.

d. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.

e. A vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.

H. Form Removal:

1. Remove forms after concrete has hardened sufficiently to resist damage from removal operations or lack of support but no sooner than 3 days after placement of concrete.

3.02 CONCRETE FINISHES

A. Surfaces Exposed to View:

1. Provide a smooth finish for exposed concrete surfaces.

2. Remove fins and projections, and patch voids, air pockets, and honeycomb areas with cement grout.

3. Fill tie holes with nonshrink nonmetallic grout.

B. Surfaces Not Exposed to View:

1. Patch voids, air pockets and honeycomb areas with cement grout.

2. Fill tie holes with nonshrink nonmetallic grout.

C. Troweled Finish:

1. Float finish surface.

D. Broom Finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom across surface.

3.03 GROUT

A. Preparation:

1. Nonshrinking nonmetallic grout:

a. Clean concrete surface to receive grout.

b. Saturate concrete with water for 24 hours prior to grouting.

2. Epoxy grout: Apply only to clean, dry, roughened, sound surface.

B. Application:

1. Nonshrinking nonmetallic grout:

a. Mix in a mechanical mixer.

b. Use no more water than necessary to produce flowable grout.

c. Place in accordance with manufacturer's instructions.

d. Completely fill all spaces and cavities below the bottom of baseplates.

e. Provide forms where baseplates and bedplates do not confine grout.

f. Where exposed to view, finish grout edges smooth.

g. Except where a slope is indicated on Plans, finish edges flush at the baseplate, bedplate, member, or piece of equipment.

h. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets.

i. Wet cure grout for seven (7) days, minimum.

2. Epoxy grout:

a. Mix and place in accordance with manufacturer's instructions.

b. Completely fill all cavities and spaces around dowels and anchors without voids.

c. Obtain manufacturer's field technical assistance as required to ensure proper placement.

3.04 FIELD QUALITY CONTROL

A. OCTA will approve a concrete testing agency selected by the Contractor that meets ASTM C1077-12 criteria and requirements. The Contractor is responsible to provide for services of the concrete testing agency to perform testing of concrete placed during construction.

1. Contractor to cooperate with OCTA in obtaining and testing samples.

B. Tests During Construction:

1. Strength test - procedure:

a. Three cylinders, 6 inches dia. x 12 inches high, will be taken from each sample per ASTM C172 and ASTM C31.

b. Cylinders will be tested per ASTM C39:

1) One at 7 days.

2) Two at 28 days.

2. Strength test - frequency:

a. Not less than one test each day concrete placed.

b. Not less than one test for each 50 cy or major fraction thereof placed in one day.

c. Not less than one test for each type of concrete poured.

d. Not less than one test for each concrete structure exceeding 2 cy volume.

3. Slump test:

a. Per ASTM C143.

b. Determined for each strength test sample.

c. Additional slump tests may be taken.

4. Air content:

a. Per ASTM C231, ASTM C173, and ASTM C138.

b. Determined for each strength test sample.

5. Temperature: Determined for each strength test sample.

C. Evaluation of Tests:

1. Strength test results:

a. Average of 28-day strength of two cylinders from each sample.

1) If one cylinder manifests evidence of improper sampling, molding, handling, curing or testings, strength of remaining cylinder will be test result.

2) If both cylinders show any of above defects, test will be discarded.

D. Acceptance of Concrete:

1. Strength level of each type of concrete shall be considered satisfactory if both of the following requirements are met:

a. Average of all sets of three consecutive strength tests equals or exceeds the required specified 28-day compressive strength.

b. No individual strength test falls below the required specified 28-day compressive strength by more than 500 psi.

2. If tests fail to indicate satisfactory strength level, perform additional tests and/or corrective measures as directed by Engineer.

a. Perform additional tests and corrective measures at no additional cost to OCTA.

3.05 SCHEDULES

A. Form Types:

1. Surfaces exposed to view:

a. Prefabricated or job-built wood forms.

b. Laid out in a regular and uniform pattern with long dimensions vertical and joints aligned.

c. Produce finished surfaces free from offsets, ridges, waves, and concave or convex areas.

d. Construct forms sufficiently tight to prevent leakage of mortar.

2. Surfaces normally submerged or not normally exposed to view: Wood or steel forms sufficiently tight to prevent leakage of mortar.

3. Other types of forms may be used:

a. For surfaces not restricted to plywood or lined forms.

b. As backing for form lining.

B. Grout:

1. Nonshrinking nonmetallic grout: General use.

2. Epoxy grout:

a. Grouting of dowels and anchor bolts into existing concrete.

b. Other uses indicated on Plans.

C. Concrete Finishes:

1. Unformed surfaces:

a. Use following finishes as applicable, unless otherwise indicated:

1) Troweled finish: All unformed surfaces.

2) Broom finish: All walking surfaces.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Concrete Structures will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

B. Parapet Beam will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

C. Precast Concrete Members will be measured and paid under Section 03 40 00 Precast Concrete.

D. Lightweight Cellular Concrete will be measured and paid under Section 31 32 32 Lightweight Cellular Concrete.

E. Concrete in structures will be measured by the neat line dimensions shown on the Plans or such other dimensions as may be ordered by the Engineer. No deduction will be made for the volume occupied by bar reinforcing steel or other embedded steel items.

F. Precast Concrete Members will be measured by the various types and lengths shown in Contract Documents and for erecting the members as shown in the Contract Documents.

G. Concrete and Concrete Aggregate Testing for field quality control conducted by the certified testing agency approved by OCTA is considered incidental to work under other payment items under this Section and no separate measurement and payment will be made to the Contractor.

4.02 PAYMENT

A. Concrete Structures furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

B. Box Culvert at MP 194.6 furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, box culvert, wing walls, U-wall section, anti-graffiti coating, excavation, subgrade preparation, removal of existing bridge 194.6, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

C. Culvert Extension at 4972+95.20 and Culvert Extension at 5017+41.5 furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, excavate and replace foundation, structural

elements, anti-graffiti coating, excavation, subgrade preparation, cable railing, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer. Culvert Extension at 4972+95.20 and Culvert Extension at 5017+41.5 do not include 24" CMP pipe extension. The pipe extensions shall be measured and paid under Section 33 42 00 Culvert and Drainage Pipe.

D. Parapet Beam furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, anti-graffiti coating, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

E. The contract Unit Price for concrete structures shall include full compensation for all forming and shoring, joints, joint filler, joint seals and waterstops necessary for constructing the concrete work complete-in-place.

F. The Contract Unit Price for concrete in reinforced concrete box and culverts, and in headwalls, endwalls, and wingwallls for culverts shall also include the payment for the earthwork involved with such structures.

G. Concrete and Concrete Aggregate Testing shall be considered incidental to work requiring structural concrete.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 03 40 00

PRECAST CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work involves furnishing all labor, materials and equipment necessary and incidental to constructing precast concrete and consists of furnishing transportation, labor, materials, and equipment for the manufacture and installation of precast concrete units.

B. Sections include but are not necessarily limited to:

1. Division 01 - General Requirements
2. Section 03 21 00 - Reinforcing Steel
3. Section 03 31 00 – Structural Concrete
4. Section 31 11 00 - Site Clearing
5. Section 31 11 50 - Demolition, Cutting and Patching.
6. Section 31 20 00 - Earthwork
7. Section 31 23 23 - Lightweight Cellular Concrete
8. Section 31 50 00 - Excavation Support
9. Section 32 31 13 - Chain Link Fencing and Gates
10. Section 32 32 16 – Gravity Walls
11. Section 32 32 21 – Prefabricated Modular Walls
12. Section 32 32 43 – Permanent Soldier Pile Wall
13. Section 34 11 27 - Sub-Ballast and Aggregate Base
14. Section 34 80 32 – Adhered Elastomeric Waterproofing for Rail Road Bridges
15. Section 34 80 41 – Structural Concrete for Railroad and Civil Works
16. Section 34 80 43 - Precast and Prestressed Concrete for Railroad Bridges
17. Section 09 96 23 –Graffiti Resistant Coating

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM A123/A123M - 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 A615 - Specification for Plain Carbon Steel Bars for Concrete Reinforcement

4. ASTM A706 - Specification for Low Alloy Deformed and Plain Bars for Concrete Reinforcement

5. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field

6. ASTM C33 - Specification for Concrete Aggregates

7. ASTM C39/C39M - Test Method for Compressive Strength of Cylindrical Concrete Specimens

8. ASTM C150 - Specification for Portland Cement

9. ASTM C877 - Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

10. ASTM C1433 - Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers

B. Precast/Prestressed Concrete Institute (PCI):

1. PCI MNL 116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products

C. 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)

D. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code – Steel

2. AWS D1.4 - Structural Welding Code – Reinforcing Steel

1.3 SUBMITTALS

A. The Contractor shall verify the existing ground elevations at the site before preparing the working drawings. The working drawings shall contain all information required for the proper construction of the system at each location including existing ground line at face of wall as verified at the site and any required revisions or additions to drainage systems or other facilities.

B. Shop Drawings: Before manufacture of precast concrete units, submit shop drawings prepared by a California registered civil engineer to the Engineer for approval. These drawings shall show the dimensions and calculations for the work and shall include complete details of the methods, materials and equipment the Contractor proposes to use. These drawings shall also show lift and support points.

1. Shop drawings shall be 11" x 17" in size, and each drawing and calculation sheet shall include the OCTA the contract number, full name of the structure as shown on the contract plans, and Project stationing. The design firm's name, address, and phone number shall be shown on the working drawings. Each sheet shall be numbered in the lower right hand corner and shall contain a blank space in the upper right hand corner for future contract sheet numbers.

C. Submit the following at least thirty (30) days prior to construction for approval:

1. Product Data

a. Submit manufacturer's product data of manufactured products and accessories. Include manufacturer's detailed drawings and dimensions when applicable.

b. Supply a Certificate of Compliance conforming to the provisions in the Caltrans Standard Specifications, Section 6-1.07, "Certificates of Compliance," stating the supplied material meets the respective index criteria set forth by OCTA, as measured in accordance with all test methods and standards specified in the Standard Specifications, these special provisions, and the approved working drawings.

2. Mix Designs

a. Mix designs shall be submitted for each class of concrete on the job and shall show names and brands of all materials, proportions, 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 job, (i.e. bridge footings, station concrete, culvert concrete, bridge columns, and the like) shall be clearly indicated at the top of all proposed mix design sheets.

b. Each mix design submittal, for concrete designated by strength,

shall be accompanied by certified test data or trial batch test reports in accordance with the requirements of these Specifications.

3. Laboratory Test Reports

a. Laboratory test reports shall show the name of testing agency, date of testing, types of tests performed and shall be signed by a principal of the testing agency who is a registered civil or structural engineer in the State of California. Laboratory tests shall not be older than eight months and shall certify that the test materials meet the specified standards.

b. Laboratory test reports for concrete mix designs shall 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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pre-formed flexible joint sealing compound: Subject to compliance with the Contract Documents, the following manufacturers are acceptable for joint sealing material between sections of precast reinforced concrete box culverts where water tightness is not required:

1. RAM-NEK.
2. BIDCO C-56.
3. Or equal.

B. Reinforcing Steel: Comply with applicable requirements of Section 03 20 00 - Concrete Reinforcing.

C. Portland Cement Concrete:

1. Comply with applicable requirements of Section 03 05 15 - Portland Cement Concrete. Provide class of concrete as indicated on the approved Contract Drawings issued for construction.

D. Anchors, Lift Devices, and Accessories: Provide concrete inserts, reglets, anchors, brackets, and fasteners as indicated or required for fabrication and installation work. All items shall be galvanized in accordance with ASTM A153/A153M or ASTM A123/A123M, as applicable. Contractor shall select the lift devices, and shall be responsible for their performance and for any damage resulting from the use of faulty or inferior devices. Lift devices shall not be visible on exposed faces of precast members.

E. Reinforced Concrete Box Culverts:

1. Precast box culverts shall conform to ASTM C1433.
2. All Work shall conform to the provisions of Section 03 30 00 - Cast-In-Place Concrete.

F. Graffiti Resistant coatings shall be per Specification Section 09 96 23.

2.2 FABRICATION

A. Requirements and Standards

1. Manufacture precast concrete units in accordance with PCI MNL-116, and applicable requirements of ACI 318/318R, Chapter 16.

2. Forms shall 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 shall be placed and secured against movement as required.

4. Concrete shall be placed and consolidated to shape, configuration, and dimensions indicated.

5. Members shall be moist cured in accordance with curing requirements specified in PCI MNL-116. Minimum curing period for combined initial curing and secondary curing shall be seven Days or until the specified strength of concrete is attained.

B. Markings:

1. 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.

C. Fractured Fin Finish on Precast Panels

Where shown on the Contract Drawings, provide a fractured fin finish to the precast panels. Fin dimensions shall be as shown on the Contract Drawings. Fins on panels shall line up along the height of the wall.

2.3 QUALITY CONTROL

A. Concrete Testing

1. Concrete shall be tested for compressive strength as specified in Section

03 31 00. Additionally, a set of 7 cylinders shall be prepared for every 10 precast units, or fraction thereof, cast in any one day. Two cylinders shall be tested at 3 Days, two cylinders at 7 Days, two cylinders at 28 Days, and one cylinder shall be retained for further testing as may be required. Cylinders shall be prepared and moist cured in accordance with ASTM C31/C31M, and tested in accordance with ASTM C39/C39M.

B. Reporting

1. The QC Inspector and independent testing laboratory shall provide reports to the Quality Control Manager (QCM) on a daily basis for each day that precasting operations are performed.

2. A daily production log for precasting shall be kept by the QCM for each day that precasting operations, including setting forms, placing reinforcement, casting, curing, post tensioning, and form release, are performed. The log shall include the facility location, and shall 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 QC personnel and the specific QC inspections they performed that day. The daily report from each QC Inspector shall also be included in the log. This daily log shall be available for viewing, at the precasting facility.

3. All reports regarding material tests and any required survey checks shall be signed by the person who performed the test or check, and then submitted directly to the QCM for review and signature prior to submittal. Corresponding names shall be clearly printed or typewritten next to all signatures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all parts of the supporting structure and conditions under which the precast concrete units are to be erected and installed. Verify the locations of anchors to predetermine the accuracy of the installation of each member.

3.2 ERECTION / 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.

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 shall be plumb, level, and square, true to line, with angles and edges parallel with related building lines.

3.3 REINFORCED CONCRETE BOX CULVERTS

A. Precast reinforced concrete box culverts shall be installed as shown on the approved Contract Drawings issued for construction according to manufacturer's recommendations.

B. Joint sealers shall be used as specified herein

C. Precast reinforced concrete box culvert structures shall be in place and plumb prior to pouring associated appurtenant structures. Dowel extensions shall be cast into the structures as a means of anchorage as detailed on the approved Contract Drawings.

D. Precast reinforced box culvert structures shall not be backfilled until the installation has been inspected and approved. Structures backfilled prior to approval shall be uncovered and re-backfilled at the Contractor's expense.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Box Culvert MP 194.6 will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement..

B. Precast concrete panels for Retaining Wall RW1 shall be measured as set forth in Specification Section 32 32 43 Permanent Steel Soldier Pile Wall.

C. Precast units for Gravity block walls and for the Prefabricated Modular Wall shall be measured as set forth in Specification Sections 32 32 16 Gravity Block Walls and 32 32 21 Prefabricated Modular Walls.

4.2 PAYMENT

A. Box Culvert MP 194.6 furnished and completed in accordance with the Contract Documents will be paid for as at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall be full compensation for furnishing box culvert, wing walls, all labor, materials, tools, equipment, supplies, supervision and incidentals necessary, and doing all work, as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 05 52 00

HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section addresses the products, materials and work for the installation of metal hand railing, stainless steel hand railing, Right-of-Way Security Gates, and pedestrian barricade as shown on the Contract Plans and as specified in these Specifications, and as directed by the Engineer.

B. Related Specification Sections include but are not necessarily limited to:

1. Section 05 12 23 - Structural Steel

2. Section 09 90 00 - Painting and Coating

A.02 REFERENCES

A. AWS D1.1: Structural Welding Code-Steel

B. SSPWC: Standard specifications for Public Works Construction, 2012

C. CALTRANS: State of California Department of Transportation Standard Specifications 2010 Section 83

D. American Iron and Steel Institute: Type 302 and 304 Steel

E. American National Standards Institute (ANSI) ANSI A12.1 Safety Requirements for Floor and Wall Openings, Railings and Toeboards

F. American Society for Testing and Materials (ASTM)

1. A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. D4956 Standard Specifications for Retroreflective Sheeting for Traffic Control

G. State of California, Department of Industrial Relations, Division of Occupational Safety and Health (CAL/OSHA): As applicable to railing

H. Use finishes for stainless steel complying with “Metal Finishes Manual” by NAAMM.

I. The sheet Work, except as otherwise indicated or specified, shall comply with “Architectural Sheet Metal Specifications” and “Architectural Sheet Metal Manual” by SMACNA.

J. SCRRA Engineering Standards ES4005, Pedestrian Barricade and Metal Hand Railing Details. Use sleeve post detail from Pedestrian Barricade Detail for Removable Metal Hand Railing.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures:

1. Shop Drawings: In accordance with the Contract Plans, showing the details and dimensions of all removable metal hand railing and metal hand railings, sleeve post, and posts and fences. Note dimensions which have been field verified.

2. Welding procedures and welder qualifications and welder registration as required by the American Welding Society.

3. Manufacturer's product data for non-shrink, non-ferrous cement grout.

B. Shop Drawings showing layout, locations, Sections, elevations, details, dimensions, finishes and installation details.

C. Certified test reports, as required, for materials specified in Part 2 - Products.

D. “Buy America” Certificates of Compliance

E. Submit Shop Drawings for the fabrication and erection of stainless steel assemblies and proprietary products which are not otherwise completely shown by manufacturer’s data sheets. Include plans and elevations at not less than one-inch to one-foot scale, and include details of sections and connections at not less than three inches to one foot scale. Show anchorage and accessory items, and finishes.

1.04 QUALITY ASSURANCE

A. All uncoated spots or damaged coating shall be repaired by hot-dip process. Small areas as determined by the Engineer may be repaired by recoating them with “Galvicon” or “Gavalloy” or approved equivalent.

B. Perform welding in accordance with AWS D1.1.

C. Set handrails and posts true to location, alignment and grade as indicated in the Contract Plans. The railings shall present a smooth, uniform appearance in their final positions.

D. Painting of Rails: In accordance with Section 09 90 00, Painting and Coating, unless otherwise directed by the Engineer.

PART 2 - PRODUCTS

2.01 STEEL PIPES

Pipe for post, sleeve post, rail and pickets shall be seamless steel pipe, conforming to ASTM A53, Type S, Grade A.

2.02 GENERAL

A. Metal Surfaces – For the fabrication of Work which will be exposed to view, use materials which are smooth and free of surface blemishes. Do not use materials which have stains and discolorations, including welds which do not match the materials in color and grain characteristics.

B. Surface Flatness and Edges – For exposed Work provide materials which have been cold-rolled, cold-finished, cold-drawn, extruded, stretcher leveled, machine cut or otherwise produced to the highest commercial standard for flatness with edges and corners sharp and true to angle or curvature as required.

2.03 STAINLESS STEEL

Use AISI Type 302 or Type 304 (at fabricator's option), except as otherwise indicated. Comply with the following general standards, with specific type, alloy, heat treatment and finish as required to produce the specific Work. Finish products to a No. 4 directional satin unless otherwise shown or specified. Protect with adhesive paper covering.

A. Sheet – ASTM A167, ASTM A480, and AISI Type 302 or 304

B. Plate – ASTM A167

C. Bar Stock – ASTM A276

D. Tubing – ASTM A269

E. Castings – ASTM A296, iron-chromium, nickel

F. Extruded Shapes – Manufacturer's standards

2.04 FASTENERS AND ANCHORAGE MATERIALS

A. Welding Electrodes and Filler Metal – Provide the alloy and type required for strength, workability, compatibility, and color match after grinding smooth and finishing the fabricated product.

B. Fasteners – Some basic metal or alloy as the metal fastened, and finished to match in color and texture. Comply with FS FF-S-92 for machine screws. Provide the type of fasteners indicated and provide Phillips flat-head screws for exposed fasteners.

C. Anchors and Inserts – Either furnish inserts to be set in concrete and masonry Work, or provide other anchoring devices as required for the installation of stainless steel Work. Furnish stainless steel or epoxy-coated inserts (See Concrete and Masonry Sections for installation); provide toothed stainless steel expansion bolt devices for drilled-in-place anchors.

2.05 FABRICATION - GENERAL

A. Fabricate from the thicknesses, sizes and shapes indicated, or if not indicated, as required to produce Work of adequate strength and durability, without objectionable deflections or “oil canning.”

B. Form exposed Work true to line and level, with flush surfaces and accurate angles. Ease exposed edges to a 1/32-inch radius, unless otherwise indicated. Miter exposed corner joints and machine fit to a hairline joint.

C. Weld corners and seams continuously, grind smooth and flush on exposed surfaces. For exposed metal finishes, use metals which will blend and match with sheet metals being joined; discolorations or stains will not be acceptable for exposed portions of natural finish metals. Comply with recommendations of AWS for welding.

D. Provide brackets, plates and straps with each assembly, as may be required for proper support and anchorage to other Work.

E. Cut, reinforce, drill and tap Work as may be required to receive finish hardware and similar items of Work.

F. Preassemble Work at shop to the greatest extent possible, so as to minimize mechanical joints, splicing and assembly of units at the site.

2.06 RAILINGS AND HANDRAILS

A. Comply with ANSI A12.1 and CAL OSHA requirements for railings around floor openings and exposed edges of floors, stairs, ramps, and similar locations. Install railings and supports able to withstand a horizontal force of 150 pounds per linear foot and vertical force of 100 pounds per linear foot at the top or 50 pounds per foot along the top rail, whichever is greater.

B. In tubular members, where mechanical joints are necessary, use bar stock inserts with flat-head screws located on the least visible surfaces. Where bends are shown, form members to a smooth, uniform radius without distortion of the cross-sectional shape.

C. Miter and cope members at corners and intersections. Bevel, weld and grind smooth, without fillets, to form smooth transitions and maintain sharp lines.

D. Post-mounted railings – Use base plates as indicated.

E. Provide dissimilar metals isolation pads where required.

G. Comply with ASTM D4956 Standard Specifications for Retroreflective Sheeting for Traffic Control for yellow sheeting on railing.

PART 3 - EXECUTION

3.01 FABRICATION

Fabrication of metal hand railings and fencing shall be in accordance with SSPWC 2009 Sub-Section 304-2.1.2.

3.02 INSTALLATION

A. Set stainless steel Work accurately as measured from established building lines and levels, plumb and in true alignment with previously completed Work. Temporarily brace or anchor securely in formwork where Work is to be built into concrete, masonry or similar construction.

B. Securely anchor in place using concealed anchorage wherever possible.

C. Accurately fit mechanical joints together to form tight joints and uniform reveals and shapes for joint fillers and sealants. Restore finishes that have been damaged by shipment and installation.

D. Do not cut or abrade finishes which cannot be completely restored in the field. Return units with such finishes to the shop for required alterations, followed by complete refinishing.

E. Remove protective coverings when there is no longer danger of damage to the stainless steel Work from other Work yet to be performed. Restore protective coverings which have been removed or damaged during shipment or installation of the Work, if other Work is yet to be performed.

F. Form bends and simple and compound curves in tubing by bending members in jigs to produce uniform curvature, maintain profile of member throughout bend without buckling, twisting or otherwise deforming exposed surfaces of handrail and railing components.

G. Railing splices performed in field - Use epoxy structural adhesive or other equivalent means standard with railing manufacturer. Field welding - Not permitted. Railing splices - Butted to flush hairline joint and reinforced using manufacturer's standard concealed fittings with concealed fasteners. Lay out Work to position splices in inconspicuous locations.

H. Provide weep holes or other means for evacuation of entrapped water in hollow Sections of railing members.

I. Provide wall returns at ends of wall mounted handrails, except where otherwise indicated.

J. Close exposed ends of handrail and tubular rail members by use of plates welded and ground smooth.

K. Furnish inserts and other anchorage devices for connecting handrails and railings to concrete or masonry Work. Fabricate and space anchorage devices as indicated and as required providing adequate support. Coordinate anchorage devices with supporting structure.

L. The galvanized bolt thread for removable metal hand railing shall not be deformed after installation.

M. Removal of Existing Pavement - Remove the existing pavement by core drilling pavement to the full depth of the existing pavement thickness in clean, straight lines with neat edges. Haul all removed material off the work site daily and dispose of in a legal manner.

N. Excavation - Remove material to the width and depth required for construction of the pedestrian gate foundation. Take care not to disturb the bottom of the excavation before the concrete for the foundation is placed. Replace excavation below the required grade or more than the required width with the same class of concrete specified for the foundation, at no additional cost to the Authority.

O. Foundation and Installation of Gate Posts

1. Inspection Required Before Placing Concrete - Do not deposit concrete until the excavation, placing of the reinforcing steel, and placing of the gate posts has been inspected and approved. Provide at least one working day's advance notice that the excavation is ready for inspection and the procedure is approved for installation of the gates.

2. Concrete - Class 520-C-3250 - Portland Cement Concrete shall be used for the foundation.

PART 4 – MEASUREMENT AND PAYMENT

A. Cable Railing (Retaining Wall No. 1) will be measured and paid under Section 32 32 43.

B. All other work of this Section is considered incidental to work under 03 31 00 Structural Concrete, 03 40 00 Precast Concrete, 32 32 16 Gravity Block Retaining Wall, 32 32 21 PMB Retaining Wall, 33 42 00 Culvert and Drainage Pipe and no separate measurement and payment will be made to the Contractor for Work of this Section.

C. Work of this section shall include furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 05 53 00

METAL GRATING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Heavy duty metal bar gratings
2. Metal frames and supports for gratings
3. Accessories required for a complete installation

B. Related Specification Sections include but are not limited to:

1. Section 03 21 00, Reinforcing Steel

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide gratings capable of withstanding imposed structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections:

1. Sidewalks, Vehicular Driveways, Other Exterior At-Grade Locations: Capable of withstanding HS20 traffic loads. At tracks, must support 8000 lbf axle loads.
2. Personnel Platforms and Walkways: Capable of withstanding a uniform live load of 250 lbf/sq. ft., plus dead load or a concentrated load of 3000 lbf, whichever produces the greater stress.
3. Greater Loads: As required to support equipment or where indicated.

1.03 SUBMITTALS

A. Make submittals in accordance with Section 01 33 00, Submittal Procedures.

B. Product Data: Manufacturer’s technical data including:

1. Clips and anchorage devices for gratings
2. Paint products

C. “Buy America” Certificates of Compliance

D. Shop Drawings: Show fabrication and installation details for gratings. Include plans, elevations, sections, details, and attachments to other work. Provide templates for anchors and bolts specified for installation under other Sections.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

1.04 QUALITY ASSURANCE

A. Metal Bar Grating Standards: Comply with applicable requirements of the following:

1. NAAMM MBG 532, Heavy-Duty Metal Bar Grating Manual

B. Professional Engineer Qualifications: A Professional Engineer, legally qualified to practice in the State of California, and experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of gratings that are similar to those indicated in material, design, and extent.

C. Fabricator Qualifications: A firm experienced in producing gratings similar to those indicated for this Project and with a record of successful in service performance, as well as sufficient production capacity to produce required units.

D. Welding: Qualify procedures and personnel according to AWS D1.1, Structural Welding Code-Steel and AWS D1.3, Structural Welding Code- Sheet Steel.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of other construction contiguous with gratings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.06 COORDINATION

A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to site in time for installation.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Obtain steel grating and products from a manufacturer specializing in fabrication of the types of units required, which has tested its units for load bearing strength and deflection, and has currently published load tables based on recognized testing procedures.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alabama Metal Industries Corp.

2. All American Grating, Inc.

3. Harris Steel Ltd.; Fisher & Ludlow Div.

4. Ohio Gratings, Inc.

5. Substantially equivalent product approved in writing by OCTA.

C. Steel Plates, Shapes, and Bars: ASTM A36 (A36M)

D. Wire Rod for Grating Crossbars: ASTM A510 (A510M)

E. Uncoated Steel Sheet: ASTM A1011 (A1011M), structural steel, Grade 30 (Grade 205)

F. Galvanized Steel Sheet: ASTM A653 (A653M), structural quality, Grade 33 (Grade 230), with G90 (Z275) coating

2.02 FASTENERS

A. Provide Type 304 or 316 stainless steel fasteners for exterior use and zincplated fasteners with coating complying with ASTM B633, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.

2.03 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy to be welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.04 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and sharp or rough areas on exposed surfaces.

1. Material for Anchors in Interior Locations: Carbon steel components zinc plated to comply with ASTM B633, Class Fe/Zn 5.

2. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) or 2 (A4) stainless-steel bolts complying with ASTM F593 (ASTM F738M) and nuts complying with ASTM F594 (ASTM F836M).

D. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated.

E. Form from materials of size, thicknesses, and shapes indicated, but not less than that needed to support indicated loads.

E. Fit exposed connections accurately together to form hairline joints.

F. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately. See Section 05 55 00, Miscellaneous Metals.

G. Unless otherwise specified, gratings shall be welded to their supports as indicated. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

H. Traffic Surface: Plain.

I. Shop Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

2.05 METAL BAR GRATINGS

A. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Heavy Duty Grating: Minimum four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.

2. Furnish threaded bolts with nuts and washers for securing grating to supports.

3. Furnish galvanized malleable iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

B. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge band openings in grating that interrupt four or more bearing bars with bars of the same size and material as bearing bars.

C. Do not notch bearing bars at supports to maintain elevation.

2.06 GRATING FRAMES AND SUPPORTS

A. Steel Frames and Supports: Fabricate from structural steel shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

B. Equip units with integrally welded anchors for casting into concrete or building into masonry.

1. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long (32 mm by 6 mm by 200 mm).

C. Galvanize exterior and interior frames and supports.

2.07 FINISHES

A. Comply with NAAMM's Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.

B. Finish gratings, frames, and supports after assembly.

C. Galvanizing: Apply zinc coating by the hot dip process complying with ASTM A123.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

3.02 INSTALLING METAL BAR GRATINGS

A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach non-removable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.

3.03 CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work under other payment items and no separate measurement and payment will be made to the Contractor for Work of this Section. Work of this section shall include furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

END OF SECTION

SECTION 05 55 00

MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Pull irons, inserts, channels and other items required by utility companies.

2. Miscellaneous metal angles, plates, bars, rods, studs, etc. shown or required to complete the work.

3. Coated Woven wire mesh (metal mesh)

4. Shop-primed finish for all miscellaneous metal fabrications not receiving galvanized finish, except for gratings.

5. Painted steel ship's ladders and brackets

B. Coordinate work of this Section with all other Sections of this Specification.

1.02 REFERENCES

A. Comply with all applicable local, State and Federal codes, specifications, standards and recommend practices, and in particular:

1. AISC - American Institute of Steel Construction: "Design, Fabrication and Erection of Structural Steel for Buildings".

2. AISI - American Institute of Steel and Iron: "Specifications for the Design of Cold-Formed Steel Structural Members".

B. AWS - American Welding Society: D-1.1, "Code for Welding in Construction"

C. ASTM

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures

1. Shop Drawings: Large scale, clearly indicating all methods of fabrication and assembly, applicable field measurements, dimensions, weights, materials, finishes and all other pertinent data.

1.04 QUALITY ASSURANCE

A. All steel fabrications shall be done by a licensed fabrication shop with a minimum of five (5) years experience in this type of work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel plates, bars and studs (including ship's ladder):

1. Rolled shapes and plates: ASTM A36

2. Bars: ASTM A36

3. Studs: ASTM A1044 / A1044M

B. Steel tubing:

1. Cold-drawn tubing: ASTM A512, sunk drawn, butt welded, cold-finished and stress relieved

2. Hot-formed tubing: ASTM A501, butt welded, cold-finished and stress relieved

C. Iron castings:

1. Gray iron castings: ASTM A48, Class 30B

2. Malleable iron castings: ASTM A47

D. Polyvinyl chloride coated and zinc coated woven steel wire with 11 GA core, 8GA finish with custom color to be selected by Authority.

1. ASTM F668 2A

2. AASHTO M181

3. Type IV Class

E. Anchors: Expansion anchors by Hilti, Rawlplug Company, Inc., or equal. Provide anchors of the types shown and required for the various conditions of use, installed in accordance with manufacturer's printed instructions.

F. Fasteners: Galvanized steel fasteners of the type, grade and class required for the installation of miscellaneous metal items.

G. Welding electrodes: Low hydrogen type conforming to AWS D1.4, E70 XX Series.

H. Shop primer: Fabricator's standard thermosetting or air-drying shop primer compatible with alkyd enamel finish paint specified in Section 09 90 00, Painting

and Coatings, applied in a uniform dry film not less than 1-1/2 mils thick.

2.02 FABRICATION

A. Metal Work Exposed to View - Use materials that are smooth and free of surface blemishes including pitting, seam marks, and roller and grinding marks, before cleaning, treating and applying finishes including zinc coatings.

B. Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work to dimensions shown on reviewed and accepted Shop Drawings, using proven details of fabrication and support. Use types of materials indicated for various components of Work.

C. Form exposed Work true to line and level, with accurate angles and surfaces and straight, sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing Work.

D. Verify dimensions by accurate field measurement before fabrication where Work of this Section adjoins preceding Work. Do not delay job progress; allow for trimming and fitting metalwork where taking field measurements before fabrication might delay the Work. Note on Shop Drawings dimensions verified by field measurement.

E. Form exposed connections with hairline joints flush and smooth, using concealed fasteners wherever possible. Exposed fasteners - f type indicated or, if not indicated, use Phillips flat-head countersunk screws or bolts.

F. Pre-drill bolt and screw holes as indicated and required for attachment of metalwork and adjacent materials.

G. Furnish inserts and anchoring devices to be set in concrete for installation of metalwork. Coordinate delivery with other Work to avoid delay

H. Provide anchorage of type indicated. Fabricate and space anchoring devices as indicated and required to provide adequate support for intended use of Work.

I. Cut, reinforce, drill and tap metalwork as required to receive finish hardware and similar items of Work.

J. Use hot-rolled steel bar for Work fabricated from bar stock, unless Work is indicated to be fabricated from cold-finished or cold-rolled stock.

K. Pre-assemble Work in shop to greatest extent practicable; minimize field splicing and assembly of units at Worksite. Disassemble units to extent necessary to comply with shipping and handling limitations. Clearly mark units for reassembly and proper installation.

L. Where indicated as galvanized, complete shop fabrication before applying coating. Remove mill scale and rust, clean and pickle units as required for

coating. Apply hot-dip zinc coating, two ounces per square foot, in accordance with ASTM A123.

M. Fabricate complete with anchors, inserts and hardware.

N. Form and finish to shape and size with sharp angles and lines.

O. Countersink metalwork to receive required hardware and to provide bevels and clearances.

P. Weld on hardware mounting plates. Drill or punch holes for bolts and screws. Conceal fastenings wherever possible.

Q. Grind exposed edges smooth. Construct joints exposed to weather to exclude water and provide weep holes indicated.

R. Brackets, lugs and similar accessories required for installation - Include as part of fabrication.

S. Welding:

1. Weld all shop and field connections continuously in accordance with the referenced AWS specifications, unless bolted connections are specifically shown.

2. Grind all exposed welds flush and smooth with parent metal surfaces.

3. All welders shall be qualified in accordance with AWS requirements.

T. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

U. Bend pipe without collapsing or deforming the walls, to produce a smooth, uniform curved sections and maintain uniform sectional shape.

V. Fabricate items in the largest sections practical to minimize field jointing.

2.03 FINISHING

A. Galvanizing: Galvanize plates and angles, after fabrication, to obtain a minimum zinc coating of 1.25 ounces per square foot when tested in accordance with ASTM A123.

B. Shop priming: After galvanizing shop prime steel surfaces as follows.

1. Clean steel surfaces of all oil and other foreign substances that would interfere with paint bond in accordance with applicable SSPWC specifications.

2. Apply pretreatment to cleaned steel surfaces using solution

recommended by SSPWC.

3. Apply the shop primer within the time limits recommended for the pretreatment system used. The shop primer shall be a smooth and even coating with a dry film thickness of not less than 1-1/2 mils.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect adjacent construction and make sure that all conditions detrimental to the timely and proper execution of this work have been corrected before proceeding.

3.02 INSTALLATION

A. Perform all cutting, drilling and fitting required for the installation of this work. Install all items accurately in their proper location, alignment and elevations, plumb and level, free of rack as measured from established lines and levels. Provide temporary bracing or anchors for items that are to be built into concrete, masonry or similar construction.

B. Fit exposed connections accurately to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and flush with parent metal and touch-up shop paint coat.

C. Comply with AWS recommendations for welding procedures, appearance and quality of welds made, and methods used to correct faulty welds.

3.03 TOUCH-UP OF DAMAGED SHOP PRIMER

A. Clean the damaged shop primer, sand smooth, re-clean and spot-prime with the same paint used for shop priming.

3.04 PROTECTION AND REPLACEMENT

A. Protect fabrications from construction damage.

B. Promptly replace work damaged beyond satisfactory field repair before its acceptance, with new materials at no additional cost to Authority.

PART 4 – MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work under other payment items and no separate measurement and payment will be made to the Contractor for Work of this Section. Work of this section shall include furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 09 90 00

PAINTING AND COATINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish all labor, materials, tools and equipment necessary and incidental to the painting, and finishing the surfaces as indicated on the Contract Drawings, as specified herein and as directed by the Engineer.

B. Painting shall include shop coat and field finish painting of all metal surfaces, including the complete canopy, railings, handrails, base plates, covers, connecting hardware, mounting brackets; field painting of railings and guardrails, fences, flashings, pipe bollards, and exposed mechanical or electrical equipment including housing; and the finish painting over shop coated exposed equipment.

C. Related Specification Sections include but are not necessarily limited to:

1. Section 03 21 00 - Reinforcing Steel

2. Section 05 52 00 - Handrails and Railings

3. Division 05 - Metals

4. Division 26 - Electrical

1.02 REFERENCES

A. Comply with all applicable local, State and Federal Codes, regulations, specifications, standards and recommended practices, and in particular:

1. ASTM - American Society for Testing and Materials

2. Federal Specification

3. SSPWC: Standard Specifications for Public Works Construction 2012

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures:

1. List of products: A complete list of products proposed for use on the project; include manufacturers' product descriptions of all materials; obtain approval before proceeding. Use the same manufacturers' products for all coats of each individual finish unless otherwise approved in writing by the Engineer.

2. Product data: Alternate manufacturers' published literature for specified products and accessories as applicable, including manufacturers'

specifications, physical characteristics and performance data. Submit as a supplement, manufacturers' instructions and directions for application if not included in the manufacturers' published literature.

3. Samples: Of all paints and finishes proposed for use on the project, minimum size 8-1/2 inches by 11 inches.

1.04 QUALITY ASSURANCE

A. Application: Shall be by an experienced painter or a painting firm employing experienced personnel.

B. Conform to manufacturers' specifications, directions and recommendations for best results in the use of each of their products for each condition. If results are at variance with Specifications, report the discrepancy to the Engineer for decision.

1.05 DELIVERY, HANDLING AND STORAGE

A. Delivery and storage: Deliver paint materials in unbroken, unopened containers bearing the manufacturers' labels; do not open containers or remove labels until the Engineer inspects and approves. Store materials in a dry location where the indicated ambient temperature of storage is not less than 50 degrees Fahrenheit.

B. Precautions: Take extraordinary care to prevent fire; open containers or inflammable materials only as needed; keep rubbing cloths and oily rags in tightly closed metal containers, or remove from the site daily. Benzine, gasoline, and distillate will not be permitted on the job site.

C. Protection: Care shall be exercised in the handling of painting materials to ensure that this work and the work of other trades are not damaged before, during, or after the installation.

D. Replacements: Repair or replace damaged work, if any, as necessary to the approval of the Engineer at no additional cost to OCTA.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. For metal surfaces paint materials shall be the products of Tnemec Co., Inc., or equal products by Ameron Protective Coatings Group, Rust-Oleum Industrial Coatings, Sherwin Williams, Porter International, Pittsburgh Paints, or substantially equivalent product approved in writing by OCTA.

B. For gypsum board surfaces paint and stain materials shall be the products of Dunn-Edwards or equal products by Frazee Paint Co. Sherwin Williams, or substantially equivalent product approved in writing by OCTA.

C. Materials selected for coating systems for each type of surface shall be the product of a single manufacturer.

D. All paint materials shall be the respective equivalent, in the opinion of the Engineer, to the several types of materials specified. Deliver all materials to the job site in the original, unbroken containers, bearing the manufacturers' labels indicating the contents and directions for use, storage, and handling.

E. Materials not specifically noted but required for the work, such as linseed oil, shellac, thinners, etc., shall be the product of the approved paint manufacturer.

2.02 MIXING

A. Mix paint products according to the manufacturers' painted directions. Do not adulterate in any manner except upon specific approval of, and in the presence of the Engineer.

2.03 COLOR SELECTION

A. The color selection will be made by the Engineer from submitted manufacture’s standard colors.

B. Submit color samples requested by the Engineer, allowing ample time for consideration before the material to be painted is delivered or ready for painting.

2.04 IDENTIFICATION

A. The manufacturers' identification numbers and specifications listed are for the purpose of indicating the type and quality of paint product desired for the purpose indicated.

PART 3 - EXECUTION

3.01 GENERAL

A. Apply paints in accordance with the manufacturers' recommendations as to the application, weather, and temperature conditions. Provide "highest" quality workmanship performed to the Engineer's satisfaction. Use clean equipment and brushes when applying paint; spread paint materials evenly, without runs, sags, laps, or brush marks, without variations in color, texture, or sheen, and without "holidays."

B. Vary colors or sheen between coats and apply all coats to uniform thicknesses.

C. Cut sharp lines against glass, other materials, and different colors. Recoat suction spots in the first coat as necessary to produce uniformity of color and gloss.

D. Refinish any work judged defective at no additional cost to OCTA; repair all work damaged during the progress of the construction.

E. Leave finished surfaces clean, completely covered, uniform in appearance, and satisfactory to the Engineer.

3.02 SURFACE PREPARATION

A. General: Clean all surfaces thoroughly, removing all rust, mill scale, fabrication films, dust, dirt, and other foreign matter from surfaces. Grind smooth all welds flush with adjacent surfaces. Apply film to completely dry surfaces.

B. Galvanized metal: Thoroughly clean surfaces, wiping with mineral spirits or xylol. If silicone surface treatments have been applied in the fabrication shop, use xylol; remove silicates or similar surface treatments and deposits of "white rust" by sanding or other approved abrasive methods. Thoroughly clean and rinse contaminants from surfaces.

C. Ferrous metal surfaces: Thoroughly clean using mineral spirits, xylol, or toluol in accordance with SSPWC-SP No. 1. Take care to ensure that adequate ventilation is provided at all times when using solvents. Carefully rinse and clean surfaces before applying paint.

D. Gypsum Board:

1. Remove dust, loose particles or other matter that would prevent proper paint adhesion.

2. Check to see that joints and screw heads are properly covered with joint compound and sanded smooth and flush with adjacent surfaces.

E. Condition of surfaces: Inspect and approve conditions of substrate surfaces scheduled to receive paint; notify the Engineer of any surfaces unsuitable for application as specified. The application of a Paint finish constitutes an acceptance of the surface as suitable, unless directed to proceed in writing by the Engineer. The work shall not be performed during wet or freezing weather, or until surfaces have thoroughly dried from the effect of such weather.

F. Mixing and thinning: Mix and thin paint products in strict accordance with the manufacturers' directions; mix and thin other materials in accordance with the "best" trade practices as approved.

3.03 APPLICATION

A. Number of coats: As specified for each type of finish.

B. Thickness of coats: Use ample undiluted materials; apply in a uniform thickness over entire areas; do not exceed the manufacturers' recommended spreading rate per gallon. Comply with DFT specified.

C. Color of coats: Tint prime coats if necessary to obtain uniform finish coats. Vary color between coats; the final coat shall exactly match approved samples.

D. Approval of successive coats: Obtain the Engineer's approval of each coat before the succeeding coat is applied; if this approval is not obtained, the Engineer reserves the right to require an additional coat.

3.04 MECHANICAL OR ELECTRICAL EQUIPMENT

A. Apply primer and 2 finish coats as specified for the appropriate metal surface according to the finish schedule.

3.05 PROTECTION OF FINISHED WORK

A. Use tarpaulins or drop cloths when working above or adjacent to completed work. Clean all paint splatters and stains from finished surfaces. Protect all work from dust and insects.

3.06 METAL SURFACES

A. General: Provide the following paint systems for the various substrates, as indicated.

B. Surface preparation not performed under other Sections: SSPWC-SP11 Power Tool Cleaning to bare metal all welds and damaged prime coat.

C. Paint system:

1. Spot prime for galvanized surfaces and surfaces primed with zinc-rich primer: 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.

2. First coat: Tnemec 60 Epoxoline applied at 4 to 6 mils DFT.

3. Top coat: Tnemec 75 Endura-Shield applied at 2 to 3 mils DFT.

3.07 GYPSUM BOARD

A. First coat: PVA sealer

B. Second coat: 100% acrylic

C. Third coat: 100% acrylic

PART 4 – MEASUREMENT AND PAYMENT

Work of this Section is considered incidental to work under other payment items and no separate measurement and payment will be made to the Contractor for Work of this Section. Work of this section shall include furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 09 96 23

GRAFFITI RESISTANT COATING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section consists of the Contractor furnishing all materials, labor, and equipment necessary and incidental to surface preparation, furnishing, and application of a clear graffiti-resistant coating to all exposed surfaces of accessible concrete, masonry, and porous surfaces. Graffiti-resistant coating shall be applied from finish grade or floor to 10 feet above finish grade or floor and at other locations to the extents as shown on the contract drawings.

1.02 REFERENCE STANDARDS

A. ASTM - American Society for Testing and Materials

1.03 SUBMITTALS

A. Materials: Copies of a manufacturer's data.

B. Samples: 24-inch square samples of coating applied to same substrates as the Work. Coat one half of each sample and identify the coated side.

C. Certification: Duplicate copies of manufacturer's affidavit with each shipment of materials delivered to the jobsite certifying that material furnished complies with specified requirements.

D. Manufacturer’s Instructions: Copies of the manufacturer’s instructions for graffiti removal and maintenance.

1.04 QUALITY CONTROL AND QUALITY ASSURANCE

A. Sample panel:

1. Apply sample finish, approximately 10-sq. ft., to areas an exposed concrete surface, as directed by the Engineer.

2. Obtain the Engineer's approval of the sample panel before proceeding further. Approved sample panel shall be used as a standard for the Work and if properly identified may remain a part of the Work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Materials shall be stored and handled in accordance with manufacturer’s

recommendations.

1.06 JOB CONDITIONS

A. Environmental requirements:

1. Compliance with air quality regulations: VOC of coatings used for the Work shall not exceed limits prescribed by law.

2. Comply with coating manufacturer's recommendations for environmental conditions regarding coating application.

3. Do not apply finish in areas where dust is being generated.

4. Provide drop cloths, shields, barricades, and other protection necessary to safeguard adjacent surfaces not to be coated.

5. Provide and maintain protection as required to protect finished work from damage until its acceptance.

1.07 MAINTENANCE

A. With closeout submittals deliver one identified unopened gallon container of graffiti- resistant coating and a 5-gallon container of cleaner to be used for graffiti removal to the Engineer. Label container with material type and area where used for future identification.

B. Provide the Engineer with a copy of instructions for graffiti removal and maintenance recommendations.

PART 2 - PRODUCTS

2.01 DESCRIPTION

A. Sacrificial: SC-1 or SC-1X by ProSoCo, or approved equivalent as approved by the Engineer.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine surfaces to be coated for conditions that would adversely affect the permanence and quality of this work. Make sure that unsuitable conditions are corrected before proceeding with painting.

3.02 SURFACE PREPARATION

A. Prepare surfaces to receive the coating in compliance with the manufacturer's printed instructions.

3.03 COATING PREPARATION

A. Open containers only as required for use. Mix coating in non-environmentally protected areas.

B. Thoroughly stir and agitate coating to uniformly smooth consistency suitable for proper application.

C. Do not reduce, change, or use any materials except in compliance with manufacturer's printed instructions.

D. In all cases, prepare and handle coating to prevent deterioration and inclusion of foreign matter.

3.04 APPLICATION

A. Test coating on each type of substrate for compatibility and desired results before proceeding further.

B. Apply coating only under conditions that will insure finishes free from blemishes and defects.

C. Remove spillage and spatters on adjacent surfaces so as not to damage the surface being cleaned.

D. Completed work shall match approved samples as determined by the Engineer.

PART 4 - MEASUREMENT AND PAYMENT

Work of this Section is considered incidental to work under other payment items and no separate measurement and payment will be made to the Contractor for Work of this Section. Work of this section shall include furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 10 14 53

ROADWAY SIGNS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Section Includes:

1. Traffic signs.

2. Accessories including but not limited to frames, brackets, supports, sign posts, cabinets, connectors, fasteners, and anchors.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 – General Requirements.

2. Section 01 33 00 – Submittal Procedures.

3. Section 01 60 00 – Product Requirements

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):

1. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges, Section 10, Architecturally Exposed Structural Steel.

B. ASTM International (formerly American Society for Testing and Materials):

1. A36 (A36M) – Standard Specification for Carbon Structural Steel.

2. A53 (A53M) – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.

3. A123 (A123M) – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

4. A153 (A153M) – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

5. A240 (A240M) – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

6. A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

7. A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

8. A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

9. A666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

10. A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

11. B209 – Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

12. B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

13. B429 (B429M) – Standard Specification for Aluminum Alloy Extruded Structural Pipe and Tube.

14. B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

C. American Welding Society (AWS):

1. D1.1 – Structural Welding Code – Steel.

D. CE – U.S. Army Corps of Engineers:

1. CE CRD-C621 – Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Non-shrink).

E. Society for Protective Coatings (SSPC):

1. Paint 20 – Specification for Zinc Rich Primers (Type I, Inorganic, and Type II, Organic)

2. SP 6 – Commercial Blast Cleaning

1.03 SUBMITTALS

A. Make submittals in accordance with Section 01 33 00: Submittal Procedures.

B. Product Data: Technical product specifications, anchor details and installation instructions for products used in metal fabrication, including paint products, hinges, locks, fasteners, light fixtures, and other components of work.

C. Coating Systems:

1. Include finish manufacturer's technical information such as basic materials analysis and installation instructions.

2. List each material and cross-reference to the specific coating, finish system and application.

3. Identify by manufacturer's catalog number and general classification.

D. Shop Drawings:

1. Submit Shop Drawings for fabrication and erection indicating all materials, sizes, configurations and required location of connections, junction boxes, and equipment provided under other Sections.

   a. Include plans, elevations, details, sections, and connections.
   b. Show anchorage and accessory items.
   c. For structural elements, show fabrication and erection tolerances.

2. For structural elements, include details of cuts, connections, camber, holes, and other pertinent data.

   a. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.

3. Provide setting Plans, templates, and directions for the installation of anchor bolts and other anchorages to be installed by others.

4. For connections designed by the fabricator as a part of fabricator's preparation of Shop Drawings, show stamp and signature of a structural engineer registered in California.

5. Show approval of lighting supplier for all illuminated signs.

6. Include porcelain enameled steel panels, indicating method and sequencing of attachment.

7. Equipment Provided by Others: Show all equipment and accessory items provided by SCRRA or provided under other contracts.

E. Samples: Representative samples of materials and finished products.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide work required under this section from sign manufacturers regularly engaged in work of this magnitude and scope for minimum of five years.

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with the AWS Standard Qualification Procedure.

C. Uniformity of Manufacture: For each component and process indicated, furnish products of a single manufacturer.

D. Notify Engineer 15 days prior to 90 percent completion of the shop fabrication, so that the work may be observed prior to delivery to job site.

1. Where fabrication is done more than 100 miles (160 kilometers) from job site, allow 14 days for observation and review before fabrication and installation of additional units.

1.05 PROJECT CONDITIONS

A. Take field measurements prior to preparation of Shop Drawings and fabrication, where possible.

B. Do not delay job progress; allow for trimming and fitting wherever taking field measurements before fabrication might delay work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect sign units during transportation to AUTHORITY by wrapping all sign units individually in soft, nonabrasive material.

B. Pay special attention to protection of sign faces with artwork and to porcelain enamel finish.

PART 2 - PRODUCTS

2.01 GENERAL

A. Where products or manufacturers are listed, make submittals for proposed comparable products and substitutions in accordance with Section 01 60 00, Product Requirements.

2.02 MATERIALS

A. Provide metal work composed of metals of the forms and types which comply with requirements of referenced standards and which are free from surface blemishes where exposed to view in the finished unit.

1. Exposed to view surfaces exhibiting pitting, seam marks, roller marks, “oil canning,” stains, discolorations, or other imperfections on finished units are not acceptable.

B. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304.

C. Aluminum: Alloy and temper recommended by aluminum producer or finisher for type of use and finish indicated, and with minimum strength and durability properties of alloy and temper designated for each aluminum form required:

1. Sheets: ASTM B209, 5052-H32, panel quality, thickness as indicated on Plans.

2. Extruded Pipe and Tube: ASTM B429 (B429M), 6063-T6.

3. Extruded Bar and Shapes: ASTM B221, 6063-T6.

4. Plate and Sheet: ASTM B209, 6061-T6.

D. Steel Plates, Shapes, and Bars: ASTM A36 (A36M).

E. Galvanizing: G60 (Z180) zinc coating for steel fabrications; where zinc coating is reduced below average thickness required by applicable standard referenced above, apply galvanizing repair paint as specified.

1. Preparation for Shop Finishing: After galvanizing, thoroughly clean ornamental metalwork of grease, dirt, oil, flux and other foreign matter, and treat with metallic phosphate process.

F. Fasteners: Provide Type 304 or 316 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

1. Do not use metals which are corrosive or otherwise incompatible with metals joined.

2. Provide tamper resistant fasteners where exposed to view.

3. Provide concealed fasteners for interconnection of metal work components and for attachment to other work except where exposed fasteners are or are unavoidable.

G. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS Specifications, and as required for color match, strength and compatibility in the fabricated items.

H. Anchors and Inserts: Provide anchors of type, size, and material required for type of loading and installation condition shown, as recommended by manufacturer, unless otherwise indicated.

1. Use nonferrous metal or hot dipped galvanized anchors and inserts for exterior locations and elsewhere as required for corrosion resistance.

2. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

I. Very High Bond (VHB) Adhesive: VHB adhesives recommended by manufacturer.

J. Nonshrink, Nonmetallic Grout: Premixed, factory packaged, nonstaining, noncorrosive, nongaseous, gypsum free grout complying with CE CRD-C621.

1. Provide grout specifically recommended by manufacturer for interior and exterior applications as indicated on Plans.

K. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20; two-component, moisture-cured urethane, zinc-rich.

1. Basis of Design: Tnemec-Zinc 90-97, Tnemec Company, Inc.

2. Manufacturers: Subject to compliance with requirements, provide the indicated product, a comparable product by one of the following, or equivalent approved as a substitution:

a. Tnemec Company, Inc.
b. Keeler & Long, div. PPG Industries.
c. International Protective Coatings, Div. International Paint.

L. Traffic Signs: Minimum 0.067 inch thick (aka 14 gauge) sheet steel and reflectorized porcelain white beaded background and black lettering; size required by sign type and Caltrans Standard Specifications Section 56-2.

1. Post Mounted: 2 inch by 2 inch by 1/8 inch (50 mm by 50 mm by 3 mm) galvanized steel pipe complying with ASTM A53; theft proof fasteners; set in concrete footing.

2.03 FABRICATION

A. Use materials of size and thickness indicated or as required to produce strength and durability in finished product for use intended.

1. Work to dimensions shown or accepted on Shop Drawings, using proven details of fabrication and support.

2. Use types of materials shown or specified for various components of work.

3. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible.

a. Use exposed fasteners of type shown.

4. Provide anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

5. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

6. Fabricate units to configurations indicated on reviewed Shop Drawings.

7. Properly mark and match mark materials for field assembly.

    a. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

8. Cut, fit, and assemble units with exposed surfaces smooth and square, free of cutting marks, shear distortion, burrs and nicks.

9. Form exposed work true to line and level with accurate angles, surfaces, and edges.

    a. Ease exposed edges to radius of approximately 1/32 inch (0.8 mm) unless otherwise shown.

    b. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

10. Form simple and compound curves by bending members in jigs or other system to produce uniform curvature for each repetitive configuration required.

    a. Maintain profile of member throughout entire bend without buckling, twisting, or otherwise deforming exposed surfaces.

B. Steel Fabrication: Fabricate with special care using material selected for best appearance, in accordance with AISC specifications and as indicated on final Shop Drawings.

1. Apply necessary fabricating techniques to produce and maintain the quality of work within required tolerances.

2. Fabrication Tolerances: As specified in AISC Code, Section 10, Architecturally Exposed Structural Steel, unless more stringent requirements are indicated.

3. Hot-dip galvanize after fabrication.

C. Aluminum Fabrication: Allow for thermal movement in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints and over stressing of welds and fasteners.

1. Base design calculations on actual surface temperatures of metals due to both solar heat gain and night time sky heat loss.

2. Provide necessary rebates, lugs, and brackets for assembly of units.

    a. Use concealed fasteners wherever possible.

3. Mill joints to a tight, hairline fit. Cope or miter corner joints.

a. Form joints exposed to weather to exclude water penetration.

4. Finish exposed surfaces to smooth, sharp, well-defined lines and arises.

D. Welded Construction: Comply with AWS Code for procedures, appearance, and quality of welds, and methods used in correcting welding work.

1. Select weld sizes, sequence and equipment to limit distortions to allowable tolerances.

a. Surface bleed of back side welding on exposed surfaces will not be acceptable.

2. Assemble and weld by methods that produce true alignment of axes without warp.

a. Grind smooth exposed fillet welds; grind butt welds flush and smooth; dress all exposed welds, feather edges onto base material and polish as required for smooth painted surfaces.

3. Provide shapes and sizes as required for profiles shown.

a. Fabricate units from structural steel or aluminum shapes, plates, and bars, with continuously welded joints and smooth exposed edges.
b. Use concealed field splices wherever possible.
c. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.

4. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and miscellaneous steel and iron shapes as required for supporting of signs.

5. Fabricate items of sizes, shapes, and dimensions required.

6. Weld corners and seams continuously, complying with AWS recommendations.

a. All exposed welds to be clean, consistent and uniform in appearance.
b. Grind exposed welds to match adjacent contours and finish to match adjacent finish.

E. Holes for Other Work: Provide holes required for securing other work to sign supports, brackets and frames, and for passage of other work through metal members as shown on approved Shop Drawings.

1. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work.

2. Drill holes 1/16 inch (1.6 mm) oversize for field alignment and fitting.

3. Cut, drill or punch holes perpendicular to metal surfaces.

4. Do not flame cut holes or enlarge holes by burning.

F. Bearing Plates: Provide bearing plates for steel items bearing on concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.

1. Drill plates to receive anchor bolts and for grouting as required.

G. Furnish inserts and anchoring devices which must be set in concrete for installation of metal work. Coordinate delivery with other work to avoid delay.

H. Surface Preparation: After inspection and before finishing, remove loose rust, mill scale, and deposits of spatter, slag, or flux.

1. Clean steel and aluminum by wheel abrader process or other method to achieve results defined by SSPC-SP 6, Commercial Blast Cleaning.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that mounting surfaces are properly prepared.

3.02 PREPARATION

A. Do not start work until conditions are satisfactory.

B. Take field measurements prior to preparation of Shop Drawings and fabrication, where possible.

1. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

C. Coordinate and furnish anchorages, setting Plans, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction.

1. Coordinate delivery of such items to project site.

3.03 FINAL ASSEMBLY

A. Porcelain Panels: Assemble all porcelain enamel sign components flush, true and accurately straight as indicated on approved Shop Drawings for each type of sign.

B. Hardware:

1. Furnish and install all hardware for the attachment of porcelain panels to other sign components.

2. In addition, furnish any other hardware item not specified which would normally be furnished or required for proper functioning of signs as indicated on the Plans.

C. Anchor Bolts:

1. Furnish anchor bolts and other connectors required for securing sign supports to in-place work.

2. Furnish templates and other devices as necessary for pre-setting bolts and other anchors to accurate locations.

3.04 ROADWAY SIGNS

A. Install roadway signs in accordance with the Contract Documents, Caltrans Standard Specifications Section 56-2 or as directed by the Engineer. Set height of pole mounted signs and other way finding signs as specified by local agencies having jurisdiction or Authority for the indicated application.

B. All signs shall be of high intensity grade (Diamond Grade Reflective) with protective overlay film.

C. Existing signs and poles as shown on the plans shall be relocated to a new location (Protected) and reinstalled.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Roadway Signs will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement**.**.

4.02 PAYMENT

A. Roadway Signs furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

B. This price shall be full compensation for including multiple sign faces, sign post, anchors, hardware, concrete post foundation, galvanizing, and fasteners, removal of existing signs, posts, and foundations (where shown), relocation of existing signs (where shown) described by the Contract Documents.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 10 14 55

RAILROAD SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section consists of furnishing all labor, materials and equipment necessary and incidental to maintaining existing railroad signage and constructing new railroad signage at the locations indicated in the reference Specifications, on the contract plans.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

C. Work Included:

1. All Work associated with constructing new and maintaining existing railroad signage along the right-of-way, including excavation for signposts.

2. If the Contractor cannot construct the signage at the locations indicated in the plans or standards due to obstructions, clearance limitations or topography, request direction from Engineer.

1.02 SUBMITTALS

A. Submit, under the provisions of Division 1 the following information:

1. Compliance: Manufacturer or Supplier’s certifications stating that the Materials delivered to the site are in compliance with these Specifications.

2. Compliance: Submit a certificate of compliance for aluminum sheeting, retroreflective sheeting, screened-process colors, nonreflective, opaque black film, protective-overlay film, and anti-graffiti overlay.

3. Shop Drawings: Details of sign lettering, manufacturer’s information for materials, posts, foundations, anchor details (including anchorage) detail.

4. Upon request, submit test samples of sign panels and materials at various stages of production. Sign panel samples shall be at least 12 by

12 inches in size and include background material legend.

5. Within 15 days before starting sign fabrication, submit at least three copies of quality control plan for sign panels. Allow 10 days for OCTA review. Do not start fabricating sign panels until OCTA accepts the quality control plan.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The Contractor shall use materials and methods, which comply with the SCRRA Engineering Standards (ES). Railroad signage shall conform to the following Standard Drawings:

1. Sign lettering shall conform to SCRRA ES1212, Arial Bold Lettering or to the SCRRA Engineering Standards drawing for a specific sign.

2. Derail switch target signage shall conform to SCRRA ES2610, Derailing Switch Target and ES2611, Derail Signs.

3. Derail switch notice signage shall conform to SCRRA ES2612, Derailing Switch Notice.

4. Safety lock indication signage shall be at the option of the Contractor, and approved by the Engineer.

5. Switch stand target colors shall conform to SCRRA ES2703, Color Indications of Targets and Lenses on Switch Stands.

6. Station train and locomotive position spot signs shall conform to SCRRA ES3330-01 through ES3330-06.

7. Other station signs shall conform to SCRRA ES3301 through ES3329.

8. Highway-railroad crossing crossbuck signs for public crossings shall conform to SCRRA ES4101, Highway-Railroad Crossing Crossbuck Signs.

9. Private, pedestrian and bicycle railroad grade crossing signs shall conform to SCRRA ES4102, Private, Pedestrian and Bicycle Railroad Grade Crossing Signs.

10. Private crossing closure notification sign shall conform to SCRRA ES4312, Private Crossing Closure Notification Signs.

11. Sign post, anchors and fasteners shall conform to SCRRA ES5210, Details for Installing Signs at Grade.

12. Milepost signs shall conform to SCRRA ES5211, Milepost.

13. Permanent speed restriction signs shall conform to SCRRA ES5213, Permanent Speed Restriction Signs.

14. No trespassing signs shall conform to SCRRA ES5214, Warning Signs.

15. Stop, slow and resume speed flags and signs shall conform to SCRRA ES5215, Stop, Slow and Resume Speed Flags and Signs.

16. Whistling Point/Quiet zone signs shall conform to SCRRA ES5216, Whistling Point/Quiet Zone Sign.

17. Yard limit signs for terminal tracks shall conform to SCRRA ES5217, Yard Limit Sign for Terminal Tracks.

18. Control Point (CP) limit signs and markings shall conform to ES5218, Control Point (CP) Limit Sign and Markings.

19. Flag stanchions shall conform to ES5219, Flag Stanchion.

20. Station signs for other than CTC territory shall conform to SCRRA ES5222, Station Signs for Other Than CTC Territory.

21. Mechanical Limit and No Ride Zone signs shall conform to SCRRA ES5223, Mechanical Limit and No Ride Zone Signs.

22. Warning paddles shall conform to ES5225, Warning Paddle.

23. Warning Signs for Underground Cables shall conform to SCRRA ES5229.

24. Bridge, trestle and culvert number signs shall conform to SCRRA ES6101, Bridge, Trestle and Culvert Numbers.

25. Radio channel sign shall conform to ES6103, Radio Channel Sign.

26. Tunnel exit sign shall conform to SCRRA ES6104, Tunnel Exit Sign.

27. Tunnel numbers shall conform to SCRRA ES6102, Tunnel Numbers.

28. Radio channel signs shall conform to SCRRA ES6103, Begin Channel Sign.

29. ATS sign shall conform to SCRRA ES8260, ATS Sign.

30. Emergency Notification Sign for Highway-Rail Crossing shall conform to SCRRA ES8270, Emergency Notification Sign for Highway-Rail Crossing.

31. Begin CTC/End CTC sings shall conform to SCRRA ES8291, Begin CTC/End CTC Sign.

32. Stop sign shall conform to SCRRA ES8292, Stop Sign.

33. Block signal with “P” Plate signs shall conform to SCRRA ES8545, Block Signal With “P” Plate.
34. Other signs shall be as referenced or as shown on the Contract Plans.

B. Signs shall be free from blemishes that could affect serviceability and detract from the general sign color and appearance when viewed during the daytime and nighttime from a distance of 25 feet. The face of completed signs shall be uniform, flat, smooth, and free of defects, scratches, wrinkles, gel, hard spots, streaks, extrusion marks, and air bubbles. The front, back, and edges of sign panels shall be free of router chatter marks, burns, sharp edges, loose rivets, delaminated skins, excessive adhesive over-spray, and aluminum marks.

C. Type Class IX retroreflective sheeting shall have Class 1, 3, or 4 adhesive backing. The adhesive backing shall be pressure sensitive and fungus resistant.

D. The type of material used for screened-process colors, nonreflective, opaque, black film, and protective overlay film shall be the type recommended by the retroreflective sheeting manufacturer.

E. Screened-process colors and nonreflective, opaque, black film shall have equivalent outdoor weatherability characteristics as the retroreflective sheeting specified in ASTM D4956.

F. Cured, screened-process colors shall be able to withstand removal when tested by applying the 3M Company's Scotch brand cellophane tape no. 600 or equivalent tape over the color and removing it with a single, quick motion at a 90 degree angle normal to the surface of the sign's face.

G. Aluminum sheeting for framed and unframed panels shall be aluminum alloy 6061-T6.

2.02 FABRICATION

A. Retroreflective Sheeting

1. Retroreflective sheeting shall be applied to sign panels at the fabrication plant under the retroreflective sheeting manufacturer's instructions without appreciable stretching, tearing, and damage.

2. The orientation of the legend shall comply with the retroreflective sheeting manufacturer's instructions.

3. The retroreflective sheeting on a sign panel with a minor dimension of 48 inches or less shall be a single, contiguous sheet without splices except for the splices produced during the manufacturing process of the retroreflective sheeting. A sign panel with a minor dimension greater than 48 inches may have 1 horizontal splice in the retroreflective sheeting other than the splices produced during the manufacturing process of the retroreflective sheeting.

4. Unless the retroreflective sheeting manufacturer's instructions require a different method, splices in the retroreflective sheeting shall overlap by a minimum of one (1) inch. The retroreflective sheeting on either side of a splice shall not exhibit a color difference under incident and reflected light.

B. Storage and Handling

1. Protect, transport, and store sign panels fabricated with screened-process colors under the retroreflective sheeting manufacturer's instructions.

2. Transport sign panels so that the face of the panels are protected from damage and weather. Ship the panels on pallets, in crates, or in tier racks. Ship the panels vertically on edge. Do not stack the panels horizontally. Place padding and protective materials between the panels as necessary. Keep the panels dry during transit.

3. Store sign panels in a dry environment at all times. Store the panels vertically on edge whether indoors or outdoors. Do not store the panels directly on the ground. Do not let the panels get wet during storage. In areas of high heat and humidity, store the panels in enclosed, climate-controlled trailers or containers. Store the panels indoors whenever the storage duration will exceed 30 days.
4. The fabricator shall perform all patterns, layouts, and set-ups necessary for the screening process.

C. Aluminum Sheeting

1. The alloy and temper of aluminum sheeting shall comply with ASTM B209 for the designation specified.

2. Aluminum sheeting shall be pretreated for corrosion resistance under ASTM B449. The surface of the aluminum sheeting shall be cleaned, deoxidized, and coated with a light, tightly adherent chromate conversion coating free of powdery residue. The conversion coating shall be Class 2 with a weight from 10 milligrams per square foot to 35 milligrams per square foot and an average weight of 25 milligrams per square foot. After the cleaning and coating process, protect the aluminum sheeting from exposure to grease, oils, dust, and contaminants.

3. Aluminum sheeting shall be free of buckles, warps, dents, cockles, burrs, and defects resulting from fabrication.

PART 3 - EXECUTION

3.01 MAINTENANCE AND PROTECTION OF EXISTING SIGNAGE

A. Maintain and protect in place the existing railroad signage until such time as it can be replaced with new signage, or relocated at a permanent location, as shown on the Contract Drawings. Signs may be temporarily relocated to prevent

their damage. Contractor shall confer with the Engineer for proper location and orientation of relocated signs.

B. No existing signage shall be removed unless approved by the Engineer.

C. Any existing railroad Milepost, whistling Post/Quiet Zone, Permanent Speed Restriction, Yard Limit, Control Point, Radio Channel, ATS, Block Signal With "P" Plate, or Derail signs damaged by the Contractor's operations shall be replaced within 36 HRS at the Contractor's sole expense. Any other signage damaged by the Contractor's operations shall be replaced within 8 days, at the Contractor's expense. Signage not replaced or repaired within these time periods will be replaced by the Authority at the Contractor's expense; the cost of such replacement will be deducted from any payment due the Contractor.

D. Placement of temporarily relocated and permanent signs shall comply with current editions of CPUC General Order 26 and 118.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Railroad Signage will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

4.02 PAYMENT

A. Railroad Signage furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

B. This price shall be full compensation for including multiple sign faces, sign post, anchors, hardware, concrete post foundation, galvanizing, and fasteners, removal of existing signs, posts, and foundations, and relocation of existing signs described by the Contract Documents.

END OF SECTION

SECTION 26 06 00

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Grounding and bonding of stray current protection for structural steel, bar reinforcing steel, railings, and fencing as identified in the Contract Drawings.

1.02 REFERENCES

A. ASTM International (ASTM):

1. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.

C. National Fire Protection Association (NFPA):

1. 70, National Electrical Code (NEC).

a. Article 230, Services.

b. Article 250, Grounding and Bonding.

c. Article 408, Switchboard and Panelboards.

d. Article 409, Industrial Control Panels.

e. Article 610, Cranes and Hoists.

f. Article 620, Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts.

D. Underwriters Laboratories, Inc. (UL):

1. 467, Grounding and Bonding Equipment.

1.03 QUALITY ASSURANCE

A. Assure ground continuity is continuous throughout the entire Project.

B. Regulatory Requirements:

1. Electrical Components, Devices, and Accessories: Listed and labeled under UL 467 as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. Comply with NFPA 70.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

1.04 SUBMITTALS

A. Product Data: Technical data for ground rods and grounding conductors.

B. Reports: Field quality control test reports.

PART 2 - PRODUCTS

2.01 GENERAL

A. Where products and manufacturers are listed, make submittals for proposed comparable products and substitutions in accordance with:

Section 01 33 00 - Submittal Procedures

Section 01 25 00 - Substitution Procedures

Section 01 60 00 - Product Requirements

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Ground rods and bars and grounding clamps, connectors and terminals:

a. Erico Products Inc., Cadweld.

b. Burndy.

c. Harger Lightning Protection.

d. Heary Brothers.

e. Joslyn.

f. Robbins Lightning Protection.

g. Thomas & Betts (Blackburn).

h. Thompson.

2. Exothermic weld connections:

a. Erico Products Inc., Cadweld.

b. Harger Lightning Protection.

c. Thermoweld.

3. Prefabricated composite test stations:

a. Quazite Composolite.

b. Armorcast Products Company.

2.03 COMPONENTS

A. Wire and Cable:

1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.

2. Insulated conductors: Color coded green, per Specification Section 26 12 00.

3. For insulated conductors, comply with Section 26 12 00 - Conductors and Cables – Low Voltage.

4. Equipment Grounding Conductors: Insulated with green colored insulation.

5. Grounding Electrode Conductors: Stranded cable.

6. Underground Conductors: Bare, stranded, unless otherwise indicated.

7. Copper Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

8. Copper Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 IN wide and 1/16 IN thick.

9. Tinned Copper Bonding Jumper: Tinned copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 IN wide and 1/16 IN thick.

10. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulated spacer.

11. Connectors: Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items. Use compression type where exposed and exothermic-welded type, in kit form, selected per manufacturer's written instructions where concealed or buried in earth.

B. Conduit: As specified in Specification Section 26 13 00.

C. Ground Bars:

1. Solid copper:

a. 1/4 IN thick.

b. 2 or 4 IN wide.

c. 24 IN long minimum in main service entrance electrical rooms, 12 IN long elsewhere.

2. Predrilled grounding lug mounting holes.

3. Stainless steel or galvanized steel mounting brackets.

4. Insulated standoffs.

D. Ground Rods:

1. Provide grounding electrodes as many as necessary to maintain maximum resistance as indicated in Section 3.02-4.

2. 3/4 IN x 10 FT.

3. Copperclad: Copper clad steel.

a. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core.

b. Corrosion resistant bond between the copper and steel.

c. Hard drawn for a scar-resistant surface.

E. Grounding Clamps, Connectors and Terminals:

1. Mechanical type:

a. Standards: UL 467.

b. High copper alloy content.

2. Compression type for interior locations:

a. Standards: UL 467.

b. High copper alloy content.

c. Non-reversible.

d. Terminals for connection to bus bars shall have two bolt holes.

3. Compression type suitable for direct burial in earth or concrete:

a. Standards: UL 467, IEEE 837.

b. High copper alloy content.

c. Non-reversible.

F. Exothermic Weld Connections:

1. Copper oxide reduction by aluminum process.

2. Molds properly sized for each application.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Install products in accordance with manufacturer's instructions.

2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.

3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections.

4. Where ground conductors pass through floor slabs or building walls provide non-metallic sleeves and install per Specification Section 01 73 20.

5. Do not splice grounding conductors except at ground rods.

6. Install ground rods and grounding conductors in undisturbed, firm soil.

   a. Provide excavation required for installation of ground rods and ground conductors.

   b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.

   c. Unless otherwise specified, connect conductors to ground rods with compressor type connectors or exothermic weld.

   d. Provide sufficient slack in grounding conductor to prevent conductor breakage during backfill or due to ground movement.

   e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.

7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

B. Use copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

C. In raceways, use insulated equipment grounding conductors.

D. Exothermic Welded Connections: Use for connections to structural steel and for underground connections.

E. Grounding Bus: Install 24 IN long ground bus in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacer; space 1 IN from wall and support from wall 18 IN above finished floor.

F. Underground Grounding Conductors: Use copper conductor, No. 4/0 AWG minimum. Bury at least 24 IN below grade or bury directly below duct bank when installed as part of the duct bank.

G. Equipment Grounding Conductors: Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

1. Install insulated equipment grounding conductors in all feeders and branch circuits.

2. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch circuit runs from computer-area power panels or power-distribution units.

3. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

4. Air Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

5. Water Heater, Heat Tracing, and Anti-frost Heating Cables: Install an insulated equipment grounding conductor to each electric water heater, heat tracing, and anti-frost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

6. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

7. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing an insulated equipment grounding conductor with supply branch-circuit conductors.

H. Metal Frame Grounding for Buildings: Drive a ground rod at the base of every corner column and at each intermediate exterior column. Connect rod to column with an underground grounding conductor. Interconnect ground rods with a continuous underground conductor (counterpoise), extending around the perimeter of the building, 24 IN minimum from building foundation. Use tinned copper conductor not less than No. 4/0 AWG for underground conductor, and bury 18 IN below grade, minimum.

I. Ground Rods: Drive ground rods until tops are 12 IN below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except as otherwise indicated. Make connections without exposing steel or damaging copper coating.

J. Grounding Conductors: Route along shortest and straightest paths possible. Avoid obstructing access or placing conductors where subjected to strain, impact, or damage.

K. Bonding Straps and Jumpers: Install so that vibration by equipment mounted on vibration isolation hangers or supports is not transmitted to rigidly mounted equipment. Use exothermic welded connectors for outdoor locations, unless disconnect type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

L. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

M. Water Meter Piping: Use braided type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

N. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided type bonding straps.

O. Bond each above ground portion of gas piping system upstream from equipment shutoff valve.

P. Connections: Make connections so that galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so that metals in direct contact will be galvanically compatible.

1. Use electroplated or hot tin coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum to steel connections with stainless steel separators and mechanical clamps.

4. Make aluminum to galvanized steel connections with tin plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

6. Exothermic Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

7. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure type connectors.

8. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

9. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

10. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

11. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

Q. Duct Banks: Install a No. 4/0 grounding conductor below each duct bank in direct contact with the earth.

R. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so that 4 IN will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 IN above to 6 IN below concrete. Seal floor opening with waterproof, non-shrink grout.

S. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

T. Pad Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad mounted equipment and noncurrent carrying metal items associated with substations by connecting them to

underground cable and grounding electrodes. Use copper conductor not less than No. 4/0 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 IN below grade and 6 IN from the foundation.

3.02 FIELD QUALITY CONTROL

A. Leave grounding system uncovered until observed by Engineer.

B. Testing: The Contractor shall engage independent agency to perform field quality control testing:

1. After installing grounding system

2. Nominal maximum values are as follows:

a. Equipment Rated 500 kVA and Less: 10 ohms.

b. Equipment Rated 500 to 1000 kVA: 5 ohms.

c. Equipment Rated More Than 1000 kVA: 3 ohms.

d. Substations and Pad-Mounted Switching Equipment: 5 ohms.

e. Manhole Grounds, Railing, and Stray Current Grounds: 10 ohms.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Grounding and Bonding will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

4.02 PAYMENT

A. Grounding and Bonding furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 31 11 00

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Site clearing and grubbing of trees, stumps, undergrowth, brush, trash, grass, weeds, roots, rubbish, refuse, or other debris, modifying irrigation systems, stripping of topsoil and protecting trees within the limits of excavation, embankment, borrow, and other areas as shown on the Contract Plans or required to perform the Work of this Contract.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 01 74 19 – Construction Waste Management and Disposal.

3. Section 31 11 50 – Demolition, Cutting, and Patching.

4. Section 32 90 00 – Soil Erosion, Sediment Control, Topsoiling and Seeding.

1.02 SUBMITTALS

A. General:

1. Submittals shall be made in accordance with Division 01 requirements.

B. Site Clearing Plan:

1. A site clearing plan must be prepared by the Contractor and submitted to the Engineer for acceptance prior to commencing work. The site clearing plan shall include:

a. Location and limits of clearing and grubbing.

b. Methods for protection of areas of vegetation designated as “no construction zones” and trees noted in plans to be saved.

c. Methods to be employed and equipment to be used.

d. Safety measures including signs, barriers, temporary walkways and hand railing.

e. Haul routes and disposal sites.

f. Permits for transport of materials off the worksite where applicable and other permits as required by local agencies, project environmental documents and the project Plans.

g. Schedule of site clearing activities including anticipated railroad flagging needs.

C. Permits, Notices, Certifications and Authorizations:

1. The following permits, notices, certifications and authorizations shall be obtained with copies submitted by the Contractor to OCTA:

a. Delivery manifests for disposed materials in accordance with site clearing plan and permit conditions in accordance with Division 01 requirements.

b. Private property owner's release for material removed and deposited on private property in accordance with Division 01 requirements.

i. Releases shall absolve OCTA from any responsibility in connection with the disposal of materials on private property.

ii. Releases shall be signed by the owner(s) of the property on which the material will be deposited.

iii. Two copies of the releases must be submitted to the Engineer for approval not more than 15 days before the start of material being deposited on private property.

c. Disposal Certification for materials removed from Job Site indicating they have been disposed of in accordance with applicable laws and regulations in accordance with Division 01 requirements.

1.03 ENVIRONMENTAL CONDITIONS

A. On site burning or burial of site clearing materials will not be allowed.

B. The Contractor must take possession of material and debris collected from site clearing procedures and be responsible for disposing of them in accordance with these Specifications, any project permits, and applicable laws and regulations in accordance with Division 01 requirements.

C. Contractor shall provide noise abatement in accordance with Division 01 requirements.

D. Site cleanliness, sweeping and dust control shall be in accordance with Division 01 requirements.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect existing trees, other vegetation, and existing site improvements on OCTA or adjacent property that are to remain.

1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.

2. Avoid foot or vehicular traffic or parking of vehicles within drip line of trees or shrubs.

3. Provide barricades, coverings, temporary fencing, or other types of temporary protection as required by the Project environmental documents or the Engineer in accordance with the Plans and these Specifications.

B. Repair or replace trees, vegetation, and existing site improvements including modifying irrigation systems that are to remain that are damaged by construction operations.

1. Repair of damaged trees and shrubs to be performed by a certified arborist or tree surgeon.

2. Repair of damaged trees and shrubs to be performed by a certified arborist or tree surgeon Remove trees that are damaged to the extent that a certified arborist or tree surgeon determines cannot be repaired and restored to full-growth status.

a. Replace with new trees of minimum 4 inches caliper.

3. Damaged vegetation shall be replaced in-kind as approved by the Engineer
.

4. Existing site improvements will be repaired or replaced as approved by the Engineer.

5. Irrigation systems shall be modified as shown in the Plans

C. The Contractor shall obtain authority for any removal and/or alteration work, as required by the Plans, on adjoining property prior to Contractor starting work.

3.02 SITE CLEARING

A. Topsoil, fertile, friable soil of a loamy character with organic matter normal to the area, Removal:

1. Strip topsoil to depths encountered.

a. Remove heavy growths of grass before stripping.

b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.

c. Separate from underlying subsoil or objectionable material.

2. Stockpile topsoil where directed by Engineer.

a. Construct stockpiles to freely drain surface water.

b. Provide temporary cover or seeding of stockpiles to prevent erosion in accordance with Specification 32 90 00.

3. Do not strip topsoil in wooded areas where no change in grade occurs.

4. Topsoil from borrow sources shall be free of subsoil, objects over 2 inches dia., weeds and roots.

5. Clearing: Clear from within limits of construction all trees except those marked to remain.

a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.

b. Rubbish shall be removed from cleared areas and disposed of in accordance with project environmental documents and federal, state and local laws in accordance with Division 01 requirements.

c. Clearing shall be level with the ground surface so that no obstruction will interfere with close machine or hand mowing of cleared areas.

d. Cleared areas shall be left smooth and free of obstructions or depressions that will impound water.

B. Removed materials shall become the property of the Contractor and shall be disposed of outside the public right of way in conformance with the provisions in Section 01 74 19 - Construction Waste Management and Disposal and reference Section 300-1.3 “Removal and Disposal of Materials” of the Standard Specifications for Public Works Construction 2009. Within the limits of clearing, all stumps, roots, root mats, logs, debris and other objectionable material shall be removed as follows:

1. Grubbing shall extend to the outside excavation and fill slope lines except where tops of slopes are to be rounded. In these locations, the areas shall extend to the outside limits of slope rounding.

2. Grub where subdrainage trenches will be dug, unsuitable material removed or structures built.

3. Grub areas in which hillsides or existing embankments will be terraced.

4. Grub areas upon which embankments, foundations or other structures will be placed.

   a. Areas beneath embankments greater than 3 feet in depth shall be free from all vegetation and roots to a depth of 6 inches below the ground surface (after topsoil has been removed).

   b. For embankments 3 feet in depth or less, roots that are over 2 inches dia. shall be removed to a depth of 1 foot below ground surface.

3.03 CLEAN-UP

A. Remove and dispose of barricades, coverings or other protections used to prevent damage to existing vegetation or improvements upon clean-up of the Work.

3.04 SCHEDULE

A. Contractor must complete clearing and grubbing work far enough in advance of other operations to permit the placement of construction stakes. Construction schedule shall be adjusted so cleared areas are not left susceptible to erosion or sediment runoff due to weather.

3.05 ACCEPTANCE

A. Upon completion of the site clearing, obtain Engineer's written acceptance of the extent of clearing, depth of stripping, and removal of deleterious material.

PART 4 - MEASUREMENT AND PAYMENT

1.03 MEASUREMENT

A. Site Clearing will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

1.04 PAYMENT

A. Site Clearing furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 31 11 50

DEMOLITION, CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Demolition, removal and disposal, salvage, cutting and patching of existing construction, surface or subsurface, where shown on Plans, or as required to accommodate new work shown or specified including backfilling of excavations and depressions to restore Worksite to final grade.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 31 11 00 – Site Clearing

3. Section 31 20 00 - Earthwork.

4. Section 31 50 00 - Excavation Support Systems.

5. Section 32 91 00 - Soil Erosion, Sediment Control, Topsoiling and Seeding.

1.02 SUBMITTALS

A. General

1. Submittals shall be made in accordance with Division 01 requirements.

B. Contractor shall provide a Site Demolition Plan:

1. The Site Demolition Plan shall include the following items:

a. Location and limits of demolition.

b. Methods and equipment to be utilized including backfilling of excavations and depressions.

c. Shoring or other structures necessary to complete the demolition in accordance with Section 31 50 00.

d. Proposed materials and methods to be used for cutting and patching, or matching and repairing existing construction to remain.

e. Safety measures including signs, barriers, temporary walkways and hand railing.

f. Schedule for performing site demolition, cutting and patching including railroad flagging needs.

g. Haul routes and disposal sites.

h. Utility coordination plan for Contractor demolished utilities as well as utilities being demolished by others as shown in the Plans.

i. Traffic control measures or traffic plan where required by Contractor's proposed methods in accordance with Division 01 requirements.

j. Identification of permits as required by the project environmental documents, federal, state or local agency in accordance with Division 01 requirements.

C. Contractor shall provide copies of notices, permits, certifications and authorizations:

1. Copies of demolition authorization permits and other permits as required by project environmental documents, federal, state or local agency in accordance with Division 01 requirements.

2. Delivery manifests for materials hauled and disposed by Contractor.

3. Private property owner's release for material removed from the OCTA project site and deposited on private property.

a. Releases shall absolve OCTA from any responsibility in connection with the disposal of materials on private property.

b. Releases shall be signed by the owner(s) of the property on which the material will be deposited.

c. Two copies of the releases shall be submitted to the Engineer for approval not more than 15 days before the start of material being deposited on private property.

4. Disposal certification for materials removed from job site indicating they have been disposed of in accordance with applicable laws and regulations.

D. Contractor shall provide material certification:

1. Indicating manufacturer and type of proposed nonshrink grout and epoxy bonding adhesive for patching or repairs to existing concrete structure to remain.

1.03 DELIVERY, STORAGE, AND HANDLING

A. General:

1. Contractor to salvage items, designated for owner's salvage, as a functional unit.

2. Clean, list and tag each item in a manner acceptable to the Engineer for storage.

3. Protect salvage items from damage and deliver to location designated in the Plans or as directed by the Engineer.

4. Salvage each item with auxiliary or associated equipment required for operation.

B. Demolished Materials:

1. On-site burning or burial of demolished materials will not be permitted.

2. Contractor shall take possession of all demolished materials except as noted in the Contract Documents to be salvaged.

3. Contractor shall be responsible for disposing of demolished materials in accordance with applicable federal, state and local laws and regulations in accordance with Division 01 requirements.

C. Environmental Requirements:

1. Cleanliness, Sweeping and Dust Control shall be maintained in accordance with Division 01 requirements.

2. Contractor shall provide noise abatement as required by environmental permits or local agency requirements in accordance with Division 01 requirements.

1.04 SITE CONDITIONS

A. Perform preliminary investigations as required in Section 31 20 00, Earthwork and in accordance with Division 01 requirements to ascertain extent of work.

1.05 SEQUENCING AND SCHEDULING

A. Coordinate and reschedule work as required to avoid interference with other operations of SCRRA, as identified in the Construction Documents or in accepted schedule of site demolition, cutting and patching.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable for nonshrink grout and epoxy bonding adhesive to be used for patching of concrete to remain after demolition:

1. Nonshrink grout:

a. Supreme Grout by Gifford Hill.

b. Masterflow 713 Plus by BASF Building Systems.

c. Sika Grout 212 by Sika.

d. Or substantially equivalent product approved in writing by OCTA.

2. Epoxy bonding adhesive:

a. Euco No.452 MV by Euclid Chemical Co.

b. Sikadur 32, Hi-Mod by Sika Corporation.

c. Or substantially equivalent product approved in writing by OCTA.

B. Submit request for substitution in accordance with Division 01 requirements.

2.02 MATERIALS

A. Nonshrink Grout:

1. Nonmetallic, noncorrosive and nonstaining.

2. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.

3. Grout to produce a positive but controlled expansion. Mass expansion not to be created by gas liberation or by other means.

4. Minimum compressive strength at 28 days to be 6500 psi.

5. Coat exposed edges of grout with a cure/seal compound recommended by grout manufacturer.

B. Epoxy Bonding Adhesive:

1. Two component, moisture insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.

C. Other Temporary or Permanent Material:

1. Other temporary or permanent material shall be provided by the Contractor for proper execution of work in this Section.

D. Backfill Material:

1. Material used for backfill shall conform to the requirements of Section 31 20 00.

PART 3 - EXECUTION

3.01 GENERAL

A. No party other than the Contactor shall remove demolished material from OCTA property.

B. Contractor shall perform the demolition, removal, salvage, cutting and patching including handling of demolished debris in accordance with the Contract Plans, Project Specifications and the submitted approved site demolition plan.

C. Any shoring, if required to accomplish demolition work, shall be designed and constructed in accordance with Section 31 50 00.

3.02 EXISTING STRUCTURES AND RELATED FACILITIES

A. Where demolition is indicated, remove and dispose of:

1. Existing fences as identified in the Plans.

a. Coordinate fence removal with maintaining temporary and permanent site security.

2. Temporary fences when no longer required to protect and secure the construction site.

3. Structures in their entirety or portions to be demolished as indicated in the Plans.

a. Exposed remaining concrete faces shall be saw cut to neat lines or finished with epoxy binder and non-shrink grout.

b. Concrete shall be removed as required and any remaining concrete to be utilized in the finished work or left as an existing structure shall be protected from damage and finished with epoxy binder and non-shrink grout or as indicated in the Plans.

4. Obstructions in their entirety or portions of obstructions as indicated in the Plans including abandoned concrete signal foundations, footings and bases located within the right-of-way shall be demolished.

5. Removal and disposal shall be in accordance with these Specifications and the submitted and approved site demolition plan.

B. Where salvage of material or portions of structures and related facilities is indicated, material shall be carefully removed as shown in the plans for installation of new work and neatly stacked at a location approved in advance to the satisfaction of the Engineer and in accordance with the approved site demolition plan. The materials shall be left in a satisfactory condition for use by OCTA as identified in the Plans or in future projects.

C. The Contractor shall replace or repair, at no expense to OCTA, any existing structure or portion of existing structure or related facility designated to remain that are damaged during removal of the portions designated for demolition.

3.03 PAVEMENT

A. Pavement shall be demolished as indicated in the Plans and removed in accordance with the submitted and approved site demolition plan.

B. Pavement shall be removed to clean straight lines. Saw cutting of edges to be joined is required. Saw cuts shall be a minimum depth of 1-1/2 inches.

1. Portland cement concrete pavement removal shall have a second full depth relief saw cut offset 12 to 18 inches parallel to the initial saw cut unless approved otherwise.

2. If a saw cut in concrete falls within three feet of a construction joint, cold joint, expansion joint, or edge, the concrete shall be removed to the joint or edge.

C. The Contractor shall provide surface drainage of resulting surfaces following pavement removal in accordance with Specification 32 91 00.

D. The Contractor shall replace at no expense to OCTA any existing pavement designated to remain that is damaged as a result of Contactor activities.

3.04 WIRING AND POLES

A. Wiring and Poles designated to be removed by the Contractor shall be removed in accordance with the Plans and the approved site demolition plan. No work shall be performed until clearance to proceed has been provided by the Engineer.

3.05 UTILITIES

A. Demolition of existing utilities removed by others as shown in the Plans shall be coordinated by the Contractor with the utility companies and agencies in accordance with Division 01 in accordance with the approved site demolition plan.

B. The Contractor shall cap and plug storm drain, sanitary sewer, and underdrain in accordance with the utility owner's standard details and instructions. Cap and plug pipe and other conduits abandoned due to demolition, with approved type caps and plugs as required by the utility owners.

C. Abandoned utilities under railroad tracks shall be removed and backfilled or filled in accordance with these specifications and the project plans and technical Specifications.

3.06 BACKFILL OF DEMOLITION EXCAVATIONS

A. Any shoring used for support of demolition excavations shall be removed in accordance with Section 31 50 00 and the submitted and approved site demolition plan.

B. Excavations created by demolition activities shall be backfilled and compacted in the same manner as backfilling excavations in Specification Section 31 20 00.

3.07 RIPRAP/BOULDER REMOVAL

A. The Contractor shall excavate the existing embankment on the west side track ML-1 from STA 4969+00 to STA 4994+50 and remove the existing riprap that is mixed with the embankment soils. Excavation limits shall be as shown in the typical sections.

B. The Contractor shall salvage all riprap that is sixteen (16) inches Caltrans D50 Equivalent Spherical Diameter and greater (RSP Class Light through RSP Class 4 Ton). Salvaged riprap shall be delivered and unloaded by the Contractor adjacent to Metrolink Marine Way Yard, within the railroad right-of-way, on Metrolink Orange Subdivision between mile posts 183.50 and 184.00 in Orange County in the City of Irvine, California..

C. All excavated riprap that is Caltrans D50 Size 8 inches through 15 inches shall be removed and legally disposed offsite by the Contractor. Rock smaller than D50 Size 8 may be placed in a single layer at the bottom of backfill at least eight feet from centerline of proposed track. Any excess rock materials smaller than D50 Size 8 shall be removed and legally disposed offsite by the Contractor.

D. Excavation created by riprap removal shall be backfilled and compacted in the same manner as backfilling excavations in Specification Section 31 20 00.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Remove and Salvage Riprap/Boulders (plus 16" material) shall be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The on-ground weight records (showing both unloaded and loaded weights), provided by the Contractor and signed by the OCTA inspector prior to each load leaving the Project site shall be will be used as the basis for this measurement.

B. No separate measurement or payment will be made for segregation, removal and legal offsite disposal of 8"-15" Riprap. This work shall be considered incidental to Remove and Salvage Riprap/Boulders (plus 16" material).

C. No separate measurement or payment will be made for segregation, removal and legal offsite disposal of excess rock materials smaller than D50 Size 8. This work shall be considered incidental to Remove and Salvage Riprap/Boulders (plus 16" material).

D. Existing facilities to be reconstructed, relaid, relocated or reset not specifically listed in this section and included in the Schedule of Quantities and Prices for measurement and payment shall be considered incidental to work under other payment items and no separate measurement and payment will be made to the Contractor these items

E. When existing facilities are to be salvaged, no separate measurement and payment will be made for removing the facilities.

F. Removal of traffic lines and marking will be considered incidental to work items measured and paid under Section 32 17 23 Traffic Striping and Pavement Marking

G. Removing, salvaging, reconstructing, relocating or resetting the various types of fence will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

H. Remove K-Rail and Fence (Slavage K-Rail to Marine Way Yard) will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

I. Removing, salvaging, reconstructing, relocating or resetting the various types of asphalt or concrete curb, curb and gutter will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

J. Removing, salvaging, reconstructing, relocating or resetting of signs will be considered incidental to work items measured and paid under Section 10 14 53 Roadway Signs and Section 10 14 55 Railroad Signage.

K. Removing, salvaging, reconstructing, relocating or resetting drainage facilities will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

L. Adjusting manholes and inlets to grade, reconstructing, remodeling, or abandoning will be determined as units from actual counts. will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

4.02 PAYMENT

A. Remove and Salvage Riprap/Boulders completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, excavation, backfill, import fill, segregation, salvage and delivery to SCRRA Marine Way Yard, transportation and any associated fees, unloading, removal and disposal of 8-inch through 15-inch riprap, removal and disposal of excess rock material less than 8-inches, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

B. Remove K-Rail and Fence (Salvage K-Rail to Marine Way Yard) completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, disassembly and removal of fencing from K-rail, removal and legal disposal of fence materials, salvage of K-rail and delivery to SCRRA at Marine Way Yard, and doing all work, as shown on the Plans, and as specified in these Specifications.

C. When the Contract Documents includes separate items, and units or lump sum prices for removing, salvaging, adjusting, modifying, remodeling, abandoning, obliterating, relaying, reconstructing, relocating or resetting any of the facilities, the quantities will be paid for at the Contract unit, or lump sum price for the item of work involved.

D. This price shall be full compensation for furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals and for doing all work involved in completing the operations as shown on the Plans, and as specified in these Specifications.

E. Full compensation for all excavation and backfill required to remove, dispose of, salvage, relay, reset, relocate and reconstruct facilities, for which payment is not otherwise provided, shall be considered as included in the Contract unit or lump sum price paid for the items of work involved and no separate payment will be made therefor.

F. When the Contract does not include separate items for removing any of the existing facilities encountered within the area to be cleared and grubbed or the removal is not included in another item, then payment for removing the facilities shall be considered incidental to work under other payment items and no separate measurement and payment will be made to the Contractor for Work of this Section.

G. Payment requests for Demolition, Cutting and Patching shall include certificates showing legal disposal of Materials from OCTA's right-of-way.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavation, embankment fill, structural excavation and backfill, borrow and removal of unsuitable material.

2. Structural excavation shall consist of excavation for the construction of foundations for structures, excavation for trenches for the construction of culverts, pipes and other facilities. Structural backfill shall consists of furnishing, installing, and compacting backfill material around structures.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 03 31 00 – Structural Concrete

3. Section 31 11 00 - Site Clearing.

4. Section 31 11 50 - Demolition, Cutting And Patching.

5. Section 31 50 00 - Excavation Support.

6. Section 34 11 27 - Sub-Ballast and Aggregate Base.

7. Section 34 71 50 – Highway-Rail Grade Crossings

1.02 REFERENCES

A. ASTM International (ASTM):

1. C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

2. D422, Standard Test Method for Particle Size Analysis of Soils.

3. D1556, Standard Test Method for Density and Unit Weight of Soil In Place by the Sand Cone Method.

4. D1557, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m)).

5. D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

6. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

7. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

8. D4829, Standard test Methods for Expansion Index of Soils.

9. D6938, Standard Test Methods for IN-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).

B. California Code of Regulations, Title 8, Subchapter 4, Construction Safety Orders.

C. Standard Specifications for Public Works Construction, 2012 Edition, Section 300 – Earthwork.

D. Caltrans Section 19 - Earthwork

1.03 SUBMITTALS

A. General:

1. Submittals must be made in accordance with Division 01 requirements.

B. Plans and Procedures:

1. Submittals of plans and procedures to the Engineer must be made and approval obtained prior to commencing work for Rough Grading, temporary storage area(s) for topsoil, Excavation, Embankment Fill, Structure Excavation and Backfill, subgrade preparation, borrow (on OCTA property and public right-of-way) and removal of unsuitable materials.

2. Plans shall include, as necessary, haul routes, public streets to be used, traffic control and other incidental work necessary to complete the Rough Grading, Excavation, Embankment Fill, Structure Excavation and Backfill, subgrade preparation, borrow (on OCTA property and public right-of-way) and removal of unsuitable materials.

3. Level 3 Health and Safety Plan requirements.

4. Contractor must submit a Rough Grading Plan, permit application and approved permits as required by project technical Specifications:

a. Phasing of the work shall be shown.

b. Demolition and proposed temporary erosion and sedimentation control measures shall be included.

5. Contractor must submit an Excavation and Embankment Fill Plan:

a. Proposed excavation methods, procedure and equipment to be utilized.

b. Information provided the Engineer does not relieve Contractor of responsibility for the successful excavation performance.

6. Contractor must submit a Structure Excavation and Backfill Plan.

a. Proposed excavation methods, procedure and equipment to be utilized for structural work.

b. Proposed backfill methods, procedure and equipment to be utilized for structural work.

c. Information provided the Engineer does not relieve Contractor of responsibility for the successful structure excavation and backfill performance.

C. Certificates:

1. Material Test Reports for products purchased and used in the project.

2. Certification of proper disposal of demolition materials.

3. Tickets or certification from material suppliers demonstrating compliance with Materials Tests or Specifications.

4. Certified laboratory test reports for fill material, imported or obtained from OCTA property, documenting:

a. ASTM D422, Sieve Analysis.

b. ASTM D1557 or ASTM D4254, Moisture Density Results.

c. ASTM D4318, liquid limit, plastic limit and plasticity index.

5. The Engineer will determine adequacy of the test reports or certifications in accordance with the Contract Documents and may require additional testing to confirm requirements with the Specifications.

D. Product Data and Shop Plans:

1. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

E. Samples:

1. Submit samples, soils test results, and sources of fill, backfill and borrow materials proposed for use.

2. Submit material samples when requested by the Engineer for use as confirmation of Contractor test results.

F. Miscellaneous Submittals:

1. Submit test results for density and compaction tests performed by certified test laboratory hired by the Contactor and approved by the Engineer to perform and report testing.

a. Test results submittal shall be on a form approved in advance by the Engineer.

2. Verification documentation, in accordance with Division 01 requirements, that Contractor requested DigAlert field location of underground utilities and SCRRA Signal and Communications field location of underground railroad lines prior to starting any excavation work.

1.04 QUALITY ASSURANCE

A. Prior to commencing Work, the Contractor must examine the Contract Plans and Specifications, inspect the site, consult all available record Plans of existing Work and utilities, and note all conditions and limitations, which may influence Work required by this Section.

B. Materials not meeting the requirements of this specification must not be used in the Work.

1.05 SITE CONDITIONS

A. Contractor must execute Work under this Specification in such a manner as to minimize impact to the daily operation of the SCRRA, vehicular and pedestrian traffic.

B. The Contractor must barricade open excavations and post with warning lights those excavations occurring on property adjacent to or within public access areas and along the SCRRA tracks in accordance with requirements of Section 31 50 00. Operate warning lights during hours from dusk to dawn each day and as otherwise required. Warning lights shall be located to avoid shining directly into Locomotive Engineer’s eyes in oncoming trains.

C. The Contractor must protect utilities, structures and facilities designated as protect in place from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation and backfill operations.

D. The Work shall allow rainfall to drain freely at all times in accordance with project environmental requirements and permit conditions in accordance with Division 01 requirements.

1.06 ENVIRONMENTAL CONDITIONS

A. The Contractor must protect against erosion and uncontrolled run-off within and adjacent to right-of-way in accordance with the Project's Storm Water Pollution Prevention Plan and the approved NPDES Permit in accordance with Division 01 requirements.

B. The Contractor must obtain all required permits for dewatering and legally dispose of water from dewatering operations.

1. Comply with requirements of permits and agencies having jurisdiction over the project site in accordance with Division 01 requirements.

C. Cleanliness, Sweeping and Dust Control shall be in accordance with Division 01 requirements.

D. Contractor must provide noise abatement as required by environmental permits or local agency requirements in accordance with Division 01 requirements.

1.07 REGULATORY REQUIREMENTS

A. Furnish required excavation Plans to jurisdictional authorities and obtain permits there from. Refer to Division 01.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structure Excavation:

1. Excavation for the construction of foundations for structures; excavation of trenches for the construction of culverts, pipes, rods, deadmen, and cutoff walls; other excavation designated on the plans or in these specifications or in the technical provisions as structure excavation.

B. Embankment fill and backfill shall consist of suitable material from project site excavation or off site borrow as shown in the Plans and approved by the Engineer.

1. Suitable fill materials may be obtained from on site excavation and rough grading operations provided the Contractor submits laboratory test results demonstrating that the materials meet or exceed the criteria established in this Section. If sufficient suitable materials are not available to meet requirements, the material shall be obtained from outside sources.

2. Materials from on-site excavations, which may otherwise be suitable for use as fill, may contain excess moisture in their natural state, or may take on excess moisture during handling and stockpiling that would render them unsuitable for use as fill. The Contractor must dry the material as necessary as specified in the Section entitled “Moisture Control” herein to attain the required minimum standard, at no additional expense to OCTA.

3. Nesting of rock pieces that will create voids will not be permitted.

4. Fill and backfill material shall be free from organic matter, excessive fines, or unsuitable products of demolition. Fill and backfill shall contain no rocks or lumps over 3 inches in greatest dimension within 1 foot of the top of subgrade.

5. Fill and backfill material shall have plasticity index of 15 or less and a liquid limit of 30 or less and expansion index of 30 or less, except where otherwise approved by the Engineer.

6. Suitable materials from structure excavation not used as structure backfill shall be deposited as fill or backfill material.

7. Materials not meeting these requirements will be classified as unsuitable and shall be removed and legally disposed off-site by the Contractor, or as directed by the Engineer.

C. Structural Backfill:

1. Various items of work involved in furnishing, placing and compacting backfill material around structures to the lines designated on the plans or specified by the Engineer.

2. Material shall have a Sand Equivalent value of not less than 20 and shall conform to the following grading in Table 1:

Table 1, Structural Backfill

Sieve Sizes	Percentage Passing
3”	100
No. 4	35-100
No. 30	20-100

3. The material used to backfill the outer 2 feet portion of structure backfill adjacent to pipe and culvert inlets and outlets, and structure backfill placed within 2 feet of finished grade around abutments, abutment wing walls, retaining walls, and other portions of structures shall be compacted impervious material. The impervious backfill shall meet the material requirements in Table 1 except there shall be 15 percent plus or minus 2 percent minus 200 sieve material present and as determined by the Engineer to be suitable for such purpose. The Sand Equivalent requirement shall not apply to the impervious material used for structure backfill.

4. When material from Structure Excavation is unsuitable for use as structure backfill, the Contractor shall, at no expense to OCTA:

    a. Use other material covered by the Contract or;.

    b. Substitute selected material meeting the requirements of structural backfill available from the project site or;

    c. Use Controlled Density Fill (CDF) or;

    d. Obtain material elsewhere meeting the requirements of structural backfill from Contractor sources in accordance with Division 01.

5. When required by the Plans or submitted as an option and approved by the Engineer in advance, controlled density fill (CDF) or slurry cement backfill, a self compacting, cementitious flowable material requiring no vibration or tamping to achieve consolidation, may be used. The Contractor must submit a mix design in writing to the Engineer for approval. The design shall provide:

    a. A minimum 28-day strength of 50 psi and a maximum 28-day strength not to exceed 300-psi.

    b. Consistency shall be flowable (3 inches to 10 inches slump).

    c. The CDF materials shall meet material properties and testing contained in Section 34 80 41.

6. Pervious Backfill Material shall be placed behind bridge abutments, wing walls and retaining walls as shown on the plans and in accordance with these Specifications.

        a. Material shall consist of gravel, crushed gravel, crushed rock, natural sands, manufactured sand or combinations thereof.

b. Pervious backfill material shall be placed in layers along with and by the same methods specified for structural backfill. Pervious backfill material at any one location shall be approximately the same grading, and at locations where the material would otherwise be exposed to erosion shall be covered with at least a one foot layer of earthy material approved by the Engineer.

c. Pervious backfill material, except for sacked material at wall drain outlets, shall conform to the following grading requirements:

Table 2, Pervious Backfill Material

Sieve Sizes	Percentage Passing
2 inches	100
No. 50	0 - 100
No. 100	0 - 8
No. 200	0 - 4

D. Aggregate Base and Crushed Miscellaneous Base:

1. Aggregate Base material shall conform to the requirements set forth in Section 34 11 27.

2. Crushed Miscellaneous Base, CMB, shall consist of broken and crushed asphalt concrete or Portland cement concrete and may contain crushed aggregate base or other rock materials. The material shall be free of any detrimental quantity of deleterious material and contain no more than 15 percent material retained on the No. 4 sieve. Material shall not contain more than 3 percent brick by weight of dry sample.

3. Crushed Miscellaneous Base shall conform to the following grading requirements:

Table 3, Crushed Miscellaneous Base

Sieve Size	Percentage Passing Sieve	
	Coarse	Fine
2 inches	100	
1-1/2”	85 - 100	100
3/4”	50 – 85	85 - 100
3/8”		55 - 75
No. 4	25 - 45	25 - 60
No. 30	10 – 25	10 - 30
No. 200	2 - 9	2 - 9
ASTM C 131 Test Grading	A	B

4. Crushed Miscellaneous Base shall only be used in paving areas.

E. Geotextile Filter Fabric:

1. Geotextile Filter Fabric shall be as specified in the Project Specific Technical Specifications.

PART 3 - EXECUTION

3.01 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:

1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.

2. Protect and maintain bench marks, monuments or other established reference points and property corners.

a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.

b. Property corners, if disturbed or destroyed, shall be reset in accordance with applicable surveying law for the State of California after completion of rough grading and prior to commencing final excavation or grading operations.

3. Verify location and protection of existing utilities.

a. Omission or inclusion of utility items does not constitute non-existence or definite location. Locations of utilities shown on the Plans are provided for the Contractor's information only and the Contractor is responsible for verifying the location of all utilities to his own satisfaction.

b. Secure and examine local utility records for location data. In accordance with Division 01, the Contractor must make all attempts to locate utilities including potholing if necessary prior to commencing excavations. If utilities cannot be located, the Contractor must first pothole anticipated location(s) by hand methods. When located, complete excavation with caution to prevent damage.

1) When utility lines not known or indicated on the Plans are encountered within the area of operations, the Contractor must notify the Engineer and utility owner immediately. Measures shall be taken to protect the utility and prevent damage to the utility.

c. Take necessary precautions to protect existing utilities from damage due to any construction activity.

d. Repair damages to utility items at own expense.

e. In case of damage, notify Engineer at once so required protective measures may be taken.

f. SCRRA'S underground signal lines will be located by the SCRRA in accordance with Division 01.

g. Excavations created for location of underground utilities shall be backfilled in accordance with the following:

1) Backfill material shall meet the criteria established for embankment fill material. The upper 12 inches of the embankment fill shall be compacted to 95 percent relative density per ASTM D1557 and the layer below 12 inches from the top of the compacted fill shall be compacted to 90 percent relative density per ASTM D1557 and shall contain no materials greater than 3 inches in maximum dimension.

2) Place the uppermost 12 inches of compacted fill in two lifts of 6 inches (compacted). Each lift shall be compacted to 95 percent relative density per ASTM D1557 and shall contain no materials greater than 1 inch in maximum dimension.

h. Any excavation that exposes or potentially could expose an existing underground utility or structure indicated as "protect in place," "to remain" or similar indication, or any unknown utility or structure found and deemed requiring special methods by the Engineer, shall be classified as a structural excavation and backfill for purposes of replacing and compacting fill. This shall be at no additional cost to OCTA.

1) The Contractor shall not disrupt any service until utility owner and the Engineer has determined the required action on such lines.

4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed in the Plans.

a. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition at no expense to OCTA.

5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel and emergency services.

6. The Contractor must take precautions to prevent damage to existing foundations and structures protecting them in place without undermining or causing movement.

7. Maintain stockpiles and excavations in such a manner to prevent movement or damage to structures on-site or on adjoining property that are not noted in plans as being demolished.

8. At all times during the execution of this Work, the Contractor must maintain safe and stable excavations. Where required by California Construction Safety Orders, the Contractor must employ side slope layback, benching, or shoring. Required excavation support methods shall be in accordance with Section 31 50 00.

B. Water and Storm Drainage Removal:

1. The Contractor must provide, operate, and maintain an adequate system to remove water throughout the excavation and construction operation as necessary.

2. Obtain all permits for and legally dispose of water dewatering operations to facilitate construction. Comply with requirements of the permits, project environmental conditions and agencies having jurisdiction.

3. Elements of the system shall be located to allow continuous water removal without interfering with other construction activities.

C. Salvageable Items: Carefully remove items to be salvaged, and store as directed by the Engineer in accordance with Section 31 11 50.

D. Dispose of waste materials, legally, off site.

1. Burning, as a means of waste disposal, is not permitted.

3.02 SITE EXCAVATION AND GRADING

A. The work includes all operations in connection with excavation, borrow, construction of fills and embankments and structures, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the railroad roadbed or other facilities.

B. Excavation and Grading: Perform as required by the Contract Plans.

1. Prior to rough grading, the Contractor must complete clearing and grubbing in accordance with Section 31 11 00.

2. Contract Plans may indicate both existing grade and finished grade required for construction of Project.

a. Stake all units, structures, piping, fills and cuts, roads, parking areas and walks and establish their elevations upon completion of site clearing in accordance with Section 31 11 00.

b. Perform other construction staking work required.

3. The Contractor must not place any embankment fill or sub-ballast the ground surface for embankment fills or base of excavations without prior acceptance of the excavated and rough graded areas by the Engineer.

4. The Contractor must perform rough grading as indicated to achieve the bottom elevation for the embankment. This work shall be considered incidental to construction of embankment cuts and fills.

5. Preparation of ground surface, rough grading, for embankment cuts or fills:

    a. Before embankment fill is started or subballast placed, scarify to a minimum depth of at least 6 inches and up to 18 inches (if necessary to reach the specified density) in all proposed embankment cut and fill areas.

        1) Moisture content shall be brought to 2.0 percent above optimum and relative compaction of 90 percent relative density per ASTM D1557 reached prior to placing any embankment fill if more than 12 inches of fill required.

        2) Moisture content shall be brought to 2.0 percent above optimum and relative compaction of 95 percent relative density per ASTM D1557 reached prior to placing any embankment fill if 12 inches or less of fill is required or sub-ballast is to be placed directly on the prepared base.

    b. Where embankment fill is to be constructed against an existing ground surface that is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will key into the existing surface.

        1) Benches shall have a horizontal dimension of not more that 6 feet and a vertical rise of not more than 2 feet.

        2) Benches cut into the slope shall not be allowed to remain unsupported overnight.

        3) Benches cut within 12 feet of the track centerline shall only be created during train free periods and shall be immediately backfilled and compacted unless shoring designed in accordance with SCRRA's Excavation Support Guidelines, constructed in accordance with Section 31 50 00, and these Specifications is installed.

6. Preparation of ground surface for foundations or footings.

    a. Before constructions of the foundation or footing are started, scarify a minimum of 6-inches.

1) Moisture content shall be brought to 2.0 percent above optimum and relative compaction of 95 percent relative density per ASTM D1557 reached prior to placing reinforcing steel for any foundation or footing.

7. In areas where unsuitable materials are encountered in the embankment cut or fill footprint, the Engineer may direct removal and replacement with suitable materials placed and compacted in accordance with these Specifications in accordance with Section 4, Measurement and Payment.

8. Fill and backfill shall be placed as promptly as work permits but not until completion of the following:

   a. Approval by the Engineer of the embankment cut or embankment fill base preparation.

   b. Recording of final location, elevation, and limits of any structure, utility or other underground feature that will remain in place and be covered by the embankment.

   c. Removal of any trash and debris.

   d. Removal of shoring and bracing where applicable and as directed by the Engineer.

9. Protection of finished grade:

   a. During construction, shape and drain embankment and excavations.

   b. Maintain ditches and drains to provide drainage at all times. Protect newly graded areas from erosion.

   c. Protect graded areas against action of elements prior to acceptance of work.

   d. Contractor must keep graded areas free of trash and debris until final inspection and acceptance by the Engineer.

   e. Reestablish grade where settlement or erosion occurs.

   f. Contractor must not operate equipment supported directly on the roadbed unless it can be demonstrated through compaction testing to the Engineer’s approval that the equipment selected can be supported without creating softening, rutting or degradation of the roadbed.

   g. Contractor must remove any excess material that was delivered and not used for the Project at its own expense.

C. Borrow:

1. Provide necessary amount of approved fill, from material obtained from OCTA property or imported, compacted to density equal to that indicated in this Specification.

2. Fill material to be approved by Engineer prior to placement.

D. Construct embankment and structure cuts and fills as required by the Contract Plans:

1. Construct embankment cuts and fills at locations and to lines of grade indicated.

   a. Completed embankment fill and cut shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.

2. Provide approved fill material for embankment fill or backfill which is free from roots, organic matter, trash, frozen material as follows:

   a. Ensure that stones larger than 3 inches are not placed in upper 12 inches of fill or embankment.

   b. Do not place material in layers greater than 8-inches loose thickness.

   c. Place layers horizontally and compact each layer prior to placing additional fill to a minimum of 90 percent relative compaction per ASTM D1557.

3. Provide approved fill material for structural fill or backfill which is free from roots, organic matter, trash, frozen material, and stones as follows:

   a. Ensure that stones larger than 3 inches are not placed against any concrete or other foundation material or used as structural fill or backfill.

   b. Do not place material in layers greater than 8 inches loose thickness.

   c. Place layers horizontally and compact each layer prior to placing additional fill to a minimum of 95 percent relative density per ASTM D1557.

4. Compaction shall be by equipment approved by the Engineer to obtain specified density.

   a. Control moisture for each layer as necessary to meet requirements of compaction.

b. Before compaction, each layer shall be moistened or aerated as necessary to provide the optimum moisture content.

c. Compaction shall not result in significant rutting under the action of the compactor on the final passes on a lift.

d. The compaction process must extend the full width of the embankment fill or cut section for the layer being worked.

5. Contractor must properly place and compact all embankment fill or structural fill or backfill materials. Deficiencies resulting form insufficient or improper compaction of such material shall be corrected by the Contractor throughout the Contract period. When specified compaction density is not being obtained or subgrade surface damaged by equipment, Contractor must:

a. Stop placing additional fill.

1) Material in place may be scarified, water content adjusted and area rerolled until required compaction is obtained.

2) Alternatively, Contractor may remove not fully compacted material and replace with different material at no additional cost to OCTA.

3) Contractor may proposed other means and methods to the Engineer for approval.

b. If softening of the subgrade surface takes place under construction traffic to a degree unsatisfactory to the Engineer, Contractor must rework or remove and replace the material, recompacting and grading as required at no additional cost to OCTA.

c. If a fill material is too wet:

1) It may be scarified or disked and aerated until the proper water content is attained.

2) With approval of the Engineer, Contractor may blend drier soil with the wet fill to achieve a water content suitable for compaction.

3) Contractor may propose other means and methods to the Engineer for approval.

3.03 COMPACTION EQUIPMENT

A. Contractor must determine the type, size and weight of the compaction equipment best suited to perform the work at hand. Select and control the lift (layer) thickness within the Specifications with approval of the Engineer. Proper

control over the moisture content of the material shall be maintained to obtain required compaction results.

B. In areas inaccessible to conventional compactors, or where maneuvering space is limited, approved impact rammers, small drum vibrators, vibratory plate, or pneumatic button head compaction equipment may be used with layer thickness not to exceed 6 inches before compaction.

C. Compaction by jetting or flooding with water is not allowed.

3.04 ROCK EXCAVATION

A. Rock excavation shall be as specified in the Project Specific Specifications.

3.05 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.

3.06 FIELD QUALITY CONTROL/QUALITY ASSURANCE

A. Include in bid price for earthwork the cost of inspection services indicated herein as being performed by the Contractor's Soils Engineer.

1. The Contractor must use a California certified testing laboratory that is approved in advance by the Engineer.

2. Included are all retests required by the Engineer to confirm successful compaction at failed test locations.

B. Moisture density relations, to be established by the Contractor's Soils Engineer, are required for all materials to be compacted.

C. Extent of compaction testing will be as necessary to assure compliance with Specifications.

1. On-site density tests in accordance with ASTM D6938 shall be used to demonstrate that proper compaction has been obtained.

2. Visual observation may be used to augment on-site density tests. Visual inspection in no way relieves Contractor of responsibility to perform on site density testing.

3. Density testing must be performed in the following frequency:

a. At least one density test must be performed for each 200 cubic yards of embankment compacted fill.

b. At least one density test must be performed in the prepared subgrade in embankment cuts every 500 feet.

c. At least one density test is to be performed for each 30 cubic yards of compacted structural backfill.

d. Density tests shall be taken in areas representative of compactive efforts and not in areas of equipment traffic.

4. The Contrator shall perform Quality Assurance (verification) testing for on-site density as determined by the Engineer.

a. Testing will be by an independent certified soils testing laboratory.

D. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary including but not limited to rerolling and manipulation of moisture. Additional compaction testing will be required to determine that corrective work provides compaction in the failed area meeting requirements of these Specifications.

E. Contractor must provide a record of compaction testing results including corrective actions taken if necessary on the approved form to the Engineer.

F. Contractor's corrective work to meet compaction requirements and retesting resulting from failing compaction density tests shall be at no additional cost to OCTA.

3.07 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:

1. The backfilling of openings dug for Structures shall be a necessary part of and incidental to the excavation for the Structure.

2. Stockpiled material shall be protected with plastic sheeting or by some other method as approved by the Engineer from contamination and weather damage.

a. Too wet or contaminated material caused by failure of the protection method shall be disposed of by the Contractor and replaced with an equal amount of suitable material at no expense to OCTA unless the project construction schedule allows for Contractor to propose a different method for Engineer's approval.

3. All costs for supplying, if necessary, storing, protecting, rehandling and placing stockpiled material shall be considered incidental to payment for construction of the structure.

4. In this Section of the Specifications, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support element placed directly on soil or deep structural foundations such as piling or drilled shafts.

5. In the paragraphs of this Section of the Specifications, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:

1. General:

a. Do not commence excavation for foundations for structures until Engineer approves Contractor’s submittals of tests or information indicating one of the following as applicable:

1) Density and moisture content of compacted fill material at structure site meets requirements of specifications.

2) Site surcharge or mass fill material can be removed due to meeting requirements in the Construction Documents from entire construction site or portion thereof.

3) Surcharge or mass fill material has been removed previously from construction area or portions thereof.

b. Engineer grants approval to begin excavations.

2. Dimensions:

a. Excavate to elevations and dimensions indicated or specified.

b. Allow additional space as required for construction operations, working space, formwork, damproofing, waterproofing and inspection of foundations.

3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Plans.

a. If undesirable material and obstructions are encountered during excavation remove material to a depth where suitable materials are found or compacted material meeting requirements of Table 1 Structural Backfill provides a stable subgrade and meets compaction requirements.

b. Unsuitable material removed below foundation elevations shall be replaced with material meeting requirements of Table 1, Structural Backfill and compacted in layers not exceeding 6 inches in depth to 95 percent of relative density per ASTM D1557.

c. Engineer will approve additional excavation for unsuitable materials below the foundation. Additional work will be paid for in accordance with Part 4, Measurement and Payment of these Specifications.

4. Do not carry excavations lower than shown for foundations except as directed by the Engineer.

   a. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor therefore.

5. Notify Engineer as soon as excavation is completed in order that excavated structure subgrades may be inspected.

   a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings as applicable has been inspected and approved by the Engineer as being free of undesirable material, being of compaction density required by this Specification as shown by the compaction tests, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon.

   b. The Engineer must be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.

   c. Place concrete for foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.

   d. Place fill material after removal of forms in accordance with time frame provisions of Section 34 80 41.

   e. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.

6. Dewatering:

   a. Where groundwater is, or is expected, to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material. The dewatering system shall be designed to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.

b. Groundwater levels shall be maintained at least 3 feet below the bottom of any excavation.

c. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.

d. Employ a hydrologist for selecting and designing the dewatering system.

1) Such design shall include field maintenance instructions for Contractor's personnel.

e. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.

f. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.

1) Install groundwater monitoring wells as necessary.

2) Obtain dewatering permits in accordance with Project Environmental requirements.

g. Upon completion of excavation and structure foundation work, do not turn off dewatering system in a manner that the upsurge in water weakens the subgrade.

7. Subgrade stabilization:

a. If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by the Engineer. Such additional work will be measured and paid for in accordance with Section 4.0, Measurement and Payment.

b. Provide compaction density of replacement material as stated in this Specification Section.

c. Loose, wet, or soft materials, when approved by the Engineer, may be stabilized by a compacted working mat of well graded crushed stone meeting requirements for Table 1, Structural Backfill.

1) Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.

d. Method of stabilization shall be as approved by the Engineer.

e. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Engineer.

8. Protection of structures:

a. Contractor must take precautions to protect new and existing structures from becoming damaged due to construction operations or other reasons.

b. Contractor must take precautions to protect subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.

9. Shoring:

a. Shore, sheet pile, slope, or brace excavations as required to prevent them from collapsing in accordance with Section 31 50 00.

b. Remove shoring as backfilling progresses but only when the area where shoring is being removed is stable and safe from caving or collapse.

10. Drainage:

a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.

b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.

c. Provide pumping required to keep excavated spaces clear of water during construction in accordance with Subsection 3.07.B.6, Dewatering, of these Specifications.

d. Should any groundwater, not noted in the Construction Documents be encountered in the excavation, notify Engineer.

e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations in accordance with Paragraph 3.07.B.6, Dewatering, of this Section.

C. Structural Fill and Backfill below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:

1. General:

a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by the Engineer and scarified to a depth of 6 inches and compacted to density specified herein.

b. Surface may be stepped by not more than 12 inches per step or may be sloped at not more than 2 percent.

c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by the Engineer as being free of undesirable material and compacted to specified density.

2. Obtain approval of fill and backfill material and source from the Engineer prior to placing the material.

3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 inches of material meeting the requirements of Table 1, Structural Backfill, unless otherwise indicated.

4. Fill and backfill placement:

a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be submitted to the Engineer for approval.

b. Place fill and backfill material in 6 inches lifts as necessary to obtain required compaction density.

c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.

d. Use hand operated equipment for filling and backfilling immediately next to walls.

e. Do not place fill and backfill when the temperature is less than 40 deg. F and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.

f. Use vibratory equipment to compact granular material; do not use water.

5. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:

a. As required to provide fill material to indicated finished grade.

b. 5 feet.

c. Distance equal to depth of compacted fill below bottom of foundations.

Or

d. As directed by the Engineer.

D. Filling and Backfilling Outside of Structures.

1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.

2. Provide material, in accordance with Table 1, Structural Backfill as approved by the Engineer for filling and backfilling outside of structures.

3. Fill and backfill placement:

a. Prior to placing fill and backfill material, determine optimum moisture and maximum density properties for the proposed material and submit to the Engineer for approval.

b. Place fill and backfill material in 6-inch lifts as necessary to obtain required compaction density.

c. Compact material with equipment of proper type and size to obtain density specified.

d. Use only hand operated equipment for filling and backfilling within a distance of 5 feet from walls, retaining walls and other concrete structures.

e. Do not place fill or backfill material when temperature is less than 40 deg. F and when subgrade to receive material is frozen, wet, loose, or soft.

f. Use vibratory equipment for compacting granular material; do not use water except as a means to reach optimum moisture.

4. Backfilling against walls or other concrete structures:

a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved by the Engineer.

b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.

c. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

E. Backfilling Outside of Structures Under Piping or Paving:

1. When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or paving at the density required for fill under piping or paving as indicated in this Section.

2. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping or paving.

3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Sections of these Specifications.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Excavation will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices as derived from the Plans will be used as the basis for this measurement.

B. Excavation and Embankment will be acceptably excavated or filled within the limits of lines and slope described in typical sections and cross sections in the plans and contract documents.

C. Materials excavated outside of the designated sections or from borrow pits will not be measured. When the project is constructed essentially to the dimensions shown on the plans no further measurement will be required, and payment will be made for the quantities shown in the contract for the various bid items involved. If disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities involved to be measured. If measured quantities do not reveal a discrepancy when compared to plan quantities, the Contractor must pay for the cost of the Engineer to perform measurements and calculations of quantities.

D. Embankment and Roadway Earthwork Embankment shall be measured as a final pay item as described in Caltrans Standard Specifications Section 9. Measurement and payment will be made based the quantities as contained on the Schedule of Quantities and Prices, payment shall be based on the Bid Item quantity regardless of the actual quantity completed unless dimensions are changed by the Engineer.

E. Structural Excavation, Structure Backfill and Pervious Backfill material shall be considered incidental to structures work. No separate measurement or payment will be made for Structural Excavation, Structure Backfill and Pervious Backfill material.

4.02 PAYMENT

A. Excavation will be paid for at the contract unit price, as listed on the Schedule of Quantities and Prices, of excavation of proper classification within the limits of lines and slopes described in the typical sections and cross sections as defined in the plans and Contract Documents. This price shall be full compensation for export and legal disposal of excess material not used for onsite fill and furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals necessary for excavating, loading, transporting, and depositing materials in embankment, spoil bank, stockpile, or other designated location by whatever method is adopted, including all permission/permitting for haul operations.

B. Embankment and Roadway Earthwork Embankment will be paid for at the contract unit price, as listed on the Schedule of Quantities and Prices, of embankment of proper type within the limits of lines and slopes described in the typical sections and cross sections as defined in the plans and Contract Documents. This price shall be full compensation for providing imported fill as needed and furnishing all labor, materials, tools, equipment, supplies, water for compaction, supervision, and incidentals necessary for excavating, loading, transporting, and depositing borrow material when required; loading, transporting, and depositing select material from stockpile when required; loading, transporting, and distributing water; spreading, aerating if necessary, and compacting the embankment material; and finishing the embankment sections to the designated line and grades.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 31 32 32

LIGHTWEIGHT CELLULAR CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

This work shall consist of furnishing materials and placement of Lightweight Cellular Concrete (LCC) constructed in accordance with these specifications and in reasonable conformity with the lines, grades, design, and dimensions shown on the plans or otherwise established. The total volume of LCC shown on the contract drawings shall be placed within an 8 to 10-hour window of the 48 hour window available for replacement of the existing Timber Bridge at Sta 4994+45, MP 194.6 with a new precast box culvert overcrossing. LCC placed in this time frame shall have the set times and design strengths as specified herein.

A. Related Sections including but are not necessarily limited to:

1. Division 01 – General Requirements

2. Section 31 20 00 - Earthwork

1.2 REFERENCES

A. Comply with local, State, and Federal codes, regulations, specifications, standards and recommended practices.

B. American Association of State Highway Transportation Officials (AASHTO)

1. T-23 Making and Curing Concrete Test Specimens in the Field

2. T-24 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

3. M-85 Standard Specifications for Portland Cement (Chemical and Physical)

C. American Society for Testing and Materials (ASTM)

1. C796 Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam

2. C869 Standard Specification for Foaming Agents Used in Making Preformed Foam or Cellular/Foam Concrete.

3. C939 Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

4. C495 Standard Test Method for Compressive Strength of Lightweight Insulating Concrete

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

1.3 SUBMITTALS

A. Submit a mix design that will produce a cast density at point of placement and a minimum compressive strength as indicated in the Design Requirements Section. Include laboratory data using the mix design verifying cast density and strength requirements. Field qualification test reports must be certified with a signature by an official in responsible charge of the laboratory performing the tests.

B. Submit a cellular concrete quality control and placement plan 30 working days before placement of embankment material. Placement of cellular concrete shall be in accordance with the information provided in the quality control plan. The submitted plan shall provide, as a minimum, the following elements:

a. An organization chart including names, telephone numbers, current certifications and/or titles, and roles and responsibilities of all those involved in the quality control program.

b. The process of communication by which quality control information will be disseminated to the appropriate persons, including materials suppliers.

c. Written evidence that cellular concrete installer is certified by and approved by the foam agent manufacturer

d. Location of equipment and batching areas.

e. Proposed construction sequence and schedule.

f. Type of equipment and tools to be used.

g. Material list of items and manufacturer's specifications

h. A copy of the AASHTO accreditation for the laboratory conducting the testing for compressive strength testing of cellular concrete cylinders.

C. Contractor shall submit complete working drawings of the system in conformance with the provisions in Division 01 for requirements for the mechanics and administration of the submittal process. Design drawings shall be submitted to the SCRRA for acceptance and approval.

D. The Contractor shall verify the existing ground elevations at the site before preparing the working drawings. The working drawings shall contain all information required for the proper construction of the system. The working drawings shall be accompanied with calculations. The working drawings and

calculations shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California. The Contractor shall allow the Engineer 30 days to review the drawings after a complete set has been received.

E. The Contractor shall provide a system specific submittal package to the Engineer at least thirty (30) days prior to construction for approval. Incomplete submittal packages will not be reviewed.

1.4 DESIGN REQUIREMENTS

A. Cast in situ LCC shall conform to the following requirements:

1. Maximum cast density: 36 pcf
2. Maximum pour height/lift thickness: 5 feet to prevent collapse of the foam bubbles within the mix.
3. Minimum compressive strength of a lift prior to placing the Precast Box Culvert or of a subsequent lift: 30 psi
4. Minimum compressive strength of the LCC prior to allowing train operations: 40 psi
5. Maximum Total placing time for entire LCC volume: 10 hours
6. Minimum 2-hour compressive strength of all lifts: 30 psi
7. Minimum 28-day compressive strength of all lifts: 80 psi
8. Maximum % Water Absorption after 120 days: 16%

B. Design submittals not meeting this design criteria or technical/administrative criteria as specified will be rejected in their entirety until complete compliance is achieved. Owner reserves all rights in determining compliance for plan approval and may reject any submittals.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle materials in accordance with manufacturer's recommendations. Check the materials upon delivery to assure that proper material has been received. Remove and replace damaged or otherwise unsuitable material, when so determined, from the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials shall be delivered, stored and handled per recommendations of cellular concrete manufacturer.

B. Admixtures for accelerating the set time may be used under the manufacturer's recommendations.

C. A foaming agent must be used and tested in accordance with ASTM C 796.

D. Mixing water shall be potable and free of deleterious amounts of acids, alkali, salts, oils, and organic materials in accordance with Caltrans Standard Specifications Section 90-1.02D.

E. Portland cement must comply with ASTM C 150, Types II/ V. Pozzolans and other cementitious materials may be used when approved by the manufacturer of the foaming agent. Fly ash and natural pozzolans must comply with ASTM C 618. Ground granulated blast furnace slag must comply with ASTM C 989, grade 100 or 120.

PART 3 – CONSTRUCTION

3.1 PERSONNEL REQUIREMENTS

A. The cellular concrete installer shall be certified and approved in writing by the foam agent manufacturer. The installer's foreman shall have a minimum of 2 years' experience in this work and shall have worked on at least three successful cellular concrete projects.

B. The installer shall use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are familiar with the specified requirements and the methods needed for proper performance of the work.

C. The Contractor's representative shall be experienced in the placement of cellular concrete and shall be on site full-time during placement.

3.2 QUALITY CONTROL AND QUALITY ASSURANCE TESTING

A. Cast in Situ LCC must comply with the following:

1. The density of LCC must comply with the specified cast density as in the section on Design Requirements. A single cast density test must represent the lesser of 50 cubic yards or 2 hours production.

2. The compressive strength must be tested under ASTM C 495 except as follows:

   At a minimum, prepare and test a set of 4 test cylinders for each 200 CY of cellular concrete placed or a minimum of 2 sets of 4 cylinders each per day (whichever is greater). Specimens shall be a 3 inch x 6 inch cylinders. During molding, place concrete in two equal layers. Raise and drop the cylinder 1 inch three times on a hard surface or lightly tap the side or bottom of the cylinder to close any accidental entrained air. No rodding is allowed. Specimens must be covered and protected immediately after casting to prevent damage and loss of moisture.

Specimens should be cured in the molds for up to 7 days and then removed from the mold and moist cured. Stop moist curing specimens from 24 to 72 hours before the 28-day compressive strength test and allow to air dry. Specimens must not be oven dried.

3.3 SUBGRADE PREPARATION

A. Over excavate and prepare the foundation to the elevation shown on the plans.

B. Place LCC on undisturbed native soils.

C. Subgrade to receive LCC material shall be free of all loose and extraneous material, uniformly moist, and any excess water standing on the surface must be remove before placing LCC material.

3.4 CAST IN SITU LCC

A. Cellular concrete shall be a homogeneous mixture and all materials shall be approved prior to use.

B. Cellular concrete must be job site mixed with foaming agent and placed with equipment specialized for cellular concrete lightweight material. Cement and water may be premixed and delivered to the job site and foaming agent added on site. Once mixed, the cellular concrete shall be conveyed promptly to the location of placement without excessive handling.

C. Cellular concrete lift thicknesses must not exceed 5 feet. After curing any crumbling area on the surface must be removed and scarified before the next layer is placed.

D. If ambient temperatures are anticipated to be below 32 degrees F within 8 hours after cellular concrete placement, mixing water must either be heated as approved by foaming agent the manufacturer or placement must be prohibited. Cellular concrete shall not be placed in wet ground condition. Dewatering is necessary where groundwater is present.

E. Any material that does not meet the minimum specified strength shall be removed and replaced by the Contractor at no additional cost.

3.5 ACCEPTANCE

A. The contractor shall rectify any cellular concrete material rejected by the Engineer that does not meet the minimum required material properties or is not installed in accordance with this specification. Corrective measures are subject to the approval of the Engineer. Accepted corrected measures will be performed by the contractor at no additional cost to the Owner or extension of the contract time. This includes removal and replacement of rejected cellular concrete material not meeting the minimum material requirements or installed in accordance with this specification.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Cellular Concrete Lightweight Embankment will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement. The total volume of the LCC will be adjusted for the changes that have been made in accordance with a written order from the Engineer.

B. Excavation, embankment, structural excavation, and structural backfill required for placement of LCC to the final grades shown shall be considered incidental to work requiring Cellular Concrete Lightweight Embankment, and no separate measurement or payment shall be made therefor.

4.2 PAYMENT

A. Excavation payment shall be per Sec Section 31 20 00 Earthworks.

B. Cellular Concrete Lightweight Embankment furnished and completed in accordance with the Contract Documents will be paid for as at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall be full compensation for furnishing all material testing, coordination of and scheduling of cellular concrete placement, specialized equipment to mix, transport and place cellular concrete and groundwater control, excavation, embankment, structural excavation, structural backfill, labor, materials, tools, equipment, supplies, supervision and incidentals necessary, and doing all work, as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 31 50 00

EXCAVATION SUPPORT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Minimum requirements for excavation and temporary excavation support adjacent to railroad tracks.

   a. Limitations on construction activities.

   b. Installation, monitoring and removal requirements for temporary excavation support systems.

   c. Design, submittal and review requirements for excavations and temporary excavation support.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 03 21 00 – Reinforcing Steel.

4. Section 03 31 00 – Structural Steel.

5. Section 31 11 00 - Site Clearing.

6. Section 31 11 50 - Demolition, Cutting and Patching.

7. Section 31 20 00 - Earthwork.

8. Section 32 90 00 - Soil Erosion, Sediment Control, Topsoiling and Seeding.

9. Section 34 80 21 - Piling.

10. Section 34 80 43 - Precast & Prestressed Concrete for Railroad Bridges.

11. Section 34 80 51 - Structural Steel for Railroad Bridges.

1.02 REFERENCES

A. SCRRA Excavation Support Guidelines.

1.03 SUBMITTALS

A. General:

1. Submittals must be made in accordance with Division 01 requirements.

B. Contractor's Superintendent:

1. The Contractor must submit the company, contact information (address, telephone and email), qualifications and record of relevant experience for the Superintendent in charge of the excavation support work to OCTA for review and acceptance at least 30 days prior to construction.

C. Contractor's Engineer:

1. Submit the name, company, contact information (address, telephone and email), qualifications and record of relevant experience for the proposed Contractor's Engineer to OCTA for review and acceptance at least 30 days prior to construction.

D. Design:

1. Unless otherwise approved by OCTA, all projects will include detailed design of excavations and temporary excavation support within the Contract Documents (Plans, Specifications and Estimates).

2. Where detailed design of excavations and temporary excavation support is included in the Contract Documents, design validation by the Contractor and submittal of design calculations will not be required for excavations and temporary excavation support constructed in conformance with the Contract Documents. The Contractor must submit a written affidavit stating that all aspects of the excavation and shoring will be constructed in accordance with the Contract Documents.

3. Any deviation or modification to the design, details or construction phasing of excavations and temporary excavation support from that shown in the Contract Documents shall require pre-approval prior to construction. Perform and submit design calculations in accordance with the SCRRA Excavation Support Guidelines for any proposed deviation or modification to the Contract Documents.

4. For alternate design of excavations and temporary excavation support by the Contractor, perform design and provide all required submittals in conformance with the SCRRA Excavation Support Guidelines, including the SCRRA Shoring Submittal Design Checklist and the Design Exception Form, as applicable.

5. Where detailed design of excavations and temporary excavation support is not included in the Contract Documents, perform and submit design calculations in accordance with the SCRRA Excavation Support Guidelines.

E. Plans:

1. Prepare and submit detailed Plans of excavation limits, temporary excavation support system(s) and all construction phasing and structural details required for the Work. Clearly show any deviations or modifications of excavations and temporary excavation support from that shown in the Contract Documents. Plans must be provided in accordance with the SCRRA Excavation Support Guidelines.

F. Site Specific Work Plan (SSWP):

1. At least 30 days prior to construction, submit a complete SSWP in accordance with the SCRRA Excavation Support Guidelines and Section 01 14 00, Work Restrictions, including, but not necessarily limited to:

a. Required Work Windows.

b. Construction procedures, materials, equipment and crews).

c. Construction schedule.

d. Contingency plans.

e. Level 3 Health and Safety Plan requirements

f. Requirements for conformance with the Environmental Documents and Permits.

G. Construction Verification:

1. The Contractor must submit a letter to OCTA confirming that the excavation and temporary shoring system has been inspected and verified to conform with the Contract Documents, approved working Plans and accepted field modifications and design variances in accordance with the SCRRA Excavation Support Guidelines. The letter must be signed and sealed by the Contractor's Engineer who is a licensed Professional Engineer in the State of California.

H. Track Monitoring Plan:

1. The Contractor must submit a detailed monitoring plan, including Plans and procedures for inspection and surveying. The monitoring plan shall comply with the Contract Documents, approved working Plans and the SCRRA Excavation Support Guidelines.

1.04 QUALITY ASSURANCE

A. Engineer in Responsible Charge:

1. Excavations and temporary excavation support shall be designed by a licensed Professional Engineer in the State of California, civil or structural, with the requisite qualifications described in the SCRRA Excavation Support Guidelines.

2. Review and acceptance of submittals by OCTA will not relieve the Engineer in Responsible Charge of responsibility for the safe design of the temporary shoring system, including responsibility for errors and omissions in submittals.

B. Contractor:

1. Qualifications of the Contractor's Superintendent who will be responsible for excavation support system installation and removal must exceed the minimum experience record described in the SCRRA Excavation Support Guidelines. The Superintendent's qualifications will be subject to review and acceptance by OCTA.

2. Excavation or construction of excavation support systems shall not proceed until the Contractor meets SCRRA safety training requirements, obtains an SCRRA Right-of-Entry agreement (for construction by third parties), and gains acceptance of a Site Specific Work Plan (SSWP) from SCRRA and OCTA.

3. The Contractor must retain a Contractor's Engineer to verify construction of excavations and temporary excavation support in conformance with the Contract Documents and approved Working Plans. The Contractor's Engineer must be a licensed Professional Engineer in the State of California, civil or structural, and meet the same qualifications described in the SCRRA Excavation Support Guidelines as the Engineer in Responsible Charge for design of the excavation support system.

4. Review and acceptance of submittals by OCTA will not relieve the Contractor of responsibility for the safe design and construction of the temporary shoring system, including responsibility for errors and omissions in submittals and construction deviations from accepted design plans. Excavation safety shall be the responsibility of the Contractor performing the shoring installation and excavation.

1.05 SITE CONDITIONS

A. Contractor must execute Work under this Specification in such a manner as to minimize impact to the daily operation of the rail, vehicular and pedestrian traffic.

B. The Contractor must barricade open excavations and post with warning lights those excavations occurring on property adjacent to or within public access areas and along the tracks in accordance with the SCRRA Excavation Support Guidelines. Operate warning lights during hours from dusk to dawn each day and as otherwise required. Warning lights shall be located to avoid shining directly into Locomotive Engineer's eyes in oncoming trains.

C. The Contractor must protect utilities, structures and facilities designated to be protected in place from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation and backfill operations.

D. The Work shall allow rainfall to drain freely at all times in accordance with project environmental requirements and permit conditions in accordance with Division 01 requirements.

1.06 ENVIRONMENTAL CONDITIONS

A. The Contractor must protect against erosion and uncontrolled run-off within and adjacent to right-of-way in accordance with the Project's Storm Water Pollution Prevention Plan and the approved National Pollution Discharge Elimination System (NPDES) Permit in accordance with Division 01 requirements.

B. The Contractor must obtain all required permits for dewatering and legally dispose of water from dewatering operations.

1. Comply with requirements of permits and agencies having jurisdiction over the project site in accordance with Division 01 requirements.

C. Cleanliness, Sweeping and Dust Control shall be in accordance with Division 01 requirements.

D. Contractor must provide noise abatement as required by environmental permits or local agency requirements in accordance with Division 01 requirements.

1.07 REGULATORY REQUIREMENTS

A. Furnish required excavation Plans to jurisdictional authorities and obtain permits as required. Refer to Division 01.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Soil and rock materials for fill, backfill or subgrade preparation shall be in accordance with Section 31 20 00 or as specified by the Engineer in Responsible Charge.

B. Protective Dividers: See Contract Documents and SCRRA Excavation Support Guidelines.

C. Handrails and Walkways: See Contract Documents and SCRRA Excavation Support Guidelines.

D. Structural materials that compose the excavation support system shall meet the requirements for the applicable material type as listed, unless specified otherwise by the Engineer in Responsible Charge in the Contract Documents or approved Working Plans:

1. Structural steel: Section 03 21 00 for steel soldier piling and steel sheet piling.

2. Structural metals other than steel: See Contract Documents.

3. Structural concrete: Section 03 31 00.

4. Reinforcing steel: Section 03 21 00.

5. Soilcrete: See Contract Documents.

6. Timber lagging: See Contract Documents and SCRRA Excavation Support Guidelines.

7. Soil tiebacks and rock anchors: See Contract Documents and SCRRA Excavation Support Guidelines.

PART 3 - EXECUTION

3.01 CONTRACTOR RESPONSIBILITIES

A. Prior to ordering materials or commencing any work:

1. Examine the Contract Documents, inspect the site, obtain all available Record Plans of existing structures and utilities and note all conditions and limitations that may influence excavation and temporary excavation support at the site.

2. Verify dimensions, elevations, extent of excavations and limits of excavation support required for construction and notify OCTA of any discrepancies or omissions.

3. Assess the constructability of temporary excavation support systems specified in the Contract Documents and the applicability of any proposed method of support for the intended purpose.

B. Provide safe and stable excavations and maintain the integrity of excavations throughout the duration of construction.

C. Perform excavation and provide excavation support as required for construction in conformance with applicable laws, codes, ordinances, and regulations of federal, state and local authorities, including furnishing any required excavation Plans and obtaining any required permits.

3.02 ALTERNATE DESIGN

A. The Contractor will be allowed to propose and submit alternate methods, designs and details for excavations and temporary excavation support. Only alternates that comply with the SCRRA Excavation Support Guidelines and satisfy the contract requirements will be considered for acceptance. Acceptance of alternates will be at OCTA's sole discretion.

B. For alternate design submittal requirements, see 1.03 Submittals.

C. For alternate designs, the Contractor must retain a Contractor's Design Engineer who will be the Engineer in Responsible Charge for the excavation and will act as the Contractor's Engineer to verify construction in accordance with the design and approved working Plans and specifications prepared by said Engineer.

D. Review time by SCRRA and OCTA as indicated in the SCRRA Excavation Support Guidelines and in the Contract Documents must be considered in the construction schedule. Impacts to the construction schedule stemming from review time or rejection of modifications, substitutions or alternate designs shall not be cause for additional compensation for delay time or extension of contract time for performance.

E. The Contractor agrees, upon and at such a time that an alternate design is submitted to OCTA, to compensate SCRRA for the full cost of reviewing the alternate design. This compensation shall include the initial review and any subsequent review of additional submittals or re-submittals to address previous SCRRA comments and must be paid regardless of the final disposition (acceptance or rejection) of the alternate design.

3.03 INSTALLATION

A. Preparation:

1. Initiate track monitoring program according to the approved Track Monitoring Plan.

2. Protect existing surface and subsurface features on-site and adjacent to site as required in Section 31 20 00 before excavating or installing temporary excavation support systems.

3. Install protective divider and/or fencing adjacent to active tracks as required in the SCRRA Excavation Support Guidelines.

4. Provide HMA track underlay for active tracks adjacent to proposed excavations as required in the SCRRA Excavation Support Guidelines.

    a. Install HMA in accordance with Section 32 12 00.

5. Perform site clearing in accordance with Section 31 11 00.

6. Perform demolition and removals in accordance with Section 31 11 50.

B. Operational Constraints:

1. Excavations and temporary excavation support systems shall be installed, maintained, removed and backfilled without interference to rail operations unless otherwise approved in advance by SCRRA.

2. Contractor operations will be constrained according to the approved SSWP and as needed to avoid interference with railroad operations.

3. Contractor must complete installation and removal of excavation support systems that require Work Windows within the approved time limits in the SSWP and as directed by the SCRRA Flagman or Employee-in-Charge.

4. Reference the SCRRA Excavation Support Guidelines for limitations to Contractor's operations.

C. Excavations and Temporary Excavation Support:

1. Follow all requirements of the Contract Documents, approved working Plans, and SCRRA Excavation Support Guidelines for excavations and temporary excavation support.

2. Install temporary excavation support systems in a manner that maintains stability and integrity of the existing track, embankment and structures.

3. Perform excavation in accordance with Section 31 20 00 and in a manner that maintains stability and integrity of any temporary excavation support and the existing track, embankment and structures.

4. Temporary excavation support systems shall allow for permanent construction without movement or settlement of adjacent track, embankment or structures under all conditions and imposed loads for the duration of construction.

5. Dewater excavations as required and maintain water levels that prevent heave or piping.

6. Direct surface drainage away from existing tracks, structures, excavation support systems and open excavations, slope base of excavation away from support systems, and protect excavations and soil slopes from erosion.

7. Remove temporary excavation support systems in a manner that maintains stability and integrity of any remaining temporary excavation support and the existing track, embankment and structures.

8. Perform backfilling in accordance with Section 31 20 00.

9. Remove rubbish and spoil piles and return the area to a condition equal to or better than original and in accordance with Section 32 90 00.

D. Excavation Safety:

1. Perform excavation work in accordance with all applicable safety regulations including, but not limited to, OCTA, SCRRA, Federal OSHA, Cal/OSHA, FRA and CPUC. See the SCRRA Excavation Support Guidelines for complete references.

2. Excavation safety shall be the responsibility of the Contractor.

3. Contractor must immediately comply with orders from SCRRA to stop work or perform immediate backfilling of open excavations or other emergency remedial work when SCRRA, at its sole discretion, determines that the safety of trains, passengers and SCRRA employees may be in peril.

E. Schedule:

1. Include excavation and temporary excavation support installation, use and removal in the overall construction schedule and perform all work within the schedule presented in the approved construction plan. See Division 01.

3.04 FIELD QUALITY CONTROL/QUALITY ASSURANCE

A. Construction Verification:

1. The Contractor's Engineer must inspect the as-built excavation support system to verify that the system is constructed in accordance with the Contract Documents and working Plans that have been reviewed and accepted by OCTA and SCRRA.

a. The number of site visits and the stage or stages of construction at which an inspection shall be performed will be determined as a condition of acceptance of the temporary shoring design to provide oversight by the Contractor’s Engineer at critical construction stages.

2. The Contractor must prepare a letter and submit to OCTA confirming that the shoring system has been inspected and verified. The letter must be signed and sealed by the Contractor's Engineer who is a licensed Professional Engineer in the State of California.

a. Any field changes must be noted and the effect of those changes must be evaluated and reported by the Contractor’s Engineer. Any deficiencies noted must be corrected by the Contractor. Deficiencies and corrections must be noted in the letter with verification of adequate correction by the Contractor’s Engineer.

B. Track Monitoring:

1. Monitor the excavation and the supported track in accordance with the approved Track Monitoring Plan, as described in the SCRRA Excavation Support Guidelines, and as directed by OCTA.

2. Track monitoring data shall be delivered to OCTA in a format similar to that shown in the SCRRA Excavation Support Guidelines no later than one working day after survey readings are taken.

3.05 ACCEPTANCE

A. Inspections:

1. Request, schedule and provide the means and access for inspection of the installed excavation support system and finished excavation by OCTA and SCRRA before proceeding with construction.

2. Once the excavation is no longer required for construction activities, request, schedule, and provide the means and access for inspection of the excavation support system by OCTA and SCRRA before proceeding with removal and backfilling operations.

B. Final Acceptance:

1. Apply for and obtain final acceptance from OCTA, with or without inspection at the sole discretion of OCTA and SCRRA, upon submittal of the final track monitoring data. Final track monitoring data shall be collected at the specified number of days following the completion of removal and backfilling operations per the approved Track Monitoring Plan.

PART 4 - MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made to the Contractor for Work of this Section. Work of this section shall include furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

B. Measurement and Payment for excavation support will be considered incidental items to Sections 03 31 00 Structural Concrete, 03 40 00 Precast Concrete, 31 20 00 Earthwork, 31 32 32 Lightweight Cellular Concrete, 32 32 16 Gravity Block Retaining Walls, 32 32 21 Prefabricated Modular Block Retaining Wall, 32 32 43 Permanent Soldier Pile Retaining Wall, 33 42 00 Culvert and Drainage Pipe, 33 46 00 Underdrain, 34 42 18 Conduit and Pull Boxes, 34 72 00 Trackwork, and other sections specifying work requiring excavation support.

C. Submittals, working Plans, design modifications, structural detail changes, alternate design, review of alternate design, SSWP, inspections, verifications and track monitoring are incidental to Section 31 20 00 and no additional payment will be made therefor.

END OF SECTION

SECTION 32 12 00

HOT MIX ASPHALT (HMA) PAVEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work covered by this Section includes preparation, placement and compaction of all asphaltic concrete and slurry seal the existing pavement. It includes the prime coat, tack coat, base course and wearing course.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 31 20 00 – Earthwork

3. Section 32 16 00 – Curbs, Gutters, and Sidewalks

4. Section 34 11 27 - Sub-Ballast and Aggregate Base.

5. Section 34 71 50 – Highway-Rail Grade Crossings

1.02 REFERENCES

A. Comply with the following Specifications, standards and recommended practices, except as otherwise indicated:

1. Orange County Department of Public Works (OCDPW): Standard Specifications for Public Works Construction (current edition) and associated OCDPW amendments, Section 2009, Section 203, Bituminous Materials, and 302, Roadway Surfacing

2. Orange County Department of Public Works (OCDPW): Standard Specifications for Public Works Construction (current edition) and associated OCDPW amendments, Section 203-5, and Section 302-4, Emulsion – Aggregate Slurry (slurry seal).

B. Caltrans: State of California Department of Transportation Standard Specifications, Section 39

C. ASTM: American Society for Testing and Materials

1. D2950, Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods

1.03 SUBMITTALS

A. Make all the following submittals in accordance with Section 01 33 00, Submittal Procedures.

1. Manufacturer's installation instructions.

2. Asphalt design mix

3. Emulsion – Aggregate Slurry Design Mix.

4. Test reports from an independent laboratory for materials and mix designs or proof that mix designs and all Materials are currently approved for use as asphaltic concrete pavement by Caltrans.

5. Tests reports for field density tests performed after placement and compaction of each course of asphaltic concrete.

6. List of equipment to be used for the placing, spreading and compaction of the Hot Mix Asphalt Pavement. Only equipment approved by the Engineer shall be used.

1.04 DELIVERABLES

A. Submit records of delivery of asphalt materials, identifying shipment numbers, dates and quantities, material designations and temperature at the time of placement.

B. Submit copies of aggregate tests, penetrations of asphalt cement, and percentages by weight and number of pounds of each of the materials making up the batch.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Asphalts:

1. Asphalt binder to be mixed with aggregate shall be steam-refined paving asphalt of the grade designated in the special provisions.

   a. The asphalt binder shall be in conformance with the Caltrans Standard Specifications, Section 92 and SSPWC Section 203.

2. The amount of asphalt binder to be mixed with aggregate for asphalt concrete shall be in conformance with the requirements of the Caltrans Standard Specifications, Section 92.

3. Liquid asphalt for the prime coat shall be of the grade designated by the contract item or specified in the special provisions.

a. The liquid asphalt shall be in conformance with the Caltrans Standard Specifications, Section 94 and SSPWC Section 203-2.

4. Asphaltic emulsion for the tack coat shall be of the grade designated by the Engineer.

a. The asphaltic emulsion shall be in conformance with the Caltrans Standard Specifications, Section 94 and SSPWC Section 203-1.

5. Paving asphalt to be used as a binder for pavement reinforcing fabric shall be a steam-refined Pavement asphalt in conformance with the Caltrans Standard Specifications, Section 92.

a. The Pavement asphalt shall be PG 70-10.

B. Aggregate:

1. Aggregate shall be clean and free from decomposed materials, organic material and other deleterious substances.

a. Coarse aggregate shall be material that is retained on the No. 4 sieve.

b. Fine aggregate shall be material that is passing the No. 4 sieve.

c. Supplemental fine aggregate is added fine material passing the No. 30 sieve, including, but not limited to, cement and stored fines from dust collectors.

2. Aggregate grading shall be in conformance with the Caltrans Standard Specifications, Section 39.

3. HMA pavement: Type A with ½" maximum, coarse aggregate gradation.

C. Prime Coat:

1. Prime coat shall be an emulsified asphalt Type RS-2, conforming to Caltrans Standard Specifications, Section 94.

D. Tack Coat:

1. Tack coat shall be a liquid asphalt Type SS-1, conforming to Caltrans Standard Specifications, Section 94.

E. Emulsion – Aggregate Slurry

1. Emulsion – Aggregate slurry shall be of a slow-set or quick set type, conforming to SSPWC 20009, Section 203-5.2.

2.02 SOURCE QUALITY CONTROL

A. Take the following aggregate samples in the presence of the Engineer and, if requested, transport samples to Contractor-hired independent testing laboratory. Samples will be used by the Contractor-hired independent testing laboratory to test aggregate quality:

1. A 75-pound sample of representative aggregate retained on the #4 sieve and

2. A 3-pound sample of the representative aggregate passing the #4 sieve for testing of aggregate quality.

B. Provide Engineer access for sampling stockpiles, hot bin analyses, and other tests.

PART 3 - EXECUTION

3.01 GENERAL

A. Subgrade, aggregate base, curbs, gutters and drains shall be approved by the Engineer before asphalt-Pavement operations are started.

B. Emulsion – Aggregate slurry shall conform to the SSPWC 2009, Section 302-4.

C. Mixing plants shall conform to the requirements of the Caltrans Standard Specifications 2010, Section 39-3.04 Mixing.

D. Verify utility locations prior to driving stakes or pins.

E. Construction procedures and requirements shall conform to SSPWC 2009, Section 302-5.

F. Legally dispose of all waste material produced as a result of Contractor's operations. All waste Materials shall be removed from the AUTHORITY'S property within 2 weeks of it being made waste. If necessary to protect the existing soils from contamination, install an impermeable barrier to protect the existing subgrade and runoff.

3.02 FIELD QUALITY CONTROL

A. Density of asphaltic concrete shall be measured using nuclear density methods in accordance with ASTM D 2950 at the time of placement.

B. Density tests shall be performed by the Contractor's independent laboratory. The Engineer may also perform testing at random selected locations. Number of cores shall be one core per 500 square yards of bituminous pavements or two cores per shift, whichever is greater. Repair core holes promptly using the same mix that was cored; where cores are taken through both base course and surface course simultaneously, use surface course mix for repair work. Wherever deficient pavement is discovered, take such additional cores as directed.

3.03 PREPARATION

A. When placing HMA for access road paving, provide an aggregate base course in accordance with Section 34 11 27.

B. Schedule placement of asphalt pavement material when the precipitation probability, within 3 hours prior to the start of such operations, is less than 50 percent.

C. Laying of HMA shall not be permitted in wet weather.

D. Spreading of HMA shall not be permitted when the mixing temperature of HMA is below 250˚ F.

E. HMA shall only be placed when the atmospheric temperature is above 50˚ F.

F. When HMA is to be placed on an existing asphalt concrete, concrete, or brick surface, broom the existing surface clean prior to the application of the tack coat.

G. Repair holes and depressions in existing surfaces by removal to sound material and replace with an asphalt-aggregate patching material.

H. Compact patch to produce a tight surface conforming to the adjacent paving area.

I. Stabilize rocking Portland cement concrete slabs by undersealing or cracking and seating.

J. Fill wide joints and cracks with asphalt concrete/sand mix material and compact.

3.04 SPREADING

A. The depositing, distributing, and spreading of the HMA shall be accomplished in a single, continuous operation by means of a mechanical spreader or a grader.

1. When laying HMA for track underlay and the use of a mechanical spreader or a grader is impractical, the Contractor must submit a request for the use of alternate equipment to the Engineer for review.

B. The prime coat shall be applied at a rate of 0.25 gal/sq yd and shall be in conformance with the Caltrans Standard Specifications, Section 39.

C. The tack coat shall be applied in one application at a rate of 0.02 gal to 0.10 gal/sq yd of surface covered and shall be in conformance with the Caltrans Standard Specifications, Section 39.

D. Following application of the tack coat, the HMA shall be spread in conformance with the Caltrans Standard Specifications 2010, Section 39.

1. Successive lifts may be laid upon previously laid lifts as soon as the previous lift has cooled sufficiently to show no displacement under equipment or loaded material delivery trucks.

3.05 COMPACTION

A. Rollers:

1. Steel-wheeled, tandem type power driven rollers shall provide a pressure of not less than 225 lbs/in width of main roll.

   a. Rolls shall be smooth and without flat spots or other imperfections.

2. Pneumatic rubber-tired rollers shall be self-propelled with wheels mounted, grouped and spaced to provide uniform coverage with each pass.

   a. Rear group wheels shall not follow the tracks of forward group wheels.

   b. Maximum wheel load shall be 5,600 lbs.

   c. Tire compression on pavement, where the area of contact is measured on a hard, unyielding surface, shall be 80 psi plus five (5) psi for each wheel.

   d. The total maximum load per axle, whether single axle or a group of axles in the same alignment, shall be 22,400 lbs.

   e. Wheel loads and tire pressures shall be controlled to produce the required degree of compaction without rutting of the surface to be rolled.

B. Rolling:

1. Proceed continuously at the following rates:

   a. For track underlay mixture, when spread by hand, not in excess of 400 sq yd/hr, per roller.

   b. For track underlay, when spread by machine, not in excess of 600 sq yd/hr, per roller.

   c. For HMA Pavement, when spread by hand, not in excess of 300 sq yd/hr, per roller.

   d. For HMA Pavement, when spread by machine, not in excess of 400 sq yd/hr, per roller.

2. Immediately after spreading, thoroughly compact by rolling with approved rollers continuously from commencement to final completion at a speed not exceeding three (3) miles per hours.

3. Make initial rolling, using tandem type rollers, parallel to the center line of the paved surface beginning at the curbs or edges of the paved surface and working toward the center, overlapping on successive trips by one-half the rear wheel roller.

    a. Immediately following the initial rolling, further compact by pneumatic rubber-tired rollers or steel wheel vibratory tandem type rollers a minimum of eight (8) passes, except flexible pavement track underlay which shall receive four (4) passes.

    b. Smooth shallow ruts and ridges with tandem rollers immediately following the rubber-tired rolling.

4. First make final roll longitudinally with the paved surface and then diagonally or at right angles.

    a. Continue until further compression results; the mixture has cooled; no marks show under the roller, and the surface is smooth and free from depressions, waves, bunches, and unevenness.

5. Test after the mixture has been rolled with approved straight edge and surface testing machine laid parallel to the centerline of the paved surface.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Prime Coat and Tack Coat will not be measured for payment. Costs associated with the prime or tack coats will be considered as incidental to the Hot Mix Asphalt Pavement.

B. Hot Mix Asphalt Pavement will be measured by the unit or fraction thereof Installed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved Schedule of Values as derived from the Contract Drawings will be used as the basis for this measurement

C. Cold Milling/Removal of existing pavement will be measured by the unit or fraction thereof Installed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved Schedule of Values as derived from the Contract Drawings will be used as the basis for this measurement

D. Hot Mix Asphalt paving constructed for underlayment of track at grade crossings and underlayment of special trackwork will not be measured for payment. Costs associated with the asphalt underlayment will be considered as incidental to work

measured and paid under 34 71 50 Highway-Rail Grade Crossings and 34 72 00 Trackwork.

E. No separate measurement or payment will be made for 7" Hot Mix Asphalt Pavement constructed within ten (10) feet of centerline of track at grade crossing locations. This shall be considered incidental to work measured and paid under 34 71 50 Highway-Rail Grade Crossings.

F. The mass of the material will be determined as provided in Section 9-1.01, "Measurement of Quantities", of the current Caltrans Standard Specifications.

4.02 PAYMENT

A. Hot Mix Asphalt Pavement constructed in accordance with the Contract Documents will be paid for at the Contract Unit Price as included on the approved Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals necessary for Hot Mix Asphalt Pavement described by the Contract Documents.

B. Cold Milling/Removal of existing pavement performed in accordance with the Contract Documents will be paid for as at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, materials, tools, equipment, supplies, removal and legal disposal or recycling of removed materials, supervision and incidentals necessary, and doing all work, as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 32 16 00

CURBS, GUTTERS AND SIDEWALKS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section consists of furnishing all labor, Materials and equipment necessary, and incidental to the manufacture, transport and placement of the curbs and gutters, related Material, and providing all associated items.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 03 21 00 – Reinforcing Steel.

3. Section 03 31 00 – Structural Concrete.

1.02 REFERENCES

A. Comply with the following Specifications, standards and recommended practices, except as otherwise indicated:

1. Orange County Department of Public Works (OCDPW): Standard Specifications for Public Works Construction (current edition) and associated OCDPW amendments, Sections 201-1, Portland Cement Concrete, 201-3, Expansion Joint Filler and Joint Sealants, and 303-5, Concrete Curbs, Walks, Gutters, Cross Gutters, Alley Intersections, Access Ramps, BUS PADS, LOCAL DEPRESSION, CONCRETE APRON, and Driveways.

2. Caltrans: State of California Department of Transportation, Standard Plans 2010.

3. CPUC: General Orders 26D and 118.

1.03 SUBMITTALS

A. Submit, under provisions of Division 01, the following information:

1. Compliance: Concrete mix and Materials, test reports, Manufacturer or Supplier's certification that Materials delivered to site are in compliance with Specifications.

2. Samples: Sampling and testing for compliance with the contract provisions shall be in accordance with SSPWC 2012 Section 201-1.1.

3. Product Data: Submit to the Engineer the manufacturer's Standard Plans or catalog cuts, and Certificate of Conformance for joint filler or other Materials, which are specified to conform to publications referenced under "Products" in this Section.

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT CONCRETE

A. Portland cement concrete for the construction of curbs and gutters shall conform to SSPWC 2012 Section 201-1.

B. The minimum 28-day compressive strength shall be 3250 psi (560-C-3250 – SSPWC) unless otherwise shown on the Plans.

2.02 REINFORCEMENT

A. All reinforcement for this portion of the Work shall conform to the provisions of Section 03 21 00. Reinforcing chairs shall be plastic or concrete.

2.03 JOINT FILLER

A. Premolded joint fillers shall conform to SSPWC 2012, Section 201-3.2.

PART 3 - EXECUTION

3.01 GENERAL

A. Establish and maintain required lines and elevations. Make gradual and smooth transitions to pavements.

3.02 ZERO FACE CURBS

A. Curb face shall be tapered to zero height within 10 feet of track centerline in order to comply with walkway requirements provision of CPUC General Order 118.

3.03 EXTRUDED PORTLAND CEMENT CONCRETE CURBS

A. Concrete curbs and gutters shall be constructed of Portland cement concrete of the class and other requirements specified in Section 303-5 of the SSPWC.

B. For curbs constructed on existing paving, refer to the Contract Documents for specific details and requirements for attaching curbs to existing paving.

C. Space joints in extruded curbs to match joints in adjacent paving. When the adjacent paving is not jointed, locate joints at angles, corners, points of curvature, and points of tangency at intervals of not more than 15 feet.

D. Joints shall be 1/8 inches minimum thickness and constructed to a minimum depth of 1 inch by scoring with a tool which will leave the corners rounded and destroy aggregate interlock to a depth of 1 inch.

E. Place expansion joints filler to full cross-section with 1/4 inches thick filler in the curb at abutting structures and at 100 foot intervals.

F. Cure the extruded concrete for not less than 72 hours by the methods specified in Section 34 80 41.

3.04 CAST-IN-PLACE CONCRETE CURB, AND COMBINED CURB AND GUTTER

A. Construction of cast-in-place curb, and combined curb and gutter shall meet the requirements of Section 03 31 00.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Concrete Curb and Gutter, Concrete Sidewalk, Concrete U-Ditch, Concrete U-Ditch with Bikeproof Grate, and Concrete Ditch will be measured by the unit or fraction thereof constructed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved Schedule of Values as derived from the plans will be used as the basis for this measurement.

B. Transitions and cutoff sills shall be considered incidental to construction of Concrete U-Ditch, no separate measurement or payment will be made therefor.

4.02 PAYMENT

A. Concrete Curb and Gutter, Concrete Sidewalk, Concrete U-Ditch, Concrete U-Ditch with Bikeproof Grate, and Concrete Ditch furnished and completed in accordance with the Contract Documents will be paid for as at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, materials, tools, equipment, supplies, supervision and incidentals necessary, and doing all work, as shown on the Plans, and as specified in these Specifications.

B.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Work involves furnishing all labor, materials and equipment necessary and incidental to applying pavement and platform striping, markings, markers, and painting of curbs.

1.02 REFERENCES

A. Comply with the following Specifications, standards and recommended practices, except as otherwise indicated:

1. Caltrans: State of California Department of Transportation, Standard Specifications 2010, Section 84.

2. Caltrans: State of California Department of Transportation, Standard Specifications 2010, Section 85.

3. Caltrans: State of California Department of Transportation, Traffic Manual; California Manual on Uniform Traffic Control Devices, latest edition, Part 3, Chapter 3A and 3B.

4. CCR, Title 24: California Code of Regulations: California State Building Code.

1.03 SUBMITTALS

A. Submit the following in accordance with Division 01: Manufacturer's or supplier's certification that the materials delivered to the site are in compliance with the Specifications as specified in this Section.

1.04 QUALITY ASSURANCE

A. Pavement striping, markings, and markers shall be applied by workers with proven skills required to perform the work in accordance with the correct location, alignment, and dimensions of the striping and markings as shown in the Contract Plans or as modified by the Engineer.

B. At no additional cost to OCTA, the Contractor shall repair or replace pavement markings, which fail to present a uniform appearance and those, which are marred and damaged by traffic and by other causes.

C. Until accepted by the Engineer, the Contractor must be responsible for the maintenance of all pavement striping, markings, and markers until the roadway is open to vehicular traffic.

D. All pavement striping and marking for roadways, whether temporary or permanent shall be completed before the roadway is opened for vehicular traffic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Paint for traffic striping and markings shall comply with Caltrans Standard Specifications Section 84. Type of paint shall either be Fast Dry or Rapid Dry solvent borne. Thermoplastic traffic stripes and pavement markings shall comply with Caltrans Standard Specifications Section 84. Markers shall comply with Caltrans Standard Specifications Section 82.

2.02 COLOR

A. Color for roadways shall be Caltrans Standard Specifications "white" and “yellow” unless otherwise indicated in the plans.

B. Painting of curbs shall use the color indicated in the Contract Plans.

PART 3 - EXECUTION

3.01 GENERAL

A. Apply paint by using a striping machine, except for special areas and markings, which are inaccessible or not adaptable to machine application, in which case hand application will be permitted with approved masking or stencil use.

B. The striping machine shall be an approved spray-type marking machine capable of producing the specified dimensions of the markings and stripings with clear-cut edges and uniform smooth film thickness.

C. The minimum wet film thickness of the paint shall be 15 mils or in accordance with the manufacturer's recommendation and approved by the Engineer.

D. Application of the paint shall be made only on a dry and clean surface free from grease, oils, dirt, curing compound or any other foreign matter, when the weather is not windy and humid, and the ambient air temperature is not less than 40 DegF. Contractor must not apply paint to uncured concrete.

E. Placement of pavement markers shall comply with Caltrans Standard Specifications Section 82.

F. Contractor must clean up all overspray with approved Materials and leave a clean and complete project.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Pavement Markings will be measured by the unit or fraction thereof furnished and placed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved Schedule of Values as derived from the plans will be used as the basis for this measurement.

B. Striping and pavement marker removal shall be considered incidental to the Contract price paid for pavement markings. No separate measurement or payment will be made for striping removal.

4.02 PAYMENT

A. Pavement Markings completed in accordance with the Contract Documents will be paid for at the contract unit price, as listed in the Schedule of Quantities and Pricing. This price shall be full compensation for furnishing all striping and pavement marker removal, labor, materials, tools, equipment, supplies, supervision, and incidentals necessary for Pavement Markings described by the Contract Documents.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 32 31 13

CHAIN LINK FENCING AND GATES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Chain link fencing and gates including the chain-link fence fabric and posts, concrete for post bases, rails, ties, bands, bars, rods and other fittings and hardware designed to support the fabric in a vertical, taut position.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 03 31 00 - Structural Concrete.

1.02 REFERENCES

A. ASTM International (ASTM):

1. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

2. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

3. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.

4. A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

5. A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

6. A824, Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for use with Chain-Link Fence.

7. F552, Standard Terminology Relating to Chain-Link Fencing.

8. F567, Standard Practice for Installation of Chain Link Fence.

9. F626, Standard Specification for Fence Fittings.

10. F900, Standard Specification for Industrial and Commercial Security Gates.

11. F1043, Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Line Fence Framework.

12. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

B. American Welding Society (AWS).

C. Chain Link Manufacturer's Institute for "Galvanized Steel Chain Link Fence Fabric and Accessories."

D. SCRRA Engineering Standards ES5106, Right of Way Fencing, Chain Link Fence.

1.03 DEFINITIONS

A. See ASTM F552.

B. NPS: Nominal pipe size, in inches.

C. Installer or Applicator:

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

1.04 SUBMITTALS

A. Shop Drawings:

1. Submittals shall be made in accordance with provisions contained in Division 01.

2. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

3. Scaled plan layout showing spacing of components, accessories, fittings, and post anchorage.

4. Details of fence materials, foundations, anchorage details and gate details.

5. Source quality control test results.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Installer shall have a minimum two (2) years experience installing similar fencing.

2. Utilize only AWS certified welders.

B. Construct fence within reasonable close conformity to lines and grades shown on the Plans and at the locations as directed by the Engineer.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Components for Chain Link Fencing shall conform to SCRRA Engineering Standards ES5106, Right of Way Fencing, Chain Link Fence and these Specifications.

B. Chain Link Fabric:

1. Fabric type:

a. ASTM A392 zinc-coated steel:

1) Coated before weaving, 2.0 oz/sf.

2. Wire gage shall be 11-gage for fences 6 feet-0 inches and less and 9-gage for fences over 6 feet-0 inches in accordance with the Project Plans or as determined by the Engineer based on field conditions in accordance with SCRRA Engineering Standards ES5106.

3. Mesh size shall be 1 inch.

4. Selvage treatment:

a. Top: Knuckled.

b. Bottom: Knuckled.

C. Concrete:

1. Minimum cement content shall be 560 lbs/cu. yd.

2. Minimum 28-day compressive strength shall be 3,250 psi.

3. Concrete shall be supplied and tested in accordance with Section 03 31 00.

D. Line Post:

1. ASTM F1083 pipe:

a. Table 1, Schedule 40, regular grade, in sizes as specified on SCRRA Engineering Standards ES5106.

E. Corner or Terminal Posts:

1. ASTM F1083 pipe:

a. Table 1, Schedule 40, regular grade, in sizes as specified on SCRRA Engineering Standards ES5106.

F. Brace and Rails:

1. ASTM F1083 pipe:

a. Table 1, Schedule 40, regular grade, in sizes as specified on SCRRA Engineering Standards ES5106.

G. Tension Wire and bars:

1. Top and bottom of fabric:

a. ASTM A824, galvanized steel, Class 3.

b. Minimum 7-gage galvanized coil spring steel wire.

2. Tension bars used in fastening fabric to end and corner posts and gate frames:

a. ASTM A500 or A501, minimum 3/16 inches x 3/4 inches galvanized high carbon steel bars.

H. Fence Fittings (Post and Line Caps, Rail and Brace Ends, Sleeves-Top Rail, Tie Wires and Clips, Tension and Brace Bands, Tension Bars, Truss Rods):

1. ASTM F626.

2. Tie wires shall not be smaller than 11 gage galvanized steel, 6 gage aluminum wire or approved noncorrosive bands.

3. Truss or tension rods shall be adjustable 3/8 inches dia. galvanized steel rod.

a. Adjustable galvanized turnbuckles or other suitable tightening devices shall be provided as necessary.

I. Security Gate:

1. ASTM F900.

    a. Gate posts in sizes as shown in SCRRA Engineering Standards ES5106.

2. Materials as specified for fence framework and fabric.

3. Hardware:

    a. Galvanized per ASTM A153.

    b. Hinges to permit gate opening as shown in the plans.

4. Hang gates on at least two (2) steel or malleable iron hinges not less than 3-inches in width, designed to clamp to the gate post and permit the gate to be swung as indicated in the plans. The bottom hinge shall have a socket to take the ball end of the gate frame.

5. Gates shall be provided with a combination steel or malleable iron catch and locking attachment system of approved design which will not rotate around the latch post.

6. Stops to hold gates open and a center rest with catch shall be provided where required.

J. Security Extension:

1. Extension arms for barbed wire shall be a type that can be attached to the tops of posts and carry three wire at approximately 5-1/2 inches centers.

2. Barbed wire shall be four-point pattern, composed of:

    a. Two strand, 12-1/2 gage galvanized steel wire.

    b. Barbs spaced at 5 inches centers.

    c. Conform to ASTM A121.

2.02 SOURCE QUALITY CONTROL

A. Test related fence construction materials to meet the following standards:

1. Posts and rails:

    a. ASTM F1043, Heavy Industrial.

2. Results of tests to be submitted with material certification submittals.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with:

1. Manufacturer's instructions.

2. Lines and grades shown on approved Plans.

3. In accordance with ASTM F567.

4. In accordance with SCRRA Engineering Standards ES5106.

B. In case of conflict between four above mentioned installation procedures, SCRRA Engineering Standards ES5106 takes precedence; use in lieu of conflicting portions.

C. Work shall be performed by workmen who are thoroughly trained and experienced in the skills required to install the products of this Section.

D. Do not start fence installation before final grading is complete and finish elevations are established.

E. Drill holes for posts in firm, undisturbed or compacted soil.

F. Posts shall be placed in a vertical position, except as directed by the Engineer where they may be set perpendicular to the ground surface.

G. Posts shall be set in concrete footings conforming to the details shown on the plans or SCRRA Engineering Standards ES5106 and crowned at the top to shed water.

H. Place fence with bottom edge of fabric at maximum clearance above grade, as shown on Plans.

1. Correct minor irregularities in earth to maintain maximum clearance.

I. Space line posts at equal intervals not exceeding 10 feet on center.

J. Provide post braces for each gate, corner, pull and terminal post and first adjacent line post.

K. Install tension bars full height of fabric.

1. Rails: Fit rails with expansion couplings of outside sleeve type when called for in plans.

2. Install rails continuous for outside sleeve type for full length of fence

3. Provide expansion couplings in top rails at not more than 20 feet intervals.

4. Anchor top rails to main posts with appropriate wrought or malleable fittings.

L. Install bracing assemblies at all end and gate posts, as well as side, corner, and pull posts.

1. Locate compression members at mid-height of fabric.

2. Extend diagonal tension members from compression members to bases of posts.

3. Install so that posts are plumb when under correct tension.

M. Pull fabric taut and secure to posts and rails.

1. Secure so that fabric remains in tension after pulling force is released.

2. Secure to posts at not over 15 inches o.c., and to rails at not over 24-inches o.c., and to tension wire at not over 24-inches o.c.

3. Use U-shaped wire conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two (2) full turns.

4. Bend ends of wire to minimize hazards to persons or clothing.

5. Fabric shall be placed on the outside of poles away from the track or as directed by the Engineer.

N. Install post top at each post.

O. Gates:

1. Construct with fittings or by welding.

2. Provide rigid, weatherproof joints.

3. Assure right, non-sagging, non-twisting gate.

4. Coat welds with rust preventive paint, color to match pipe.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. 8’ Chain Link Fence (Remove Exist and Install New) will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement..

B. Chain Link Fencing shall consist of a fabric, including posts, horizontal members, post anchorages, stretcher bars, tension wires and other required hardware and fittings, as shown on the Contract Documents.

4.02 PAYMENT

A. 8’ High Chain Link Fence (Remove Exist and Install New) furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, removal and legal disposal of existing fence and footings, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

B. Full compensation for furnishing and installing connections on Fencing and Gates, drilling anchor bolt holes and bolts shall be considered as included in the prices and no additional compensation will be allowed.

C. Full compensation for furnishing and installing fabric, posts, post tops, tension wires, post clips, wire ties and hog rings shall be considered as included in the prices and no additional compensation will be allowed.

D. Full compensation for clearing the line of the fence and disposing of the material, excavating high points in the existing ground, excavating and backfilling holes, disposing of surplus excavated material, and furnishing and placing concrete footings and connecting new fences to structures and existing cross fencing, and constructing temporary fences for protection of stock, shall be considered as included in the prices and no additional compensation will be allowed .

END OF SECTION

SECTION 32 31 16

WELDED WIRE FENCING AND GATES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work involves furnishing all materials, labor and equipment necessary and incidental to the installation of wire mesh fence at the locations shown on the Contract Plans.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 – General Requirements

2. Section 01 33 00 – Submittal Procedures

3. Section 03 31 00 – Structural Concrete

1.02 REFERENCES

A. Comply with all local, State and Federal codes, regulations, Specifications, standards and recommended practices.

B. ASTM: American Society for Testing and Materials

1. A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

2. A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

3. A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

4. A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

5. A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

6. B117 Standard Practice for Operating Salt Spray (Fog) Apparatus

7. B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

8. D1654 Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

9. D2248 Standard Practice for Detergent Resistance of Organic Finishes

10. D2794 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation

11. F2408 Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets

C. SSPWC: Standard Specifications for Public Works Construction 2012 Section 304

D. SCRRA Engineering Standard ES5105, Right-of-Way Fencing, Welded Wire Mesh Fencing

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures:

1. Compliance: Manufacturer's or supplier's certification that the materials delivered to the site are in compliance with the Specification.

2. Product data in form of manufacturer’s technical data, and installation instructions for the fence.

3. Shop Drawings: Details of fence materials, post spacing, foundations, and anchorage details.

1.04 QUALITY ASSURANCE

A. Work shall be performed by workmen who are thoroughly trained and experienced in the skills required to install the products of this Section.

B. Construct fence to lines and grades shown on the Contract Plans and at other locations as directed by Engineer.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Fence:
1. SuperMeshG Fencing manufactured by Secure Technology, Inc. of 23016 Del Lago Drive, Suite A, Laguna Hills, CA 92653. Telephone 949-707-4270. Fence materials to be galvanized.
2. Fencing manufactured by Betafence USA, Ennis, Texas 75118. Telephone 888-650-4766. Fence materials to be galvanized.
3. A substantially equivalent galvanized welded wire mesh fencing conforming to SCRRA ES5105 and approved in writing by the Authority.

C. Concrete: Class 500-C-2500 per SSPWC Section 201

PART 3 – EXECUTION

A. Unless otherwise specified or directed construct fence in accordance with materials and methods to conform to the Contract Plans and installation instructions provided by the supplier.

B. Fence top extension shall face away from the track.

C. Posts shall be installed at 10 feet intervals in accordance with SSPWC Section 304-3 for installation of posts.

D. Galvanizing damaged during installation shall be repaired in accordance with SSPWC Section 210-3.5, Repair of Damaged Zinc Coatings.

PART 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Welded Wire Fencing will be measured by the unit or fraction thereof furnished and Installed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved Schedule of Values as derived from the Plans will be used as the basis for this measurement.

B. Welded Wire Gates will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

C. Quantities of gates will be determined from actual count. When more than one gate is placed in an opening, each single unit placed will be counted as a gate. A gate unit complete shall include one gate with necessary fittings, hardware and gate posts with braces.

D. Welded Wire Fencing and gates shall consist of a fabric, including posts, horizontal members, post anchorages, stretcher bars, tension wires and other required hardware and fittings, as shown on the Contract Documents.

4.01 PAYMENT

A. Welded Wire Fencing and Gates constructed in accordance with the Contract Documents will be paid for at the Contract Unit Price as included on the approved Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals necessary for Welded Wire Fencing and Gates described by the Contract Documents.

B. Gates installed in accordance with the Contract Documents will be paid for by actual count at the Contract Unit Price as listed on the Schedule of Quantities and Prices.

C. Full compensation for furnishing and installing connections on Welded Wire Fencing and Gates, drilling anchor bolt holes and bolts shall be considered as included in the prices and no additional compensation will be allowed.

D. Full compensation for furnishing and installing fabric, posts, post tops, tension wires, post clips, shall be considered as included in the prices and no additional compensation will be allowed.

E. Full compensation for clearing the line of the fence and disposing of the material, excavating high points in the existing ground, excavating and backfilling holes, disposing of surplus excavated material, and furnishing and placing concrete footings and connecting new fences to structures and existing cross fencing, and constructing temporary fences for protection of stock, shall be considered as included as listed on the Schedule of Quantities and Prices.

END OF SECTION

SECTION 32 32 16

GRAVITY BLOCK RETAINING WALLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work involves furnishing all labor, materials and equipment necessary and incidental to constructing gravity block retaining walls to the limits and at the locations shown on the Contract Drawings. This work consists of furnishing and constructing gravity block retaining walls of prefabricated modular units at locations and in close conformity to the lines, grades, and dimensions shown or established.

B. Sections include but are not necessarily limited to:

1. Section 03 21 00 - Reinforcing Steel
2. Section 03 31 00 – Structural Concrete
3. Section 03 40 00 – Precast Concrete
4. Section 09 96 23 - Graffiti Resistant Coatings
5. Section 26 06 00 – Grounding and Bonding
6. Section 31 20 00 – Earthwork
7. Section 31 50 00 – Excavation Support
8. Section 32 31 13 - Chain Link Fencing and Gates
9. Section 33 46 00 – Underdrains
10. Section 34 11 27 Sub-Ballast and Aggregate Base

1.2 SUBMITTALS

A. The Contractor shall verify the existing ground elevations at the site before preparing the working drawings. The working drawings shall contain all information required for the proper construction of the system at each location including existing ground line at face of wall as verified at the site and any required revisions or additions to drainage systems or other facilities.

B. Shop drawing showing wall materials and construction details and supporting design calculations as provided by the supplier of the wall system. Drawings are to be certified by a qualified Engineer licensed in the State of California, and shall be suitable for obtaining City permits, as necessary.

1. Shop drawings shall be 11" x 17" in size, and each drawing and calculation sheet shall include the OCTA the contract number, wall number, full name of the Project as shown on the contract plans, and Project stationing for the wall limits, and associated Metrolink railroad milepost (MP). The design firm's name, address, and phone number shall be shown on the working drawings. Each sheet shall be numbered in the lower right hand corner and shall contain a blank space in the upper right hand corner for future contract sheet numbers.

2. The shop drawing shall include all details, dimensions, quantities and cross-sections necessary to construct the wall.

C. Submit the following at least thirty (30) days prior to construction for approval:

1. Product Data

a. Material description and installation instructions for each manufactured product specified including gravity wall block.

b. Supply a Certificate of Compliance conforming to the provisions in the Caltrans Standard Specifications, Section 6-1.07, "Certificates of Compliance," stating the supplied material meets the respective index criteria set forth by OCTA, as measured in accordance with all test methods and standards specified in the Standard Specifications, these special provisions, and the approved working drawings.

2. Retaining Wall Final Design Submittals

a. Shop Drawings: For initial review, Five (5) sets of the retaining wall system design, including wall elevation views, pertinent details, and drainage provisions. A registered professional engineer licensed in the state of wall installation shall sign and certify that the shop drawings are designed in accordance with the project civil plans and specifications. After review, between six (6) to twelve (12) sets of the retaining wall system design, including wall elevation views, pertinent details, and drainage provisions shall be submitted for final approval and use during construction.

b. Design Calculations: Four (4) sets of engineering design calculations prepared in accordance with SCRRA Design Criteria Manual. Analysis shall include Internal and External Stability and Bearing Capacity Calculations.

1.3 DESIGN REQUIREMENTS

A. Designs for Gravity Retaining Walls shall be prepared according to design methodology presented in the SCRRA Design Criteria Manual. Where the wall is subject to rail loads (e.g., Cooper E-80), wall shall be designed in accordance with the applicable sections of AREMA, such as Section 2.2.3c for surcharges and

Section 20.3.2.2 for lateral pressures.

B. Design of the Gravity Retaining Walls shall be based on the static and seismic soil parameters as determined during the geotechnical investigation as provided in the contract plans.

C. Design shall meet or exceed the minimum required safety factors for sliding overturning and bearing capacity failure of the wall for the static case and the design seismic event per the SCRRA Design Criteria Manual, 2014 and AREMA, 2014. The design shall also meet or exceed other requirements stated in Chapter 12 of the SCRRA Manual and Chapter 5 of AREMA.

D. Design submittals not meeting this design criteria or technical/administrative criteria as specified will be rejected in their entirety until complete compliance is achieved. Owner reserves all rights in determining compliance for plan approval and may reject any submittals.

E. The top of the gravity block retaining wall and top of leveling pad profiles of the earth retaining system shall conform to the elevations shown on the Plans. The vertical limits of the gravity block retaining walls may vary from plan but shall not be less than that required to provide the minimum embedment below finish grade in front of wall and shall equal or exceed the top of wall profile elevations shown on the Plans. The lengths of gravity block retaining walls to be used shall be not less than those shown on the Plans.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Enviro-Block by Inter-Block Retaining Lock-Block Retaining Systems, San Marcos, CA, or another substantially equivalent Gravity Block Retaining Wall System approved in writing by OCTA.

B. Standard full blocks shall be composed of solid concrete and have dimensions of 2.5 feet x 2.5 feet x 5 feet. Specialty blocks may deviate from these specifications according to the manufacture’s requirements.

C. Blocks are to be standard grade, gray color with smooth face finish.

D. Blocks shall be sound and free of cracks or other defects that would interfere with the proper placement of the block or significantly impair construction of the wall.

E. Block face exposed to view shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused light.

F. Tolerance - Molded dimensions are not to differ more than 1/4 inch from the manufacturer’s published dimensions, except height, which is not to differ more than 1/8 inch.

G. Graffiti resistant coating shall be per Specification Section 09 96 23

H. Geotextile fabric shall be Mirafi “Filterweave 404” or substantially equivalent geotextile product approved in writing by OCTA.

2.2 ACCEPTANCE OF BLOCKS

A. Acceptability will be determined based on tolerances specified in 2.1 of this section and visual inspection. Any one of the following defects will be cause for rejection:

1. Concrete not suitable for common structural applications, imperfect molding;
2. Honeycombed or open texture concrete;
3. Broken, cracked or chipped blocks, or
4. Extreme color variation on visible face of block.

PART 3 - EXECUTION

3.1 PREPARATION

A. The Contractor shall verify the existing ground elevations at the site before preparing the working drawings. The working drawings shall contain all information required for the proper preparation and construction of the proprietary wall type.

B. Excavate existing material in accordance with Section 31 20 00 as needed to construct the wall as detailed on the plans.

C. Prepare the subgrade in accordance with Section 31 20 00 and suppliers recommendations.

3.2 GRAVITY BLOCK WALL CONSTRUCTION

A. Over excavate native soil to the extents shown on the drawings. Place and compact granular Structural Backfill conforming to 31 20 00 at wall base and Pervious Backfill conforming to 31 20 00 behind the wall for a width of 12” to finished grade or sub ballast elevation shown on the drawings. Backfill beyond the 12-inch width shall be Embankment Fill per 31 20 00. The exposed bottom of any over excavation should be inspected by the project geotechnical engineer prior to placement of engineered fill to ensure that competent and unyielding subgrade has been exposed and that no additional over excavation is necessary. Proof-rolling can be used to verify that the ground is firm and unyielding. If voids resulting from the removal of vegetation/trees or buried structures are exposed at the over excavation limits, they shall be over excavated to a depth exposing firm and competent soil. Prior to placing engineered fill, the exposed bottom of over excavation shall be scarified to a minimum depth of 6”, conditioned as necessary to achieve near-optimum moisture content, and re-compacted in-place to at least 95% relative compaction based on maximum densities determined in accordance with ASTM D-1557 or equivalent.

B. Wall base course and block profile may slope up to 0.5% where indicated on plans to provide track walkway.

C. The top of the backfill shall be shaped to a slope to match the base of the lowest block. Each block shall be placed with full contact with the compacted base at the angle indicated on the approved submittal.

D. Block Installation and Backfill Placement - Blocks shall typically be placed in a running bond pattern unless placed perpendicular to the face of the wall. The best face of the block should be exposed. Place blocks so the final position is battered as shown. Place the first course of blocks on top of and in full contact with the prepared base pad surface.

E. Install drain pipe filter fabric and pervious rock in accordance with the plans and Section 33 46 00 during placement of wall backfill.

F. Closely follow erection of each course of blocks with placement of Fill against block face opposite track and block face on trackside. Remove excess backfill from the top of the blocks prior to installing the next course of blocks.

G. During construction of the wall and placement of blocks maintain a vertical tolerance and tangent horizontal alignment tolerance not in excess of 1-1/8 inch when measured with a 10-foot straightedge. Check the batter and tolerances of each course of blocks before erecting the next course.

H. Form, install reinforcement and cast-in-place concrete curb with fence and gate post anchorage per Caltrans alternative anchorage detail on Standard Plan B11-7. Expansion joints in the curb shall be provided at 25 feet maximum to match running bond pattern. Reveals and chamfers shall be installed in the form to match the chamfered corners of the precast block and running bond pattern. Alternately the fence posts may be installed by coring into the top block after wall construction is complete.

I. Remove forms, finish per Section 03 31 00, Structural Concrete. Clean exposed face of finished wall to remove all dirt, debris and marks caused during construction.

J. Grade embankment at top of wall in accordance with the plans.

K. Clean exposed face of finished wall to remove all dirt, debris and marks caused during construction.

L. Install fencing as indicated on the plans.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Gravity Block Retaining Wall will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived

from the plans will be used as the basis for this measurement.

B. Excavation, temporary shoring, subgrade preparation, forms, reinforcing steel (including drilling and bonding of dowels), cast-in-place concrete fillets; backfill to finished grades, perforated under drain, filter fabric, permeable rock and other appurtenances for the retaining wall shall be considered work incidental to the retaining wall. No separate measurement and payment shall be made for the same.

4.2 PAYMENT

A. Gravity Block Retaining Wall furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals necessary for Gravity Block Retaining Wall described by the Contract Documents.

END OF SECTION

SECTION 32 32 21

PREFABRICATED MODULAR BLOCK (PMB) RETAINING WALLS

PART 1 - GENERAL

1.1 SUMMARY

This work shall consist of furnishing materials and placement of prefabricated modular block retaining wall constructed in accordance with these specifications and in reasonably conformity with the lines, grades, design, and dimensions shown on the plans or otherwise established.

The prefabricated modular block retaining wall (PMB) is a retaining structure whose dimensions are bounded by a front plane formed by the facing panels and a back plane formed by the ends of the stems which have a tee (“T”) shape in plan view. The wall system shall consist of concrete PMB units installed on leveling pads for both face and stem with select backfill compacted between the concrete units.

A. Section Includes:

1. Concrete retaining wall units
2. Reinforcement
3. Drainage aggregate
4. Structural Backfill
5. Drainage System

B. Related Sections including but are not necessarily limited to:

1. Division 01 – General Requirements
2. Section 03 21 00 – Reinforcing Steel
3. Section 03 31 00 – Structural Concrete
4. Section 03 40 00 – Precast Concrete
5. Section 26 06 00 – Grounding and Bonding
6. Section 31 20 00 – Earthwork
7. Section 31 50 00 Excavation Support
8. Section 34 80 43 - Precast and Prestressed Concrete for Bridges

9. Section 33 46 00 – Underdrains

10. Section 09 96 23 – Graffiti Resistant Coatings

1.2 REFERENCES

A. Comply with local, State, and Federal codes, regulations, specifications, standards and recommended practices.

B. American Association of State Highway Transportation Officials (AASHTO)

1. M288 Geotextile Specification for Highway Applications

2. Standard Specifications for Highway Bridges

3. T-22 Compressive Strength of Cylindrical Concrete Specimens

4. T-23 Making and Curing Concrete Test Specimens in the Field

5. T-24 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

6. T-141 Sampling Freshly Mixed Concrete

7. M-85 Standard Specifications for Portland Cement (Chemical and Physical)

C. American Society for Testing and Materials (ASTM)

1. C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

2. C1262 Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units

3. C1372 Standard Specification for Segmental Retaining Wall Units

4. D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction

5. D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/f^3)(600 kN-m/m^3)

6. D1556 Standard Test Method for Density and Unit Weight of Soil In Place by the Sand Cone Method

7. D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f^3) (2700 kN-m/m^3)

8. D2487 Standard Classification of Soils for Engineering Purposes

(Unified Soil Classification System)

9. D2922 Standard Test Methods for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)

10. D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer pipe and Fittings

11. D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

12. D4873 Standard Guide for Identification, Storage and Handling of Geosynthetics

13. D5084 Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

14. G51 Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing

15. A370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products

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

E. T-Wall Retaining Wall System by the Neel Company (Railroad Construction Manual), Gravix retaining wall system by Earth Wall Products, LLC, or substantially equivalent prefabricated modular block retaining system approved in writing by OCTA.

1.3 DEFINITIONS

A. Prefabricated Modular Block Retaining Wall (PMB) units: Dry stacked monolithic concrete units bounded by a front plane formed by the facing panels and a back plane formed by the ends of the stems which are used to construct a gravity wall retaining system.

B. Select Backfill: Granular aggregate material used within, between, and directly behind the PMB units.

C. Geotextile Filter: Material used for separation and filtration of dissimilar soil types.

1.4 SUBMITTALS

A. The Contractor shall submit complete working drawings for each installation of the system in conformance with the provisions in Division 01 for requirements for the mechanics and administration of the submittal process. Design drawings shall be submitted to the SCRRA for acceptance and approval.

B. Design drawings shall be 11" x 17" in size, and each drawing and calculation sheet shall include the OCTA Contract number, full name of the Project as shown on the contract plans, and associated Metrolink railroad milepost (MP). The design firm's name, address, and phone number shall be shown on the working drawings. Each sheet shall be numbered in the lower right hand corner and shall contain a blank space in the upper right hand corner for future contract sheet numbers.

C. The design drawing shall include all details, dimensions, quantities and cross-sections necessary to construct the wall and shall include but shall not be limited to the following:

1. An elevation view for each wall shall include the top of wall elevation at all horizontal and vertical break points and at least every 50 feet along the face of wall, the elevation of all steps in the leveling pads, the designation as to the type of panel, the distance along the face of the wall to where changes in length of the soil reinforcing elements occur; and an indication of the final ground line and maximum calculated bearing pressures.

2. A typical cross section or cross sections showing the elevation relationship between ground conditions and proposed grades.

3. General notes shall include at the minimum relevant design criteria and parameters, material notes and wall construction procedures.

4. A listing of the summary of quantities for each wall

5. All PMB unit details shall show all dimensions necessary to construct the element and reinforcing steel in the element.

6. Clearly indicated details for construction of walls around drainage facilities

7. Details of the architectural treatment, in any.

D. The Contractor shall verify the existing ground elevations at the site before preparing the working drawings. The working drawings shall contain all information required for the proper construction of the system at each location including existing ground line at face of wall as verified at the site and any required revisions or additions to drainage systems or other facilities. The working drawings shall be accompanied with calculations. The working drawings and calculations shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California. The Contractor shall allow the Engineer 30 days to review the drawings after a complete set has been received.

E. Unless otherwise specified, at the completion of each structure for which working drawings were submitted and if the work detailed in these working drawings is permanent, the Contractor shall submit to the Engineer one set of corrected as- built prints 11" x 17" in size and on 20-pound (minimum) bond paper, showing as-built conditions. As-built drawings that are common to more

than one structure shall be submitted for each structure.

F. The Contractor shall provide a system specific submittal package to the Engineer at least thirty (30) days prior to fabrication of units for approval. Incomplete submittal packages will not be reviewed.

Submit the following at least thirty (30) days prior to fabrication of units for approval:

1. Product Data

a. Supply a Certificate of Compliance conforming to the provisions in the Caltrans Standard Specifications, Section 6-1.07, "Certificates of Compliance," stating the supplied material meets the respective criteria set forth by the Contract Documents, as measured in accordance with all test methods and standards specified in the Standard Specifications, these special provisions, and the approved working drawings.

b. Material description and installation instructions for each manufactured product specified including prefabricated modular block (PMB).

c. Name and address of the production facility where the proposed PMB units will be manufactured. All units to be manufactured at the same facility.

d. Notarized letter from the PMB manufacturer that the units supplied for this project are manufactured in complete compliance with Section 2.01 of this specification. The letter shall state that the PMB units shown in the attached test reports are representative samples of the plants normal mix design and regular production runs.

2. Test Reports:

a. Independent laboratory reports indicating compressive strength, moisture absorption and freeze-thaw durability of the concrete retaining wall units from the proposed production facility. Only test performed within the past 12 months will be considered current and valid.

3. Retaining Wall Final Design Submittals

a. Shop Drawings: For initial review, Five (5) sets of the retaining wall system design, including wall elevation views, pertinent details, and drainage provisions. A registered professional engineer licensed in the state of wall installation shall sign and certify that the shop drawings are designed in accordance with the project civil plans and specifications. After review, between six (6) to twelve (12) sets of the retaining wall system design,

including wall elevation views, pertinent details, and drainage provisions shall be submitted for final approval and use during construction.

b. Design Calculations: Four (4) sets of engineering design calculations prepared in accordance with SCRRA Design Criteria Manual. Analysis shall include Internal and External Stability and Bearing Capacity Calculations.

1.5 DESIGN REQUIREMENTS

A. Designs for PMB walls shall be prepared according to design methodology presented in the SCRRA Design Criteria Manual. Where the wall is subject to rail loads (e.g., Cooper E-80), wall shall be designed in accordance with the applicable sections of AREMA, such as Section 2.2.3c for surcharges and Section 20.3.2.2 for lateral pressures.

A. Design of the PMB shall be based on the static and seismic soil parameters as determined during the geotechnical investigation and as provided in the contract plans.

B. Design shall meet or exceed the minimum required safety factors for sliding overturning and bearing capacity failure of the wall for the static case and the design seismic event per the SCRRA Design Criteria Manual, 2014 and AREMA, 2014. The design shall also meet or exceed other requirements stated in Chapter 12 of the SCRRA Manual and Chapter 5 of AREMA.

C. Design submittals not meeting this design criteria or technical/administrative criteria as specified will be rejected in their entirety until complete compliance is achieved. Owner reserves all rights in determining compliance for plan approval and may reject any submittals.

D. The Design Engineer of Record shall be responsible for selecting and specifying back fill material. The Contractor is responsible for ensuring and documenting the back fill meets the specified parameters for both strength and compaction. Compacted retained soil shall meet the minimum requirements specified.

1.6 DELIVERY, STORAGE AND HANDLING

A. PMB Units and Accessories: Deliver, store, and handle materials in accordance with manufacturer's recommendations, in such a manner as to prevent damage. Check the materials upon delivery to assure that proper material has been received. Store above ground on wood pallets or blocking. Remove and replace damaged or otherwise unsuitable material, when so determined, from the site.

B. Exposed faces of concrete wall units shall be free of chips, cracks, stains, and other imperfections detracting from their appearance, when viewed from a distance of 10 feet.

C. Prevent mud, wet cement, adhesives and similar materials that may harm appearance of units, from coming in contact with system components.

PART 2 - PRODUCTS

2.1 MATERIALS

A. T-Wall by the Neel Company, 4661 Carter Trail, Boulder, CO 80301, Gravix Retaining Wall System by Earth Wall Products, LLC, 1349 Old 41 Hwy, Suite 135, Marietta, GA 30060, or a substantially equivalent PMB Retaining Wall System approved in writing by OCTA.

B. Prefabricated Modular Block Units (PMB)

1. Concrete used in precast PMB units for earth retaining structures shall conform to the details shown on the working drawings and the provisions in Section 03 30 00.

2. PMB facing panels shall have a minimum thickness of 6 inches and a minimum concrete cover on reinforcing steel of 2 inches. Cement shall be Type II and shall conform to the requirements of AASHTO M-85. Additives containing chloride shall not be used without the approval of the Engineer. Attachment devices and lifting devices shall be set in place to the dimensions and tolerances shown on the plans and called out in these specifications prior to casting.

3. The top row of PMB panels shall be designed with a stem that ends 2'-6" below top of panel facing to accommodate a full depth trackbed section and associated signal conduit and track under drain system.

4. Acceptability of the PMB units shall be determined on the basis of compressive strength tests and visual inspection. The PMB units shall be considered acceptable regardless of curing age when compressive strength test results indicate that the compressive strength will conform to the 28-day requirement. The Contractor, or his supplier, shall furnish facilities and perform all necessary sampling and testing in an expeditious and satisfactory manner. PMB units shall be considered acceptable for placement in the wall when the seven-day initial strength equals or exceeds 85 percent of the 28-day requirement.

5. The PMB units shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength. Any production lot which does not conform to the strength requirements shall be rejected.

6. Unless otherwise indicated on the plans or elsewhere in the specifications, the concrete surface for the front face shall have an ordinary steel form finish, and for the rear face an unformed finish. The rear face of the panel shall be free of open pockets of aggregate and surface distortions in excess of ¼ inch.

7. Graffiti-resistant coating shall be per Specification Section 09 96 23.

8. All PMB units shall be manufactured within the following tolerances with respect to the dimensions shown on the shop drawings.

   a. Unit Dimensions - All panel dimension shall be within ¼ inch. All hardware embedded in the panel with the exception of attachment devices shall be within ¼ inch.

   b. Unit Squareness - Squareness, as determined by the difference between the two diagonals, shall not exceed ½ inch.

   c. Surface Finish - Surface defects on smooth-formed surfaces, measured on a length of 5 feet, shall not exceed ¼ inch. Surface defects on textured-finished surfaces, measured on a length of 5 feet, shall not exceed 5/16 inch.

9. Acceptance of the PMB units, with respect to compressive strength, shall be determined on the basis of production lots. A production lot is defined as a group of panels that shall be represented by a single set of compressive strength samples and shall consist of not more than 80 units or a single day's production, whichever is less.

   a. Compressive strength tests shall be performed on 6-inch diameter by 12-inch cylinders prepared in accordance with AASHTO T-23. During the production of the concrete panels, the manufacturer shall randomly sample the concrete in accordance with AASHTO T-141. A single set of compressive strength samples, consisting of a minimum of four (4) cylinders, shall be made for every production lot.

   b. For every compressive strength sample, a minimum of two cylinders shall be cured in the same manner as the panels and tested at seven (7) days or less. The average compressive strength of these cylinders, when tested in accordance with AASHTO T-22, will determine the initial strength of the concrete. In addition, a minimum of two cylinders shall be cured in accordance with AASHTO T-23 and tested at 28 days. The average compressive strength of these cylinders, when tested in accordance with AASHTO T-22, will determine the compressive strength of the production lot.

   c. If the initial strength test result indicates a compressive strength greater than or equal to 5,000 pounds per square inch, then this test result will be utilized as the compressive strength test result for that production lot, and the requirement for testing at 28 days will be waived for that particular production lot.

   d. Acceptance of a production lot will be made if the compressive strength test result is greater than or equal to 5,000 pounds

per square inch. If the compressive strength test result is less than 5,000 pounds per square inch, the acceptance of the production lot will be based on its meeting the following acceptance criteria in its entirety:

1) Ninety (90) percent of the compressive strength test results for the overall production shall exceed 5,150 pounds per square inch.

2) The average of any six (6) consecutive compressive strength test results, including the one in question, shall exceed 5,250 pounds per square inch.

3) No individual compressive strength test result shall fall below 4,600 pounds per square inch.

e. In the event that a production lot fails to meet the specified compressive strength requirements, the production lot shall be rejected. Such rejection shall prevail unless the manufacturer, at their own expense, obtains and submits evidence of a type acceptable to the Engineer that the strength and quality of the concrete placed within the panels of the production lot is acceptable. If such evidence consists of tests made on cores taken from the panels within the production lot, the cores shall be obtained and tested in accordance with AASHTO T-24.

10. It is recognized that certain cracks and surface defects are not detrimental to the structural integrity of the panel if properly repaired. The Engineer shall determine the need for and proper method of such repair. All repairs shall be approved by the Engineer prior to acceptance of the panel for use in wall construction.

11. The date of manufacture, the production lot number, and the piece-mark shall be clearly marked on the side of each panel.

12. The concrete leveling pads for the PMB system shall conform to the provisions in the Caltrans Standard Specifications, Section 90-10, "Minor Concrete."

C. Reinforcement

1. Reinforcement shall conform to the provisions in Section 03 21 00.

D. Backfill:

1. Structural Backfill conforming to Section 31 20 00 shall be used for backfilling native soil over excavation at the base of the PMB. This backfill shall be provided at least to the limits shown on the drawings.

2. Embankment Fill conforming to Section 31 20 00 for use behind the PMB retaining structures up to bottom of sub ballast and beyond the limits of Pervious Structure Backfill, unless wall vendor has more stringent requirements for this backfill.

3. Pervious Backfill conforming to Section 31 20 00 shall be used for backfilling immediately behind the wall for a 12” width.

4. Select Backfill shall be used as backfill between the PMB stem units. Select Backfill can be sand, gravel, crushed rock or aggregate blends. Select Backfill for use within the PMB retaining structure shall conform to the following requirements, unless wall vendor has more stringent requirements for this backfill.

Gradation Requirements		
Sieve Size	Percentage Passing	California Test
3"	100	202
#40	60	202
# 200	0-15	202

Property Requirements		
Test	Requirement	California Test
Internal Friction	32 deg minimum	
Sand Equivalent	30 minimum	217
Plasticity Index	6 maximum	204
Minimum Resistivity	2000 ohm-cm	643
Chlorides	< 250 ppm	422
Sulfates	< 500 ppm	417
pH	5.5 to 10.0	643

If 12 percent or less passes the No. 200 sieve and 50 percent or less passes the No. 4, the Sand Equivalent and Plasticity Index requirements shall not apply.

Select Backfill shall have a minimum angle of internal friction of 34 degrees and shall have a density range of 120 to 125 pcf, or the requirements of the PMB wall system, if more restrictive.

5. Filter fabric shall conform to the provisions in the Caltrans Standard Specifications, Section 88-1.02, "Filtration." Filter fabric shall be Class A.

6. Adhesive for bonding filter fabric to concrete PMB unit shall be commercial grade.

PART 3 - CONSTRUCTION

A. Earth retaining structures shall be constructed to the lines, grades, and details shown on the plans, and shall conform to these special provisions. The PMB structure shall be installed in accordance with the manufacturer's approved shop drawings, construction procedures and standard details, where more restrictive.

3.1 EARTHWORK AND BACKFILL

A. Over excavate native soil to the extents shown on the drawings. Place and compact granular Structural Backfill conforming to 31 20 00 at wall base and Pervious Backfill conforming to 31 20 00 behind the wall for a width of 12" to finished grade or sub ballast elevation shown on the drawings. Backfill beyond the 12-inch width shall be Embankment Fill per 31 20 00. The exposed bottom of any over excavation should be inspected by the project geotechnical engineer prior to placement of engineered fill to ensure that competent and unyielding subgrade has been exposed and that no additional over excavation is necessary. Proof-rolling can be used to verify that the ground is firm and unyielding. If voids resulting from the removal of vegetation/trees or buried structures are exposed at the over excavation limits, they shall be over excavated to a depth exposing firm and competent soil. Should the excavation bottom expose unsuitable soil or pumping conditions, they shall be removed to expose firm and competent soil a minimum of 12" below the specified excavation bottom. Permeable woven filter fabric shall be placed on the exposed subgrade and granular backfill shall be placed on the fabric up to the specified excavation bottom. The backfill material can be using granular soil having an SE of at least 30, aggregate base, or open-graded clean rock (maximum size of 1" and maximum 2% fines). If rock is used, it shall be wrapped on all sides with permeable woven fabric. Prior to placing engineered fill on competent soil, the exposed bottom of over excavation shall be scarified to a minimum depth of 6", conditioned as necessary to achieve near-optimum moisture content, and re-compacted in-place to at least 95% relative compaction based on maximum densities determined in accordance with ASTM D-1557 or equivalent.

B. The foundation for the PMB structure shall be graded level for a width equal to the length of PMB structure plus 12 inches minimum. Where possible the width of excavation should allow sufficient room to set the longest stem and still leave space to access the area between the stems.

C. The Contractor shall remove unsuitable material as determined and directed by the Engineer. This work shall be paid for as extra work as provided in the Caltrans Standard Specifications, Section 4-I.03D, "Extra Work."

D. Excavate for and construct the leveling pad, stepping the pad where needed. Leveling pad tolerance is 1/4" in any 10' length with no more than 1/4" overall.

E. Grade and compact subgrade material level with top of the pad the full length of the stems so that the front face will be plumb. Layout alignment for the first course on the leveling pad.

F. Install first course, adjusting for level and alignment as needed. Construct the

wall horizontally, one course at a time. Contact manufacturer for specific instruction if staged construction is required.

G. Before backfilling, install filter fabric strips centered on vertical joints. Adhesive may be placed in spots on the units to hold the fabric during back-filling. Install horizontal joint material (rubber blocks) in horizontal joints. Install shear key wrap, placed in the space between stem teeth where the top and bottom units come together.

H. Vertical and horizontal alignment tolerances of PMB units shall not exceed 3/4 inch when measured along a 10-foot straightedge. The maximum allowable offset in any PMB joint shall not exceed 3/4 inch. Check the plumbness and tolerances of each course before erecting the next course. Adjust alignment and/or shim units before backfilling.

I. Place Select Backfill to fill both sides of the PMB unit stems equally and to prevent lateral movement of the unit. The loose lifts of backfill should not exceed 12 inches before compaction. Backfill and compact each course of units completely before starting the next course.

J. Place Unclassified Backfill behind the PMB units in accordance with Section 31 20 00 - Earthwork.

K. Compaction of Structural Fill, Unclassified Backfill and Select Backfill shall achieve a minimum 95% Standard Proctor Density per ASTM—698 (AASHTO T-99) per the manufacture’s requirements, unless otherwise indicated, within the limits shown on the drawings.

L. Compaction should be performed with heavy vibratory equipment sized to ensure proper compaction throughout the backfill zone. Small walk-behind vibratory roller, “Rammax” type equipment, or vibratory plate compactors may be used for compacting material between the stems in accordance with the manufacturer’s recommendations.

M. The Contractor shall grade the backfill to rapidly drain away from the wall face at the end of each work shift. Berms or ditches shall be provided to direct runoff away from the wall site. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

N. Construct subsequent course as needed. Confirm plumbness and alignment and make any corrections prior to proceeding. Follow the manufacturer’s tolerance requirements.

O. Grade embankment at top of wall in accordance with the plans.

P. Install concrete coping, curb, gutter or fencing at top of wall as shown on the Plans.

3.2 FILTER FABRIC

A. Filter fabric shall be placed at the locations and in conformance with the details shown on the plans and these special provisions.

B. Immediately prior to placing filter fabric, the subgrade to receive the filter fabric shall conform to the compaction and elevation tolerance specified for the material involved and shall be free of loose or extraneous material and sharp objects that may damage the filter fabric during installation.

C. Concrete panel surfaces to receive filter fabric shall be dry and thoroughly cleaned of dust and deleterious materials.

D. Filter fabric shall be handled and placed in conformance with the manufacturer's recommendations.

E. Filter fabric shall be stretched, aligned, and placed in a wrinkle-free manner.

F. Adjacent borders of filter fabric shall be stitched or overlapped from 12 inches to 18 inches. The preceding roll shall overlap the following roll in the direction the material is being spread or shall be stitched. When filter fabric is joined by stitching it shall be stitched with yarn of a contrasting color. The size and composition of the yarn shall be as recommended by the filter fabric manufacturer. The stitches shall number 5 to 7 per inch of seam.

G. If the filter fabric is damaged during installation, it shall be repaired by placing a piece of filter fabric that is large enough to cover the damaged area and that meets the overlap requirement.

H. Equipment or vehicles shall not be operated or driven directly on filter fabric.

3.3 CONCRETE

A. Concrete for the leveling pads shall be placed at least 24 hours prior to erecting PMB units.

3.4 PMB EARTH RETAINING SYSTEM REPRESENTATIVE

A. A qualified representative of the PMB earth retaining system manufacturer shall be present during erection and backfill of the first 10 feet of height of the entire length of the wall(s) and shall be available during any remaining installations. The manufacturer's representative shall not be an employee of the Contractor.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. PMB Retaining Wall RW3 and PMB Retaining Wall RW3 Wall Pocket will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. Cost includes the backfill placed between the stems of the PMB units. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of

values, as applicable, as derived from the Plans will be used as the basis for this measurement.

B. The vertical height of each section will be taken as the difference in elevation on the outer face from the bottom of the lowermost face element or top of footing to the top of wall profile.

C. PMB Retaining Wall RW3 Wall Pocket shall be considered the entire portion of the wall within the gap of the wall face as required for the pocket.

D. Structural excavation, structural backfill, excavation as required to install the wall and comply with the manufacturer's recommendations, temporary shoring, subgrade preparation, backfill to finished grades beyond the PMB unit limits, perforated underdrain, filter fabric, permeable rock, railing, and other appurtenances for the retaining wall shall be considered work incidental to the retaining wall. No separate measurement and payment will be made therefor.

4.2 PAYMENT

A. PMB Retaining Wall RW3 and PMB Retaining Wall RW3 Wall Pocket furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 32 32 43

PERMANENT SOLDIER PILE WALL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work involves furnishing all labor, materials and equipment necessary and incidental to constructing a drilled soldier pile wall to the limits and at the locations shown on the Contract Drawings, as modified by the Engineer, as specified herein and in close conformity to the lines, grades, and dimensions shown or established.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 03 21 00 – Reinforcing Steel.

4. Section 03 31 00 – Structural Concrete

5. Section 03 40 00 – Precast Concrete

6. Section 05 12 23 – Structural Steel

7. Section 26 06 00 – Grounding and Bonding

8. Section 31 11 00 - Site Clearing.

9. Section 31 11 50 - Demolition, Cutting and Patching.

10. Section 31 20 00 - Earthwork

11. Section 32 31 13 - Chain Link Fencing and Gates

12. Section 32 90 00 - Soil Erosion, Sediment Control, Topsoiling and Seeding.

13. Section 09 96 23 – Graffiti Resistant Coating

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM A123/A123M - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. ASTM A992 – Standard Specification for Structural Steel shapes

3. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test
Specimens in the Field

4. ASTM C33 - Specification for Concrete Aggregates

5. ASTM C39/C39M - Test Method for Compressive Strength of Cylindrical Concrete Specimens

6. ASTM C150 - Specification for Portland Cement

7. ASTM D4396 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used in Nonpressure Applications

B. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code – Steel

2. AWS D1.4 - Structural Welding Code – Reinforcing Steel

1.3 SUBMITTALS

A. The contractor shall verify the existing ground elevations at the site before preparing the working drawings. The working drawings shall contain all information required for the proper construction of the system at each location including existing ground line at face of wall as verified at the site and any required revisions or additions to drainage systems or other facilities.

B. Shop Drawings: Before fabrication of piles, submit shop drawings prepared by a California registered civil engineer to the Engineer for approval. These drawings shall show the dimensions and calculations for the work and shall include complete details of the methods, materials and equipment the Contractor proposes to use. These drawings shall also show lift and support points.

1. Shop drawings shall be 11" x 17" in size, and each drawing and calculation sheet shall include the OCTA the contract number, full name of the structure as shown on the contract plans, Project stationing, and Mile-Post. The design firm's name, address, and phone number shall be shown on

the working drawings. Each sheet shall be numbered in the lower right hand corner and shall contain a blank space in the upper right hand corner for future contract sheet numbers.

C. Submit the following at least thirty (30) days prior to construction for approval:

1. Product Data

   a. Material description and installation instructions for geocomposite drain, filter fabric and PVC drain pipe.

   b. Material description and allowable strength values for timber lagging.

   c. Supply a Certificate of Compliance conforming to the provisions in the Caltrans Standard Specifications, Section 6-1.07, "Certificates of Compliance," stating the supplied material meets the respective index criteria set forth by OCTA, as measured in accordance with all test methods and standards specified in the Standard Specifications, these special provisions, and the approved working drawings.

   d. “Buy America” Certificates of Compliance.

2. Mix Designs

   a. Mix designs shall be submitted for each class of concrete on the job and shall show names and brands of all materials, proportions, 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 job shall be clearly indicated at the top of all proposed mix design sheets.

   b. Each mix design submittal, for concrete designated by strength, shall be accompanied by certified test data or trial batch test reports in accordance with the requirements of these Specifications.

3. Laboratory Test Reports

   a. Laboratory test reports shall show the name of testing agency, date of testing, types of tests performed and shall be signed by a principal of the testing agency who is a registered civil or structural engineer in the State of California. Laboratory tests shall not be older than eight months and shall certify that the test materials meet the specified standards.

   b. Laboratory test reports for concrete mix designs shall 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.

4. Soldier Pile Wall Construction Plan Submittal

   a. Provide project specific installation information including a detailed construction sequence. Submit installation details including drilling equipment and details of casing for stabilizing holes.

1.4 DELIVERY, STORAGE AND HANDLING

A. Soldier piles: Deliver, store, and handle materials in such a manner as to prevent damage. Check the materials upon delivery to assure that proper material has been received. Store above ground on wood pallets or blocking. Remove and replace damaged or otherwise unsuitable material, when so determined, from the site.

B. Identify, store and handle drain strips and fabrics in accordance with ASTM D4873. Drain strips and fabrics with defects, flaws, deterioration or damage will be rejected. Do not leave drain strips and fabrics uncovered for more than 7 days.

C. PVC Drain pipe: Deliver, store, and handle materials in such a manner as to prevent damage. Check the materials upon delivery to assure that proper material has been received. Remove and replace damaged or otherwise unsuitable material, when so determined, from the site.

1.5 QUALITY ASSURANCE

A. Contractor:

1. Qualifications of the Contractor’s Superintendent who will be responsible for pile installation must meet or exceed the minimum experience record described in the SCRRA Excavation Support Guidelines. The Superintendent's qualifications will be subject to review and acceptance by SCRRA and OCTA.
2. Level 3 Health, Safety, and Environmental Specification associated with requirements for PMB wall construction activities.

B. The Contractor must protect utilities, structures and facilities designated to be protected in place from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation and backfill operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural steel piles shall conform to the requirements of ASTM A992. Minimum yield and tensile strength of the steel shall be 50 ksi and 65 ksi respectively. Piles shall be galvanized (zinc coating) as shown on Contract Drawings. Dry film thickness of the zinc coating shall not be less than 4 mils nor more than 6 mils.

B. Timber lagging shall be pressure treated lagging with a minimum bending strength of 1000 psi, minimum shear strength of 100 psi and of the minimum nominal thickness shown on the contract plans.

C. Geocomposite drain strips centered between each pair of adjacent pile.

1. Geo-composite drain shall consist of a manufactured core not less than 0.25-inch thick nor more than 2 inches thick with one or both sides covered with a layer of filter fabric that will provide a drainage void.

2. The drain shall produce, a flow rate, through the drainage void, of at least 2.0 gallons per minute per foot width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 3,500 pounds per square foot.

3. The manufactured core shall be either a preformed grid of embossed plastic, a mat of random shapes of plastic fibers, a drainage net consisting of a uniform pattern of polymeric strands forming two sets of continuous flow channels, or a system of plastic pillars and interconnections forming a semi-rigid mat.

4. The core material and filter fabric shall be capable of maintaining the drainage void for the entire height of geo-composite drain.

5. Filter fabric shall be integrally bonded to the side of the core material with the drainage void.

6. Core material manufactured from impermeable plastic sheeting having non-connecting corrugations, shall be placed with the corrugations approximately perpendicular to the drainage collection system.

7. Filter Fabric shall be as specified in Section 88, "Geosynthetics"; of the Caltrans Standard Specifications". Provide ultraviolet (UV) protected filter fabric.

D. Pervious Backfill Material conforming to 31 20 00.

E. Structural concrete with a minimum 28-day compressive strength of 4000 psi and a slump not less than 6 inches nor more than 8 inches.

F. 2 sack sand cement slurry mix with a minimum 28-day compressive strength of 100 psi. The mix shall contain 2, 94-lbs sacks of cement per cubic yard of slurry.

G. Graffiti Resistant Coatings shall be per Specification Section 09 96 23

PART 3 - CONSTRUCTION

3.1 PRECONSTRUCTION MEETING

A. Before starting soldier pile wall construction, conduct a preconstruction meeting to discuss the construction and inspection of the soldier pile walls. Schedule this meeting after all soldier pile wall submittals have been accepted.

3.2 PILE INSTALLATION

A. Install piles in accordance with the accepted submittals and this provision. Contact the Engineer if the design pile embedment is not achieved.

B. Maximum allowable verticality tolerance for the drilled hole is 0.5% from vertical. Install piles within 1 inch (25 mm) of specified plan location. Minimum clear concrete cover to the pile from the sides of the drilled hole shall be 1 inch.

C. Piles shall be installed in drilled holes subsequently filled with concrete. Use drilling equipment of adequate capacity and capable of drilling through the various subsurface materials and conditions expected to be encountered in order to advance the drill hole. Dispose of drilling spoils in accordance with contract documents and as directed by the Engineer. Drilling spoils consist of all excavated materials including fluids removed from excavations by pumps or drilling tools. Use of a temporary casing is required to advance the drill hole. Steel casings should consist of clean watertight steel of sufficient strength to withstand handling and installation stresses and the pressures imposed by concrete, earth and backfill.

D. If ground water is encountered, maintain a water or slurry head within the casing throughout the drilling process in order to prevent entry of groundwater into the casing.

E. After the hole has reached the design tip elevation, support and center piles in excavations. Splice piles as required per details in the design drawings. Fill around piles with concrete to the elevations shown in the accepted submittals. Ensure that concrete flows completely around piles. Place concrete in a continuous manner via a tremie pipe and remove all steel casings as concrete is placed. The termie pipe at all times shall be submerged at least 6” below the concrete surface. Free fall of concrete into the drill holes shall not be permitted.

F. Drill holes installed in wall sections where excavation is required to achieve finished grades, shall be backfilled with concrete to the elevations shown in the drawings and shall be backfilled with the 2 sack cement slurry specified herein above that elevation.

3.3 BACKFILL BEHIND PILES

A. For wall sections where backfill to finished grades is required, place precast lagging between piles as shown on the design drawings and attach the geocomposite drain to the back of the lagging. Install PVC drainage pipe as shown on the design drawings. Backfill against the lagging using Pervious Backfill Material as specified in 31 20 00, to finished grades. Pervious backfill shall be placed in-between the timber and precast lagging when timber lagging is present or for a minimum width of 12 inch behind the wall when no timber lagging is present. Remainder of backfill behind the wall may be Embankment Fill as specified in 31 20 00. Lift thickness and compaction requirements shall be as in 31 20 00.

3.4 EXCAVATION IN FRONT OF PILES

A. For wall sections where excavation is required in front of the wall to meet finished grades, excavate soil after piles have been installed and concreted and concrete has gained design strength. Do not excavate more than 5 feet at a time. Place timber lagging behind the back flange of the piles to retain the exposed earth. Fill voids between lagging and soil with peagravel or grout. Upon completion of excavation, attach the geocomposite drain to the timber lagging. Install PVC drainage pipe as shown on the design drawings. Place precast lagging behind the front flange backfill the space between the timber lagging and the precast lagging with Pervious Backfill Material as specified in 31 20 00.

3.5 PROTECTION OF GALVANIZING ON PILES

A. Galvanizing on piles shall be protected during installation and backfilling operations. Damaged galvanizing shall be field repaired using zinc rich paint. Galvanizing shall be removed as required during field welding and pile splicing operations. After completion of welding, galvanizing shall be restored using field applied zinc rich paint.

3.6 PROTECTION OF THE BACKFILLED AND EXISTING SLOPES

A. Existing and backfilled slopes shall be protected as specified in the Contract Drawings.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Retaining Wall No. 1 CIDH Piles shall be measured will be measured by the unit as shown on approved schedule of values or fraction thereof furnished and complete in place, backfilled in accordance with Contract Documents and completed with insertion of the steel soldier pile and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

B. Precast Concrete Lagging (Retaining Wall No. 1) will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement

C. Cable Railing (Retaining Wall No. 1) will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

D. Concrete parapet beam shall be measured and paid under Section 03 31 00 Structural Concrete.

4.2 PAYMENT

A. Retaining Wall No. 1 CIDH Piles, Precast Concrete Lagging (Retaining Wall No. 1), and Cable Railing (Retaining Wall 1) furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

B. The contract price paid for Retaining Wall No. 1 CIDH Piles at each location shown on the plans shall include drilled holes, steel soldier piles, structural concrete backfill, and 2-sack cement slurry backfill. Geocomposite drain, PVC drain, temporary timber lagging and excavation to install lagging and backfill behind piles is considered incidental to work items in this section and no separate measurement and payment will be made for the same. No payment will be made for galvanizing of steel piles in excess of the limit indicated herein.

END OF SECTION

SECTION 32 91 00

SOIL EROSION, SEDIMENT CONTROL, TOPSOILING AND SEEDING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Soil erosion and sediment control.

2. Seeding.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 31 11 00 - Site Clearing.

3. Section 31 20 00 - Earthwork.

4. Section 33 42 00 - Culvert and Drainage Pipe.

1.02 REFERENCES

A. Erosion Control Standards: "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas" by the United Sates Department of Agriculture (USDA), Soil Conservation Service, College Park, Maryland.

B. California Stormwater Quality Association (CASQA), “BMP (Best Management Practice) Handbook Portal (www.casqa.org) – Construction”.

C. ASTM International (ASTM):

1. D586, Standard Test Method of Ash in Paper.

D. Caltrans Standard Specifications 2010.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Division 01 requirements.

B. Material test reports or certifications

C. Soil Analysis Test & Recommendations Report: Submit Two (2) copies of the results of the Agronomic Soils Report Recommendation shall be received by the Engineer a minimum of fourteen (14) days prior to amending of the soil and ordering soil amendments. Seeding Schedules: Submit anticipated seeding dates for each seed area.

1. Representative soil samples shall be taken for the disturbed slopes to receive hydroseeding and tested. Consult with the Engineer on locations and depth. Soil Analysis Testing: For each un-amended soil type, including native soil and import topsoil, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; permeability, sodium absorption ratio (SAR), electrical conductivity (ECe), boron content, the existence of possible toxic elements, deleterious material; pH; and mineral and plant-nutrient content of the soil.

2. Report shall include recommendations for soil treatments and soil amendments to be incorporated to native soil to be used for native seed mix purposes. Recommendations shall be provided for correcting pH levels to an acceptable range of 6.5 to 7.5. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd. (0.76 cu. m) for recommended quantities of soil amendments and fertilizers listed in the specifications to produce satisfactory planting soil suitable for healthy, viable plants.

3. Soil and Plant-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

1.04 QUALITY ASSURANCE

A. Certifications:

1. Association of Official Seed Analysts – Seed Laboratory Certification.

2. Society of Commercial Seed Technologists – Seed Technologist Certification.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. Submittals shall be made in accordance with Division 01 requirements.

B. Certificates:

1. Material test reports or certifications for all seed mixtures and products intended to be purchased and used for the Project shall be furnished to the Engineer for approval prior to commencing Work under this Specification.

C. Straw Bales: Twine tied.

D. Pipe Riser and Barrel: 16 gage corrugated metal pipe (CMP) of size indicated. Coating and fabrication shall be in accordance with Section 33 42 00.

E. Stone for Stone Filter: 2 inches graded gravel or crushed stone in accordance with Section 32 11 00.

F. Commercial Fertilizer:

1. Conform to requirements of the California Food and Agricultural Code.

2. Shall be in pelleted or granular form.

3. Shall have a guaranteed chemical analysis of 16 percent nitrogen, 20 percent phosphoric acid and 0 percent water soluble potash and shall contain a minimum of 12 percent sulfur or a chemical analysis as required in the plans.

G. Straw shall be derived from wheat, rice or barley.

1. Contractor must furnish evidence that clearance has been obtained from the County Agricultural Commissioner, as required by law, before straw obtained from outside the county in which it is to be used is delivered to the site of the work.

H. Mulch Fiber shall be a Bonded Fiber Matrix (BFM) consisting of a high performance flexible growth medium- composed of 100% recycled thermally refined wood fibers, crimped interlocking man-made biodegradable fibers, mineral activators, naturally derived cross-linked biopolymers and water absorbents and shall be free of other synthetic or plastic materials.

1. Fiber shall not contain more than 7 percent ash as determined by ASTM D586.

2. Fiber shall have a water-holding capacity by weight of not less than 1700 percent.

3. Fiber shall be of such character that the material will disperse into a uniform slurry when mixed with water.

4. Fiber shall be colored to contrast with the area on which the fiber is to be applied and shall not stain concrete or painted surfaces.

5. pH between 4.3 and 6.0.

6. Function longevity up to 18 months in accordance with ASTM D5338

7. Ecotoxicity of 48-hr LC50 > 100% in accordance with EPA 2021.0

8. Effluent Turbidity of 250 NTU maximum.

I. Grass Seed:

1. Provide grass seed mix in trackside ditches. When not specified in the Plans, grass seed mix shall be used per the following table:

Botanical Name	Common Name	Pounds/ Acre	Purity / Germination
Bromus Carinatus	California Brome	5.0	
Deinandra Fasciculata	Fascicled Tarplant	3.0	
Distichlis Spicata	Salt Grass	2.0	
Eriophyllum Confertiflorum	Golden Yarrow	1.0	
Nassella Cernua	Foothill Needlegrass	7.0	
Nassella Pulchra	Purple Needlegrass	7.0	
Sisyrinchium Bellum	Blue-Eyed Grass	3.0	
Trifolium Tridentatum	Tomcat Clover	1.5	
Trifolium Obtusiflorum	Clammy Clover	2.0	
TOTAL POUNDS PER ACRE		31.5	
Slurry Mix			
	Fiber- First Application (See Part 3.04 B)	500	
	Organic Soil Stabilant (Tackifier)	140	

2. When not specified in the Plans, Coastal Sage Scrub Mix shall be used per the following table:

Botanical Name	Common Name	Pounds/ Acre	Purity / Germination
Artemisia California	California Sage Brush	4	50/15
Encelia California	Bush Sunflower	3	60/40
Eschscholzia California	California Poppy	2	75/98
Lotus Scoparius	Deerweed	8	60/90
Eriogonum fasciculatum	California Buckwheat	8	65/10
Lasthenia glabrata	Goldfields	2	85/90
Lupinus Succulentus	Arroyo Lupine	4	85/90
Eriophyllum confertiflorum	Golden Yarrow	3	60/30
Salvia apiana	White Sage	4	50/70
Sisyrinchium bellum	Blue-Eyed Grass	1	75/95
Diplacus longiflorus	Monkey Flower	2	55/2
Salvia mellifera	Black Sage	4	50/70
Stipa pulchra	Purple Needlegrass	2	70/60
Bromus arizonicus	Cucamonga Brome	5	95/80
Melica california	California Melic	3	90/60
TOTAL POUNDS PER ACRE		55	
Slurry Mix			
	Fiber- First Application (See Part 3.04 B)	500	
	Organic Soil Stabilant (Tackifier)	140	

3. Seed (per seed type) shall be a minimum of 50 percent Pure Live Seed (PLS) content. PLS content is defined as the product of 1) the percentage of tested purity and 2) the percentage of tested germination of the specified seed (PLS content - % purity x % germination = 50%) unless otherwise stated. The Engineer may reduce the PLS content if the specified minimum is not available.

4. All legumes shall be inoculated with viable bacteria compatible for use with that species of seed. Contractor must furnish written statement of inoculation. The application rate for seed shall be the weight exclusive of inoculating Materials.

5. Inoculated seed shall be sown within 20 days of inoculation or shall be reinoculated. The inoculant shall be added at the rate of five times the amount recommended in the inoculant package.

6. Signed copies of vendor's statement for the seed mixture shall be supplied the Engineer for approval prior to using the seed.

    a. State botanical and common name.

    b. Place of Origin.

    c. Strain.

    d. Percentage of purity, germination.

    e. Amount of PLS per bag.

7. Each container of seed will be labeled in accordance with Federal and State Seed Laws with certification that the seed equals or exceeds requirements in these Specifications or as shown on the Plans.

J. Stabilizing Emulsion:

1. Organic Soil Stabilant shall be registered with and licensed by the State of California, Department of Food and Agriculture, as an "auxiliary soil chemical."

2. Shall be a concentrated liquid chemical that forms a plastic film upon drying and allows water and air to penetrate.

K. Water shall be free of substances harmful to growth. Provide water from a source approved prior to use.

L. Erosion Control Blanket:

1. General:

    a. Plans shall specify if the erosion control blanket will have seeds mixed with material and the type and rate of seeds to be placed in the mat.

2. Straw Mat/Blanket:

    a. The blanket shall be machine-produced mat consisting of 70 percent agricultural straw and 30 percent coconut fiber

    b. The straw and coconut fiber shall be uniformly distributed throughout the mat to a loose thickness of about 1/2 inches, plus or minus 1/8 inches.

c. The blanket shall be of consistent thickness with its straw and coconut fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with polypropylene netting having an approximate 3/4 inches x 3/4 inches mesh containing ultraviolet additives to resist breakdown for at least 90-days, and on the bottom with a polypropylene netting with an approximate 1/2 inches by 1/2 inches mesh. The blanket shall be sewn together with biodegradable thread.

d. Average dry weight shall be at least 0.70 lbs/sq. yd.

e. Minimum width shall be 6 feet.

3. Jute Matting:

a. Uniform open plain weave of unbleached, single jute yarn treated with a fire retardant chemical.

b. Yarn shall be of loosely twisted construction and not vary in thickness by more than 1/2 of its nominal diameter.

c. Furnished in rolled strips about 150 feet long, average width about 48 inches, plus or minus one (1) inch.

d. Average weight about 0.92 lbs/sq. yd., plus or minus 5 percent.

4. Excelsior Blanket:

a. Machine produced mat of wood excelsior with 80 percent of fibers being at least 6 IN long

b. Wood from which excelsior is cut shall be properly cured to achieve adequately curled and barbed fibers.

c. Blanket shall be of consistent thickness, with even distribution of fibers.

d. The blanket shall be covered on the top side with a 90-day biodegradable extruded plastic mesh netting, entwined with the blanket.

e. Minimum weight of blanket shall be 0.8 lbs/sq. yd., plus or minus 5 percent.

f. Minimum width of blanket shall be 24 inches, with rolls being about 150 feet long.

g. Blanket shall not flame or smolder for more than a distance of 12 inches from a spot where a lighted cigarette is placed on the surface of the blanket.

5. Erosion control anchors shall be as recommended by the manufacturer.

M. Wattles and Coir Logs:

1. Wattles shall consist of cylinders of biodegradable plant material such as straw, coir, compost, or wood shavings encased within biodegradable or photodegradable netting.

   a. Minimum 5 inches dia.

   b. Encasing material clean, evenly woven, free of encrusted concrete or other contaminating materials.

   c. Encasing material shall be free from cuts, tears, or weak places and shall have a life-span greater than 6 months.

   d. Fill shall be coarse compost material.

2. Coir Logs shall be 100 percent durable coconut (coir) fiber uniformly compacted with an outer netting.

   a. Log Segments shall have a maximum length of 20 feet and a diameter as shown in the plans.

   b. Logs shall have a density of 7 lbs/cu. feet or greater

   c. Logs shall be manufactured with a woven wrapping netting made of bristle coir twine with minimum strength of 80 lbs tensile strength. Netting shall have nominal 2 inches x 2 inches openings.

   d. Wood stakes as shown in the plans, shall have a notch to secure rope ties of 1/4 inches dia. commercially available hemp rope.

N. Topsoil:

1. Original surface soil typical of the area.

2. Existing topsoil stockpiled under Section 31 11 00.

3. Capable of supporting native plant growth.

O. Tolerances:

1. Finish Grading Tolerance: 0.1 feet plus/minus from required elevations

P. Silt Fence:

1. Posts:

   a. Posts must be wood or metal.

   b. Wood posts must be:

1) At least 2 X 2 inches in size and four (4) feet long.

2) Untreated fir, redwood, cedar, or pine, cut from sound timber.

3) Straight and free of loose or unsound knots and other defects that could render the posts unfit for use.

4) Pointed on the end to be driven into the ground.

c. Metal posts must:

1) Be at least 4 FT long.

2) Be made of steel.

3) Have a U-shaped, T-shaped, L-shaped, or other cross-sectional shape that can resist failure from lateral loads.

4) Be pointed on the end to be driven into the ground.

5) Weigh at least 0.75 lbs/ft.

6) Have a safety cap attached to the exposed end. The safety cap must be orange or red plastic and must fit snugly onto the metal post.

d. Do not use metal posts for a temporary large sediment barrier.

e. Posts for a temporary reinforced silt fence must be at least six (6) feet in length for a Type 1 installation and five (5) feet in length for a Type 2 installation.

f. Posts used as stakes for a temporary straw-bale barrier must be wood or metal.

2. Silt Fence Fabric:

a. When tested under the referenced ASTMs, the properties of silt fence fabric must have the values shown in the following table:

Property	Test	Value	
		Woven	Nonwoven
Grab breaking load, 1-inch grip, lb min, in each	ASTM D 4632	120	120
Apparent elongation, percent min, in each	ASTM D 4632	15	50
Water flow rate, gal per minute/sq ft min and max average roll value	ASTM D 4491	10–100	100–150
Permittivity, sec^{-1} min	ASTM D 4491	0.1	1.1

Apparent opening size, inches max average	ASTM D 4751	0.023	0.023
Ultraviolet resistance, percent min retained grab breaking load, 500	ASTM D 4355	70	70

3. Fasteners:

a. Steel staples must be a minimum of 11 gage, 6 inches, U-shaped staples with a one (1) inch crown. Provide heavier gage and greater length if required by the site conditions. You may use an alternative attachment device such as a 100 percent biodegradable fastener to install RECP instead of staples.

Q. Inlet Protection:

1. Gravel bag berm:

a. Gravel-filled bags must:

1) Be made of geosynthetic gravel-filled bag.

2) Have inside dimensions from 24 to 32 inches long and from 16 to 20 inches wide.

3) Have a bound opening to keep gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.

4) Weigh from 30 to 50 lbs when filled with gravel.

b. Gravel for gravel-filled bags must be from 3/8 to 3/4 inch DIA and must be clean and free of clay balls, organic matter, and other deleterious materials.

2. Fiber Rolls:

a. Fiber roll must have a minimum functional longevity of 1 year and comply with the following requirements:

1) Type A fiber roll must be fabricated from an erosion control blanket rolled along its width. Secure with natural fiber twine at 6 feet intervals, and 6 inch from each end. Fiber roll size must comply with either one of the following:

a) 8 to 10 inch DIA, 10 to 20 feet long, and at least 0.5 lbs./ft.

b) 10 to 12 inch DIA, at least 10 feet long, and at least 2 lbs./ft.

2) Type B fiber roll must be a premanufactured roll filled with rice or wheat straw, wood excelsior, or coconut fiber. Rolls must be covered with biodegradable jute, sisal, or coir fiber netting secured tightly at each end. Fiber roll size must comply with either one of the following:

a) 8 to 10 inch DIA, 10 to 20 feet long, and at least 1.1 lbs./ft.

b) 10 to 12 inch DIA, at least 10 feet long, and at least 3 lbs./ft.

3. Check Dams:

a. Gravel bag berm:

1) Gravel-filled bags must:

a) Be made of geosynthetic gravel-filled bag.

b) Have inside dimensions from 24 to 32 inch long and from 16 to 20 inch wide.

c) Have a bound opening to keep gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.

d) Weigh from 30 to 50 lbs. when filled with gravel.

2) Gravel for gravel-filled bags must be from 3/8 to 3/4 inch in diameter and must be clean and free of clay balls, organic matter, and other deleterious materials.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to General Stripping Topsoil and Excavating:

1. Install perimeter dikes and swales.

2. Excavate and shape sediment basins and traps.

3. Construct pipe spillways and install stone filter where required.

4. Machine compact all berms, dikes and embankments for basins and traps.

5. Install straw bales where indicated.

a. Provide two stakes per bale.

b. First stake angled toward previously installed bale to keep ends tight against each other.

6. Install wattles and coir logs where indicated or as Engineer directs, staking as required by the Plans

B. Construct sediment traps where indicated on Plans during rough grading as grading progresses.

C. Temporarily seed basin slopes and topsoil stockpiles:

1. Rate: 1/2 lb/1000 sf.

2. Reseed as required until good stand of grass is achieved.

3.02 DURING CONSTRUCTION PERIOD

A. Maintain Basins, Dikes, Traps, Stone Filters, Straw Bales:

1. Inspect regularly especially after rainstorms.

2. Repair or replace damaged or missing items.

B. After rough grading, sow or hydroseed temporary grass cover over all exposed earth areas not draining into sediment basin or trap.

C. Construct inlets as soon as possible.

1. Excavate and tightly secure straw bales completely around inlets as detailed on Plans.

D. Provide necessary swales and dikes to direct all water towards and into sediment basins and traps.

E. Do not disturb existing vegetation (grass and trees).

F. Excavate sediment out of basins and traps when capacity has been reduced by 50 percent.

1. Remove sediment from behind bales to prevent overtopping.

G. Topsoil and Fine Grade Slopes and Swales or other project areas:

1. Seed and mulch as soon as areas become ready.

3.03 NEAR COMPLETION OF CONSTRUCTION

A. Verify rough grading, finish grading and compaction are complete and accepted by Engineer.

B. Eliminate basins, dikes, traps, and other features that may cause ponding water.

C. Loosen top surface to a depth of 2 inches, removing all stones and debris over 2 inches in any dimension.

D. Spread topsoil from stockpiles or approved sources to compacted depth of 4 inches or as indicated in the Plans.

E. Provide finished surface free of stones, sticks and other material 1 inch or more in any dimension.

1. Provide finished surface smooth and true to required grades.

2. Remove all rivulets and gullies.

F. Fine grade all remaining earth areas, loosen top surface as preparation for seeding and mulching.

G. Spread and mix mulch and fertilizer in accordance with these Specifications or as required in the plans during top surface preparation for seeding and mulching.

H. Do not seed until prepared topsoil has been approved by the Engineer

1. Notify Engineer at least 24 hours before beginning any seeding operations.

3.04 SEEDING

A. General:

1. Do not seed during windy weather or excessively wet or frozen ground conditions.

2. When drought or other unsatisfactory conditions prevail, work shall be stopped when directed.

3. Upon completion of Project, a final check of total quantities of seed used will be made against total area seeded. If minimum rates of application have not been met, Contractor must be required to distribute additional quantities to make up minimum application specified.

B. Hydro Seeding:

1. Prior to seeding, provide a roughened surface on slopes such as with a sheep foot roller or land imprinter. Areas to be planted by this method shall be moistened to a depth of 6 IN but shall not be surface wet at the time of application.

2. Proportion and seed mix may be changed by the Engineer to meet field conditions.

3. Mixing of hydro seeding Materials shall be performed in a thoroughly clean tank with a built-in, continuous agitation system, which will apply the slurry to the slopes at a continuous and uniform rate.

4. A dispensing agent may be added provided the Contractor furnishes evidence that the additive is not harmful to the mixture.

5. Use the soil amendments listed below for bidding purposes only. Materials and application rates may be modified after receipt of soils tests. Amendments may be mixed and sprayed with the first application of erosion control mix.

Amendments	**Rate or Quantity/1000 SF**	
Gypsum	100	lbs.
Soil Sulfur	10	lbs.
Iron Sulfate	10	lbs.
Soil Amendment (Composted Organic)	4	cubic yards
Soil Penetrating Agent	16	oz.

6. Apply erosion control materials in separate two-part applications as shown in the following:

a. EROSION CONTROL MIX- FIRST APPLICATION

Material	**Pounds Per Acre (Slope Measurement)**
Seed	Per Seed Mix Tables in Part 2
High Performance Flexible Growth Medium (Bonded Fiber Matrix)	500
Micorrhizal Inoculum	60
Commercial Organic Fertilizer	900
Humate Organic Soil Conditioner	550
Tri-C Soluble Humate	1

b. EROSION CONTROL MIX- SECOND APPLICATION

Material High Performance	**Pounds Per Acre (Slope Measurement)**
High Performance Flexible Growth Medium (Bonded Fiber Matrix)	3000 Slopes <1V:3H
High Performance Flexible Growth Medium (Bonded Fiber Matrix)	3500 Slopes >1V:3H and <1V:2H
High Performance Flexible Growth Medium (Bonded Fiber Matrix)	4000 Slopes >1V:2H

7. The seed shall be the last item added to the slurry. Slurry shall be applied within 30 minutes after seed has been added.

   a. Mixture shall be such that an absorbent, porous mat will be formed.

8. The slurry planted areas shall be kept moist during the germination period, but puddling shall be avoided.

9. Any Materials considered harmful, as determined by the Engineer, shall not be used.

C. Power-Drawn Drills or Seeders:

1. Equipment must be certified by Contractor to place seed at the required rates in these Specifications or as shown on the Plans.

2. Method may be used for slopes flatter than 3 horizontal to 1 vertical.

3. Drills or seeders shall be run at right angles to the direction of slope.

4. Engineer will approve use of method.

D. Hand Methods:

1. Use where above methods are not practical as determined by the Engineer.

2. Method must show ability to spread seeds evenly at rates required by these Specifications or the Plans in the areas other methods not practical.

3.05 STRAW MAT/BLANKET

A. Prior to seeding and until placing the blanket, the area to be covered shall be relatively free of all rocks or clods over 1 inch in diameter and all sticks or other foreign material that will prevent the close contact of the blanket with the soil. The area shall be smooth and free of ruts or other depressions.

B. The blanket shall be installed as recommended by the manufacturer.

C. The straw mat/blanket shall be placed within 24 hours after seeding operations have been completed.

1. If straw mat/blanket contains the seeds, install as soon as practicable after final topsoil preparation has been completed and accepted by the Engineer.

D. Installing Mat or Blanket:

1. The blanket shall be laid out flat, even, and smooth without stretching or crimping the material.

2. The blanket shall be applied with the length running parallel to the flow of water.

3. The blanket edges shall be tightly butted together.

4. Staples shall be spaced not more than three feet apart in 3 rows for each strip, with a row along each edge and one row alternately spaced in the middle. All ends of the mesh shall be secured by staples spaced six inches apart across the width.

5. Immediately after the straw mat/blanket has been placed and stapled, the area covered shall be sprinkled and rolled with a light roller of sufficient weight to press the blanket into the surface of the soil.

E. Silt Fence:

1. Construct a temporary silt fence with silt fence fabric, posts, and fasteners assembled at the job site or with prefabricated silt fence.

2. If prefabricated silt fence is used, attach the fabric to the posts by inserting the posts into the sewn pockets. If assembled at the job site:

   a. Fasten the fabric to the posts with staples or nails if wood posts are used.

   b. Fasten the fabric to the posts with tie wires or locking plastic fasteners if steel posts are used.

   c. Space the fasteners not more than eight (8) inch apart.

3. Place temporary silt fence parallel with the slope contour. For any 50 feet section of temporary silt fence, do not allow the base elevation of the fence to vary by more than 1/3 of the height of the fence above the ground.

4. Install a temporary silt fence as follows:

   a. Place the bottom of the fabric in a six (6) inch deep trench.

   b. Secure it with the posts placed on the downhill side of the fabric.

   c. Backfill the trench with soil and compact by hand or mechanical methods to secure the fabric in the trench.

5. Connect sections of a temporary silt fence as follows:

   a. Join separate sections of the silt fence to form reaches not more than 500 feet long. Each section must be a continuous run from end-to-end or from an end to an opening, including joined panels.

   b. Secure the end posts of each section by wrapping the tops of the posts with at least 2 wraps of 16 gage tie wire.

6. You may install the silt fence by mechanically pushing the silt fence fabric vertically into the soil. Mechanically installed fabric must not slip out of the soil or allow sediment to pass under the fabric.

F. Inlet Protection:

1. Provide temporary drainage inlet protection around drainage inlets as changing conditions require. Drainage inlet protection must be Type 1, Type 2, Type 3A. Type 3B, Type 4A, Type 4B, Type 5, Type 6A, Type 6B, or a combination, as appropriate for conditions around the drainage inlet.

2. For drainage inlet protection at drainage inlets in paved and unpaved areas:

   a. Prevent runoff ponds from encroaching onto the traveled way or overtopping the curb or dike. Use a linear sediment barrier to redirect runoff and control ponding.

   b. Clear the area around each drainage inlet of obstructions, including rocks, clods, and debris greater than one (1) inch DIA, before installing the drainage inlet protection.

   c. Install the linear sediment barrier upslope of the existing drainage inlet and parallel with the curb, dike, or flow line to prevent sediment from entering the drainage inlet.

3. If gravel-filled bags are used for Type 3A and Type 3B temporary drainage inlet protection, place the gravel-filled bags end-to-end to eliminate gaps. Stack the bags so that the upper row overlaps joints in the lower row. Arrange the bags to create a spillway by removing 1 or more gravel-filled bags from the upper layer.

4. Place fiber rolls over the erosion control blanket for Type 4A temporary drainage inlet protection.

5. If a foam barrier is used for Type 4B temporary drainage inlet protection, secure the barrier to the pavement at the angle and spacing shown. Place the barrier to provide a tight joint with the curb or dike. Cut the cover fabric or jacket to ensure a tight fit.

6. If a rigid sediment barrier is used for Type 6A or Type 6B temporary drainage inlet protection at a grated catch basin without a curb inlet, place the barrier using a gasket to prevent runoff from flowing under the barrier. Secure the barrier to the pavement with nails and adhesive, gravel-filled bags, or a combination.

7. Install a sediment filter bag for Type 5 temporary drainage inlet protection as follows:

   a. Remove the drainage inlet grate.

b. Place the sediment filter bag in the opening.

c. Replace the grate to secure the sediment filter bag in place.

8. AUTHORITY does not pay for relocation of temporary drainage inlet protection during the course of work.

G. Fiber Rolls:

1. Before installing fiber roll remove obstructions from the ground, including rocks, clods, and debris greater than one (1) inch DIA.

2. Install fiber roll approximately parallel to the slope contour. For any 20 feet section of fiber roll, prevent the fiber roll from varying more than five (5) percent from level. Install fiber roll on slopes at the following spacing unless shown otherwise:

a. 10 feet apart for slopes steeper than 2:1 (horizontal:vertical).

b. 15 feet apart for slopes from 2:1 to 4:1 (horizontal:vertical).

c. 20 feet apart for slopes from 4:1 to 10:1 (horizontal:vertical).

d. 50 feet apart for slopes flatter than 10:1 (horizontal:vertical).

3. Type 1 fiber roll installation consists of placing and fastening as follows:

a. Place in a furrow that is from two (2) to four (4) inch deep.

b. Fasten with wood stakes every 4 feet along the length of the fiber roll.

c. Fasten the ends of the fiber roll by placing a stake 6 IN from the end of the roll.

d. Drive the stakes into the soil so that the top of the stake is less than two (2) inch above the top of the fiber roll.

4. Type 2 fiber roll installation consists of placing and fastening as follows:

a. Fasten with notched wood stakes and rope.

b. Drive stakes into the soil until the notch is even with the top of the fiber roll.

c. Lace the rope between stakes and over the fiber roll. Knot the rope at each stake.

d. Tighten the fiber roll to the surface of the slope by driving the stakes further into the soil.

5. Maintain fiber roll in a manner that provides sediment holding capacity and reduces runoff velocities as follows:

   a. Remove sediment from behind the fiber roll when sediment is 1/3 of fiber roll height above ground.

   b. Repair or adjust the fiber roll when rills or other evidence of concentrated runoff occur beneath the fiber roll.

   c. Repair or replace the fiber roll when they become split, torn, or unraveled.

   d. Add stakes when the fiber roll slumps or sags.

   e. Replace broken or split wood stakes.

   f. Remove sediment deposits, trash, and debris from fiber roll as needed or when ordered. If removed sediment is deposited within project limits, it must be stabilized and not exposed to erosion by wind or water.

H. Check Dams:

1. Before placing a temporary check dam, remove obstructions, including rocks, clods, and debris greater than one (1) inch DIA from the ground.

2. If a temporary check dam is to be placed in the same area as an erosion control blanket, install the blanket before placing the dam.

3. A temporary check dam must be:

   a. Placed approximately perpendicular to the centerline of the ditch or drainage line.

   b. Installed with sufficient spillway depth to prevent flanking of concentrated flow around the ends of the check dam.

   c. Type 2 if the ditch is lined with concrete or HMA.

   d. Type 1 or Type 2 if the ditch is unlined.

4. For a Type 1 temporary check dam:

   a. Secure the fiber rolls with rope and notched wood stakes as shown.

   b. Drive the stakes into the soil until the notch is even with the top of the fiber roll.

   c. Lace rope between the stakes and over the fiber roll. Knot the rope at each stake.

d. Tighten by driving the stakes further into the soil and forcing the fiber roll against the surface of the ditch or drainage line.

5. Place a Type 2 temporary check dam as a single layer of gravel-filled bags, placed end-to-end to eliminate gaps. If you need to increase the height of the dam, add more layers of gravel-filled bags. Stack the bags in the upper row to overlap the joints in the lower row. Stabilize the rows by adding more rows of bags in the lower layers.

3.06 ACCEPTANCE

A. Upon completion of the soil erosion and sediment control obtain Engineer's written acceptance of the work.

B. Upon completion of the topsoil and finish grading, obtain Engineer's written acceptance of the work.

C. Upon completion of the seeding, obtain Engineer's written acceptance of the work.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Temporary Grave Bag Berm, Temporary Fiber Roll, Temporary Inlet Protection, Temporary Construction Entrance, Temporary Silt Fence, and Hydroseeding w/ Bonded Fiber Matrix will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

4.02 PAYMENT

A. Temporary Grave Bag Berm, Temporary Fiber Roll, Temporary Inlet Protection, Temporary Construction Entrance, Temporary Silt Fence, and Hydroseeding w/ Bonded Fiber Matrix furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, maintenance, watering, removal and legal disposal of temporary facilities, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

B. Full compensation for temporarily placing topsoil along the top of the slopes and later spreading the topsoil over the prepared slopes shall be considered as included in the Contract price.

C. Full compensation for removing and disposing of rocks and debris from embankments constructed as part of the work shall be considered as included in the Contract prices and no additional compensation will be allowed therefore.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 33 42 00

CULVERT AND DRAINAGE PIPE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Culverts.
2. Storm drainage systems.
3. Storm drainage pipe.
4. Storm Drain Cleanouts.
5. Concrete Collars.
6. Brick and Mortar Plugs
7. Headwalls
8. Concrete Caps
9. Inlets, headwalls, flumes and flared end sections.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.
2. Section 31 11 00 - Site Clearing.
3. Section 31 11 50 - Demolition, Cutting and Patching.
4. Section 31 20 00 - Earthwork.
5. Section 31 50 00 – Excavation Support
6. Section 33 05 23 - Steel Casing.
7. Section 34 11 27 - Sub-Ballast and Aggregate Base.

8. Section 34 80 32 - Adhered Elastomeric Waterproofing for Railroad Bridges.

9. Section 03 31 00 - Structural Concrete.

10. Section 34 80 43 - Precast and Prestressed Concrete for Railroad Bridges.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M274, Steel Sheet, Aluminum Coated (Type 2), for corrugated steel pipe.

2. M252, Corrugated Polyethylene Drainage Pipe.

3. M294, Corrugated Polyethylene Pipe 1 to 5 feet Diameter.

B. ASTM International (ASTM):

1. A31, Standard Specifications for Steel, Rivets and Bars for Rivets, Pressure Vessels.

2. A48, Standard Specifications for Gray Iron Castings.

3. A164, Coating.

4. A760, Corrugated Steel Pipe, Metallic Coated for Sewers and Drains.

5. A761, Corrugated Steel Structural Plate, Zinc-Coated, for Field –Bolted Pipe, Pipe-Arches, and Arches.

6. A780, Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

7. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

8. C150, Standard Specifications for Portland Cement.

9. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.

10. C1784, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe.

11. D2729, Standard Specification for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

12. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Material.

C. AREMA Manual for Railway Engineering

1. Chapter 1, Part 4, Section 4.3 Specifications for Prefabricated Corrugated Steel Pipe and Pipe Arches for Culverts, Strom Drains, and Underdrains.

2. Chapter 1, Part 4, Section 4.5, Standard Specification for Corrugated Aluminum Alloy Pipe.

3. Chapter 1 Part 4, Section 4.6, Specifications for Corrugated Structural Steel Plate Pipe, Pipe-Arches and Arches.

4. Chapter 8, Part 10, Reinforced Concrete Culvert Pipe.

5. Chapter 8, Part 16, Design and Construction of Reinforced Concrete Box Culverts.

D. Standard Plans for Public Works Construction (SSPWC) “Green Book”, 2009.

E. Standard Specifications for Public Works Construction (SSPWC) “Green Book”, 2009.

F. SCRRA Engineering Standards:

1. ES5001, ES6340, and ES6301 through ES6310.

G. State of California Department of Transportation “Caltrans” Standard Plans and Specifications, 2010.

1.02 SUBMITTALS

A. General:

1. Submittals shall be made in accordance with Division 01 requirements.

B. Plans and Procedures:

1. Layout Plans for approval by the Engineer.

2. Schedules of work.

3. Design calculations for culverts not constructed in accordance with SCRRA Engineering Standard Plans. Structures subject to railroad loading per AREMA shall be designed in accordance with Cooper E-80 loading.

1. Calculations to be performed by a Professional Engineer licensed to practice in California.

4. Details for culverts and drainage structures and joints including Shop Drawings and installation procedures.

5. Proposed bedding test procedures.

C. Certificates:

1. Product technical data including:

1. Acknowledgement that products submitted meet requirements of standards referenced.

2. Certifications:

1. Crushed Stone Bedding Material meeting gradation requirements of Section 34 11 27.

3. Test reports:

1. Culvert and Drainage Pipe test reports from the fabricator.

4. Compaction testing in accordance with Section 31 20 00. Submit test results for density and compaction tests of culvert bedding and backfill performed by certified test laboratory hired by the Contactor and approved by the Engineer to perform and report testing.

1) Test results submittal shall be on a form approved in advance by the Engineer.

2) Test results shall be organized by culvert or drainage structure.

2. Other tests as required for cast-in-place concrete and precast concrete in accordance with Section 03 31 00 and Section 34 80 43 respectively.

5. Submit all tests and certification in a single coordinated submittal. Partial submittals will not be accepted.

D. Miscellaneous Submittals:

1. Verification documentation that Contractor requested DigAlert and SCRRA field location of underground utilities prior to starting any excavation work.

1.03 PROJECT SITE CONDITIONS

A. The Contractor shall barricade open excavations and post with warning lights those excavations occurring on property adjacent to or within public access areas and along tracks in accordance with Section 31 50 00. Operate warning lights during hours from dusk to dawn each day and as otherwise required. Warning lights shall not shine into the eyes of locomotive engineers on oncoming trains.

B. The Contractor shall protect utilities, structures and facilities designated as protect in place from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation and backfill operations in accordance with Section 31 50 00 and Division 01. Damage to utilities designed to remain must be repaired by the Contractor to the satisfaction of the Engineer in accordance with these Specifications or replaced at no cost to the Authority.

C. Contractor shall dewater excavations as necessary to allow placement and compaction of bedding material, placement of culvert or drainage structure and placement and compaction of backfill in accordance with Section 31 20 00.

1.04 ENVIRONMENTAL CONDITIONS

A. The Contractor shall protect against erosion and uncontrolled run-off within and adjacent to right-of-way in accordance with Division 01.

B. The Contractor shall obtain all permits for and legally dispose of all water from water removal operations in accordance with Division 01.

C. Cleanliness, Sweeping and Dust Control:

1. Contractor shall maintain the construction site in accordance with Division 01.

D. Contractor must provide continuous noise abatement as required.

1. Prevent disturbances and nuisances to the public, workers and occupants of adjacent premises and surrounding areas in accordance with Division 01.

1.05 REGULATORY REQUIREMENTS

A. The Contractor shall furnish any required Excavation Plans to jurisdictional authorities and obtain permits from the jurisdictional authorities as required. Refer to requirements contained in Division 01.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS OF JOINT SEALING MATERIAL

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable for joint sealing material between sections of precast reinforced concrete pipe or precast reinforce concrete box culverts when water tightness is not specified:

1. Preformed flexible pipe joint sealing compound:

1. RAM-NEK.

2. BIDCO C-56.

3. Or equal.

B. Submit request for substitution in accordance with Division 01.

2.02 MATERIALS

A. Reinforced Concrete Pipe (RCP):

1. When used for storm drainage pipe or culverts and not placed under the track.

2. Reinforced concrete culvert, storm drain and sewer pipe:

1. Pipe shall be designed in accordance with AREMA and at the minimum meet the requirements of SSPWC Section 207-2 and ASTM C76, Class V, Wall B, with a D-Load design of 3000.

2. The size, class, D-load and manufacturer for each pipe barrel throughout each pipe run shall be the same.

3. RCP Joint Sealer:

1. Rubber gasket: ASTM C361 when water tight joints indicated in the Plans.

2. Joint sealing material per Article 2.01 above for other joints of concrete pipe.

4. Flared End Sections:

1. Shall be as shown in the Plans.

5. Jointing: Same as pipe.

B. Corrugated Metal Pipe (CMP) and Structural Plate Pipe (SPP):

1. CMP and Structural Plate Pipe may be used in all culvert or storm drainage applications.

2. CMP shall be either Class 1, annular rings with riveted seams or Class 2, helical rings with lock seams or welded seams per the AREMA Manual Chapter 1, Part 4, Section 4.3 Specifications for Prefabricated Corrugated Steel Pipe and Pipe Arches for Culverts, Storm Drains, and Underdrains. In addition to these requirements, CMP culverts shall meet the following:

1. Minimum cover and gage shall be per the SCRRA Engineering Standards.

2. CMP shall be coated in accordance with AASHTO M274, Steel Sheet, Aluminum Coated (Type 2), for corrugated metal pipe.

3. CMP over 48 inches dia. shall be fabricated with a 5 percent elongation in the vertical direction.

4. CMP Class 1 Culvert Riveted Seams:

   1) CMP Class 1 culverts shall have riveted longitudinal seams with one rivet in each corrugation valley for all pipes 24 inches in diameter and smaller. Longitudinal seams shall be riveted with two rivets in each corrugation valley for all pipes larger than 24 inches. Circumferential seams shall be riveted with two rivets in each corrugation valley for all pipes larger than 24 inches. Circumferential seams shall be riveted with a maximum rivet spacing of 2 inches.

   2) CMP Class I culverts shall have all 14 gage pipe with at least 5/16 IN DIA rivets. CMP Class I culverts shall have all 12 gage and thicker pipe with at least 7/16” dia. rivets.

   3) All rivets shall be cold driven in a workmanlike manner to completely fill the hole without bending.

   4) Rivets shall conform to ASTM A31, Grade A and shall be electroplated in accordance with the Specifications of ASTM A164, Type RS.

5. CMP Class 2 Culvert Seams:

   1) Lock Seams shall be either continuous welded in accordance with ASTM A 760 or lock seams in accordance with ASTM A 760 and the AREMA Manual for Railway Engineering, Chapter 1, Part 4.5.3.6.

3. Structural Plate Pipe:

   1. Structural Plate Pipe shall meet the requirements of AREMA Manual for Railway Engineering Chapter 1, Part 4.6.

      1) Base metal shall be in accordance with ASTM A761.

      2) Structural Steel Plates shall be coated in accordance with AASHTO M274, Aluminum Coated (Type 2) for corrugated steel pipe with thickness of coating in accordance with ASTM A761.

      3) Thickness shall conform to gage shown in table contained in the SCRRA Engineering Standards.

4. Jointing and End Finish:

1. Corrugated connecting bands of same base metal, corrugations and finish coating as pipe.

2. Connection bands shall conform to Section 66-1.02D of the Caltrans Standard Specifications.

3. Thickness shall conform to gage shown in Table 2 – Round Corrugated Steel Pipe (CSP) contained on the SCRRA Engineering Standards.

4. CMP Class 2, Helical, Culvert Joints shall be made by rerolling the ends of individual pipe sections at least four corrugations from the pipe end or 14 inches to meet the connection band requirements.

5. CMP Joint Sealer when culvert is under pressure or is used in an irrigation application:

1. Cold applied asphalt joint compound.

2. Preformed flexible pipe joint sealing compound.

6. Perforated CMP shall have perforations meeting requirements of ASTM A760 for Class 1 Perforations.

7. Concrete and Reinforcement for Inlets, Headwalls, Flumes and End Sections:

1. Comply with Section 34 80 32.

2. Concrete and Reinforcement for Inlets, Headwalls, Flumes and End Sections shall conform to SCRRA Engineering Standards ES6301 through ES6310.

C. Corrugated High-Density Polyethylene Drainage Pipe:

1. Corrugated High Density Polyethylene Drainage Pipe may be used for under drains or other storm drainage not subject to railroad live loading.

1. It must be installed in a steel casing meeting requirements of Specification Section 33 05 23 and SCRRA ES5001 if placed under the track.

2. Pipe and fittings shall be a high-density polyethylene meeting ASTM D3350 minimum cell classification 325420C.

3. Sizes less than 1 foot dia. shall meet requirements of AASHTO M252, Corrugated Polyethylene Drainage Pipe.

4. Sizes 1 foot up to 5 feet in diameter shall meet requirements of AASHTO M294, Corrugated Polyethylene Pipe 1 to 5 feet dia...

D. Smooth Steel Pipe:

1. Smooth Steel Pipe may be used for all culvert or storm drainage applications.

2. Smooth Steel Pipe shall meet the requirements contained in Specification Section 33 05 23.

E. PVC Pipe:

1. PVC may be used for under drains and storm drainage applications. When subjected to railroad live loading, Schedule 80 PVC pipe shall be used.

2. PVC Pipe shall meet the requirements of ASTM D1784, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40 and 80. All fittings shall meet ASTM D2729.

3. Perforated PVC pipe shall have perforations meeting the requirements of ASTM D1784. Perforations shall be 3/8” dia.

F. Reinforced Concrete Box Culvert (Cast-in-Place or Precast) (RCB):

1. RCB may be used in all culvert or storm drainage applications.

2. Design shall be per AREMA Manual for Railway Engineering, Chapter 8, Part 16, Design and Construction of Reinforced Concrete Box Culverts.

3. Concrete and Reinforcing Steel shall meet the requirements of Section 03 31 00 for Structural Concrete, Section 34 80 43 for precast concrete and Section 03 21 00for reinforcing Steel.

4. Concrete Strength, reinforcing steel quantities and other culvert details shall be per SCRRA Engineering Standards ES6003 sheets 1-4.

G. Crushed Stone Bedding Material:

1. Crushed Stone Bedding Material shall meet the requirements of Sub-ballast contained in Section 34 11 27.

PART 3 - EXECUTION

3.01 PREPARATION

A. The site including the drainage facilities shall be prepared in accordance with Section 31 11 50 and Section 31 11 00.

B. It shall be the Contractor's responsibility to verify the actual locations (horizontal and vertical) of all utilities prior to beginning trench excavation. If utilities are to remain in place, provide protection from damage during construction operations.

3.02 HANDLING OF MATERIAL

A. Pipe, fittings and supplementary items shall be handled in such a manner as not to damage the Material. All dirt and trash shall be removed from the pipe prior to installation. Damage to the pipe, pipe lining or coating, if any, shall be repaired to the satisfaction of the Engineer in accordance with these Specifications or replaced at no additional cost to OCTA.

1. Repairs to damaged coating on CMP shall be made in accordance with ASTM A780 except the repaired area coating shall be modified for aluminum-zinc coated material.

B. Pipes or structural steel plate materials shall not be dropped to or dragged over the ground, but shall be handled with rolling slings on skids or with cranes.

C. Bent or otherwise damaged pipe Materials shall not be used.

D. Distribute pipe and other Materials along the line of Work and outside the trench as near as practical to the point of placement. Do not deposit site Materials on or against pipe.

E. Protect pipe ends until the pipe is placed in its final position.

3.03 INSTALLATION

A. Foundation Preparation

1. Excavate as necessary, prepare pipe bed pre-rolling and removing any unacceptable soil, place and compact Crushed Stone Bedding Material in accordance with the SCRRA Engineering Standards for CMP, SPP and Smooth Steel Pipe when not using jacking and boring installation methods, and SCRRA Engineering Standards ES4700 for Reinforced Concrete Box Culverts.

1. Other drainage pipes use bedding material as shown in the Plans.

2. Refer to Specification Section 31 20 00 for additional general excavation requirements.

2. The foundation shall be a smoothed and compacted surface conforming to bottom of pipe grade or camber and will hereafter be referred to as the foundation line. The foundation bed shall be free of boulders, tree stumps, cut-off piling, and other projections. Suitable camber to allow for settlement of pipe due to consolidation of embankment material will be provided when required in accordance with the SCRRA Engineering Standards. Shaping to pipe contour is not required.

3. When acceptable foundation material is present, the width of the foundation line shall be a minimum of 4 feet plus the pipe diameter or pipe-arch span. For multiple pipes the above width shall be increased by the sum of the distances between pipe or pipe-arch centers.

4. Where there is solid rock or other unsuitable material, such as boulders, or unstable material that may deform the pipe during minor settlement, at the foundation line, it will be necessary to provide suitable bedding for pipes. Such work will only be undertaken at the specified direction of the Engineer.

5. The width of excavation and bedding backfill shall be the pipe diameter or pipe-arch span in solid rock and boulders, and in other unsuitable material, the width shall be three pipe diameters or pipe-arch spans for single pipes, and for multiple pipes, this width shall be increased by the distances between pipe or pipe-arch centers.

6. Soft, spongy or otherwise unsuitable material encountered at the established and approved grade shall be removed and backfilled with granular material as directed by the Engineer in accordance with Section 31 20 00. Excavation of unsuitable soils will be made in accordance with the unit price for excavation. Payment for backfilling and compacting with suitable soils will be made at the contract unit price for embankment.

7. The Contractor must by diversion ditches, dikes, or other means, keep the foundations free of water at all times after the work is started, and until the embankment is placed over the pipe. Any channel work necessary to allow free flow through the pipe shall be completed before the embankment is placed. This work is incidental to installation of the culvert or drainage pipe.

B. Install Smooth Steel Pipe, if using jacking and boring method, in accordance with Section 33 05 23.

C. Placing Culvert or Drain Pipe:

1. General:

1. No pipe shall be laid until it has been inspected and approved. All pipes shall be laid upgrade beginning at the lower end of the line. Pipe shall be laid accurately to line and grade. Ensure that the pipe has a full solid bearing along its entire length. When pipe has been checked for line and grade, the body of the pipe shall be sufficiently backfilled and compacted in accordance with Section 31 20 00 on both sides to hold the pipe firmly in position.

2. All adjustments to line and grade of the pipe laid on earth foundation shall be done by removal or filling of the bedding under the pipe and not by blocking or wedging.

3. Where two or more pipes are used, there shall be a minimum of 3 feet, or 1/2 pipe diameter or pipe-arch span, clear distance apart, whichever is greater. Where practicable, in the opinion of the Engineer, a space of 10 feet may be provided between pipes to facilitate the compaction of fill material around the pipes with heavy equipment.

2. Placing CMP:

1. Pipe having riveted seams shall be laid with outside laps of circumferential joints pointing upstream, longitudinal laps on the sides and, when shown in the Project Plans, asphalt paving on the flow line.

2. Pipe sections shall be firmly joined together with connecting bands. All dirt or other foreign materials must be kept out from between pipe and band. Outside connecting bands should be slipped over the end of one section, and the adjoining section brought within 1 inch of the first. Band shall be made to fit snugly and equally on each pipe section and bolted to produce a tight joint. The lower half of two-piece connecting bands for pipe having riveted seams may be furnished already connected to one of the pipe sections, and in such cases the end having the fixed half band shall be placed downstream. Band couplers and ends of pipe under the bands may be lubricated with oil or solvent, which has been approved by the Engineer. Excess asphalt at joints may be removed by an application of heat, if necessary. Where corrugated pipe is to be placed in an irrigation ditch, continuous waterway or spring area, rubber gaskets shall be placed around the first re-rolled corrugation at each end of the pipe before the band is placed to keep the joint watertight.

3. At locations where the existing corrugated pipe is to be extended with new pipe, the joining end of the existing pipe shall be free of breaks, cracks or other defects. If in the judgment of the Engineer the end of the existing corrugated pipe is not suitable for making a proper joint, the Contractor must, as directed by the Engineer, remove or trim the amount of pipe necessary to allow making of an approved joint. Such removal and trimming will be considered incidental to the cost of the pipe and no direct payment will be made therefore.

4. Pipe-arches shall not be strutted.

5. Identification tag, supplied by manufacturer, shall be attached near top of and inside of pipe at upstream end.

6. Field strutting of corrugated pipe:

   1) When the distance from base of rail to the top of pipe will be less than the dimensions given in Table 1, corrugated pipes must be field strutted by the Contractor using Contractor supplied material.

TABLE 1

CMP Pipe Diameter - Inches	Base of Tie to Top of Pipe - Feet
48	3.5
54 to 66, incl.	4.0
72 to 96, incl.	4.5
102 to 108, incl.	5.0
114 to 120, incl.	5.5

7. Struts shall be placed after embankment is compacted to top of corrugated pipe but before any embankment is placed over the pipe. No equipment shall pass over the corrugated pipe until struts are in place and 3 feet of embankment is in place over the pipe.

8. Struts shall consist of 6 by 6 inches longitudinal timbers at the invert and top of corrugated pipe separated by 6 by 6 inches timber posts at 3 feet centers. Struts shall be shimmed tight using hard wood wedges nailed securely in position. Placement of struts shall be limited to the portion of corrugated pipe located within 12 feet of centerline of tracks.

9. Unless otherwise directed by the Engineer, struts shall be left in place until track laying is completed after which the struts shall be removed.

10. The furnishing and placing of field strutting material shall be considered incidental to pipe placement.

11. Reinforced Concrete Pipe.

12. Installation shall be in accordance with AREMA Manual For Railway Engineering Chapter 8, Part 10.4, Installation.

13. Gaskets out of position or loaded with dirt or other foreign material shall be removed, cleaned, and replaced before the joint is made.

3. Polyethylene and PVC Pipe:

1. Install in accordance with the manufacturer's written recommendations and as shown in the Plans.

4. Structural Plate Pipe:

1. Structural plate pipe shall be erected at the site, in accordance with detailed plans or instructions of the Engineer.

2. Where two or more structural plate pipes are used, they shall be a minimum of 1/2 pipe diameter or one-third of pipe-arch span apart. Where practicable, in the opinion of the Engineer, a space of 10 feet may be provided between pipes to facilitate compacting fill material around the pipe with heavy equipment.

3. Structural plate pipes may be made up of corrugated plates of variable gages. The invert plate may be two gages heavier than the plates for the sides and top of the pipe section, and heavier gage plates may be used in the center sections than at the end sections of the pipe. An erection diagram will be provided and must be followed without exception.

4. Strutting of structural plate pipe, if required, shall be as shown in the Installation Procedures or Erection Diagram.

5. Structural plate pipes are to be assembled at the site with as few bolts as possible until all plates are in place. Three or four untightened bolts near the center of each plate along the longitudinal and circumferential seams are sufficient, and after several rings have been assembled the remaining bolts can be inserted, the corner bolts being the last. Bolts are to be tightened progressively from one end of the structure to the other after assembly has been completed, and shall be check-tightened in the same manner to be sure none is left loose. All bolts shall be tightened with proper tools, either hand or power wrenches, initially to a minimum of 100 ft-lbs. and a maximum of 300 ft-lbs of torque. After backfilling is complete, bolts are to be checked for tightness and re-tightened if no longer torqued within these parameters.

6. Where heavy camber is necessary, erection procedures may be modified, but only as specifically approved by the Engineer for each such case.

7. At locations where the existing structural plate pipe is to be extended with new plates, the joining end of the existing pipe shall be free of breaks, cracks or other defects. The Contractor must remove any existing damaged and beveled plates so that extension can be made using standard plates. Such removal will be considered incidental to the cost of the pipe, and no direct payment will be made therefore.

8. Identification tag, supplied by manufacturer, shall be attached near top of and inside of pipe at upstream end.

9. End plates must be removed and remaining plates and bolts inspected for reuse by the contractor prior to ordering the extension culvert material. Existing bolt holes shall be reused for the extension connection.

10. In stock and vehicular underpasses which are to receive concrete invert paving, the area to be covered by concrete shall be clean and dry. Wire mesh reinforcement may be tack welded to bolts.

D. Backfill and Embankment:

1. General:

1. When the pipe foundation line is below natural ground, compacted backfill, placed in accordance with Specification 31 20 00 shall be placed around the pipe in the area within the limits of the embankment section which was removed as channel excavation. The upper limit of this backfill shall be the top of pipe elevation or the elevation of natural ground surface as it existed before any excavation was made, whichever is lower.

2. Embankment above natural ground shall be placed in accordance with Specification 31 20 00. When the upper limit of backfill is the top of pipe elevation, three (3) feet depth of material shall be placed above the pipe without compaction. This material shall be compacted in accordance with Section 31 20 00 at the time the roadbed receives its final finish.

2. Placing and Compacting Backfill and Embankment:

1. The placing of embankment around pipes is to be started with the approval of the Engineer only after assembly and erection work has been completed in every detail. Embankment material to be placed around pipe must be approved by the Engineer in accordance with Section 31 20 00.

2. Embankment under the haunches, along each side for a minimum width equal to the pipe diameter, and over the pipe is to receive special handling both as to placing and as to compaction. Except as modified by the provisions of Section 31 20 00, embankment shall be hand tamped directly under the haunches throughout the width beyond the reach of machine compacting equipment.

3. All material, except that noted to be left non-compacted until the roadbed is completed on top of the culvert, shall be compacted to the full amount required by Section 31 20 00. Compaction methods and equipment shall be approved in advance by OCTA.

4. If the Engineer permits the clear distance between multiple pipes, or the clear distance between pipe and cut face, to be less than 3 feet, lean concrete slurry shall be used to fill under the haunches and to a minimum depth of the spring lines of the pipe installation. The concrete slurry mix shall be approved by the Engineer. Care shall be taken to ensure that the concrete slurry does not float the pipes above their intended elevation.

5. The embankment directly above the pipe for a distance of one-third pipe diameter, but not less than 3 feet is to be placed without compaction.

6. Where the distance from subgrade to top of pipe is less than 3 feet, the excess material shall be left in place until the roadbed receives its final finish. At this time the material over the pipe to a depth of 1 foot below subgrade elevation shall be compacted to the full amount required by Section 31 20 00.

7. Care must be taken to prevent water form leaking through the fill or along the side of the pipe. When granular materials have been used for bedding or backfill, the ends of such material must be sealed against infiltration. This can be done by using impervious embankment material for 3 feet at both ends of the pipe.

E. Headwalls and Connection Structures:

1. Reinforced concrete headwalls and connection structures shall be constructed in accordance with the details indicated on the Contract Plans and the appropriate SCRRA Engineering Standards, ES6301 through ES6310 for the type of culvert or drain pipe placed and Section 03 31 00.

2. Prefabricated concrete or steel headwalls shall be constructed in accordance with the details indicated on the Contract Plans and in accordance with the manufacturer’s instructions for the products called out thereon.

3. Seal all joints at headwalls and connection structures to ensure water tightness.

F. Installation Finalization:

1. The Contractor must remove all waste materials, including unacceptable excavated material, trash, and debris from the worksite and legally dispose of it off site at no additional cost to OCTA.

2. At the conclusion of the Work, the Contractor must thoroughly clean the entire length of all the installed, extended or modified culvert by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material, which may have entered the culvert during the construction period. Debris cleaned from the lines shall be removed from the Worksite. If there are any remaining obstructions after such cleaning, such obstructions must be physically removed by the Contractor.

3. Contractor must provide Engineer 48 hours advance notice to perform final inspection and acceptance of culvert installation.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Culvert Pipe will be measured by the type and size of the pipe, and the unit or fraction thereof furnished and installed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved Schedule of Values, as applicable, as derived from the plans will be used as the basis for this measurement.

B. All material, work and services furnished for excavation and backfill, structural fill, crushed aggregate bedding material, structural concrete, Concrete for connection structures between existing and new culverts and headwalls and precast concrete will be included in this Section and are considered incidental to work under this Section and will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer.

4.02 PAYMENT

A. Culvert and drain pipe furnished and installed in accordance with the Contract Documents will be paid for at the contract unit price for each type and size of pipe, as listed on the Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals necessary for culvert and drain pipe described by the Contract Documents.

B. Full compensation for excavation and backfill, structural fill, crushed aggregate bedding material, structural concrete, Concrete for connection structures between existing and new culverts and headwalls and precast concrete shall be considered as included as listed on the Schedule of Quantities and Prices.

END OF SECTION

SECTION 33 46 00

UNDERDRAINS

PART 1 - GENERAL

1.01 SUMMARY

A. The Work in this Section consists of furnishing all labor, materials and equipment necessary and incidental to providing underdrains, and subsurface drainage Materials behind foundations, piers, retaining walls and along track bed. The Work includes connecting system to existing or new storm drains as indicated on the Contract Plans.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 31 20 00 - Earthwork.

4. Section 31 50 00 - Excavation Support and Protection.

5. Section 34 80 23 - Subdrainage System for Railroad Bridges and Retaining Walls.

6. Section 33 42 00 - Culvert and Drainage Pipe

1.02 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA) – Manual for Railway Engineering.

B. American Association of State Highway and Transportation Officials (AASHTO)

1. M294 Corrugated Polyethylene Pipe

C. ASTM International (ASTM)

1. D2323 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

D. Caltrans: State of California Department of Transportation Standard Plans and Specifications, 2010 Sections 19, 51, 68, and 88.

E. Standard Plans for public Works Construction (SSPWC) “Green Book”, 2012.

F. SCRRA: Engineering Standards.

1.03 DEFINITIONS

A. The term “underdrain” pipe is in reference to any perforated plastic underdrain pipe as indicated in the Contract Plans.

B. The term “plastic” as it relates to pipe and fittings is in reference to high-density polyethylene (HDPE) or polyvinyl chloride (PVC).

C. The term “permeable rock” as it relates to bedding is in reference to Aggregate Base Material as indicated in the Materials section of this Specification.

D. The term “ballast” rock as it relates to bedding of underdrain pipe is in reference to ballast material as indicated in Part 2 of Section 31 11 26 of the Standard Specifications.

1.04 SYSTEM DESCRIPTION

A. Underdrain: Underdrain shall consist of furnishing and placing under-drain pipe adjacent to the tracks as detailed on the Contract Plans.

B. Permeable Backfill Material: Permeable backfill Material shall consist of furnishing and placing permeable backfill material around underdrains in accordance with details shown on the Contract Plans and this Section.

C. Trenching and Backfilling for the underdrain as shown on the Contract Plans or other Referenced Standard.

1.05 SUBMITTALS

A. Submit, under the provisions of Division 01 the following information:

1. Submit Product Data, certifications and samples for each Material used in this Section. Samples of permeable rock shall be no less than 150 lbs and shall be accompanied with Supplier’s certified test data.

PART 2 - PRODUCTS

2.01 BEDDING MATERIALS

A. Sand bedding shall conform to Caltrans Section 19-3.025B.

2.02 PERFORATED AND SOLID DRAIN PIPE

A. Underdrain pipe material shall be in accordance with Section 33 42 00, unless otherwise noted. Allowable underdrain materials are as follows.

B. Plastic Pipe: Plastic, corrugated, smooth interior to conform to AASHTO Designation M252 (HDPE), OR M294 (HDPE) Type S with Class1 perforations or M304 (PVC). Plastic pipe shall be designed for rail live loading PVC underdrains shall be Schedule 80 PVC pipe. HDPE pipe used within 20 feet of track and subject to rail loading shall be designed in accordance with Cooper E-80 loading

C. Corrugated metal pipe: Polymeric Coated Corrugated Galvanized Steel Pipe conforming to AREMA Manual, Volume 1, Chapter 1, Section 4.4.2. Perforations, where indicated, shall be per Chapter 1, Section 4.3.3.2 of the AREMA manual.

2.03 OUTLETS, RISERS, FITTINGS AND CLEANOUTS

A. Outlets, risers, fittings, and cleanouts shall be of the same materials as the perforated pipe and shall be supplied from the same manufacturer. Riser cover shall be as detailed on the Contract Drawing.

2.04 GEOTEXTILE

A. Geotextile shall conform to Caltrans Standard Specifications Section 88-1.03.

2.05 PERMEABLE BACKFILL

A. Permeable rock backfill material shall be Class 1Type B in accordance with Caltrans Standard Specifications Section 68-2.02F.

PART 3 - EXECUTION

3.01 PREPARATION

A. Preparation of site for the installation of underdrains shall be in accordance to Part 3.01 of Section 33 42 00 of these Specifications.

3.02 HANDLING OF MATERIAL

A. Handling of underdrain materials shall be in accordance to Part 3.02 of Section 33 42 00 of these Specifications.

3.03 EXCAVATION AND EXCAVATION SUPPORT

Excavation and excavation support shall be in accordance with Section 31 50 00 and Section 31 20 00.

A. Subgrade for drainage installation shall be free of rock, rubble, debris, or stones larger than 1.5 inches. If this condition is present, excavate an additional 4 inches, and place 4 inches of sand bedding material at no additional cost to OCTA.

3.04 UNDERDRAIN INSTALLATION

A. Place the filter fabric as indicated. Place the long axis of the fabric parallel with long axis of the pipe. Filter fabric sections shall be overlapped a minimum of 12 inches.

B. Place 6 inches of permeable rock on the filter fabric. Grade the rock to the line and grade indicated for the perforated drainpipe.

C. Install aggregate filter material above the bottom of the trench and below the pipe to the depths as indicated on the Contract Plans. The depth aggregate filter material above and around the pipe shall also be as indicated on the Contract plans.

D. Installation of ballast material as for bedding material should be per the limits as shown in the Contract Plans.

E. Place the perforated or slotted drain pipe with the perforations or slots facing down in a semi-circular seat prepared in the permeable rock. Connect sections of pipe in accordance with the manufacturer’s instructions.

F. Continue placing permeable rock in 4 inches layers under the sides and to the spring line of the pipe. Tamp material to provide thorough compaction under and on each side of the pipe. Successive layers of permeable rock may be placed in 8 inches layers and thoroughly compacted to the indicated depth shown on the Contract Plans. Exercise caution not to damage the filter fabric. Torn or punctured areas of filter fabric shall be repaired by placing a piece of fabric that is large enough to cover the damaged area plus 12 inches of overlap on all sides.

G. Complete permeable rock backfill as indicated and close the filter fabric at the top of this backfill with 12 inches lap per the detail shown on the Contract Drawing.

H. Place and compact structural backfill or ballast backfill where indicated in accordance with Section 31 20 00. Exercise caution not to damage the filter fabric and sheet drain material.

3.05 PIPE CLEANING

A. At the conclusion of the work, the Contractor shall thoroughly clean all the installed pipe lines by flushing with water or other means to remove all dirt, stones, and pieces of wood or other material which may have entered the pipe line during the construction period. Contractor shall install traps, basins, or other provisions at the drainage outfall to comply with environmental regulations. Debris cleaned from the lines shall be removed from the job site. If after this cleaning any obstructions remain, they shall be removed by the Contractor.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Underdrains will be measured by the individual unit furnished and installed in accordance with the Contract Documents and as measured by the Engineer. The quantities for each item included in the Schedule of Quantities and Prices or approved Schedule of Values as derived from the Contract Plans will be used as the basis for this measurement.

B. Underdrain connections and cleanout risers are incidental to the items listed above and will not be measured separately for payment.

4.02 PAYMENT

A. Underdrains constructed in accordance with the Contract Documents shall be paid for at the contract unit price as listed in the Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, materials, tools, equipment, supplies, supervision, fittings, trenching and backfilling, permeable material, geotextile fabric, cleanout risers, and incidentals necessary for all underdrains described by the Contract Documents.

B. Underdrain connections are incidental to the items listed above and will be included in prices of the underdrain pipe listed above.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 34 11 10

CONTINUOUS WELDED RAIL (CWR)

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for the Continuous Welded Rail (CWR) to be furnished in accordance with Contract Documents or required by the Engineer.

1.02 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering

2. Portfolio of Trackwork Plans

3. Specifications for Special Trackwork

B. Association of American Railroads (AAR)

1. AAR: Manual of Standards and Rec. Practices

2. AAR Section J: Quality Assurance M-1003

C. American Society for Testing and Materials (ASTM):

1. ASTM E10: Test Method for Brinell Hardness of Metallic Materials

2. ASTM E94: Recommended Practice for Radiographic Testing

3. ASTM E164: Standard Practice for Ultrasonic Contact Examination of Weldments

D. American Welding Society (AWS):

1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications

2. AWS D1.1: Structural Welding Code

E. SCRRA: Engineering Standards.

1.03 DEFINITIONS

A. Detail Fractures – A progressive fracture originating near the rail surface from a shell or head check

B. Rail Wear – The change in shape of the cross-sectional area of the rail head due to the passage of rail traffic and grinding

C. Shelling – A rail condition consisting of one or more horizontal separation that may originate in the rail head and may crack out at the gage side of the rail. Shelling normally originates towards the gage side of the rail head and extends longitudinally

D. Spalling – A rail surface condition that is the direct result of micro-cracking, often with material separating from the surface of the rail head.

1.04 SUBMITTALS

A. The Vendor shall submit supporting information within 60 days of award documenting the past successful performance in furnishing the materials included in the Schedule of Quantities and Prices. Provide references and contact numbers at the railroads where the CWR have been placed in service.

B. The Vendor shall submit data documenting past performance and projects within the last ten (10) years furnishing CWR to Class 1 Freight, passenger or commuter railroads.

C. The Vendor shall submit for OCTA's review and approval quality control and quality assurance plans and related certifications such as ISO 9001, "six sigma" or equivalent demonstrating that the Vendor has the processes, personnel and systems to produce high quality CWR included in the Schedule of Quantities and Prices.

D. The Vendor shall submit certification that materials delivered to site are in conformance with specifications. For CWR, include weld test results. Include all material testing results and submittals stipulated in the AREMA Manual.

E. The Vendor shall submit "Buy America" Certificates of Compliance.

F. Prior to the start of welding, submit a schedule of lengths of CWR strings to be fabricated and the location of each string in the delivery train.

G. The Vendor shall submit drawings and specifications of the proposed equipment, materials, methods and procedures to be used for the electric flash butt welding process for joining of rail. Include layouts of the welding line showing locations of welding components.

H. The Vendor shall submit procedure for transportation of CWR to site, unloading and handling.

I. The Vendor shall submit qualifications of welding supervisor demonstrating flash butt welding experience of no less than three years.

1.05 QUALITY ASSURANCE

A. Vendor's Quality Control Program (QCP) shall be in accordance with the AAR M-1003 or OCTA approved equivalent quality control program. Comply with AREMA Portfolio of Trackwork Plans.

B. Equipment used for the manufacturing materials shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be certified and traceable to national standards such as the National Institute of Standards and Technology.

C. Testing and inspection of CWR manufacture shall be performed by Vendor in conformance with AREMA Manual.

D. Material not meeting the requirements of this Specification shall not be used.

E. OCTA shall have access to Vendor's plant during normal working hours and all Project related procurement and production records for inspection any time during the Contract period of performance.

1.06 DELIVERY, STORAGE AND HANDLING

A. The Vendor shall load, transport, and deliver CWR in a manner which will prevent damage to the CWR. Vendor shall submit to OCTA the procedures and equipment information for loading, unloading, handling, and storing rail.

B. OCTA will review the Vendor's methods and procedures for unloading and handling continuous welded rail.

PART 2 – PRODUCTS

2.01 CWR

A. Rail shall be new 136 RE CWR (continuous welded rail) Head Hardened rail conforming to AREMA Volume 1, Chapter 4, Section 2.1, Specifications for Steel Rails. The rail shall be controlled cooled low alloy high strength rail, Grade HH (Head Hardened) or LH (Low Alloy Head Hardened) and shall meet or exceed 370 HB (Brinell Hardness).

B. If the Vendor furnished CWR are in sections of strings, CWR shall be manufactured on-site by welding rail sections in nominal 80 feet length into 1,400 feet strings.

2.02 SOURCE QUALITY CONTROL

A. Rail and welds shall be ultrasonically tested as per AREMA Section 2.1 8.

B. Surface and internal hardness shall be determined as per AREMA Section 2.1.3.

C. Perform ultrasonic testing on all welds in accordance with ASTM E164.

D. For fabrication of CWR, flash butt production welds shall be tested by an inspection agency approved by the OCTA during the fabrication process using the dry powder method of magnetic particle inspection (or ultrasonic method) in accordance with ASTM E709 and the AREMA Manual of Railway Engineering, Chapter 4.

2.03 SPECIFICATIONS, SECTION, AND STANDARDS

A. Unless otherwise shown on the drawings or listed in the Schedule of Quantities and Prices, rail shall conform to the 136 RE section shown on SCRRA Engineering Standard ES 2301**.**

2.04 MANUFACTURE

A. Melting and Casting:

The steel for rails shall be made by purifying molten iron from the blast furnace (plus any added scrap steel) using the Basic Oxygen Steelmaking process, or by melting scrap steel using the Electric Arc Furnace Steelmaking process. The resulting molten steel from either process shall be cast into strands by a continuous casting process. Strands shall be cut into blooms of an appropriate length for further processing and rolling.

B. Hydrogen Elimination:

1. The rail shall be free from shatter cracks and other inclusions caused by hydrogen. Hydrogen elimination shall be accomplished by at least one of the following processes:

    a. Control Cooling of Rails (CC)
    b. Control Cooling of Blooms (BC)
    c. Vacuum Treated (VT)

2. Other processes (OP) for hydrogen and inclusion elimination in steel shall be accepted in the production of steel rail, and be approved by OCTA.

3. When controlled cooling of rails is used for elimination of hydrogen, all rails shall be cooled on the hot beds or runways until full transformation is accomplished and then charged immediately into insulated cooling containers. In no case should the rail be charged into the containers at a temperature below 725 degrees F. The temperature of the rails before charging shall be determined at the head of the rail at least 12 inches from the end of the rail.

4. A cover shall be placed on the container immediately after completion of the charge and shall remain in place for at least 10 hours. The container shall be so protected and insulated that the control temperature shall not drop below 300 degrees F in 7 hours for rails 100 lbs. per yd. in weight or

heavier from the time the bottom tier is placed in the container and 5 hours for rails of less than 100 lbs. per yd. in weight. The control temperature shall be established by measuring and recording the temperature of an outside rail or between an outside rail and the adjacent rail in the bottom tier of the container, at a location not less than 12 inches but not more than 36 inches from the rail end.

5. If the above cooling requirement is not met, the rails may be considered control-cooled, provided that the temperature at a location not less than 12 inches from the end of a rail at approximately the center of the middle tier does not drop below 300 degrees F in less than 15 hours.

6. After removal or raising of the lid of the container, no rail shall be removed until the temperature of the top layer of rails has fallen to 300 degrees F or lower. The manufacturer shall maintain a complete record of the cooling process for each container of rails.

2.05 CHEMICAL AND MATERIAL PROPERTIES

A. Chemical Composition:

The chemical composition of a rail steel grade must be within the limits given in **Table 1** for standard chemistry rail steel. Rail steel with a high carbon content in a range from 0.9 to 1.1 percent by weight and chemistry similar to that disclosed in United States Patent No. 7,288,159 is also acceptable provided that rail rolled this specification has been in successful use for more than five years by a Class I railroad operating in North America.

Table 1: Product and Chemical Analysis Table for Standard Chemistry Rail Steel

Elements	Notes	Chemical Analysis Weight Percent		Product Analysis, Weight Percent Allowance Beyond Limits of Specified Chemical Analysis	
		Minimum	Maximum	Under Minimum	Under Maximum
Carbon	1	0.740	0.860	0.040	0.040
Manganese		0.750	1.250	0.060	0.060
Phosphorus	2		0.020		0.008
Sulfur	3		0.020		0.008
Silicon		0.100	0.600	0.020	0.050
Nickel			0.250		
Chromium	1		0.300		
Molybdenum	1		0.060		
Vanadium			0.010		
Aluminum			0.010		
Other	4				
Note 1: The chemical composition of head-hardened rails will be subject to the requirements of standard strength rails Any alteration of the chemical composition may require modification of welding procedures.					

Note 2: Up to 5% of the order may exceed 0.020, but in no case may the phosphorus exceed 0.025
Note 3: Up to 5% of the order may exceed 0.020, but in no case may the sulfur exceed 0.025.
Note 4: Additional elements may be included in the chemistry and the chemical analysis when agreed upon by the purchaser and supplier.

B. Surface Hardness:

Rails furnished shall be high strength or high carbon pearlite. The minimum Brinell hardness of the surface shall be within the limits found in **Table 2**.

Table 2 – Rail Hardness Table for Standard Chemistry Rail Steel

Type of Rail	**Minimum Surface Brinell Hardness, HB**
High Strength Rail	370
High Carbon Pearlite (Patent No. 7,288,159)	390
Note 3: If 410 HB is exceeded, the microstructure through the head shall be examined at 100X or higher for confirmation of a fully pearlitic microstructure in the head.	
Note 4: No untampered martensite shall be present within the rail.	

A fully pearlitic microstructure shall be maintained in the head of the rail for all ranges of rail chemistry and no un-tempered martensite may be present within the rail at any point of the rail section.

C. Tensile Properties:

The tensile properties of rails shall be produced within the limits found in Table 3 for a particular grade of rail steel.

Table 3 – Tensile Properties Table for Standard Chemistry Rail Steel

Description	**High-Strength**	**High Carbon Pearlite (United States Patent No. 7,288,159**
Minimum Yield Strength	120,000 psi	120,000 psi.
Minimum Tensile Strength	171,000 psi	174,000 psi
Minimum Elongation in 2 in.	10% [1]	10%
Note 1: Up to 5% of the order may be less than 10% elongation for high-strength rail, but in no case may the elongation be less than 9%		

2.06 ROLLING, CUTTING, AND PREPARING RAIL ENDS

A. Rolling:

The length of rails for welding into CWR strings shall be not less than 80 feet when corrected to a temperature of 60 degrees F. Not more than 10 percent of standard length rail of the total tonnage accepted from each individual rolling may be comprised of shorter lengths corresponding to 78, 74, 70, 66, 60, or 39 feet.

Individual rails not welded into CWR strings as part of the purchase shall be furnished to the length shown on the Schedule of Quantities and Prices. The allowance for 10 percent shorter lengths will not apply to individual rails ordered to a specific length.

B. Straightening:

Rails shall be straightened cold in a press or roller machine to remove twists, waves and kinks until they meet the surface and line requirements within the tolerances specified.

C. Drilling:

Rails to be welded into CWR strings shall be furnished undrilled (blank). Individual rails not welded into CWR strings shall be furnished undrilled but chamfered and finished on both ends in accordance with SCRRA Engineering Standard No. ES 2301.

2.07 IDENTIFYING RAIL LENGTH AND TYPE

A. Rails shall be marked to identify the length and grade with colored paint or other identifying markings. Individual rails shall be paint-marked only one color according to grade or length. High-strength rails shall be marked by either a metal plate permanently attached to the neutral axis, hot stamped in the web, or rolled in the brand. The marking shall give the manufacturer, type, and method of treatment.

B. Heat treated rail shall be paint-marked orange. Alloy rail shall be paint-marked aluminum color. Short rails (less than 80) feet) shall be paint-marked green. Rails meeting the tolerances for Special Trackwork shall be paint-marked white. The length of each rail shall be painted at the end of the rails in accordance with the standard practices of the manufacturer.

C. Rails not meeting the requirements of this specification but acceptable under another specification for use in low speed industry tracks shall be paint-marked yellow. Industrial quality rails shall also be permanently identified by cutting diagonally through every “RE” or other designation within the rolled branding of the rail. Each designation brand shall be ground or milled diagonally from the top right-hand corner to the bottom left-hand corner, a minimum of 1/4” in width and to within 0.010” of the parent rail web surface.

D. Rail Branding:

Branding shall be rolled in raised characters on the side of the web of each rail at a minimum of every 16 feet. The design of the letters and numerals shall be

determined by the manufacturer. The data and order of arrangement of the branding shall be as shown in the following typical brand:

136	RE	Manufacturer	2003	III or 3
(Weight)	(Section)	(Mill Brand)	(Year Rolled)	(Month Rolled)

The method of Hydrogen Elimination shall be located in the brand when a Hydrogen Elimination method other than Vacuum Treated (VT) is used.

E. Rail Stamping:

1. The web of each rail shall be hot stamped a minimum of 3 times per rail (short rails must contain a minimum of one full stamp) on the side opposite the brand, except that stamping shall not occur within 2 feet of either end of rails.

2. Rails from continuous cast blooms shall be identified by a designation for heat number, strand number, and bloom number. The rail shall be identified by an alphabetical designation beginning with “P”, and succeeding “S”, “T”, “U”, etc., consecutively, or any other identification of the position of the rail within the cast, as agreed between the purchaser and manufacturer.

3. The data shall be shown in the following typical stamping, except that strand and bloom numbers may be joined or may be coded at the manufacturer’s option. The height of the letters and numerals shall be 5/8 inch.

Table 4 – Example Stamping Markings

	Stamping Markings				
	SS, HH, LA, IH or LH	297165	PSTU	12	BC
Description	Rail Type SS = Standard Strength HH = Head Hardened LA = Low Alloy Standard Strength IH = Low Alloy Intermediate LH = Low Alloy Head Hardened	Heat Number	Rail Letter	Strand and Bloom Number	Method of Hydrogen Elimination, if indicated in stamping

4. The 5/8 inch stamped characters shall have a flat or radius face (0.040 inch to 0.060 inch wide) with bevels on each side so as not to produce metallurgical stress risers. The letters and numbers shall be rotated to a 10 degree angle from vertical and shall have rounded corners. No sharp corners are permitted. The stamping shall be between 0.020 inch and 0.060 inch in depth along the center of the web. The design shall be as shown in **Figure 1**.

Figure 1 – Design of Special Letters and Numbers for Rail Stamps

2.08 RAIL MANUFACTURE TESTING

A. Chemistry Testing:

1. Steel from each heat must be tested to ensure that the chemistry of the finished rail conforms to the limits shown in **Table 1**, or the limits for any permitted alternative chemistry rail steel. Separate analyses shall be made from test samples representing the front, middle (optional), and back of the heat taken during pouring of the heat. Determination of the chemical composition may be made chemically or spectrographically. Any portion of the heat meeting the chemical analysis requirements of **Table 1** (below) may be applied.

2. Upon request by the purchaser, samples shall be furnished to verify the analysis. The analysis, most representative of the heat (clear of the transition zone for continuous cast steel), shall be recorded as the official heat analysis, but the purchaser shall have access to all chemical analysis determinations.

3. Rail heats shall be tested for hydrogen content using a sampling/analytical method or a direct measurement method. The testing shall be performed during the continuous casting process. Hydrogen content shall be recorded and available for review or reporting at the request of the purchaser. The producer shall define the method used to determine hydrogen content, which of the following methods are used for

hydrogen removal, and present evidence of applicable procedures used to control the final rail hydrogen.

a. Vacuum Degassing.
b. Bloom Controlled Cooling.
c. Rail Controlled Cooling.

4. Product analysis limits may be applied only in testing for chemical composition after the rail manufacturing process is completed and will not supersede chemical composition limits done for the same heats when the steel is in the molten state.

B. Tensile Strength Testing:

1. One longitudinal tension test specimen shall be taken from the gage corner of the rail head, centered ½ inch from the gage side and ½ inch from the running surface. The specimen shall be 0.5 inch diameter and shall be tested per ASTM A370, “Standard Test Methods and Definitions for Mechanical Testing of Steel Products.”

2. If any test specimen fails because of a malfunction of the test equipment or a flaw in the specimen, it shall be discarded and another one taken. If a test specimen fails to meet the required tensile properties, two additional test specimens shall be cut from rails from the same lot and tested. If both meet the requirements, the lot shall be accepted. If one of the tests fails to meet the requirements, two additional rails from the lot shall be sampled and tested. Both of the tests must be satisfactory for the lot to be accepted. If one of these tests is unsatisfactory, each individual rail may be sampled and tested for acceptance. If the results for off-line head hardened rail fail to meet the requirements, the rails represented by the test may be re-treated and re-tested.

3. Except for high-strength rail, the test frequency shall be one test for each heat for the first one hundred heats, one test for every fifth heat for the second hundred heats and one test for every tenth heat thereafter for heats furnished to the same manufacturing practice. In addition, a minimum of one tensile test per order shall be furnished at the request of OCTA, from a heat supplied on the order. For high-strength rail of all steel grades, the testing frequency shall be one test for each heat or 10,000 feet of rail, whichever represents the smaller amount of rail.

C. Ultrasonic Testing:

1. Rails shall be ultrasonically tested for internal imperfections. The full length of the rail shall be tested using in line ultrasonic testing equipment at the rolling mill. The rail shall be free from rough surfaces, loose scale or foreign matter which would interfere with the ultrasonic detection of defects. Testing shall be done when the rail temperature is below 150 degrees F.

2. The calibration test rail shall be a full section rail of the same section as that being tested. The test rail shall be long enough to allow a calibration at the same rate of speed as the production rail. The size, shape, location and orientation of calibration references to be placed in the test rail shall be agreed upon by the purchaser and manufacturer. At least one reference shall be put into the test rail to represent each search unit in the system.

3. The in-line testing system sensitivity level, using the calibration rail, shall be adjusted to detect a minimum 1/16 inch diameter defect anywhere in the sound path in the head, a minimum of 3/32 inch diameter in the web, and longitudinal imperfections exceeding ½ inch length and greater than 1/16 inch depth occurring in the base. Any indication equal to or greater than the above defect sizes when scanning the rail at the production speed shall be cause for initial rejection. A record shall be made of each suspect rail. This record shall be made available to OCTA upon request.

4. The calibration rail shall be run through the ultrasonic testing equipment at the start of each shift or at least once each 8 hour operating turn and additionally at any section change or at any indication of equipment malfunction. A record shall be maintained by the manufacturer of each time the calibration test rail is run through the test system. This record shall be made available to OCTA upon request. In the event of a calibration failure, all rails processed since the last successful calibration shall be retested.

5. Rejected rails may be cut back to sound metal as indicated by the ultrasonic testing. Rails shall be cut to one of the specified non-standard short lengths. The cut shall be a minimum of 12 inches from any indication.

D. Brinell Hardness:

1. The Brinell hardness test shall be performed, using a tungsten carbide indentor, on a piece of rail not less than 6 inches long. The test piece shall be cut from a rail taken from each heat of steel or heat-treatment lot, or from a ground/milled transverse sample cut from the 6 inch sample rail. A copy of the report of each test shall be furnished to OCTA.

2. The test shall be conducted in accordance with the current version ASTM E 10, “Standard Test Method for Brinell Hardness of Metallic Materials.” The test shall be made on the side or top of the rail head after decarburized material has been removed to permit an accurate determination of hardness. Alternately, the test may be made on the prepared transverse ground/milled sample no less than 3/8 inch inward from all rail surfaces.

3. If any test result fails to meet the specifications, two additional checks shall be made on the same piece. If both checks meet the specified hardness, the heat or heat treatment lot meets the hardness requirement. If either of the additional checks fails, two additional rails in the heat or lot

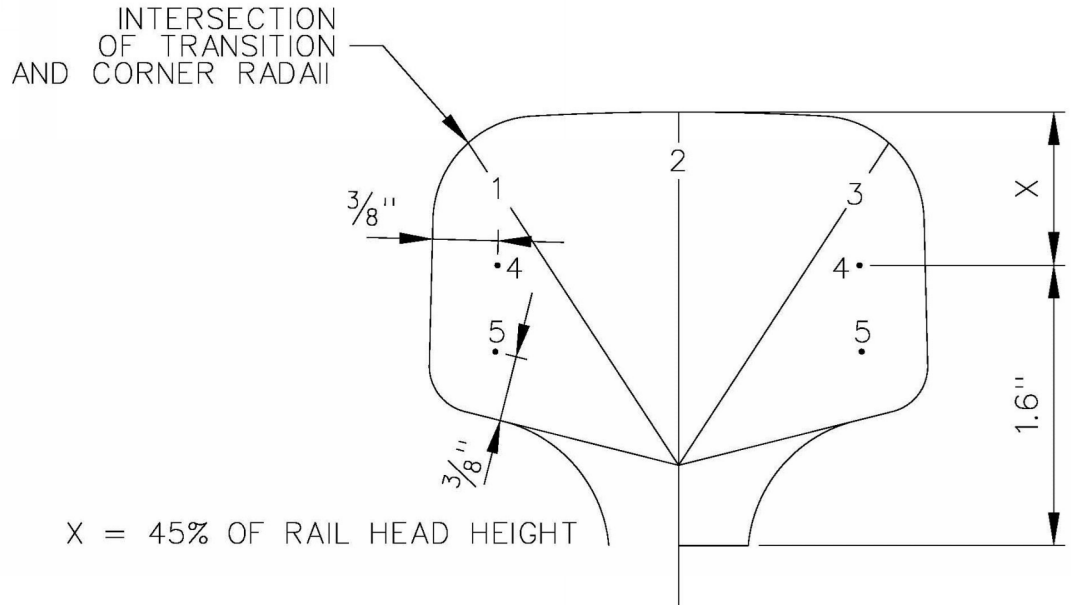
shall be checked. Both of these checks must be satisfactory for the heat or lot to be accepted. If any one of these two checks fails, individual rails may be tested for acceptance.

4. If the results for off-line head hardened rails fail to meet the requirements shown in **Table 5** (below), the rails may be retreated at the option of the manufacturer, and the retreated rails shall be re-tested.

E. Internal Hardness of High-Strength Rail:

1. The internal hardness of high-strength rail of any rail steel grade shall be determined on a transverse specimen cut from the head and at least 6 inches from the end of the rail. The specimen shall be ground or milled so that the transverse surfaces are parallel. The hardness test shall be conducted in accordance with ASTM E-18, "Standard Test Methods for Rockwell Hardness of Metallic Materials." The results shall be reported in Brinell using the conversions in **Table 5**.

2. The hardness shall be determined at intervals of not greater than 1/8 inch along traverses 1, 2, and 3 and at positions 4 and 5 as shown in **Figure 2**. Hardness gradient of head hardened rail along lines 1, 2, and 3 shall be gradual towards the center of the rail, with no sharp drop or discontinuity. Traverse 2 can extend into the web of the rail (X + 1.6 inch).



	115#	119#	132#	133#	136#	140#	141#
X	¾" 0.750"	27/32" 0.844"	25/32" 0.781"	7/8" 0.875"	7/8" 0.875"	15/16" 0.938"	1" 1.000"

Figure 2 – Determining Internal Hardness of High Strength Rail

Table 5 – AREMA HRC TO HB Conversion for Rail Steels (Developed by AREMA Committee 4 specifically for rail steel)

HRC	HB	HRC	HB	HRC	HB
20	244	30	306	41.8	400
21	250	31	314	42	402
22	255	32	321	43	411
23	261	33	328	44	420
24	267	34	336	45	429
25	273	35	344	46	439
26	280	36	351	47	448
27	286	37	359	48	458
28	293	38	368	49	468
29	300	39	376	50	478
		40	384		
$HB = 165.77 + 2.3597HRC + 0.0777HRC^2$					

3. The hardness at a depth of 0.6 inch on lines 1, 2 and 3 and at points 4 and 5 of (depth of 3/8 inch) Figure 2 shall be 352 HB or higher for high strength rail. For the low alloy head hardened rail steel grade (LH) the hardness at a depth of 7/8 inch on lines 1, 2, and 3 shall be 341 HB or higher. The testing frequency shall be one test per heat or 10,000 feet of rail, whichever is the smaller amount of rail.

4. If any test specimen fails to meet the required hardness, two additional test specimens shall be obtained from the same lot and tested. If both meet the requirements, the lot shall be accepted. If one of the specimens fails to meet the requirements, two additional rails from the lot shall be sampled and tested. Both of these tests must be satisfactory for the lot to be accepted. If one of the tests is unsatisfactory, individual rails may be sampled and tested for acceptance. If the results for off-line head hardened rail fail to meet the requirements for internal hard, the rails represented by the test may be re-treated and re-tested.

F. Interior Condition and Macroetch Standard Tests:

1. Sample Location and Frequency

a. A test piece representing a rail from each strand from the beginning of each sequence and whenever a new ladle is begun shall be shall be macroetched which is the point representative of the lowest level in the tundish (i.e. the point of the lowest ferrostatic pressure.) One additional sample from the end of each strand of the last heat in the sequence shall also be tested. A new tundish is considered to be the beginning of a new sequence.

b. OCTA may, upon receipt, examine and test any rail from any part of a heat at its option, and if the determines that the rail sample selected in rejectable, the entire heat shall be reevaluated according to Section 2.06, Part F, Paragraph D, below.

2. Sample Preparation

a. A full transverse section of the rail can be cut by abrasive or mechanical means as long as care is maintained in preventing metallurgical damage. The face to be etched shall have at least a 125 microinch finish. The sample shall be degreased and totally immersed in a hot (160 degrees to 180 degrees F) one to one mixture, by volume, of concentrated hydrochloric acid (38 volume percent) and water to sufficiently etch the specimen.

b. Etching time shall be between ten and twenty minutes. The solution surface shall be at least one inch above the etched surface. Upon removal from the bath, the sample shall be rinsed and brushed under hot water and dried. The sample shall not be blotted dry. A rust inhibitor may be applied to the etched face at the option of the manufacturer.

3. Macroetch Evaluation and Rejectable Conditions

The areas of cross section shall be defined as head, web, and base in accordance with Figure 4-2-9 of Chapter 4 of the AREMA Manual for Railway Engineering. A description of each of the rejectable conditions and corresponding figure in Chapter 4 of the AREMA Manual for Railway Engineering are given in **Table 6**.

Table 6 –Macroetch Evaluations and Rejectable Conditions

AREMA Figure Number	Rejectable Condition
4-2-9	Definition of rail cross sectional areas for macroetch evaluation
4-2-10 and 4-2-11	Hydrogen flakes
4-2-12 and 4-2-13	Pipe; any size.
4-2-14 and 4-2-15	Central web streaking extending into the head or base
4-2-16 and 4-2-17	Streaking greater than 2-1/2 inches in length
4-2-18	Scattered central web streaking from the web into the head and base.
4-2-19	Scattered segregation extending more than one inch into the head or base.
4-2-20	Subsurface porosity
4-2-21	Inverse or negative segregation having a width greater than 3 inches and extending more than ½ inches into the head or base
4-2-22	Streaking greater than 1/8 inches in the head from radial streaks, radial cracks, halfway cracks, or hinged cracks
4-2-23	Other defects that could cause premature failure (i.e. slag, refractory, etc.)
4-2-24 and 4-2-25	Segregation extending into the head or base
4-2-26	Segregation greater than 1/8 inches wide in the head or base.
4-2-27	Scattered central web segregation extending into the head and base.

4. Retesting

a. If any specimen fails to meet the macroetch standard for interior quality, two additional samples of rail representative of the same strand shall be obtained. These retests shall be taken from positions selected by the manufacturer and the material from between the two retest positions shall be rejected. If any retest fails, testing shall continue until acceptable internal quality is exhibited.

b. All rails represented by failed tests shall be rejected. If finished rail from the beginning of a strand shows defects, successive rails from that strand shall be tested until sound metal is identified. Those portions of rails exhibiting sound metal may be cut from longer rails and accepted as short rail, subject to the limitations of length.

c. In the event that there is a question of the seriousness of the indication, further examination may be performed with a stereo microscope up to 5X. A polished sample may be inspected at 100X for metallographic interpretation.

G. Interior Condition and Microcleanliness Standard Tests:

1. Sampling

a. The metallurgical cleanliness of the rail steel shall be determined from samples taken from the finished rail section. A minimum of every tenth heat must be tested. A minimum of three one-inch long full section samples per heat tested shall be taken, one from the end of the first acceptable rail, one from the end of a rail representing the approximate middle of the heat, and one from the end of the last acceptable rail. Test specimens will be sectioned and surface analyzed as shown in **Figure 3**.

b. Each ¾" by ¾" section (Sample A in **Figure 3**) shall be carefully prepared and evaluated according to Method A of ASTM Standard E45, "Standard Test Methods for Determining the Inclusion Content of Steel." Each individual metallographic sample shall have a maximum average rating of 2 and a maximum individual rating of 3 for inclusions type, thin or heavy. Results shall be furnished to OCTA upon request.

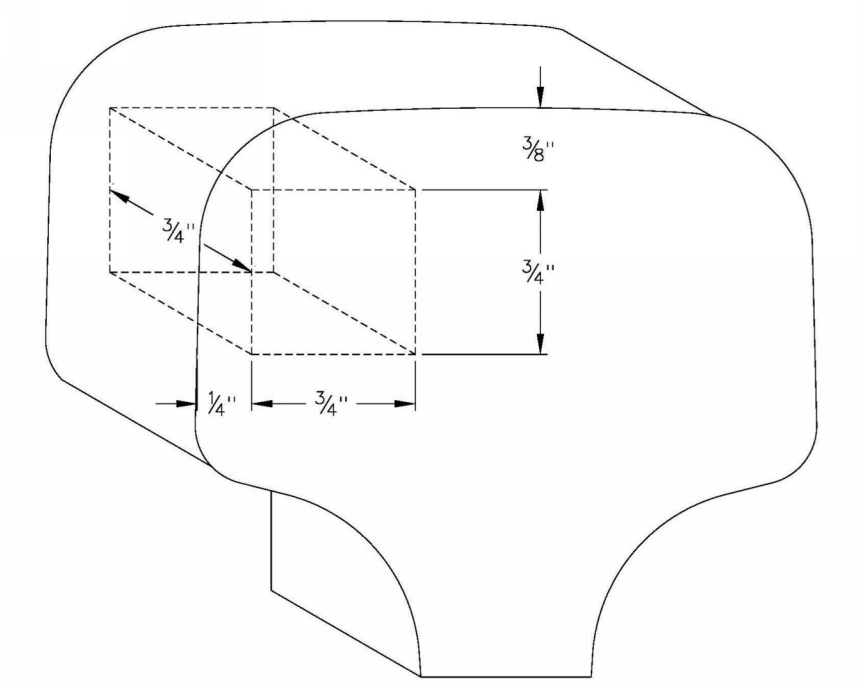


Figure 3 – Sample "A" location in rail head – Shaded area denotes area to be analyzed

H. Tolerances:

1. Section and Length

Rail shall be rolled to the standard section shown on the drawings or listed in the Schedule of Quantities and Prices within the section tolerances given in **Table 5**, and to the specified length within the tolerances given in **Table 4**.
Gauges for checking basic rail dimensions shall conform to those illustrated in **Figure 4-2-28** through and including **Figure 4-2-40 of Chapter 4 of the AREMA Manual for Railway Engineering**.

Table 4 – Tolerance in Length

End Condition	Length > 40 ft.	Length ≤ 40 ft.
Undrilled	-0, +6 inch	-0, +4 inch
Drilled one end	-0, +6 inch	-0, +4 inch
Drilled both ends	±7/8 inch	±7/16 inch

Table 5 – Section Tolerances

Description	Tolerance, Inches			
	Rail		Trackwork Rail	
	Plus	Minus	Plus	Minus
Height of rail (measured within one foot from end)	0.030	0.015	0.030	0.015
Width of rail head (measured within one foot	0.025	0.025	0.015	0.015

from end)				
Thickness of web	0.040	0.020	0.040	0.020
Fishing template standout	0.060	0.000	0.030	0.000
Asymmetry of head with respect to base	0.050	0.050	0.030	0.030
Width of base	0.040	0.040	0.030	0.030
Flange height	0.025	0.015	0.015	0.015
Note 1: Base concavity shall not exceed 0.010 inch. Convexity is not permitted.				
Note 2: No variation will be allowed in dimensions affecting the fit of the joint bars, except that the fishing template may stand out not to exceed 0.060 inch laterally.				
Note 3: All four corners of the rail base shall have the radii according to the drawing ± 1/32 inch. Any disputes shall be analyzed on an Optical Comparator.				
Note 4: The section of the rails to be used in AREMA trackwork shall conform to the design specified by the purchaser subject to the tolerances listed under trackwork rail above.				
Note 5: Head radius to be within (±) 2 inches per Figure 4-2-40.				
Note 6: On up to 5% of the order, the height of the rail plus tolerance can be between 0.030 and 0.040 inches. This exception does not apply to trackwork rail.				

2. Rail Straightness

a. When placed head up on a horizontal support, rails that have ends higher than the middle will be accepted, if they have a uniform upsweep, the maximum ordinate of which does not exceed ¾ inch in any 80 feet as illustrated in **Figure 4**.

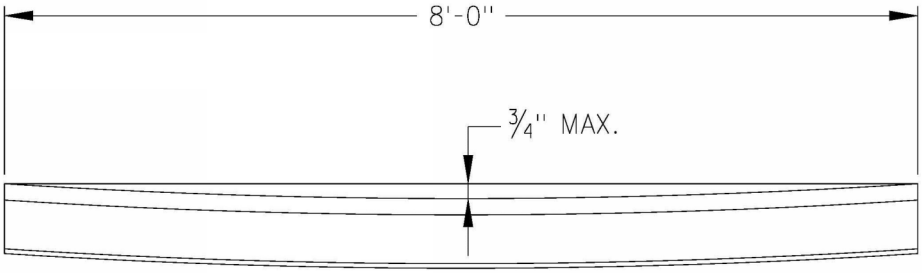


Figure 4 – Side Elevation of Rail Uniform Upsweep Tolerance

b. The uniform surface upsweep at the rail ends shall not exceed a maximum ordinate of 0.020 inch in 3 feet and the 0.020 inch maximum ordinate shall not occur at a point closer than 18 inches from the rail end as illustrated in **Figure 5**. Surface down-sweep and droop must not be accepted.

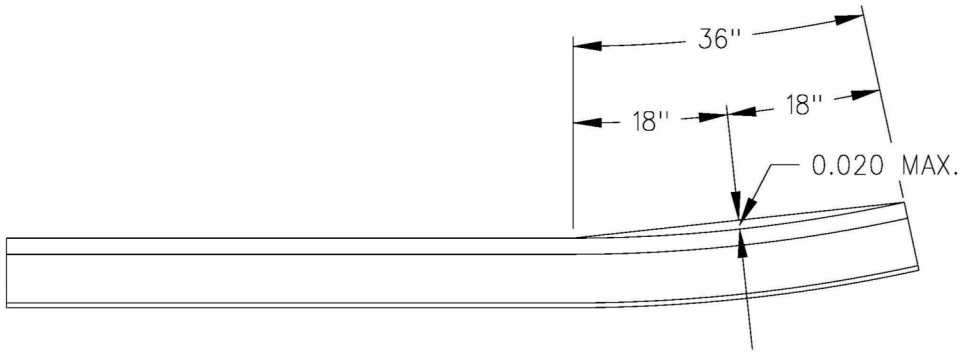


Figure 5 – Side Elevation of Rail Uniform Upsweep Tolerance at Rail Ends

c. Deviations of the lateral (horizontal) line in either direction at the rail ends shall not exceed: 1) a maximum mid-ordinate of 0.020 inch in 3 feet using a straight edge and of 0.010 inch at the end quarter point as illustrated in Figure 6a.; 2) a maximum of 0.040 inch measured by the tangent offset method at the end of the rail as illustrated in Figure 6b.

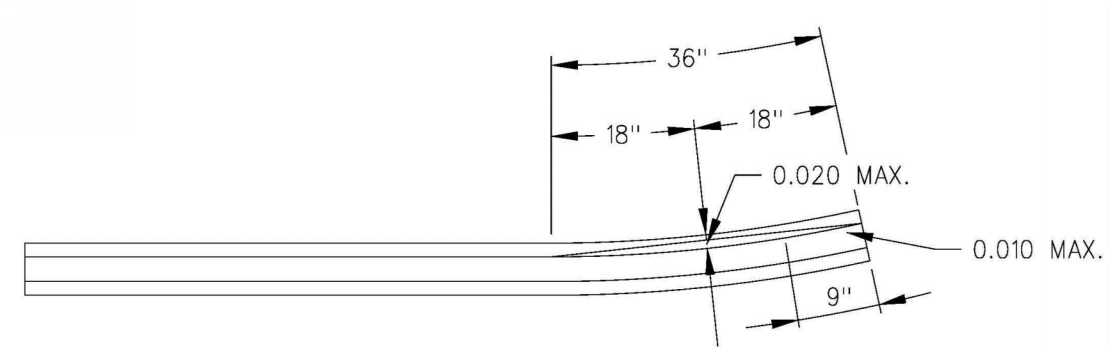


Figure 6a – Top View of Rail Lateral (Horizontal) Line Tolerance at Rail Ends

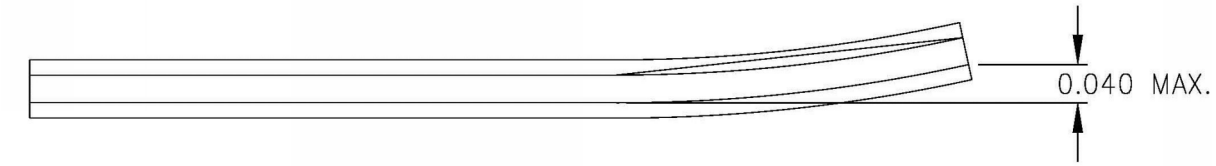


Figure 6b – Top View of Rail Lateral (Horizontal) Line Tolerance at Rail Ends

d. Uniform lateral sidesweep in any 80 feet shall not exceed ¾ inch as illustrated in Figure 7. When required, proof of compliance with, “Side Uniform Upsweep” tolerance shall be determined by string (wire) lining, and a straight edge and taper gage shall be used to determine rail end surface and line characteristics specified in “Uniform Surface Upsweep” tolerance and “Rail Lateral Line” tolerance. Surface downsweep and droop shall not be accepted.

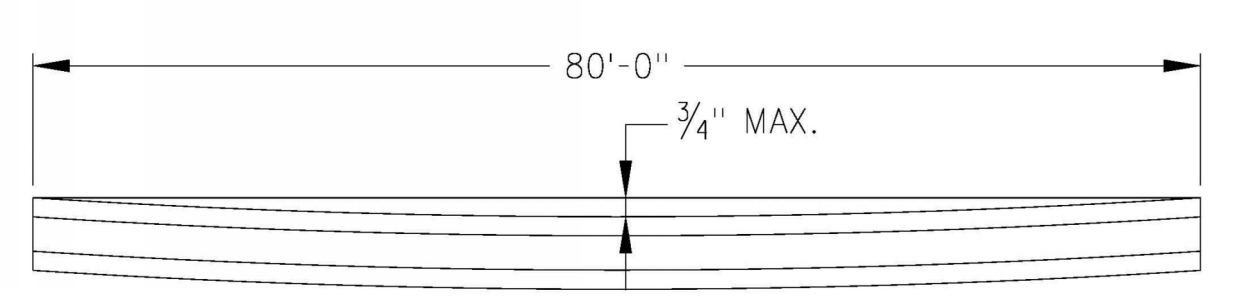


Figure 7 – Top View of Uniform Lateral Sidesweep Tolerance

e. Rails shall be hot sawed, cold sawed, milled abrasive wheel cut, or ground to length. Rail ends shall be square with a variation of not more than 1/32 inch allowed. The method of finishing the ends of rails shall not cause metallurgical or mechanical damage to the rail.

f. If the rail shows evidence of twist while being laid head up on the final inspection bed, it will be checked by inserting a taper or feeler gage between the base and the rail skid nearest the end. If the gap exceeds 0.060 inch the rail will be rejected. Alternatively, a twist gage may be used and if the rail exceeds 1.5 degrees in 80 feet the rail will be rejected. Rejected rails may be subject to straightening.

I. Evaluation of Residual Stresses in Rail by Web Saw Cut:

1. Preparation and Test

a. Finished rail shall meet the requirements of a web saw cut test conducted of a fully roller-straightened rail sample of a regular production rail. The rail ends not affected by the roller straightening process shall not be used for the test. For those production rails that are not roller-straightened, the rail shall also meet the following requirements of a web saw cut test.

b. The test sample shall be 24” in length and cut from a production rail. The sample end face furthest from the end of the rail from which the sample is cut shall be punch marked with two central, vertically aligned sharp cone pointed marks, one on each side of the neutral axis a sufficient distance apart such that the marks are not affected or obliterated by the subsequent saw cut. The caliper measurement shall be taken at a distance no more than 0.25” (6mm) from the rail end at the vertical centerline of the rail. The caliper point locations shall be marked and this measurement shall be recorded.

c. The initial vertical distance between the two punch marks shall be measured with a calibrated vernier or digital caliper and recorded. Alternatively, a calibrated vernier or digital caliper may be used to

measure the initial height of the de-burred end of the rail to be saw-cut.

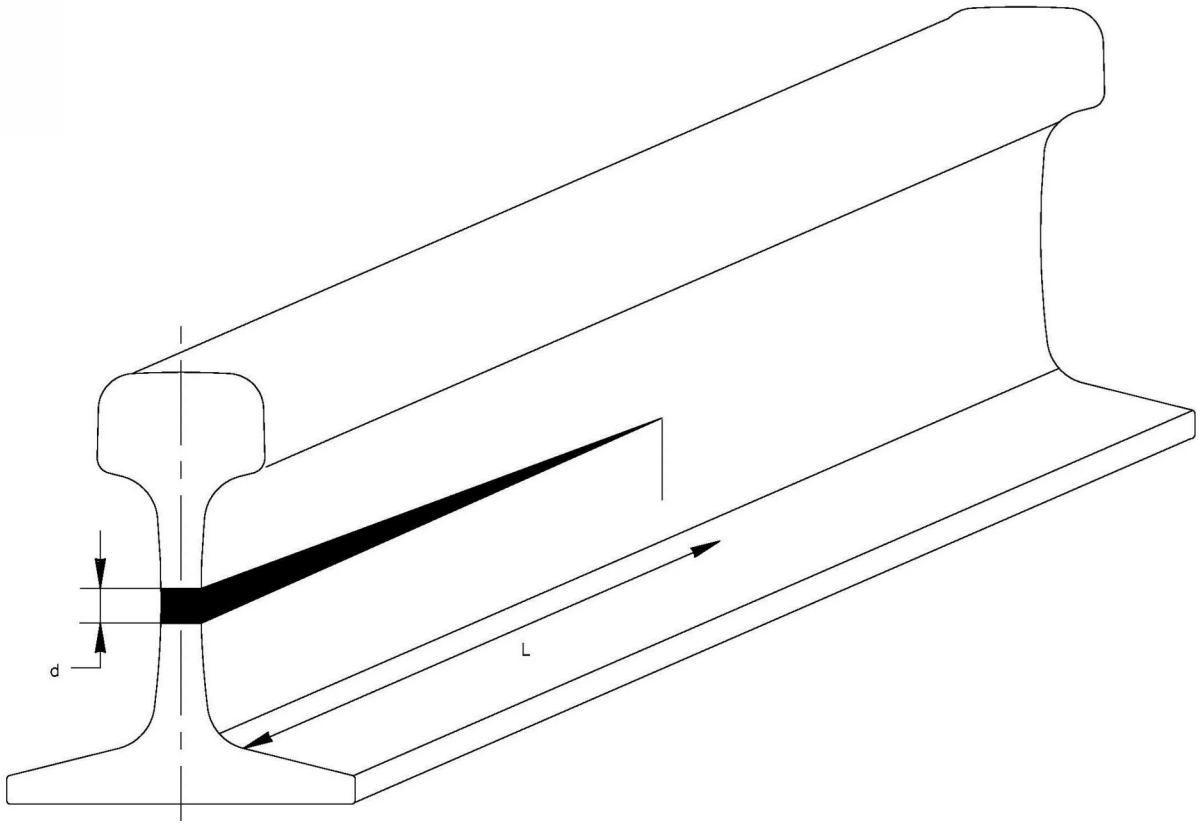


Figure 8 – Rail-Web Saw Cut Test

d. The web of the test sample shall then be saw cut on a straight line along the neutral axis of the web for a distance (L) of 16". If the rail closes during the saw cut, sufficient material shall be removed from the mouth of the saw cut to prevent the top portion of the rail from touching the bottom portion of the rail. The sawing process shall employ a procedure and sufficient precautions such that there is no induced distortion or heating of the rail.

e. Immediately after cutting, the distance between the two vertical punch marks shall again be measured with the vernier caliper and recorded. For the alternate method the rail height shall be re-measured by placing the caliper points at the same position on the top and base of the rail as initially measured. This value shall be recorded.

f. For either procedure, the value after subtracting the final measurement from the initial measurement is called the vertical displacement (d). The vertical displacement may be a positive or negative value depending upon whether the longitudinal and vertical residual tensile stresses of the rail sample are in tension (+) or compression (-). The web saw cut test shall be the primary

method used to evaluate the magnitude of the residual stresses in rail.

2. Rail Acceptance Criteria

Any rail demonstrating a vertical displacement (+ or -) of greater than 0.148" (3.75 mm) shall be rejected. For fully-hardened rails, that have significantly higher fracture toughness properties in the web of the rail, an alternate acceptance criteria based on stress intensity and fracture toughness measurements may be used if it is the standard practice of the mill to use such a test. If the stress intensity level is less than the fracture toughness level the rail may be considered acceptable.

3. Re-Test and Acceptance Criteria

Any rail that does not meet the acceptance criteria of the primary saw cut test, may be accepted if a steel wedge forced into the mouth of the saw cut generates crack propagation and completed fracture through either the base or head of the rail.

Alternately, any rail that does not meet the acceptance criteria in may be accepted if two additional rails from the same week's production are secured, saw cut tested and pass the primary acceptance criteria.

4. Testing Frequency

A rail manufacturer that has developed a continuous statistical control process and monitoring tests for control of their critical processing steps during production of rail may test a rail not less than a frequency of once each week. If a changes occur in the critical rail manufacturing processes in the course of production, tests must be taken at a frequency of one rail per 24 hours for a one week period of that change.

These monitoring tests shall demonstrate to OCTA that there exists a positive correlation between the continuous process monitoring and the saw cut test measurements performed on the finished rail. During development of a statistical control and monitoring process, a saw cut test shall be taken at a frequency of one rail per 24 hours for a two week period.

PART 3 - EXECUTION

3.01 GENERAL

A. Flash butt welding and testing of rail shall conform to the current AREMA Manual, Chapter 4, Part 2, Section, "Specification for Fabrication of Continuous Welded Rail" unless otherwise specified herein.

B. Vendor must fabricate CWR off site.

C. Lengths of CWR strings delivered to site shall be not less than 1,200 feet unless otherwise approved by OCTA.

D. Fabrication shall be in accordance with this specification.

E. Rejected welds shall be cut out and rewelded with a minimum of 19'-6" plugs at Vendor's expense.

F. Bolt holes for the end of CWR strings are acceptable and must be approved (size, location and number) with the OCTA prior to shipment.

3.02 EQUIPMENT

A. The welding machine shall be capable of automatically recording pertinent data including pre-heating impulses, flashing time, upset current, time and platen travel during flashing and shall be capable of testing the welds during production using the ultrasonic testing method or the dry powder method of magnetic particle inspection.

B. The Vendor shall maintain welding equipment in good working order at all times.

3.03 RAIL BENDING AND STRAIGHTENING

A. Straightened rail sections shall achieve the alignment tolerance as specified in AREMA Manual, Chapter 4.

B. Any rail sections that cannot be straightened shall be cut back a sufficient distance to achieve the specified tolerances.

C. If straightened rail does not meet specification tolerance in two passes through the straightener, it will be cut out of the string.

3.04 RAIL CUTTING AND END PREPARATION

A. Rails used for electric-flash butt welds shall have their ends saw-cut or abrasive disc-cut clean and square by means of accepted equipment.

B. Torch cutting of rail is prohibited.

C. The head and base of the rail for a length of approximately six inches from welding end shall have mill scale removed down to bright metal.

D. All burrs shall be removed from the area where the welding current carrying electrodes contact on the head and base of the rail.

F. Holes will not be permitted in the rail, except as approved by OCTA.

3.05 ELECTRIC FLASH BUTT WELDING

A. CWR strings shall be fabricated so that all of the branding appears on one side of the string.

B. Alignment of rail in the welding machine shall:

1. Be done on the head of the rail.

2. Vertical alignment shall provide for a flat running surface. Any difference in height of the rails shall be in the base.

C. Horizontal alignment shall be done in such a manner that any difference in the widths of heads of rails shall be divided equally on both sides of the head.

D. All electric flash butt welds shall be forged to point of refusal to further plastic deformation and have a minimum upset of 0.5 inches with 0.625 inches as standard.

E. The upset cylinder shall not bottom out during the upset portion of the weld cycle.

F. Post weld straightening may be permitted if performed before the surface temperature of the weld falls below 500 degrees Fahrenheit.

G. Quenching the weld metal shall not be permitted on standard rail. Quenching of premium rail weld is permitted and shall be per the standard industry practice as accepted by class I railroad.

3.06 FINISHING AND ALIGNMENT

A. Jagged, notched or badly mismatched end faces shall be preflashed to an even or mated condition before setting up rails for preheating and final flashing to assure that the entire surfaces of rail ends are uniformly flashing immediately preceding upsetting.

B. All heavy grinding used in the finishing process shall be performed on the hot metal immediately following welding, to prevent metallurgical damage.

C. Finishing shall eliminate cracks visible to the unaided eye. Notches created by offset conditions shall be eliminated by grinding to blend variations.

D. All notches created by offset conditions or twisted rails shall be eliminated by grinding to blend the variations.

E. All fins on the weld due to grinding drag shall be removed prior to final inspection.

3.07 TOLERANCES IN ELECTRIC FLASH BUTT WELDS

A. Trimming and grinding of rail welds shall result in the weld being within the tolerances set forth in the AREMA Manual, Chapter 4, Part 2, Section "Specifications for Fabrication of Continuous Welded Rail."

3.08 RECORDS FOR ELECTRIC FLASH BUTT WELDING

A. A record shall be submitted to OCTA documenting the production of each string of CWR. Included shall be the following:

1. The CWR string designation number and station location in the field.

2. The heat numbers of the first and last pieces of rail in the string.

3. The heat numbers on each side of any weld which has been cut out and rewelded.

4. A small sketch or graph indicating the current flow during the production of each weld.

3.09 CWR STRING MARKINGS

A. Mark each completed string with the appropriate CWR string designation indicated in the schedule of CWR strings.

3.10 CWR STRING HANDLING

A. Handling of CWR shall be in accordance with submitted procedures for transport and handling.

B. As welding is completed on each CWR string, the string shall be transported from the welding line by the Vendor to the track location or a suitable stockpile location.

C. The stockpile location shall be approved by OCTA if it lies within the right-of-way.

3.11 VISUAL INSPECTION

A. Production welds shall be visually inspected for surface cracks.

B. Welds with surface cracks visible to the eye will not be accepted.

3.12 REPLACEMENT OF DEFECTIVE WELDS

A. Flash butt production welds giving fault indication in magnetic particle inspection during production shall be cut, rewelded and retested and shall not be left for field welding.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work associated with project item in Section 34 72 00, Trackwork or Section 34 72 20, Track Shifting, Relocation, and Resurfacing and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery and incidentals as shown on the Plans, and as specified in these Specifications.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 34 11 15

OTHER TRACK MATERIALS (OTM)

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for Other Track Materials (OTM) to be furnished in accordance with Contract Documents or required by the Engineer.

B. OTM materials shall include rail fastening systems, screw spikes, track bolts, nuts, spring washers, tie plates, tie plugs, rail anchors, standard toeless joint bars, compromise joint bars, and insulated joints.

1.02 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering

2. Portfolio of Trackwork Plans

3. Specifications for Special Trackwork

B. American Welding Society (AWS):

1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications

2. AWS D1.1: Structural Welding Code

C. American National Standards Institute, Inc. (ANSI)

1. ANSI B1.1: Unified Inch Screw Threads

2. ANSI B1.3M: Screw Threads Gaging System for Dimensional Acceptability

3. ANSI B18.22.1: Plain Washers

D. American Society for Testing of Materials (ASTM)

1. ASTM A36: Standard Specifications for Carbon Structural Steel

2. ASTM A123: Standard Specification for Zinc (Hot-Dip-Galvanized) Coating on Iron and Steel Products

3. ASTM A325: Standard Specifications for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

4. ASTM D257: Test Methods for D-C Resistance or Conductance of Insulated Materials

5. ASTM D1002: Test Methods for Apparent Shear Strength of Single-Lap-Joint Adhesive Bonded Metal Specimens by Tension Loading (Metal to Metal)

E. Association of American Railroads (AAR)

1. AAR: Manual of Standards and Rec. Practices

2. AAR Section J: Quality Assurance M-1003

3. AAR: Assembly and Test of Insulated Track Part 16, Signal Section

4. AAR: Signal Manual Assembly and Testing of Insulated Fittings, Part 14.5.1

F. SCRRA: Engineering Standards.

1.03 DEFINITIONS

A. Compromise Rail – A relatively short rail, the two ends of which are different sections, corresponding with the sections of the rail to which they are to be joined

B. The word “Vendor” used in the Material Specifications (SS) shall mean the Contractor.

C. Fasteners – Joint bars, bolts, clips and spikes

D. Joint Bar – A steel member used in pairs for the purpose of joining rail ends together, and holding them accurately, evenly and firmly in position

E. Insulated Joint – A rail joint designed to arrest the flow of electric current from rail to rail by means of insulation placed so as to separate the rail ends and other metal parts connecting them

F. OTM – A general term referring to all miscellaneous materials other than rail and ties

G. Tie Plug – Rectangular sections of wood for filling unused spike holes in wood ties

H. Switch – A track structure to divert rolling stock from one track to another

1.04 SUBMITTALS

A. The Vendor shall submit supporting information within 60 days of award documenting the past successful performance in furnishing the materials included in the Schedule of Quantities and Prices. Provide references and contact numbers at the railroads where the OTM have been placed in service.

B. The Vendor shall submit certificate of compliance that the material delivered is in compliance with the specification within 60 days of approval of payment.

C. The Vendor shall submit OTM packaging, loading, shipping, and handling method.

D. The Vendor shall submit for OCTA's review and approval quality control and quality assurance plans and related certifications such as ISO 9001, "six sigma" or equivalent demonstrating that the Vendor has the processes, personnel and systems to produce high quality OTM included in the Schedule of Quantities and Prices.

E. The Vendor shall submit data documenting past performance and projects within the last ten (10) years furnishing OTM to Class 1 Freight, passenger or commuter railroads.

F. The Vendor shall include installation instructions. The Vendor shall Include, at a minimum, the Care and storage of materials; Date of glue manufacture; Glue shelf life; Rail end preparation; Weather and temperature restrictions; Mixing and application of glue; Installation of insulated joint bar and pin bolts; Curing restrictions; Detection of glue bond failures

G. Submit Certificates of Compliance for all OTM. Include material qualification test reports for materials, components, and assemblies.

H. Administrative and procedural requirements for proposed changes in product and materials from those required by these specifications shall be as per OCTA Contract Specifications Section 01 25 00, "Substitution Procedures".

1.05 QUALITY ASSURANCE

A. Vendor's Quality Control Program (QCP) shall be in accordance with the AAR M-1003 or OCTA approved equivalent quality control program. Comply with AREMA Portfolio of Trackwork Plans.

B. Equipment used for the manufacturing materials shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be certified and traceable to national standards such as the National Institute of Standards and Technology.

1.06 DELIVERY, STORAGE AND HANDLING

A. The Vendor shall load, transport, and handle the material in a manner which will prevent damage to the material.

B. Steel tie plates shall be palletized, with each standard non-returnable pallet holding not more than 6,000 pounds. Binding for the palletized tie plates shall be of sufficient strength to facilitate multiple loading, unloading and handling with cranes and/or forklifts.

C. Resilient fasteners shall be packaged in burlap bags or other suitable container, with the weight of each package not exceeding 125 pounds. The bag or container

shall be of sufficient strength to facilitate multiple loading, unloading and handling and storage.

PART 2 - PRODUCTS

2.01 GENERAL

A. OTM shall be new and conform to SCRRA Engineering Standards.

B. OTM ordered to the Engineering Standards shall be produced in conformance to these specifications and AREMA Specifications for Special Trackwork.

2.02 TIE PLATES

A. Tie plates shall conform to AREMA Volume 1, Chapter 5, Section 1.1, Tie Plates - “Specifications for Steel Tie Plates” and appropriate SCRRA Engineering Standard.

B. Tie plate dimensions for resilient fastening systems for 5½” base shall conform to SCRRA Engineering Standard ES2453, “Rolled Steel Tie Plate to Suit 5½” Base AREMA Rail and Pandrol Rail Clips E2055”. Tie plate dimensions for resilient fastening systems shall conform to SCRRA Engineering Standard ES2454, “Rolled Steel Tie Plate to Suit 132 LB. RE – 141 LB. RE Rail and Pandrol Rail Clips E2055”.

C. Tie plate dimensions for standard fastening systems for 5½” base shall conform to SCRRA Engineering Standard ES2451, “Standard 13” Tie Plate for 5½” Base Rail”. Tie plate dimensions for standard fastening systems for 6” base shall conform to SCRRA Engineering Standard ES2452, “14” Tie Plate for 6” Base Rail”.

2.03 TRACK SPIKES

A. Cut spikes shall be new and conform to the requirements of the AREMA Manual, Chapter 5, Part 2, Section 2.1, “Specifications for Soft-Steel Track Spikes”, and SCRRA Engineering Standard ES2355.

B. Cut spikes shall be 5/8 inches by 6 11/16 inches and conform to all other dimensions specified in the AREMA Manual, Chapter 5, Part 2, Section 2.2, “Design of Cut Track Spike”.

C. Screw spikes shall be 15/16 inch by 6 inches straight shank screw spikes with a minimum tensile strength of 73,000 psi. Head shall be hot forged and centered relative to the shank in accordance with SCRRA Engineering Standards ES2355.

D. Stamp screw spikes with manufacturer’s identification and date of manufacture (month and year) in accordance with SCRRA Engineering Standard ES2355.

2.04 RAIL ANCHORS

A. Rail anchors shall be Channeloc-type rail anchors manufactured by Chemtron True Temper or equal.

B. Material for rail anchors to be high carbon steel. Material to be heat treated to Rc 34-47.

C. Rail anchors shall be sized to conform to the rail section used. Rail anchors shall have sufficient bearing area and depth to minimize the possibility of the anchor damaging or becoming embedded in the tie.

D. Rail anchors shall conform to the AREMA Manual, Chapter 5, Part 7, Section 7.1, “Specifications for Rail Anchors”. Rail Anchors shall be one-piece conforming to the requirements of AREMA Manual and of standard weight.

2.05 TRACK BOLTS, NUTS AND SPRING WASHERS

A. Track bolts and nuts shall conform SCRRA Engineering Standard Plan ES-2352 and AREMA Manual, Chapter 4, Part 3, Section 3.3, “Rail Drilling, Bar Punching, and Track Bolts”, AREMA Manual, Chapter 4, Part 3, Section 3.5, Specifications for Heat-Treated Carbon-Steel Track Bolts, and Carbon-Steel Nuts. SCRRA standards and criteria shall take precedence in any case where conflicting dimensions or requirements are specified.

B. Spring Washers shall conform to the requirements of the AREMA Manual, Chapter 4, Part 3, Section 3.6, Specifications for Spring Washers.

2.06 RESILIENT FASTENING SYSTEM

A. Resilient fastening system for wood ties shall be a Pandrol rail fastening system per relevant SCRRA Engineering Standards, “Pandrol Rail Clip – Type “e” 2055”, consisting of elastic fastener ”E-Clip” galvanized, type elastic clips, screw spikes, and elastic fastener tie plates or approved equal or as otherwise indicated in the Contract Drawings.

B. Resilient fastening system for concrete ties shall be a Pandrol Rail fastening system consisting of “Fast-Clip” type elastic fasteners pre-installed in the “off” position on concrete ties, or approved equal, unless indicated otherwise on the Contract Drawings.

C. Rail seat pads shall be “3-part” with steel interior plate.

D. Resilient fasteners for Insulated Joints shall be type specified in SCRRA Engineering Standards for the type of resilient fasteners to be used.

1. The Contractor must provide suitable fasteners in accordance Relevant Engineering Standards requirements.

2.07 JOINT BARS

A. Joint bars shall conform to AREMA Volume 1, Chapter 4, Part 3, Section 3.2, “Joint Bars and Assemblies”; Section 3.3, “Rail Drillings, Bar Punchings and Bolts”; and Section 3.4, “Specifications for Quenched Carbon-Steel Joint Bars, Micro-alloyed Joint Bars and Forged Compromise Joint Bars”.

B. Bar dimension and details shall conform to SCRRA ES2502, “Rail and Joint Assembly for 136 lbs. RE Rail”.

C. Joint bars used to temporarily connect rails that will be field welded in the final configuration shall be bolted with the rails ends drilled in the outer four holes only.

2.08 COMPROMISE JOINT BARS

A. Compromise Joints or connections to other rail weights on OCTA mainline track (track used in passenger revenue service will be considered mainline track for purposes of this section) will be made through the use of transition rails as specified in SCRRA ES2372 or ES2373 as appropriate.

1. Other rail weight connections or those connections necessary for “Industry Track” or “Other than main line” will be made using Compromise Bars.

2. Compromise Bars shall be 6-hole conforming to AREMA Volume 1, Chapter 4, Part 3, Section 3.4, “Specifications for Quenched Carbon-Steel Joint Bars, Micro-alloyed Joint Bars and Forged Compromise Joint Bars” and conform to the requirements of SCRRA ES2503, “Compromise Joints for Various Weights of Rail”.

3. Final configuration of the track shall utilize field welds to join transition rails wherever applicable in mainline track.

4. Compromise joint bars may be used for interim phases of construction on mainline track provided interim phase duration is expected to be six (6) months or less.

5. Temporary Compromise joint bars as noted above shall use track bolts in the outer four holes only.

2.09 INSULATED RAIL JOINTS

A. Bonded insulated rail joints shall conform to the current requirements of the SCRRA Engineering Standards ES2504 and AREMA Manual, Chapter 4, Part 3, Section 3.8, “Specifications for Bonded Insulation Rail Joints”.

B. Insulated rail joints shall be of the epoxy-bonded type as manufactured by Allegheny Rail Products, Co., or equal.

C. Insulated rail joints shall be complete with bars, end posts, bushing, washers, pin bolts, collars, washers and adhesives.

D. Straight bars shall be new and smooth and will be providing full face contact, conforming to the applicable rail section, and fabricated from material which meets or exceeds the mechanical properties and workmanship requirements of the current AREMA Volume 1, Chapter 4, Part 3, Section 3.4, “Specifications for Quenched Carbon-Steel Joint Bars, Micro-alloyed Joint Bars and Forged Compromise Joint Bars”. The toe of the joint bar shall properly fit against the web of the rail. When elastically fastened, the joint bar shall provide adequate

clearance to maintain electrical isolation.

E. Pin bolts shall be of ASTM A325 structural steel furnished with the appropriate collar.

F. Flat circular shall be hardened steel washers in accordance with ASTM F436.

G. Bolt hole size shall be in accordance with the bonded insulated joint Vendor's recommendation. If bolt hole diameter is larger than 1-3/16 inches, place ASTM A325 hardened washers between the joint bars and the nut.

H. The bolt hole locations shall be as specified in AREMA, Chapter 4, Part 3, Section 3.3, Rail for a 36-inch joint bar. Insulated joint bar lengths for main track installations shall be 36 inches.

I. Insulated material shall be high pressure, laminated design, impervious to oil, grease, and water, and having electrical characteristics equal to or greater than fiber insulation meeting requirements of the AAR Manual, Part 14.5.1, and electrical resistance tested as specified.

J. Each plug shall be Megohmmeter electrical resistance tested as per AREMA Manual.

2.10 TIE PLUGS

A. Tie hole plugging material shall be SpikeFast as supplied by Willamette Valley Company of Eugene, Oregon, or equal.

2.11 SUPERELEVATION TAGS

A. Furnish metal superelevation tags manufactured from 16-gauge aluminum in accordance with SCRRA Engineering Standard ES2206. Stamp tags in 1/4-inch increments from zero to maximum superelevation.

1. Nails for Securing Tags to Timber Crossties: Galvanized No 10.

2. Adhesive for Securing Tags to Concrete Ties must be approved by OCTA.

2.12 DERAILS

A. Derails shall be as manufactured by Western Cullen Hayes or approved equal. Sliding derail shall meet the requirements shown in UPRR Standard Drawing 2007E or Norfolk Southern Railway Corporation. The sliding and hinged derails shall be painted yellow.

2.13 SOURCE QUALITY CONTROL

A. During OTM fabrication, perform the tests and inspections specified in the AREMA Specifications.

B. The bonded insulated rail joints shall meet electrical resistance test as specified in AREMA Chapter 4, Section 3.8.7.3.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with the SCRRA Engineering Standards and OCTA Contract Specifications unless specifically noted or excepted within these specifications. Promptly notify OCTA of any conflicts, omissions or needed clarifications arising from the use of the designated drawings, standards or specifications.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work associated with project item in Section 34 72 00, Trackwork or Section 34 72 20, Track Shifting, Relocation, and Resurfacing and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery and incidentals as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 34 11 23

SPECIAL TRACKWORK

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for the Special Trackwork to be furnished in accordance with Contract Documents or required by the Engineer.

B. Special Trackwork materials furnished under this IFB shall include rail, switches, frogs, insulated joints, derails, compromise/transition rail, stick rail, and bumping posts and individual turnout components to be used as replacement parts. All materials furnished shall be entirely new materials.

1.02 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering

2. Portfolio of Trackwork Plans

3. Specifications for Special Trackwork

B. American Welding Society (AWS):

1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications

2. AWS D1.1: Structural Welding Code

C. American National Standards Institute, Inc. (ANSI)

1. ANSI B1.1: Unified Inch Screw Threads

2. ANSI B1.3M: Screw Threads Gaging System for Dimensional Acceptability

3. ANSI B18.22.1: Plain Washers

D. American Society for Testing of Materials (ASTM)

1. ASTM A307: Carbon Steel Externally Threaded Standard Fasteners

2. ASTM D257: Test Methods for D-C Resistance or Conductance of Insulating Materials

3. ASTM E325: Requirements for a Testing and Inspection Laboratory

E. Association of American Railroads (AAR)

1. AAR: Manual of Standards and Rec. Practices

2. AAR Section J: Quality Assurance M-1003

F. SCRRA: Engineering Standards.

G. BNSF: BNSF Railway applicable specifications and standards

H. UPRR: Union Pacific Railroad applicable specifications and standards

1.03 DEFINITIONS

A. Closure Rails – The rails between the parts of any Special Trackwork layout, such as the rails between the switch and the frog in a turnout

B. The word “Vendor” used in the Material Specifications (SS) shall mean the Contractor.

C. Fasteners – Joint bars, bolts, clips and spikes

D. Frog – A track structure used at the intersection of two running rails to provide support for wheels and passageways for the flanges, thus permitting wheels on either rail to cross the other

E. Guard Rail – A rail or other structure laid parallel with the running rails of a track – used to hold wheels in correct alignment to prevent their flanges from striking the end of switch points of frog points

F. Point Rail – Switch rail or switch point – the tapered rail of a switch used to divert traffic along either route of a turnout

G. Railbound Manganese Steel Frog- A frog consisting essentially of a manganese steel body casting fitted into and between rolled rails and held together with bolts, known as RBM

H. Running Rail – The rail that carries a wheel as differentiated from a guard rail or flange rail which carry no weight

I. Spring Frog – A frog having a movable wing rail which is normally held against the point rail by springs thus making an unbroken sunning surface for wheels using the track. The flanges of wheels on the other track force the movable wing rail away from the point rail to provide a passageway

J. Stock Rail – A running rail against which the switch points operate

K. Switch – A track structure to divert rolling stock from one track to another

1.04 SUBMITTALS

A. The Vendor shall submit supporting information within 60 days of award documenting the past successful performance in furnishing the materials included in the Schedule of Quantities and Prices. Provide references and contact numbers at the railroads where the turnouts have been placed in service.

B. The Vendor shall submit certificate of compliance that the material delivered is in compliance with the specification within 60 days of approval of payment.

C. The Vendor shall submit Special Trackwork packaging, loading, shipping, and handling method.

D. The Vendor shall submit for OCTA's review and approval quality control and quality assurance plans and related certifications such as ISO 9001, "six sigma" or equivalent demonstrating that the Vendor has the processes, personnel and systems to produce high quality Special Trackwork Materials included in the list of Special Trackwork items as provided in the Schedule of Quantities and Prices.

E. The Vendor shall submit data documenting past performance and projects within the last ten (10) years furnishing Special Trackwork material to Class 1 Freight, passenger or commuter railroads.

F. Administrative and procedural requirements for proposed changes in product and materials from those required by these specifications shall be as per OCTA Contract Specifications Section 01 25 00, "Substitution Procedures".

1.05 QUALITY ASSURANCE

A. Vendor's Quality Control Program (QCP) shall be in accordance with the AAR M-1003 or OCTA approved equivalent quality control program. Comply with AREMA Portfolio of Trackwork Plans.

B. Materials or partially or fully assembled products not meeting the specifications shall be rejected.

C. Equipment used for the manufacturing materials shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be certified and traceable to national standards such as the National Institute of Standards and Technology.

D. Insulated gauge plates and switch rods shall be tested in accordance with AAR Manual, Part 116, Signal Section, Assembly and Test of Insulated Track Fittings.

1.06 DELIVERY, STORAGE AND HANDLIONG

A. The Vendor shall load, transport, and handle the material in a manner which will prevent damage to the material.

B. Band all switch points and stock rails together in one package for each turnout unit.

C. Package all frogs as a single unit per turnout, and identify to indicate the turnout number.

D. Band guard rails together, and identify as to which turnout it is to accompany.

E. All materials delivered will be colored coded and have bar coded control tags on all parts/hardware for easy assembly by field personnel.

PART 2 - PRODUCTS

2.01 GENERAL

A. Use SCRRA Engineering Standards for all turnouts and crossovers and related replacement and spare parts.

B. Rails, castings, forging, rolled shapes, washers, and fastening used in Special Trackwork ordered to the Engineering Standards shall be produced in conformance to these Specifications and AREMA Specifications for Special Trackwork.

2.02 RAIL

A. All steel rail used in the manufacturing of switches, turnouts and crossovers shall be new Low Alloy, Head Hardened, High Strength Grade HH or LH 136 RE (10 inch radius) conforming to AREMA Chapter 4, Part 2, Section 2.1, “Specifications for Steel Rail” and shall meet or exceed 370 HB or new BNSF Specification HH 370 Rail or an equivalent “Premium Type Head Hardened” Rail. If the Bidder is providing rail from a BNSF or UP specification that meets or exceeds these specifications and the AREMA standard – the Special Trackwork Manufacturer shall supply a copy of the applicable UPRR or BNSF standard for the rail being furnished.

2.03 SWITCHES

A. All switch point rails and stock rails shall be Samson type construction in accordance with SCRRA Engineering Standards.

B. Concrete switch ties shall conform to Section 34 11 33 Concrete Railroad Ties and shall be in accordance with SCRRA Engineering Standards.

C. Switch rails shall be fully heat-treated per specifications for heat-treated rails for Special Trackwork, Plan No. 100-92 Specifications in the AREMA Portfolio of Trackwork Plans.

D. Helper rod assemblies for turnout sizes #14 and larger (and associated hollow steel ties for rods) shall be per SCRRA Engineering Standard Plans.

E. Switch rod assemblies shall conform to AREMA Specifications for Special Trackwork, rolled mild steel.

2.04 FROGS

A. Spring frogs shall conform to SCRRA Engineering Standards or approved equal. Castings shall be 3-shot explosion-hardened. Rail shall be deep head hardened rail. Furnish frogs without plates for turnouts and crossovers on concrete ties. Bolts shall be 1-3/8 inch Grade 8 square head with 1/4 inch hardened flat washers and hexagon security locknuts. Lubricate frog bolts and torque to 2,500 foot pounds.

B. Railbound Manganese (RBM) frogs with elastic fastening system shall conform to SCRRA Engineering Standards or approved equal. Manganese castings shall be 3-shot explosion-hardened in accordance with AREMA Specifications. Heel of the frog shall incorporate a 30-degree cut. Frog plates shall be with one inch round holes except as otherwise indicated on the SCRRA Engineering Standards. Bolts shall be 1-3/8 inch Grade 8 square head with 1/4 inch hardened flat washers and hexagon security locknuts. Lubricate frog bolts and torque to 2,500 foot pounds.

C. Casting for frog inserts manganese steel shall be in accordance with AREMA Specifications for Special Trackwork, Article M2.

D. Frog guard rails may be machined initially and subsequently heat treated to achieve the requirements of high strength rail as specified n AREMA Specifications.

E. Tie plates shall conform to AREMA Volume 1, Chapter 5, Section 1.1, Tie Plates - “Specifications for Steel Tie Plates” and appropriate SCRRA Engineering Standard.

2.05 INSULATED JOINTS

A. Bonded insulated rail joints shall conform to the current requirements of the SCRRA Engineering Standards ES2504 and AREMA Manual, Chapter 4, Part 3, Section 3.8, “Specifications for Bonded Insulation Rail Joints”.

B. Insulated rail joints shall be of the epoxy-bonded type as manufactured by Allegheny Rail Products, Co., or equal.

C. Insulated rail joints shall be complete with bars, end posts, bushing, washers, pin bolts, collars, washers and adhesives.

D. Straight bars shall be new and smooth and will be providing full face contact, conforming to the applicable rail section, and fabricated from material which meets or exceeds the mechanical properties and workmanship requirements of the current AREMA Volume 1, Chapter 4, Part 3, Section 3.4, “Specifications for Quenched Carbon-Steel Joint Bars, Micro-alloyed Joint Bars and Forged Compromise Joint Bars”. The toe of the joint bar shall properly fit against the web of the rail. When elastically fastened, the joint bar shall provide adequate clearance to maintain electrical isolation.

E. Pin bolts shall be of ASTM A325 structural steel furnished with the appropriate

collar.

F. Flat circular shall be hardened steel washers in accordance with ASTM F436.

G. Bolt hole size shall be in accordance with the bonded insulated joint Vendor's recommendation. If bolt hole diameter is larger than 1-3/16 inches, place ASTM A325 hardened washers between the joint bars and the nut.

H. The bolt hole locations shall be as specified in AREMA, Chapter 4, Part 3, Section 3.3, Rail for a 36-inch joint bar. Insulated joint bar lengths for main track installations shall be 36 inches.

I. Insulated material shall be high pressure, laminated design, impervious to oil, grease, and water, and having electrical characteristics equal to or greater than fiber insulation meeting requirements of the AAR Manual, Part 14.5.1, and electrical resistance tested as specified.

J. Each plug shall be Megohmmeter electrical resistance tested as per AREMA Manual.

2.06 DERAILS

A. Bi-directional Power Sliding Derail 136RE shall be Hayes model HBXS or approved equal. Derail package shall include all rods, hardware and wood switch timbers, dual powered Electric/Hand operated machine, target and fasteners. Timber to conform No. 8 Turnout Standards above. Derail to be compatible with 136 lb. rail.

B. Bi-directional Sliding Derail 136RE shall be Hayes model HBXS or approved equal. Derail package shall include all rods, hardware and wood switch timbers, low profile switch stand, target and fasteners. Derail shall be compatible for use with or without electric lock. Timber to conform No. 8 Turnout Standards above. Derail to be compatible with 136 lb. rail.

C. Switch Point Derail 136RE or Double Switch Point Derail with wood switch timbers shall meet the requirements of SCRRA Engineering Standard drawing ES2601, ES2602 and ES2604. 16’-6” switch points, Pandrol plates, and galvanized e-clip fasteners with all rods, connection hardware, and target shall be included for use with Union Switch and Signal M23E USS model machine. Timber to conform No. 8 Turnout Standards above. Derail to be compatible with 136 lb. rail.

D. Rail Mounted Flop-over Derail shall be bi-directional with flag, 136RE or 115RE as listed in the Schedule of Quantities and Prices, all hardware and mounting kit included.

2.07 COMPROMISE/TRANSITION RAIL

A. Forged transition rail shall be 136RE to 115RE conforming to the requirements of SCRRA Engineering Standard Plans ES-2372 and E-2373. Length of forged rail section to be 25 feet plus or minus one inch.

2.08 STICK RAIL

A. Furnish 80'-00" long rail with blank ends, conforming to section 2.02 of this specification.

2.09 BUMPING POST

A. Bumping Post shall be as manufactured by Western Cullen Hayes Model "WAC" Bumping Post or equal. Western Cullen Hayes "Hayco Cushion Head" or equivalent that matches with the WAC bumping Post. Bumping post to be compatible for stopping Passenger Cars.

2.10 SWITCH STANDS

A. Hand throw switch stands shall be Racor 36-EH switch stand or approved equal furnished with a 14-inch red target with reflective material such as Scotchlite or equal on both sides.

B. Hand throw switch stand for crossovers shall be Racor 36-E switch stand, or approved equal, furnished with a 40 1/2 inch straight handle providing maximum clearance between tracks and an 8-inch red target with reflective material such as Scotchlite or equal on both sides.

C. Hand throw switch stand for double point split switch derail shall be Racor 36-EH switch stand, or approved equal, in accordance with SCRRA Engineering Standards furnished with a 14-inch round "D" target with yellow reflective material such as Scotchlite or equal on both sides.

2.11 SOURCE QUALITY CONTROL

A. During Special Trackwork fabrication, perform the tests and inspections specified in the AREMA Specifications.

B. Examine each forging and weld by the dry powder method of magnetic particle inspection in accordance with ASTM E709.

C. Perform ultrasonic testing on all forging and welds in accordance with ASTM E164.

D. All frog points shall be Brinell hardness tested on the head and along the side wearing surface in accordance with ASTM E10.

E. The bonded insulated rail joints shall meet electrical resistance test as specified in AREMA Chapter 4, Section 3.8.7.3.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with the SCRRA Engineering Standards and OCTA Contract Specifications unless specifically noted or excepted within these specifications. Promptly notify OCTA of any conflicts, omissions or needed clarifications arising

from the use of the designated drawings, standards or specifications**.**

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Work of this Section is considered incidental to work associated with project item in Section 34 72 00, Trackwork or Section 34 72 20, Track Shifting, Relocation, and Resurfacing and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery and incidentals as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 34 11 26

BALLAST

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for ballast to be furnished in accordance with Contract Documents or required by the Engineer.

B. Ballast shall consist of crushed stone which is angular fragments resulting from crushing by mechanical means the following types of rocks quarried from undisturbed, consolidated deposits: granite and similar phanero-crystalline igneous rocks, extrusive igneous rocks, or massive metamorphic quartzite or similar rocks. No crushed gravel shall be allowed.

1.02 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering

2. Portfolio of Trackwork Plans

3. Specifications for Special Trackwork

B. ASTM International (ASTM):

1. C88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

2. C117: Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.

3. C127: Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.

4. C131: Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

5. C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

6. C142: Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

7. C535: Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

8. D4791: Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

9. D3744: Standard Test Method for Aggregate Durability Index.

10. D3042: Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

11. E11: Standard Specification for Wire Cloth and Sieves for Testing Purposes.

A. CALTRANS: Standard Specifications – State of California Department of Transportation – Current Edition

C. SCRRA: Engineering Standards, and Track Maintenance and Engineering Instructions, particularly but not limited to SCRRA ES2007-02.

1.03 DEFINITIONS

A. Fine Graded Aggregates – Mineral aggregates which will pass a No. 4 mesh screen and be retained on No. 200 screen

B. The word “Vendor” used in the Material Specifications (SS) shall mean the Contractor.

C. Fine Screening – Material below No. 4 mesh screen

D. Gravel – A rock fragment whose diameter range from 2 to 64 mm

E. Hardness of Minerals – A scale of hardness used as an aid in identifying minerals and based on a scale of one to ten with talc having a value of one and diamond a value often

1.04 SUBMITTALS

A. The Vendor shall submit supporting information within 60 days of award documenting the past successful performance in furnishing the materials included in the Schedule of Quantities and Prices. Provide references and contact numbers at the railroads where the turnouts have been placed in service.

B. The Vendor shall submit certificate of compliance that the material delivered is in compliance with the specification within 60 days of approval of payment.

C. Representative samples of ballast, of not less than 150 pounds for gradation and other required tests shall be taken from each source of ballast and tested as specified herein. Samples will be delivered to Authority within 20 days of award. Each shipment of ballast shall be accompanied by a certification as specified.

D. The Vendor shall submit for OCTA’s review and approval quality control and quality assurance plans and related certifications such as ISO 9001, “six sigma”

or equivalent demonstrating that the Vendor has the processes, personnel and systems to produce high quality ballast included in the list of ballast items as provided in the Schedule of Quantities and Prices.

E. The Vendor shall submit data documenting past performance and projects within the last ten (10) years furnishing Special Trackwork material to Class 1 Freight, passenger or commuter railroads.

1.05 QUALITY ASSURANCE

A. Testing shall be performed by Vendor's independent certified testing laboratory approved by OCTA.

B. The Vendor shall provide laboratory certification that ballast Material meets the Specifications of this Section.

C. If the Vendor observes ballast material not suitable for work, or not in compliance with this part, OCTA must be notified within three (3) hours of discovery of condition.

D. The product delivered shall be from the same source from which samples were tested and found to conform to the Specification and shall be of the same type and quality of that which was tested.

1.06 DELIVERY, STORAGE AND HANDLING

A. Prepared ballast shall be handled in such a manner that it is kept clean and free from segregation, and when delivered, the ballast shall be clean and free from rubbish or any substance, which might foul the ballast.

B. Blending, stockpiling, and other production and handling operations must be managed by the Vendor to minimize segregation of finished product.

C. Stockpiling operations shall minimize breakage or excessive fall in stockpiling operations.

D. The movement of wheeled or tracked machines over stockpiled or installed Materials shall be limited.

E. Vendor shall be responsible for unloading ballast under the direction of the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL

A. Use SCRRA Engineering Standards ES2007 for all ballast and sub-ballast supply.

2.02 MATERIAL GRADING REQUIREMENTS

A. Ballast gradation shall conform to SCRRA ES2007-02 and AREMA Volume 1, Chapter 1, Section 2.4.4, Table 1-2-2, Standard No. 4A ballast unless otherwise noted. Gradation test shall be determined in accordance to ASTM C136, utilizing square opening sieves conforming to ASTM E11. The percentage passing each sieve shall fall within the following limits:

SIEVE SIZE	SIEVE OPENING	PERCENT PASSING BY WEIGHT
2 ½	2.50”	100
2”	2.0”	90-100
1 1/2”	1.50”	60-90
1”	1.0”	10-35
3/4"	0.75”	0-10
1/2"	0.50”	-
3/8”	0.375”	0-3
No. 4	0.187”	-

B. Walkway rock or yard ballast gradation shall conform to SCRRA ES2007-02 and AREMA Volume 1, Chapter 1, Section 2.4.4, Table 1-2-2, Standard No. 5 ballast unless otherwise noted. The percent passing each sieve shall fall within the following limits:

SIEVE SIZE	SIEVE OPENING	PERCENT PASSING BY WEIGHT
2 1/2"	2.50”	100
2”	2.0”	100
1 1/2"	1.50”	100
1”	1.0”	90-100
3/4"	0.75”	40-75
1/2"	0.50”	15-35
3/8”	0.375”	0-15
No. 4	0.187”	0-5

C. Sub-Ballast or aggregate base gradation shall conform to SCRRA ES2007-02 and the quality requirements outlined in the most current Caltrans Standard Specifications Section 26-1.02A Class 2 Aggregate Base.

2.03 MATERIAL QUALITY REQUIREMENTS

A. Ballast shall consist of crushed stone which is comprised of angular fragments resulting from crushing, by mechanical means, the following types of rocks quarried from undisturbed, consolidated deposits:

1. Granite and similar, phanero-crystaline igneous rock, extrusive igneous rock, or massive metamorphic quartzite or similar rock.

2. No crushed limestone, dolomites, or gravels shall be allowed.

3. Furnish prepared ballast that is hard, strong, angular, durable particles of crushed rock containing no carbonates or slag and free from injurious amounts of deleterious substances and conforming to the following requirements of these Specifications.

B. Material qualities shall be as follows:

PROPERTY	MINIMUM	MAXIMUM	TEST METHOD
Percent material passing No. 200	--	1.0 percent	ASTM C 136 ASTM C 117
Bulk specific Gravity – Rock	2.60	--	ASTM C 127
Absorption - Rock	--	1.0 percent	ASTM C 127
Clay lumps and friable particles	--	0.5 percent	ASTM C 142
Degradation Granite Traprock Quartzite	-- -- -- -- --	As Noted for Material Type 35 percent 25 percent 30 percent	ASTM C 535 or ASTM C 131 (Note 1)

Soundness – (Sodium Sulfate) – 5 cycles	--	2.5 percent	ASTM C 88
Flat or elongated particles (length is equal to or greater than three times the average thickness)	--	5 percent	ASTM D 4791
Durability Test – Procedure A	65	--	ASTM D 3744
Magnesium Carbonate	--	0	ASTM D 3042
Sand Equivalent	50	__	California 217/ASTM D2419

Note 1: Materials having gradations containing particles on the 1 inch sieve shall be tested by ASTM C 535. Materials having gradations with 100% passing the 1 inch sieve shall be tested by ASTM C131. Use ASTM C 535 for Ballast Standard Type 4A and ASTM C131 for Ballast Standard Type 5.

C. All particles of the ballast shall have been broken by the crusher and must have at least two fractured surfaces.

2.04 SOURCE QUALITY CONTROL

A. Vendor's testing laboratory shall take and perform gradation and other tests on representative samples of ballast, of not less than 150 lbs, from each source of ballast.

1. Perform tests to ensure compliance with these Specifications.

2. Each shipment of ballast shall be accompanied by a certification as specified.

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with the SCRRA Engineering Standards and OCTA Contract Specifications unless specifically noted or excepted within these specifications. Promptly notify OCTA of any conflicts, omissions or needed clarifications arising from the use of the designated drawings, standards or specifications.

.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work associated with project item in Section 34 72 00, Trackwork or Section 34 72 20, Track Shifting, Relocation, and Resurfacing and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery and incidentals as shown on the Plans, and as specified in these Specifications.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 34 11 27

SUB-BALLAST AND AGGREGATE BASE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for roadway and pathway aggregate base to be furnished in accordance with Contract Documents or required by the Engineer.

1.02 REFERENCES

A. SCRRA: Engineering Standards, and Track Maintenance and Engineering Instructions, particularly but not limited to SCRRA ES2007-01 and ES2007-02.

B. American Railway Engineering and Maintenance of Way Association (AREMA): Manual for Railway Engineering.

C. Caltrans Specifications: Section 26 – Aggregate Bases.

1.03 SUBMITTALS

A. Samples: As required by the Engineer samples of not less than 150 lbs. Samples shall be furnished by the Vendor or may be obtained independently by the Engineer's representative for testing to determine whether the material delivered to the site is in compliance with the Specifications.

B. The Vendor shall submit supporting information within 60 days of award documenting the past successful performance in furnishing the materials included in the Schedule of Quantities and Prices. Provide references and contact numbers at the railroads where the turnouts have been placed in service.

C. The Vendor shall submit certificate of compliance that the material delivered is in compliance with the specification within 60 days of approval of payment.

1.04 QUALITY ASSURANCE

A. Testing shall be performed by Vendor’s independent certified testing laboratory approved by OCTA.

B. The Vendor shall provide laboratory certification that ballast Material meets the Specifications of this Section.

C. If the Vendor observes material not suitable for work, or not in compliance with this part, OCTA must be notified within three (3) hours of discovery of condition.

D. The product delivered shall be from the same source from which samples were tested and found to conform to the Specification and shall be of the same type and quality of that which was tested.

1.05 DELIVERY, STORAGE AND HANDLING

A. Prepared sub-ballast and aggregate base shall be handled in such a manner that it is kept clean and free from segregation, and when delivered, the sub-ballast and aggregate base shall be clean and free from rubbish or any substance, which might foul the ballast.

B. Blending, stockpiling, and other production and handling operations must be managed by the Vendor to minimize segregation of finished product.

C. Stockpiling operations shall minimize breakage or excessive fall in stockpiling operations.

D. The movement of wheeled or tracked machines over stockpiled or installed Materials shall be limited.

PART 2 - PRODUCTS

2.01 MATERIAL REQUIREMENTS

A. Sub-ballast shall conform to the gradation and quality requirements for SCRRA ES2007-02 and Caltrans Specifications Section 26-1.02A, Class 2 Crushed Aggregate Base, 3/4” Maximum. In addition, the aggregate shall consist entirely of crushed rock with a minimum of 75 percent of the material having at least two fractured faces. No reclaimed asphalt or concrete shall be included in this material.

B. Aggregate base shall be the same material as sub-ballast.

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with the SCRRA Engineering Standards and OCTA Contract Specifications unless specifically noted or excepted within these specifications. Promptly notify OCTA of any conflicts, omissions or needed clarifications arising from the use of the designated drawings, standards or specifications.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Construct Track Subballast will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

B. Construct Aggregate Base (Roadway Pavement) will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

4.02 PAYMENT

A. Construct Track Subballast and Construct Aggregate Base (Roadway Pavement) furnished and completed in accordance with the Contract Documents will be paid for as at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, materials, tools, equipment, supplies, supervision and incidentals necessary, and doing all work, as shown on the Plans, and as specified in these Specifications

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery, subgrade preparation, and incidentals as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 34 11 33

CONCRETE RAILROAD TIES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for production and inspection of monoblock, pretensioned, prestressed concrete ties for standard gage track (4' – 8 1/2") to be furnished in accordance with the specifications and SCRRA Engineering Standards ES2402, ES2403, ES2406, ES2407, or the concrete turnout ties as shown in the SCRRA Engineering Standard Plans for the specific turnout to be constructed as appropriate.

B. Work included in this Section encompasses work necessary for the manufacturing and production of concrete crossties and guardrail concrete cross ties both with or without neoprene pads.

C. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 34 72 00 - Trackwork.

4. Section 34 72 20 - Track Shifting, Relocation, and Resurfacing.

1.02 REFERENCES

A. SCRRA Engineering Standards:

1. ES2402, ES2403, ES2406 or ES2407 as appropriate.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. T-26, Standard Method of Test for Quality of Water to Be Used in Concrete.

C. American Concrete Institute (ACI):

1. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

2. 214, Standard Practice for Evaluation of Strength Test Results of Concrete.

3. 301, Specifications for Structural Concrete.

4. 318, Building Code Requirements for Structural Concrete.

D. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering, Volume 1, Chapter 30, Part 4.2.3 Duggan Concrete Expansion Test.

E. ASTM International (ASTM):

1. A421, Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete.

2. A536, Standard Specification for Ductile Iron Castings.

3. A881, Specification for Steel Wire, Deformed, Stress-relieved or Low-relaxation for Prestressed Concrete Railroad Ties.

4. A886, Standard Specification for Steel Strand, Indented, Seven-Wire Stress-Relieved for Prestressed Concrete.

5. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.

6. C33, Standard Specification for Concrete Aggregates.

7. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

8. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens).

9. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.

10. C150, Standard Specification for Portland Cement.

11. C191, Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.

12. C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

13. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).

14. C260, Standard Specification for Air-Entraining Admixtures for Concrete.

15. C295, Standard Guide for Petrographic Examination of Aggregates for Concrete.

16. C359, Standard Test Method for Early Stiffening of Hydraulic Cement (Mortar Method).

17. C430, Standard Test Method for Fineness of Hydraulic Cement by the 45-µm (No. 325) Sieve.

18. C457, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete.

19. C494, Standard Specification for Chemical Admixtures for Concrete.

20. C617, Standard Practice for Capping Cylindrical Concrete Specimens.

21. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

22. C666, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.

23. C403, Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.

24. C1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

25. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.

26. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).

27. E994, Standard Guide for Calibration and Testing Laboratory Accreditation Systems General Requirements for Operation and Recognition.

F. Precast/Prestressed Concrete Institute (PCI):

1. MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

1.03 DEFINITIONS

A. The word "Inspector" in this Specification shall mean the duly authorized representative of OCTA.

B. The word “Vendor” used in the Material Specifications (SS) shall mean the Contractor.

C. The word "manufacturer" in this Specification shall mean the manufacturer of concrete ties.

D. The word "supplier" in this Specification shall mean a supplier of materials or components for use in the concrete ties.

E. The word "source" in this Specification shall mean a plant where a material or component used in the concrete ties, is produced. For aggregates, the word "source" shall mean the strata or quarry face from which the aggregate is obtained.

F. The word "bed" in this Specification shall mean a prestressing bed with forms placed end to end. Each bed is only one form wide.

G. The word "form" in this Specification shall mean a battery form, one tie long, with 5 to 8 cavities in which ties are cast upside down.

H. The word "line" in this Specification shall mean a series of ties end to end on a prestressing bed. Each line is only one tie wide.

I. The words "long line process" in this Specification shall mean ties being, made on a bed with at least ten forms end to end and on which the prestressing wires are tensioned between fixed abutments, independent of the forms, and prior to placing concrete.

J. The words "outside testing laboratory" in this Specification shall mean a testing laboratory, independent of the manufacturer, which conforms to ASTM E994 and is approved by the Engineer.

1.04 SUBMITTALS

A. Submit under the provisions of Division 01:

1. Compliance: Manufacturer’s certification that the materials delivered are in compliance with the specification.

   a. Certification that the proposed concrete tie and shoulder inserts will satisfy all test requirements as specified herein.

   b. Certification shall include qualified laboratory test results, calculations and performance reports from a proven fastener design with five (5) years of operational service.

2. Tests:

   a. Certified test results, as required to demonstrate compliance of materials specified herein shall be submitted to the Engineer. The test results for the following items shall be supplied:

      1) Cement.

      2) Aggregates.

      3) Water.

      4) Concrete.

      5) Rail Seat Pads.

      6) Fasteners.

      7) Electrical Properties.

8) Tie Testing.

3. Design Analysis:

a. A complete design analysis of the proposed tie and associated hardware, verifying the tie's capability to pass the test requirements contained in the Specifications and verifying the adequacy of the materials for their intended use.

b. Design submission shall include:

1) Structural detail Drawing(s) of the proposed tie and fastening assembly.

a) The Drawing shall include tie configuration, prestressed strand size and location, and details of the shoulders with their fabrication tolerances.

2) All structural calculations shall be based upon current industry standards for prestressed concrete design and the ACI standard requirements applied as follows:

a) Calculations shall include moment analysis for the tie under no-cracking conditions and shall consider all long-term permanent prestress losses.

3) Concrete batch compositions:

a) Submission shall include physical and chemical composition of the batch; including, type and source of cement admixtures used, source and gradation of aggregates, source and quality assurance of water, curing, procedure, including concrete strength at prestress transfer, and separation of the tie from the form.

b) It is the Vendors responsibility to ensure that the concrete composition and quality is suitable for its intended purpose.

4) Specifications for pretensioning tendons:

a) Documentation confirming the quality of material used in these elements.

5) Cure time:

a) The length of cure time necessary for the tie to reach 7,000 psi strength prior to delivery for placement in track.

4. Submit Shop Drawings prepared by the manufacturer for the standard “Fastclip” concrete ties and the guardrail equipped “Fastclip” concrete ties both with and without neoprene pads, if required.

5. Submit to the Engineer Shop Drawings prepared by the manufacturer for the forms and for the gages.

    a. Forms and gages shall not be used until the Plans have been approved by the Engineer.

6. Before production commences, submit a Quality Control Manual prepared by the manufacturers for approval by the Engineer.

    a. This Manual shall include the following details:

        1) Management organization.

        2) Responsibilities of production and quality control personnel.

        3) Plant Standards.

        4) Checks to be carried out by production personnel.

        5) Inspection and testing to be carried out by quality control personnel.

        6) Procedures for approving sources of materials and for order in materials.

        7) Procedures to insure that only materials complying with these Specifications are used.

        8) Procedures to insure all measuring equipment is properly calibrated.

        9) Procedures to insure that ties are not shipped until acceptance load testing is complete and that rejected ties are clearly marked and segregated from good ties.

        10) Quality Audit procedures.

    b. The Manual shall be revised or amended whenever there are changes in personnel, responsibilities, or other items contained in it.

7. Submit the Quality Control Program and the Production Program specified under “Quality Assurance and Quality Control” herein.

8. Submit written reports to the Engineer prepared by the manufacturer documenting strict adherence to the Quality Control Program and the Production Program.

1.05 QUALITY ASSURANCE

A. Qualification of the Manufacturer:

1. The manufacture shall have a minimum of 5 years experience, in a fixed location, of the large-scale manufacture of pretensioned prestressed concrete railroad crossties by the long line process.

   a. The manufacturer's existing plants in the USA shall have been certified under the PCI Plant Certification Program.

   b. If the manufacturer's existing plants are outside the USA, they shall have been certified by the equivalent National Certification Organization for that country.

2. The manufacturer shall show to the satisfaction of the Engineer that he has, or can obtain, the necessary and proper equipment, tools, facilities and means, and that he has the experience, ability and financial resources to perform the work within the time specified and to the quantity standards required.

3. Ties shall be manufactured by the long line process with 5 to 8 lines per bed.

4. If the manufacturer produces the ties in a new plant, that plant shall be certified under the PCI Plant Certification Program within 6 months from the start of production.

5. The requirements of ACI 301 and PCI MNL 116 shall apply except where other requirements are stated in these Specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Concrete ties shall be shipped in open-top cars or flat bed truck trailers.

1. Ties shall be securely braced for transportation to prevent any movement that will cause damage.

2. Ties shall be shipped in a horizontal position and braced with spacer blocks in such a manner that the top surface or cast-in-place hardware does not contact ties loaded above.

3. Ties shall not be loaded higher than the top of the cars and not more than six layers deep.

B. Ties must be delivered, unloaded, and neatly stockpiled as necessary on the project site by the Vendor.

1. When handling ties in the plant, yard or at the delivery site, ties must not be dropped or otherwise damaged.

2. Ties must be stacked on firm level ground, not more than 10 ties high and supported on dunnage at the rail seats only.

PART 2 - PRODUCTS

2.01 GENERAL - MATERIALS

A. The manufacturer shall only use materials from sources approved by the Engineer.

1. For cement, the source of clinker and the source of the ground cement will be approved by the Engineer.

2. All tests for cement and aggregate shall be completed in accordance with this Specification before approval of materials is requested from the Engineer.

B. Adequate time shall be allowed for the Engineer to approve new sources.

1. Trial concrete mixes shall be cast at least 90 days prior to approval being requested.

C. For aggregates to be supplied from a new source that has not been previously tested, a minimum period of 224 days shall be required for testing to ASTM C227 prior to approval being requested.

1. Alternatively, 70 days shall be allowed for the Osmotic Cell Test. OCTA will accept previous test results on these aggregates from a qualified laboratory performing these tests as required to the standards of the appropriate ASTM which has been supervised, signed and sealed by a California Registered PE or Geologist.

2.02 CONCRETE

A. The minimum 28-day-design compressive strength of concrete used for concrete ties shall be 7000 psi as determined in accordance with ASTM C39.

1. The test cylinders shall be made and stored as specified in ASTM C31.

B. Batching and Mixing:

1. Aggregates and cement shall be measured by weight.

a. The weight of aggregate shall be based on a saturated surface dry condition corrected for free moisture.

2. Water shall be measured by weight or volume and admixtures shall be measured by volume.

3. Each batch of concrete shall be mixed separately in a pan mixer or approved horizontal drum mixer located at the site of the concrete tie manufacturing, process.

4. No water shall be added to concrete after discharge from the mixer.

5. The quantity of each material used in each batch of concrete shall be automatically recorded.

C. Proportioning:

1. Mix proportions shall be developed using the method in ACI 301, Section 3.9. The cement content shall be not less than 600 lbs/cy.

D. Temperature: The temperature of freshly mixed concrete shall not exceed 90° F.

E. Curing:

1. Immediately after placing and consolidating, the concrete, the exposed surface shall be protected from rapid evaporation.

2. Concrete shall not be placed in forms whose temperature is less than 40 DegF and the concrete temperature shall not be allowed to fall below 50 DegF between casting, and transfer of prestress.

3. If heat curing is used, the forms may be preheated to avoid cooling of the concrete after placing but the temperature of concrete shall not exceed 90 DegF during the first three (3) hours and 105 DegF during the first four (4) hours (ASTM C403).

4. The rate of temperature rise in the concrete shall not exceed 35° F per hour and the maximum concrete temperature shall not exceed 158° F.

a. Transfer of prestress shall not be carried out at a concrete temperature above 135° F.

b. The heating method used shall be such that all ties in a bed are at a similar temperature.

5. During curing, the temperature at the center of the rail seat cross section of one tie in each bed shall be automatically recorded.

F. Testing Fresh Concrete:

1. The first batch on any bed shall be tested in accordance with this Specification and if this requires no adjustment to the mix, a further test shall be made after approximately 25 cubic yard has been poured.

a. If the first batch requires adjustment to the mix each subsequent batch shall be tested until no further adjustment is necessary and then a further batch shall be tested after approximately 25cubic yard has been poured.

2. Slump:

a. When measured in accordance with ASTM C143, the slump shall not exceed 2 inches when concrete is placed in the forms.

b. A minimum of two measurements of slump shall be made, on separate batches of concrete, for each bed cast or each 50 cubic yard concrete whichever is less volume of concrete.

3. Air Content: Air entrainment of the concrete shall comply with the following table:

PERCENT AIR ENTRAINMENT STAGE	AIR CONTENT
Plastic Concrete	4.5% ±0.7%
Cured Concrete	3.5% ±0.5%

G. Testing Hardened Concrete:

1. Compressive Strength:

a. When measured on 4” x 8” cylinders capped in accordance with ASTM C617 and tested in accordance with ASTM C39, the minimum compressive strength shall be:

1) At transfer of prestress: 4500 psi.

2) At 28 days: 7000 psi.

b. The minimum number of test cylinders per bed shall be:

1) For transfer strength: 4.

2) For 28 day strength: 3.

c. The cylinders shall all be made from one batch of concrete and the slump and air content shall also be measured on the same batch.

d. The cylinders shall be cured with the ties until transfer of prestress, in such a way that the temperature of the cylinders is with +0˚ -15° F of the temperature of the ties.

e. After transfer of prestress, the 28-day cylinders shall be cured in accordance with ASTM C192.

2. As an alternative to cylinders 4 inches cubes may be used to measure the compressive strength at transfer of prestress.

3. Two cylinders shall be tested for transfer strength.

   a. If either result is less than 4500 psi, curing shall be continued for at least a further one (1) hour.

   b. No bed shall be detensioned until at least two cylinders achieve a strength of 4500 psi.

   c. If all transfer cylinders are tested without conforming to this requirement the bed may be detensioned if at least one cylinder achieves 4500 psi.

   d. An additional set of ties from one form shall then be acceptance load tested.

   e. If no transfer cylinders achieve 4500 psi, the bed may be detensioned providing, all ties are acceptance load tested.

4. The strength at 28 days shall be satisfactory if the average of three cylinders is not less than 7000 psi and no individual result is less than 6500 psi.

H. Durability:

1. One tie shall be selected at the start of production and thereafter every three months, for air void content and durability factor tests by an outside testing laboratory.

2. The air void content shall be measured in accordance with ASTM C457 on the top, center and bottom of a cross section slice cut from the rail seat of a tie.

   a. The measured air void content shall be not less than 3.0 percent and the air void spacing factor shall not exceed 0.008 inch.

3. The durability factor shall be measured in accordance with ASTM C666 on a minimum of 4 prisms of concrete taken adjacent to the samples used for the durability tests as required by this Specification.

   a. The durability factor shall not be less than 90 percent.

4. The frequency of testing, for durability shall be increased at the Engineer's request if there is evidence that not all ties satisfy the requirements of this Specification.

I. Chloride:

1. The water-soluble chloride content of the concrete shall not exceed 0.06 percent expressed as chloride ion by weight of cement.

a. This shall be measured by an outside testing laboratory on fresh concrete or on individual materials in the mix when mix proportions are developed in accordance with Paragraph entitled “Proportioning” in the Article “Concrete” of this Specification and thereafter, by tests at three monthly intervals which include materials from all sources in use.

J. Alkali - Silica Reactivity:

1. The composition of the cement, fine aggregate shall be analyzed and tested in accordance with ASTM C33, ASTM C227, and the "Duggan" Concrete Expansion Test so as to ensure that the resulting combination does not produce a concrete subject to deleterious expansion resulting from an alkali-silica reaction.

a. These tests are to be repeated every 6 months, from each source, unless otherwise defined in this Specification.

b. In addition, whenever a component or source is changed, new tests will be performed on these components or sources.

2.03 CEMENT

A. Cement shall conform to ASTM C150, and low alkali.

1. Cement alkali content of Na_2O equivalent (Na_2O + 0.658 K_2O) shall be as low as possible and not greater than 0.6 percent.

2. The false set penetration, when tested in accordance with ASTM C359, shall be not less than 50 mm at intermediate times and 40 mm after remix.

B. Separate random samples of cement shall be taken each day to represent the cement used on each bed.

1. Each sample shall be not less than 1 gallon and shall be clearly identified with the date and bed number.

2. Each sample shall be kept in air- tight container until the corresponding 28-day cylinder tests have been carried out and results accepted by the Engineer.

C. Not more than two sources of clinker or ground cement shall be used by the manufacturer during any one-month.

1. Cement from each source shall be clearly identified and stored in separate weather tight silos.

2. If two sources of cement are used on one bed, the tests in Paragraph 2.02E herein shall be performed on the first batch of concrete made with each cement and if no adjustment to either mix is required, testing shall continue as single design as required in Paragraph 2.02E. herein Strength tests as required in Paragraph 2.02.F.1 herein shall also be conducted on concrete made with each type of cement.

D. Cement mill certificates shall be provided weekly by each supplier and shall include the results of the following tests on cement delivered during that week.

1. Under no circumstances shall substitution of cement be permitted unless it has been pre-qualified through the tests listed in this Section.

a. Fineness by air permeability (ASTM C204).

b. False Set (ASTM C359) - Penetration at 3, 5, 8, and 11 minutes and remix.

c. Setting Time (ASTM C191).

d. Compressive Strength (ASTM C109) at 1 day, 3 days, and 7 days.

e. Chemical Analysis (ASTM C114) - INCLUDING SIO Al_202_3, Fe_2O_3, CaO, MgO, SO_3, K_2O, Na_2O and calculated alkalis as N_2O equivalent, C_3S, C_2S, C_3S, C_4AF.

f. Residue on 325-mesh sieve (ASTM C430).

E. At least once during every three months, a randomly chosen sample of cement from each source used shall be analyzed for alkali content in accordance with ASTM C114 by an outside testing laboratory.

2.04 AGGREGATES

A. Both fine and coarse aggregates shall meet the requirements of the AREMA Specifications for Aggregates, Part 1, Section 1.3, Chapter 8 of the AREMA Manual.

B. Aggregates shall be natural aggregates complying with ASTM C33 Class 4S. The maximum combined coarse aggregate percentage wear shall not exceed 39 percent.

C. The manufacturer shall provide evidence that concrete containing aggregate from the proposed source with a cement content and alkali burden similar to the job mix, has a satisfactory service history of at least 5 years. This evidence shall include structures requiring a Class 4S aggregate.

D. The maximum size of aggregate shall be ¾". If the coarse or fine aggregate is supplied in more than one size, each size shall be stored separately.

E. Washed aggregate shall be allowed to drain, in stockpiles, before use. All aggregates shall be free from ice when used.

F. In additional to the requirements of ASTM C33, the following tests shall be conducted by an outside testing laboratory.

1. Petrographic examination to ASTM C295. Examination shall be repeated on aggregate from each new source.

2. Evaluation of potential alkali reactivity to ASTM C227 or ASTM C1293.

a. A separate test shall be conducted with each job cement and the results shall conform with ASTM C33 at three and six months.

b. This shall be repeated every 6 months for each source.

c. When there is insufficient time for testing, to ASTM C227 or ASTM C1293, potential alkali reactivity may be evaluated by the Osmotic Cell Test* developed by PCA.

1) The flow rate at 30 days shall not exceed 1.5 mm per day. Proceedings 6th International Conference on Alkalis in Cement, Danish in Concrete Institute, Copenhagen, 1983.

3. Evaluation of potential alkali carbonate reactivity:

a. Aggregates containing carbonate shall be tested in accordance with ASTM C586.

2.05 WATER

A. Water in mixing concrete and washing aggregates shall be potable and free of injurious amounts of oil, acid, alkali, inorganic matter, or other deleterious substances, that may be harmful to concrete or steel as specified in AASHTO T-26.

1. In addition, the mixing water, including that portion of the mixing water contributed in the form of free moisture on the aggregates, shall not contain a chloride ion content greater than 400 ppm.

2.06 ADMIXTURES

A. Chemical admixtures for concrete shall conform to ASTM C494.

1. Admixtures containing chlorides, fluorides, sulfides, or aluminum powder shall not be used.

2. Only liquid admixtures shall be used.

3. Air-entraining, admixtures shall conform to ASTM C260 and contain neutralized Vinsol Resin or other approved natural resins as the active ingredient.

4. Water reducing admixtures shall only be used with the approval of the Engineer. They shall conform to ASTM C494, Types A, B, D, or E.

   a) Water-reducing admixtures, retarding admixtures, accelerating admixtures, water reducing and retarding admixtures, water-reducing and accelerating admixtures, and high range water reducing admixtures, when authorized by the Engineer, shall conform to ASTM C494 or ASTM C1017 in the case of superplasticizers.

5. Other mineral admixtures shall not be used, except for Class F Flyash as noted below, unless mix and quality control program are specifically approved by the Engineer.

6. Class F Flyash, if used, shall conform to ASTM C618. The properties shall not exceed the following:

   a. 1.5 percent available alkalis and 6 percent loss on ignition.

   b. Mill test certificates shall accompany each lot of Class F Flyash used in tie production in order to ensure consistency.

   c. The combined mix design with admixtures, if used, shall be tested using ASTM C1567 on the proposed job mix to verify alkali-silica reaction (ASR) potential.

2.07 PRESTRESSING TENDONS

A. General:

1. Prestressing shall be indented wire strand or stress relieved wire.

2. The wires shall comply with ASTM A881 or stress relieved wire complying with ASTM A421.

3. The minimum tensile strength of the wire shall be 225,000 psi.

4. Strands for pretensioning tendons shall conform to ASTM A886.

5. All tendons shall be thoroughly cleaned of drawing lubricants before shipment.

6. Tendons from one source only shall be used on each bed.

7. Tendons shall not be contaminated with mud, oil, grease, or chloride salts.

8. Loose rust shall be removed during stringing and tendons pitted due to corrosion shall not be used.

B. Pretensioning:

1. During stringing, tendons shall not become contaminated with form release agent.

2. Each tendon shall be individually tensioned with the same initial force of between 5 percent and 20 percent of the final force using, a hydraulic jack.

a. The final force shall then be applied by multiple tensioning with hydraulic jacks.

b. The force shall be measured by pressure cases located immediately adjacent to each jack and be measured by elongation.

c. The forces measured by the two methods shall agree to within 5 percent.

C. Detensioning:

1. Stress transfer shall be performed in a controlled manner with hydraulic jacks.

a. The forms shall be free to move and the stress in all tendons shall be transferred at the same time and the same rate.

b. No tendon shall be cut until it is completely detensioned.

2. If any tendons break during, curing, all ties shall be load tested in Rail Seat Positive in accordance with Paragraph entitled “Acceptance Load Testing” in Article “Testing of Ties”, starting with the ties from the form adjacent to the abutment where the tendon broke and moving towards the other abutment, when a point on the bed is reached at which all ties from one form pass the test, the remaining ties shall be accepted without further load testing.

2.08 RAIL FASTENING COMPONENTS

A. Rail fastening system shall be resilient, thread-less and adjustable in three steps without dismantling the fastener. The three steps shall be:

1. Retracted: Permits installation or removal of rail.

2. Intermediate: Permits longitudinal rail movement.

3. Clamped: Provides full rail clamping force.

B. Fasteners shall be comprised of as few components as economically and technically feasible for ease of assembly, disassembly, and maintenance. The rail clips, rail seat pads, and insulators shall be furnished by rail clip manufacturer and shall be compatible with concrete tie shoulders.

C. Configure fasteners so that the rail clip can be installed or replaced in the field by one person using standard readily available track tools. Clips shall also be capable of being installed by commercially available automated equipment.

D. Configure fasteners so that when the rail clips are retracted, the rail may be lifted vertically until it is completely free of the fastener without disturbing the horizontal or vertical alignment of the fastener.

E. Fasteners shall have, on both sides of the rail base, a positive means of preventing more than 1/8 IN total lateral movement of the rail base relative to the fastener in case of failure or loosening of one or both rail clips. The positive means shall extend at least 3/8 IN above the base of rail in the installed position.

F. Fasteners shall be Pandrol “Fastclip” or approved equal. Rail clips, insulators and tie pads shall be pre-assembled on cross tie at manufacturer’s plant.

G. Rail Clips:

1. Rail clips shall not be dependent on elastomeric components in torsion. The clips shall be reusable after removal through repeated applications without any effect on the operating performance of the system.

2. The minimum vertical hold down force for spring clips shall be 2,500 LBS with total minimum force of 5,000 LBS per rail fastener assembly.

H. Insulators:

1. An insulator shall be used between the rail clip, shoulder insert and the rail to position rail to the proper gauge, provide electrical insulation, reduce abrasion, and transfer the rail loading to the rail clip and shoulder insert.

2. The insulator shall be capable of withstanding degradation from oxidation, water, alkali, petroleum oils, synthetic lubricants, and sunlight without having detrimental effect on the performance of the insulator.

3. Insulator dimensions shall be appropriate to provide standard gauge dimension.

4. Insulators for different uses (adaptive insulators) shall be of different colors or different appearance for ease in identification.

I. Rail Seat Pads:

1. Provide rail seat pads compatible with the rail fastening system with a shape which provides positive means of preventing movement of the pad parallel to the rail. Pads must comply with SCRRA Engineering Standard ES2363.

2. Alternate designs of rail seat pads shall be considered, provided they have successful history of performance of at least three years service under comparable service conditions.

a. Any alternate design must be specifically approved by the Engineer.

b. Submit results of industry standard tests concerning the above properties.

J. Iron Shoulders:

1. Iron Shoulders shall be Pandrol cast shoulders for “fast clip” or approved equal, sized for 136 lbs., 6” IN base rail dimension, with adaptive insulators, pads, and clips

2. Ductile iron shoulders shall be obtained by the manufacturer and shall conform to ASTM A536 Grade 60-40-18 or 65-45-12.

a. They shall be marked with the part number, supplier's identification and pattern number.

b. At least four Y block specimens shall be cast from each heat, or in continuous casting, from each four-hour period.

c. All specimens shall be heat treated under the same conditions as the shoulders they represent.

d. Tension test specimens with a cage length of 2 inch shall be machined from the Y blocks and one tension test shall be made for each heat or each four-hour pour period.

e. If the elongation and tension test results do not conform to ASTM A536, a further specimen shall be tested and if this fails the cast shall be reheated or rejected.

f. The shoulders and test specimens may not be reheated more than once.

1) After reheating, two test specimens shall be tested.

2) If either of these fails to conform to ASTM A536, the cast shall be rejected.

g. The shoulders shall be free from burned-on sand, cracks, cavities, injurious blowholes and other defects.

1) All fins shall be removed from the vertical faces of the head of each shoulder.

2) Fins across the top of the head shall not exceed 1/32 inch and below the head, fins shall not exceed 1/16 inch.

3) At gates, there shall be no cavity in the shoulder more than 1/8” below the general surface level.

h. Go and No Go inspection gages shall be used to check that tolerances conform to the Plans.

1) A sampling plan for Acceptable Quality Levels of 1 percent for major dimensions and 4 percent for minor dimensions shall be used.

2) The manufacturer shall decide which are major and minor dimensions in consultation with the Engineer (through the Vendor).

3. Iron shoulders shall be free of mud, oil, loose rust and other contamination when cast into ties. They shall be rigidly secured in the forms during casting and shall not move within the concrete when the securing device is released.

4. Location within the ties shall comply with the tolerances on the tie Plans.

5. Ductile iron shoulders shall conform to the dimensions on the Plans issued by the fastening clip suppliers.

K. Guard Rail Inserts: Inserts for guardrail concrete ties shall be as shown on SCRRA Engineering Standards ES2406 or ES2407 or approved equal.

L. Neoprene Pads: Neoprene Pads cast into the bottom of the tie for use on bridge decks in certain applications as indicated in the Contract Documents shall be as shown on SCRRA Engineering Standards ES2403 or ES2407.

2.09 TIE DIMENSIONS, CONFIGURATION AND WEIGHT

A. Dimensions, configuration and weight shall conform to the following:

1. Alternative designs of concrete ties will be considered if they have the same general profile, and length.

2. Alternative designs must have a successful history of performance of at least five years service under comparable service conditions.

3. Any alternative design must be specifically approved by the Engineer.

B. Dimensions:

1. General:

a. Weight: Maximum weight shall be 750 lbs..

b. Base Width: 10-3/8 inch (±1/4 inch).

c. Height, at rail seat: 8 inch (+3/16 inch -1/8 inch).

2. Cross Ties:

a. Length: 8 FT 3 inch (±1/8 inch).

b. Height, at center of tie: 6-1/4 inch (+3/16 inch -1/8 inch).

c. The rail seat shall provide for a cant of 1 in 40 toward centerline of track.

3. Track Gauge shall be 4" – 8 1/2".

2.10 FLEXURAL STRENGTH

A. Flexural strength performance and test requirements shall comply with Section 4.4, Chapter 30 of AREMA Manual.

1. Results per Section 4.9, Chapter 30 of the AREMA Manual shall be provided.

2. The minimum flexural performance requirements for the concrete ties shall be as follows:

a. Positive rail seat moment of 280 inch-kips static.

b. Negative rail seat moment of 146 inch-kips static

c. Static center positive moment of 110 inch-kips.

d. Static center negative moment of 162 inch-kips.

2.11 LONGITUDINAL AND LATERAL RAIL RESTRAINT

A. The concrete tie and elastic fastener shall provide longitudinal and lateral rail restraint as specified in Section 4.6 and Section 4.7, Chapter 30 of the AREMA Manual.

2.12 ELECTRICAL PROPERTIES

A. Each concrete tie, together with its elastic fastening, shall comply with Section 4.8, Chapter 30 of the AREMA Manual.

2.13 TESTING OF TIES

A. Prior to approval of the concrete tie design, tests specified in Section 4.9, Chapter 30 of the AREMA Manual, unless otherwise modified by this Section, shall be performed at testing facility approved by the Engineer and results provided to the Engineer.

1. Surface Finishes.

2. Every tie produced shall be visually inspected.

3. Two ties which, in the opinion of the Inspector, show the required bottom surface finish and two ties which in the opinion of the Inspector show the maximum allowable rail seat defects shall be set aside as comparison standards for acceptance of ties.

4. The bottom surface of each tie shall have a rough struck, leveled surface.

    a. Projections from and indentations into the general level of the surface shall not exceed 3/16 inch.

    b. The indent pattern shall be approved by the Engineer.

5. The surface of the rail seat shall have a smooth, formed finish not inferior to the comparison standards.

    a. No forms, seams or warpage in the rail seat will be allowed.

    b. The rail seat flatness shall not exceed a 1/32 inch difference across any part of the rail seat.

        1) When referring to voids and rail seat flatness in the rail seat area, the rail seat will be defined as "area between adjacent shoulders and edge of tie to edge of tie" and the area adjacent to the shoulder and 3/8 IN beyond the face of the front face of the shoulder.

        2) Grinding or shaving with a jig is acceptable.

        3) Freehand grinding is not acceptable, unless approved by the Engineer.

        4) Filling of rail seat voids with fillers is not acceptable.

        5) No rubbing, brushing or other treatment shall be used on the rail seat.

6. All ties will require a lateral resistance pattern to be placed on the side of the tie.

    a. The Engineer will review for approval the design, but not provide the design of this pattern.

    b. The tie shall provide a minimum lateral in a single tie push test of 5,000 lbs..

    c. The tested tie must be in track on a major heavy haul railroad with adequate ballast depth.

    d. Proof of the lateral resistance design will be through multiple single tie tests as performed by the AAR.

e. The tie manufacturer assumes all responsibility for maintenance and design of these forms and patterns.

f. The Engineer will not accept a tie without a proven pattern.

7. Other formed surfaces shall be smooth and holes shall not exceed 1/4 inch in depth and diameter.

a. Ties with a limited number of holes up to 3/8 inch diameter but not exceeding 1/4 inch in depth will be accepted providing that holes are filled with a mixture of 3 parts washed sand, 1 part cement and 1 part SBR latex measured by volume or other accepted material.

8. Holes in tie ends shall not exceed 3/8 inch diameter and 1/2 inch in depth or 1/4 inch diameter and 1 inch in depth below the general surface level of concrete.

9. Corner breakage at tie ends shall not exceed 1 inch in depth.

10. Ties with visible cracks shall be rejected.

11. Prestressing wire shall not protrude more than 1/8 IN beyond the tie end and shall not have ragged ends, which would be hazardous in handling.

12. The surfaces where fastening components bear on the iron shoulders shall be 100 percent free from concrete or other foreign materials.

B. Tie Dimension Inspection:

1. Approved Go and No Go gages shall be used to check the following:

a. Out to out shoulder spacing.

b. Adjacent shoulder spacing.

c. Shoulder height.

d. Rail seat cant.

e. Rail seat flatness.

f. Rail seat wind or warpage.

g. Wire location.

2. A "Go and No Go" gage is the basis for acceptance and rejection. No interpretation of a gage is acceptable.

3. The inspector may gage as often as is required or as the Engineer feels necessary to QC confidence. If a problem is found then it is the responsibility of the Manufacturer to provide inspection as directed by the Engineer (100 percent if necessary) until the extent of the problem has been determined or the rework has been properly confirmed.

4. When new forms, modified forms or repaired forms are used, the first tie cast in each cavity shall be checked with Go and No Go gages and normal measuring equipment to insure conformity with dimensional tolerances on the tie Plans.

5. All ties selected for routine acceptance load testing shall be checked as described in this Specification.

6. Wire pattern shall:

   a. Ensure 3/4 inch minimum concrete cover of prestress tendons.

   b. Be placed accurately to prevent electrical short between embedded fasterners.

   c. Achieve flexural bending strength in Section 2.10.

7. Wire pattern for all ties on both ends shall be visually inspected every day.

C. Acceptance Load Testing:

1. All acceptance load testing shall be carried out on the day that detensioning is performed. Vendor must provide sufficient notice to the Engineer so as to allow for OCTA Inspectors to be present during acceptance load testing.

2. Production Start-up Testing: From the first bed cast under any contract, all the ties from one form, selected at random, shall be load tested as follows:

   a. Rail seat positive and bond development at one end.

   b. Rail seat negative at the other end.

   c. If the ties meet these test requirements, further beds may be cast.

   d. If any tie fails to meet the test requirements, two further ties shall be taken from the same line and, if either of these ties fails to meet the test requirements, each tie in the line shall be individually tested, excluding the bond development test.

      1) One further bed shall then be cast and the test procedure repeated.

      2) When the test ties meet these requirements an additional four (4) ties shall be randomly selected from the bed already cast and tested as follows:

a) Two (2) ties tested for Tie Center Negative Moment Test.

b) Two (2) ties tested for Tie Center Positive Moment Test.

3) If any tie fails to meet test requirements, two further ties shall be taken from the same line.

a) If either of the ties fail, then the batch is rejected.

b) When the test ties meet all of the production startup testing requirements, further beds may be cast.

3. Routine Production Testing:

a. After initial production acceptance testing routine acceptance testing shall be carried out on all beds cast.

b. All ties from one form, selected at random from each bed cast, shall be load tested as follows:

1) Rail Seat Positive at one end.

c. Every sixth (6th) tie selected for test shall additionally be tested as follows:

1) Rail Seat Positive at one end to first crack.

2) Rail Seat Negative at other end to first crack.

d. If any tie fails to comply with the test requirements in Paragraphs 2.13 C. 3 b. and c. above, two (2) additional ties shall be taken from the same line and all tests repeated.

1) If either of these ties fails the test, each tie in the line shall be tested.

e. One tie per day shall be selected at random from ties subject to Rail Seat Positive test and additionally tested for bond development.

1) If the tie fails to conform to the requirements of this test, two further ties from the same line shall be tested.

a) If either of these fails the test, one tie shall be tested from each bed cast on the same day as the ties, which failed the test.

b) No ties from beds with test failure shall be shipped until a test program to identify ties with unsatisfactory bond is agreed with the Engineer and the tests completed.

f. One tie per day shall be selected at random from ties subject to Rail Seat Positive Test and additionally tested for Tie Center Negative Moment.

1) If the tie fails to conform to the requirements of this test, two further ties from the same line shall be tested. If either of these ties fails, each tie in the line shall be tested.

D. Rail Seat Positive Test:

1. The tie shall be supported in a hydraulic testing machine with loading points so arranged that the load is applied at right angles to the base of the tie midway between the supporting pads. Test configuration shall be in accordance with Chapter 30 of the AREMA Manual.

2. A test load of 52 kips shall be applied at a rate not exceeding 10 kips per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

3. A tie will be considered to have failed the test if at the 52 kips test load, it contains a structural crack when viewed under 5-power magnification. The illumination at the surface shall be not less than 125 FT candles.

4. When a tie is to be tested to first crack loading shall continue, after inspection at the 52 kip load until a crack 1 IN in vertical length is observed. The load shall then be recorded.

E. Rail Seat Negative Test:

1. The tie shall be supported in a hydraulic testing machine, in accordance with the test configuration in AREMA Manual, Chapter 30.

2. The testing procedure shall be in accordance with Chapter 30 of the AREMA Manual.

3. A test load of 29 kips shall be applied at a rate not exceeding 5 kips per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

F. Bond Development Test:

1. The tie shall be supported in a hydraulic testing machine, in accordance with the test configuration in AREMA Manual.

2. Dial gages reading, to 0.001 inch shall be attached to the tie at the end being tested, to measure any movement relative to the tie of the outermost wire in each of the bottom corners of the tie.

3. A test load of 78 kips shall be applied at a rate not exceeding, 5 kips per minute and maintained for a period of five minutes.

    a. The wire movement shall not exceed 0.001 inch

    b. If during this test, a structural crack more than 3 inch long occurs, the test tie shall be rejected after completion.

G. Tie Center Negative Moment Test:

1. The tie shall be supported in a hydraulic testing, machine in accordance with the test configuration in the AREMA Manual.

2. A test load of 12 kips shall be applied at a rate not to exceed 5 kips per minute and maintained for at least 3 minutes to permit proper inspection. Both sides of the tie should be inspected.

H. Tie Center Positive Moment Test:

1. The tie shall be supported in a hydraulic testing machine in accordance with the test configuration in the AREMA Manual.

2. A test load of 8 kips shall be applied at a rate not to exceed 5 kips per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

I. Electrical Short:

1. Each tie tested in accordance with Paragraph 2.13.C. herein shall be checked for shoulder to shoulder direct electrical shorts under 10 Vdc using an Ohm Meter.

    a. The resistance shall not be less than 100 ohms.

2. If any tie fails this test, all ties from the same line shall be individually tested.

J. Test Reports:

1. The Vendor must submit a monthly manufacturer’s test report to the Engineer. This shall include:

    a. Number of good ties cast.

    b. Number of reject ties cast and reasons for rejection.

    c. Concrete compressive strength test results at transfer and at 28 days.

d. Average and standard deviation of the 28-day compressive strength results.

e. Percentage probability of 28-day compressive strength results failing to meet the minimum specified strength and the actual number of failures.

f. Tie first structural crack loads, rail seat positive and rail seat negative.

g. Average and standard deviation of the first crack loads.

h. Percentage probability of the first crack loads failing to meet the minimum specified load and the number of failures.

i. The 28-day Compressive Strength results shall also be presented as frequency histogram.

j. The Average 28-Day Strength results, Average first Crack Loads and Percentage probability of failing figures shall also be plotted on graphs showing, the corresponding results for the previous 12 months or since production started, whichever is the shorter period.

2. The manufacturer shall retain for a period of 10 years all test certificates provided by suppliers and outside testing laboratories.

a. Results of all inspection and testing carried out by the manufacturer shall also be retained for 10 years.

2.14 INSPECTION

A. Inspectors shall have access, during any and all working hours, to all parts of the manufacturer's plant involved in tie production and to those parts of suppliers plants engaged in producing materials or components for use in the ties.

B. Inspectors shall access to the results of all tests carried out by the manufacturer, suppliers and outside testing laboratories.

2.15 PLANT AND YARD HANDLING

A. When handling ties in the plant or yard, they shall not be dropped or otherwise damaged.

1. Ties shall be stacked on firm level ground, not more than 20 ties high and supported on dunnage at the rail seats only.

2.16 IDENTIFICATION

A. Each tie shall be marked with indented or raised letters or numerals to identify the manufacturer, SCAX designation, form designation and date/month/year of manufacture as detailed on the SCRRA Engineering Standard Plans ES2402, ES2403, ES2406 or ES2407 as appropriate.

PART 3 - EXECUTION

3.01 QUALITY CONTROL

A. Quality Control:

1. Testing and inspection shall conform to AREMA Manual, Volume 1, Chapter 30, unless otherwise modified by these Specifications. The cost for testing of materials to be performed by an outside agency shall be provided by the manufacturers and will be included in unit price in the schedule.

2. Ties may be inspected by the Engineer at suitable and convenient places either at points of shipment or destination.

3. The Engineer reserves the right to examine any equipment used for any manufacturing process at any stage of tie production.

4. Material not meeting the requirements of this Specification shall not be used in the work.

5. Quality Control Program:

a. Vendor must comply with the following Quality Control Program requirements.

1) A quality control program under which the manufacturer will perform sufficient inspection and tests of all items of work, including those by suppliers or subcontractors in order to ensure conformance to applicable standards, Specifications or Plans with respect to materials, workmanship, fabrication, and identification.

2) The control plan shall specifically provide for:

a) Manufacturer’s surveillance (e.g. but not limited to shoulder inserts, wire).

b) Drawing- control (changes).

c) Mold Certification.

d) Document control.

e) Inspection procedures - in process and final.

f) Production test requirements.

g) Segregation and disposition of defective material and products.

h) Material and process control in plant identifying critical control points.

i) Production equipment and instrumentation calibration, maintenance, and data recording.

j) Work procedures and instruction.

k) Failure reporting analysis and corrective action.

l) Sample plans and quality levels shall conform to Military Standard 105D, AQL Level H unless otherwise stated or approved.

m) Raw materials standards and controls.

n) Records of test and inspections.

o) Time and temperature control.

p) Strength testing.

q) Storage handling and shipment controls.

r) Procedures or tests for determining within 24 HRS that the conditions necessary to achieve the 28-day strength have been met, with a margin of safety.

s) Quality budget in percentage of contract price.

t) Assurance that the plant will meet and continue to meet PCI certification.

u) Quality control organization chart showing all QC personnel and their corresponding contact level at OCTA. QC organization must report independently from Production to Project Manager level or above.

v) The person responsible for quality control shall be independent of production management and shall report functionally to the manufacturing, company's senior management.

6. Production Program:

a. Vendor must comply with the following Production Program requirements. A complete production program shall include:

1) Plant layout.

2) Form design with tolerances.

3) Raw material requirements.

4) Primary and alternate sources.

5) Material handling.

6) Material placement with tolerances.

7) Curing method.

8) Bond release method.

9) Method of vibration.

10) Pretensioning and detensioning method for strand or wire.

11) Daily production capability.

12) Finished tie inventory plan.

13) Plan for handling ties from finished product to assigned rail cars or alternate transportation arrangements.

14) Flow chart of production process indicating points of control for all significant operations.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work associated with project item in Section 34 72 00, Trackwork or Section 34 72 20, Track Shifting, Relocation, and Resurfacing and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery and incidentals as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 34 11 34

WOOD RAILROAD TIES

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for the Wood Railroad Ties to be furnished in accordance with Contract Documents or required by the Engineer.

B. Work included in this Section encompasses work necessary for the manufacturing, production and handling of wood switch ties, crossties, and grade crossing ties.

1.02 REFERENCES

A. AWPA: American Wood Preserver's Association:

1. C1 – Standard for All Timber Products – Preservative Treatment by Pressure Processes.

2. C2 – Lumber, Timber, Bridge Ties and Mine Ties – Preservative Treatment by Pressure Processes.

3. C6 – Standard for Cross Ties and Switch Ties: Preservative Treatment by Pressure Processes.

4. M2 – Standard for Inspection of Wood Products Treated with Preservatives.

5. M4 – Standard for the Care of Preservative – Treated Wood Products.

6. P1 – Standard for Creosote Preservative Use.

7. P2 – Standard for Creosote Solution.

8. P3 – Standard for Creosote – Petroleum Solution.

9. P4 – Standard for Petroleum Oil for Blending with Creosote.

B. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering and Portfolio of Trackwork Plans.

C. RTA: Railway Tie Association – Specifications for Timber Crossties and Switch Ties.

D. SCRRA: Southern California Regional Rail Authority (SCRRA) Engineering Standards.

1.03 DEFINITIONS

A. Anti-Splitting Device – Any device applied to the end or near the end of a tie or timber such as anti-splitting iron, dowel or nail plate to reduce its splitting.

B. The word “Vendor” shall mean the Contractor.

C. Boulton Drying Process – A process for drying wood by removing moisture from it by heating in preservatives under sufficient intensity of vacuum to evaporate water from the material at the temperature of the preservative used.

D. Creep – The time-dependent deformation of a material under load.

E. Empty Cell – A treatment in which the cell walls in the treated portion of the wood remain coated with preservative, the cell being empty or only partially filled.

F. Hardwood – One group of trees (deciduous) which have broad leaves. The term has no reference to the hardness of the wood.

G. Softwood – One of the group of trees (conifers) which have needle-like or scale-like leaves. The term has no reference to the softness of the wood.

1.04 SUBMITTALS

A. The Vendor shall submit supporting information within 60 days of award documenting the past successful performance in furnishing the materials included in the Schedule of Quantities and Prices. Provide references and contact numbers at the railroads where the wood railroad ties have been placed in service.

B. The Vendor shall submit certificate of compliance that the material delivered is in compliance with the specification within 60 days of approval of payment.

C. The Vendor shall submit wood railroad ties packaging, loading, shipping, and handling method.

D. The Vendor shall submit for OCTA’s review and approval quality control and quality assurance plans and related certifications such as ISO 9001, “six sigma” or equivalent demonstrating that the Vendor has the processes, personnel and systems to produce high quality wood railroad ties included in the Schedule of Quantities and Prices.

E. The Vendor shall submit data documenting past performance and projects within the last ten (10) years furnishing wood railroad ties to Class 1 Freight, passenger or commuter railroads.

F. Administrative and procedural requirements for proposed changes in product and materials from those required by these specifications shall be as per OCTA Contract Specifications Section 01 25 00, “Substitution Procedures”.

G. Tests: Certified test results, as required to demonstrate compliance of materials specified herein shall be submitted to OCTA before any wood ties are used.

1.05 QUALITY ASSURANCE

A. Vendor's Quality Control Program (QCP) shall be in accordance with the AAR M-1003 or OCTA approved equivalent quality control program.

B. Testing and inspection of tie manufacture shall be performed by Vendor in conformance with AREMA Manual, RTA and AWPA.

C. Ties may be inspected by OCTA, at suitable and convenient times and places including points of manufacture, shipment, or destination.

D. OCTA reserves the right to examine any equipment used for any process or method of treatment at any stage of tie production.

E. Material not meeting the requirements of this Specification shall not be used in the Work.

F. OCTA shall have access to Manufacturer's plant during normal working hours and all Project related procurement and production records for inspection any time during the Contract period of performance.

1.06 DELIVERY, STORAGE AND HANDLING

A. All rejects shall be marked with an "X" on the end. This is to preclude the accidental shipment of less than grade ties to OCTA. Treated ties not handled directly from tram to car shall be carefully and neatly stored. Different size classifications shall be kept separate, and all bundles or stacks shall be marked with OCTA, grade or length, and treatment date. Ties shall be stacked to ensure that tie straightness is not impaired during temporary storage. Treated stringers shall be placed underneath all stacks of treated ties. No loose windrows of OCTA treated ties shall be allowed. Shipments shall be made from the oldest stacks first. If any ties become excessively bleached during storage, they shall be retreated or replaced by the supplier. Yard drainage conditions shall provide rapid drainage of water from beneath stacks of treated ties. Storage areas shall be kept free of grass and weeds to aid free flow of air and to minimize the possibility of fire. The Vendor shall be liable for all fire damage. A minimum 10 foot weed-free zone shall be maintained around OCTA stored inventory at all times. Care shall be exercised in handling of OCTA ties for storage or shipment to prevent damage.

B. Ties shall be stored to avoid contamination of water and soil by the ties.

C. Long-term tie storage shall not be located within 250 feet of an open road crossing or residences.

D. Ties temporarily located within 250 feet of a public road crossing or residences shall be covered by an impervious sheet material to control odor and vapor emitted by the crossties.

PART 2 - PRODUCTS

2.01 GENERAL

A. Wood railroad ties shall be new and conform to SCRRA Engineering Standards.

B. Wood railroad ties ordered to the Engineering Standards shall be produced in conformance to these specifications and AREMA Specifications.

2.02 WOOD CROSS TIES AND SWITCHTIES

A. The following hardwood species can be used for cross ties, switch ties and grade crossing ties:

1. Oak-Hickory Group: Red Oak, White Oak and Hickories.

2. Mixed Hardwoods Group: Gums, Ashes, Cherry, Walnuts, Birches, Maples, Beech, Locusts, Sycamore, Elms and Cypress

B. The following species are not acceptable:

1. Oak-Hickory Group: Live Oak and Blackjack Oak.

2. Mixed Hardwoods & Softwoods: Douglas Fir, Hem-Fir, Ponderosa Pine, Lodgepole, Pine, Larch, Cottonwood, Willow, Basswood, Hackberry and Poplar.

C. Oak and elm ties shall be of compact wood throughout the top fourth of the tie.

D. All cross ties shall be the full length specified; double end trimmed, and should have full body and full face.

1. Ties with greater than 1” of wane within the 20” and 40” rail-bearing sections, when measured from the center of the tie, are not acceptable.

a. Thickness and width tolerance shall be not more than ¼” thinner or narrower than the specified size.

E. Vendor shall provide a maximum of 50 percent of the ties from oak-hickory species and the remaining 50 percent from mixed hardwoods from list of ties specified under Attachment A, Part E, Section 1 through 4.

1. Oak ties must be air seasoned unless otherwise directed by OCTA and preapproved and specified in writing.

2. Mixed Hardwoods must be air seasoned unless otherwise directed by OCTA and preapproved and specified in writing.

2.03 GENERALTIE REQUIREMENTS

A. All wooden ties shall be made from sound, straight, live timber and shall be free from any defects that may impair their strength or durability, such as bark, splits, shakes, large or numerous holes or knots, pitch seams, pitch rings, slanting grain or other imperfections.

1. Decay and/or insect damage in any form is not acceptable.

B. All ties shall be well sawn on all four sides and cut square at the end to the full dimensions specified.

1. All ties shall be straight and opposite faces shall be true and parallel, and with all bark entirely removed.

C. All ties shall be straight.

1. A tie shall be considered straight when:

a. Timber Cross Tie: When a straight line from a point on one end to a corresponding point on the other end is no more than 1-1/2” from surface at all points.

b. Timber Switch Ties: When straight line from a point on one end to a corresponding point on the other end is no more than 2” from the surface at all points.

D. A tie is not well sawn when its surfaces are cut with score marks more than ½” deep, or when its surfaces are not even.

E. The top and bottom of a tie shall be considered parallel, if any difference in the thickness at the sides or ends does not exceed ½”.

F. For proper seating of nail plates, tie ends must be flat and will be considered square with a sloped end of up to ½”, which equals a 1 in 20 cant.

2.04 ANTI-SPLITTING DEVICES

A. Anti-splitting devices are required.

1. Anti-splitting devices (endplates) shall be multi-nail plates as specified in AREMA Manual, Volume1, Chapter30, Part3.1.6, Specifications for Devices to Control the Splitting of Wood Ties.

a. Structural type, Grade “C”, 18 gauge galvanized steel, ASTM A653 or better with ultimate strength of 55,000 psi and yield strength of 40,000psi.

b. Galvanizing per ASTM A653, G60 coating.

c. 4-5 teeth per square inch.

d. ½" to 9/16" length of tooth.

2. This application should enable the plate to hold both vertical and horizontal splits.

3. End plates shall be applied by a mechanical device capable of squeezing any splits; bringing the tie back to its original (cross section) dimensions prior to application.

4. End plates for 7"x9" ties are to measure 6" x 7" or 6-1/4" x 7".

5. No part of the end plate is to be within ¼" of any side

6. All anti-split end plates shall have rounded corners and a smooth perimeter.

B. Embossed on all end plates will be "SCRRA" and manufacturer name followed by the year of manufacture and Treating Plant. End plates will be installed with the letters "SCRRA" upright with the tie oriented with heartwood down.

2.05 DIMENSIONS

A. All cross ties shall have a 7"x 9" cross-section and shall be double end trimmed, unless otherwise ordered.

B. Length of ties shall be as ordered in each shipping release.

1. Ties will be ordered as 9'-0" or in one (1) foot increments from 9'-0" to 24'-0".

C. The length, thickness, and width specified are minimum.

1. Ties with thickness and width more than ¼" thinner or narrower than specified will be rejected. Ties over 1" longer shall be rejected.

2. Tie dimensions shall not be averaged.

2.06 PRESERVATIVE

A. The preservative shall consist of a mixture of 50 percent by volume of P-1 creosote oil conforming to AWPA Specifications (AWPA P3 and AWPA P4), and 50 percent by volume of an approved petroleum residuum oil.

1. The creosote and oil shall be thoroughly mixed in the working tank until the mixture is of uniform composition. (Note: use of treatment with P-2, 7lbs / cu ft is an approved equal).

B. The residuum oil shall be approved asphalt base petroleum residuum oil.

1. It shall be free from water and any foreign substance that might interfere with its penetrating qualities.

2. The flash point of the residuum oil shall not be less than 210˚F as determined in the Cleveland Open Cup.

3. The viscosity of the residuum oil shall be such that a blend of 50 percent residuum oil and 50 percent creosote shall have a viscosity exceeding 50 seconds Saybolt Universal 180˚F.

4. BS&W shall not exceed one (1) percent and the creosote oil mixture shall show no sludge formation upon standing. (Note: AWPA P4 is acceptable as an approved equal for residuum oil).

2.07 APPROVALS AND REJECTIONS

A. Ties with any type of decay will be rejected.

B. Rejection of ties for holes and knots. All such holes and knots as defined shall be allowed if they occur outside the sections of the tie between 20” and 40” from its middle.

1. A “large hole” is any hole more than ½” in diameter and 3” in depth within the rail bearing area, or more than 1” in diameter and 3” deep outside the sections of the tie between the 20” and 40” rail bearing area measured from the center of the tie.

2. “Numerous holes” are any number of holes equaling a large hole in damaging effect. Such holes, whether caused in manufacture or otherwise, will because for rejection.

3. A “large knot” within the rail bearing area is one whose average diameter is more than 1/3 the width of the surface on which it appears. “Numerous knots” are any number, which, in total, equal a large knot in damaging effect. A cluster of knots will be judged as if it were a large knot in damaging effect.

C. Ties with shake more than 1/3 the width of the tie, and nearer than 1” to any surface, will be rejected.

1. Fire scar will be considered as bark seam and graded accordingly.

D. Except in woods with interlocking grain, ties with a slant grain in excess of 1 in 15 will be rejected.

E. Ties with continuous checks whose depth in a fully seasoned and/or treated tie is greater than ¼ the tie thickness and longer than ½ the length of tie will be rejected.

F. Any other imperfections that are within the limits of current AREMA and RTA Specifications will be allowed.

G. A split is a separation of the wood extending from one surface to an opposite or adjacent surface.

1. A split 1/8” wide and 4” long in an unseasoned cross tie is acceptable.

2. A split more than ¼” wide and/or 9” long on the face on which it occurs in a seasoned cross tie will be rejected.

3. Do not count the end as a surface.

H. Bark seam or pocket is a patch of bark partially or wholly enclosed in the wood.

1. Bark seams will be allowed outside the rail bearing area provided they are not more than 2” below the surface, ¼” wide, and not more than 5” long.

I. Ties with heart – checks that go into the tie plate area will be rejected if the check is more than a cumulative ½” wide or if the check causes the plate area to be concave or convex.

J. Holes:

1. Ties having solid holes on any surface within the rail bearing areas greater than ½” diameter and greater than 3” deep will be rejected.

2. Ties having solid holes on any surface outside the rail bearing areas greater than 1” in diameter or greater than 3” deep will be rejected.

3. Stump pull will be graded the same as a split in the end of a tie.

4. A stump pull that goes into the interior of the tie more than 5” will be rejected.

5. Numerous holes are defined as having any number equaling a large hole in damaging effect. Such holes may be caused in manufacture or otherwise.

6. Mechanically damaged ties shall be replaced by the party that damages the tie.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with the SCRRA Engineering Standards unless specifically noted or excepted within these specifications. Promptly notify OCTA of any conflicts, omissions or needed clarifications arising from the use of the designated drawings, standards or specifications.

3.03 PLANT EQUIPMENT

A. Treating plant shall be equipped with the thermometers and gauges necessary to indicate and record accurately the condition of all stages of treatment, and all equipment shall be maintained in acceptable, proper working condition.

B. All green ties should be checked periodically for moisture content prior to going in the cylinder.

1. Twenty (20) borings per charge shall be taken from cross ties, so that the moisture content level can be measured, to determine the amount of water that is to be removed from the crossties.

C. Material shall be conditioned by air seasoning

D. All material, either under vacuum or at atmospheric pressure, should be handled in such a manner that will not cause degrading, checking, splitting, warping or render it unfit for the service intended.

3.04 AIR SEASONING

A. When air seasoning is used, material shall be treated before it begins to deteriorate. Air seasoned material must be given a preliminary heating in the preservative for not more than three (3) hours at a temperature of not more than 210˚F, just before the regular treating operation.

1. All Oak/Hickory ties will be seasoned for approximately 10 months to obtain moisture content not to exceed 45 percent on 2” cores.

2. Mixed Hardwood ties will be seasoned for approximately five months to obtain a moisture content not to exceed 40 percent on 2” cores.

3.05 BOULTONIZING

A. Ties shall only be Boultonized as directed by a designated OCTA representative. Cross ties and switch ties scheduled for Boultonizing shall be separated by size and species, incised, and forwarded to the tramming station for handling prior to initiation of the drying process. Hickory ties must be Boultonized with oaks. Each layer of ties on the tram shall be separated with one ¾” steel cable, steel rod, or ¼” Grade 30 steel chain placed on alternate ends as the layers are built. Switch ties will require two cables, rods, or chains per layer for 9’–12’, and three cables, rods, or chains per layer for 13’–16’ + lengths. All steel or wooden stickers must be removed prior to shipment.

B. When boultonizing, the oils shall cover the material in the cylinder.

1. The temperature of the oil during the conditioning period shall not exceed 210˚F.

2. When a vacuum is then drawn, it shall be of sufficient intensity to evaporate water from the material at the temperature of the oil.

3. The intensity of the vacuum or the temperature of the oil, or both, shall be adjusted so as to regulate the evaporation of the waters.

4. The conditioning shall continue until the materials are sufficiently heated and enough water removed from the cylinder before an empty-cell process is applied for pressure treatment.

5. The Boultonized process used is to conform to AWPA section C1-00 Section 1.3.3, most recent version.

6. Maximum moisture content is to be 50 percent for oak-hickory and 40 percent in mixed Hardwoods before press cycle begins.

3.06 MANNER OF TREATMENT

A. Following the conditioning period, material shall be treated by an empty-cell process to obtain as deep and uniform penetration as possible with the retention of preservative stipulated.

1. The range of pressure, temperature and time duration shall be controlled so as to get the maximum penetration by the quantity of preservative injected.

3.07 EMPTY CELL PROCESS (LOWRY AND RUEPING)

A. Treatment shall be by the empty cell method with a creosote/coal tar solution or creosote/petroleum (50percent-50 percent) solution in accordance with AWPA Standard P-2, P-3, and P-4. The preservative solution shall be tested monthly according to AWPA Standard A-1 with a copy of the results forwarded to the OCTA representative. In no case shall treatment be less than that required for AWPA U1, UC4B.

B. Material shall be subjected to atmospheric air pressure or to higher initial air pressure of the necessary intensity and duration.

1. The preservative shall be introduced until the cylinder is filled while the air pressure is being maintained during the filling operation.

C. The Pressure shall be raised on not more than 210lbs/sq inch.

1. Material shall be held under pressure until there is adequate preservative injected to meet specified retention.

D. The temperature of the preservative during the entire pressure period shall not be more than 210˚F but shall average at least 180˚F.

E. After pressure is completed, the cylinder shall be emptied speedily of preservative, and a vacuum of not less than 22” at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative, or;

1. After pressure is completed, and before removal of preservative from tie cylinder, the preservative surrounding the material may be preheated to a maximum of 215˚F, either at an atmospheric pressure or under vacuum; the steam to be turned off the heating coils and the leader lines opened immediately after the minimum temperature is reached.

2. The cylinder shall then be emptied speedily of preservative and a vacuum of not less than 22" at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative.

F. At the completion of treatment, material may be cleaned by final steaming (when authorized) at a temperature not more than 240˚F for not more than 30 minutes.

3.08 RESULTS OF TREATMENT RETENTION

A. No charge shall contain less than 75 percent or more than 110 percent of the quantity of preservative specified for the class of material except when the character of the wood in any charge makes these requirements impracticable despite treatment to refusal.

1. The amount of preservative retained shall be calculated from readings of working tank gages or scales or weights before and after treatment of loaded trams on suitable track scales, with the necessary corrections for changes in moisture content.

B. The column of oil preservatives shall be calculated on the basis of 100˚F.

1. Calculations of volume or weight shall be made by the use of temperature of specific gravity factor contained in the Volume of Specific Gravity Correction Tables of the AWPA.

3.09 PENETRATION

A. Penetration of ties shall not be less than the following for at least 80 percent of the pieces bored in each charge.

Thickness (inches)	Depth (Inches)	Percent of Sapwood
5 and over	½	90

B. Penetration of ties shall be determined by boring not less than two (2) ties in each tram in each charge or more than 20 ties per charge.

C. Penetration of timber and ties shall be determined by boring approximately midway between ends and midway between top and bottom on 7" side of tie.

1. Only material meeting the penetration requirements shall be accepted.

D. Any charge not conforming to stipulated minimum requirements may be retreated and re-offered for acceptance.

E. Any holes, which may be bored, shall be filled with tight fitting treated plugs.

F. Process and preservative to be used on material and retention required shall be as follows, unless otherwise specified, for all ties.

50 percent Oil *Process*		50 Percent Creosote *Process*
Hardwood	7 ½ lbs or Ref.	L&R
Oak	7 ½ lbs or Ref.	L&R or Bethel

G. Retention will be determined by gauge. The amount of preservative solution retained shall be determined from readings of working tank gauges or scales made before and after treatment. The retention of preservative will be calculated after correcting the volume of preservative solution to 100˚F.

3.10 CARE OF TREATED WOOD

A. In handling treated material, extreme care shall be used to avoid damage to the edges of the timbers or breaking through the portions penetrated by the treatment and exposing untreated wood.

B. The use of peaveys, timber dogs, picaroons, log hooks, or other pointed tools shall be such as not to break through the treated portion of treated timber.

3.11 PLANT STORAGE

A. The storage yard for seasoning shall be in the open where the air current will circulate freely; shall not be in a low humid situation if it can be avoided; shall have good drainage; and shall be kept free from vegetation and debris, especially from scrap wood already infected with decay.

B. Treated materials shall be stored in a similar manner to untreated, but must not be piled in same area with untreated materials.

C. Unseasoned material must be stacked separately from seasoned or partly seasoned material.

3.12 STACKING

A. Sawn ties shall be stacked either 1 x 9 or 2 x 9 standard stacking method.

B. Alternate: If necessary to retard evaporation of moisture from the ties, they may be stacked parallel on edge, using cross ties as separators.

3.13 BARKING

A. Remove bark and inner skin before treatment.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work associated with project item in Section 34 72 00, Trackwork or Section 34 72 20, Track Shifting, Relocation, and Resurfacing and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery and incidentals as shown on the Plans, and as specified in these Specifications

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 34 11 36

ELASTIC RAIL FASTENERS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for Elastic Rail Fasteners to be furnished in accordance with Contract Documents or required by the Engineer.

1.02 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering, Chapter 5, Part 9, Design Qualification Specification for Elastic Fasteners on Timber Cross Ties

B. American Society for Testing of Materials (ASTM)

1. ASTM A123, Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on iron and Steel Products;

2. ASTM A689 - Standard Specification for Carbon and Alloy Steel Bars for Springs;

3. ASTM E112 - 10 Standard Test Methods for Determining Average Grain Size;

4. ASTM E18 - 08b Standard Test Methods for Rockwell Hardness of Metallic Materials

C. British Standards Institute

1. BS EN 10089 - Hot rolled steels for quenched and tempered springs, grade 56SiCr7

D. International Organization for Standardization (ISO)

1. ISO 9001 Quality Management Systems – Requirements;

2. ISO 643:2003 Steels -- Micrographic Determination of the Apparent Grain Size

E. SCRRA: Engineering Standards.

F. Shepherd Fracture Grain Size Standards

1.03 DEFINITIONS

A. The word “Vendor” used in the Material Specifications (SS) shall mean the Contractor.

B. Closure Rails – The rails between the parts of any Elastic rail fasteners layout, such as the rails between the switch and the frog in a turnout

C. Fasteners – Joint bars, bolts, clips and spikes

D. Shepherd Fracture Grain Size Standards:

1. Shepherd Fracture Grain Size Standards were developed by B.F. Shepherd for use in conjunction with his paper titled "The P - F Characteristic of Steel,” published in the Transactions of the American Society for Metals 1934, Vol. 22, Page 979.

2. The set of Fracture Grain Size Standards consists of 10 fractured specimens (each 3/4" diameter) in an enclosed compact case. Each specimen is numbered consecutively from 1 (coarse grain) to 10 (fine) and are accurately spaced with equal increments of fracture differential through this range.

3. Shepherd Fracture Grain Size Standards are available from MetLab Corporation, Post Office Box 1075, 4011 Hyde Park Boulevard, Niagara Falls, New York 14302-1075. Telephone (800) 828-6866.

4. Galvanizing: Hot-dip galvanizing per ASTM A123 or ASTM A153 with minimum coating of 2.0 oz. of zinc per square foot of metal (average specimens) unless noted otherwise or directed by the standard.

1.04 SUBMITTALS

A. The Vendor shall submit supporting information within 60 days of award documenting the past successful performance in furnishing the materials included in the Schedule of Quantities and Prices. Provide references and contact numbers at the railroads where the turnouts have been placed in service.

B. The Vendor shall submit certificate of compliance that the material delivered is in compliance with the specification within 60 days of approval of payment.

C. The Vendor shall submit for OCTA’s review and approval quality control and quality assurance plans and related certifications such as ISO 9001, “six sigma” or equivalent demonstrating that the Vendor has the processes, personnel and systems to produce high quality Elastic rail fasteners Materials included in the list of Elastic rail fasteners items as provided in the Schedule of Quantities and Prices.

D. The Vendor shall submit data documenting past performance and projects within the last ten (10) years furnishing Elastic rail fasteners material to Class 1 Freight, passenger or commuter railroads.

E. Administrative and procedural requirements for proposed changes in product and materials from those required by these specifications shall be as per OCTA's Contract Specifications Section 01 25 00, "Substitution Procedures".

F. Qualifying Tests: The Vendor or supplier must submit the results of the following initial qualifying tests for equivalent fasteners:

1. AREMA Manual for Railway Engineering, Chapter 30, Part 2.6:

a. Test 5A – Fastener Uplift,

b. Test 5B – Fastener Longitudinal Restraint,

c. Test 5C – Fastener Repeated Load,

d. Test 5D – Fastener Lateral Load Restraint,

e. Test 5E – Fastener Assembly Rotation.

G. Fatigue Tests:

1. The Vendor or supplier must submit the results of the fatigue tests used to determine final acceptance of the clips from each heat of steel.

H. Shepherd Fracture Grain Size Analysis: The Vendor must submit the results of the Shepherd Fracture Grain Size analysis.

I. Samples:

1. The Vendor or supplier must submit samples of the raw material used in the production of the clips for independent verification, by OCTA, of the chemical, physical, and mechanical properties steel used in the production of the clips.

2. The Vendor or supplier must submit, upon request by OCTA, up to 20 samples of finished clips without charge for fatigue testing by OCTA

J. Mill Test Reports:

1. The Vendor or supplier must submit mill test reports for each heat of steel used in the manufacture of the clips furnished on a given order.

1.05 QUALITY ASSURANCE

A. Vendor's Quality Control Program (QCP) shall be in accordance with the AAR M-1003 or OCTA approved equivalent quality control program.

B. Manufacture must be performed by companies certified to ISO 9001: 2000. Certification must be held by the plant producing the clips. Certification of a distributor for a manufacturer is not sufficient to satisfy this requirement.

C. Equipment used for the manufacturing materials shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be certified and traceable to national standards such as the National Institute of Standards and Technology.

D. Final fatigue testing of the clips may be performed in the facility of a manufacturer, or a distributor, or an independent testing laboratory. However, all fatigue testing must be performed within the coterminous United States and subject to witness by representatives of OCTA. Notice of testing must be provided to OCTA a minimum of three weeks prior to the tests. A representative of OCTA will select the samples to be tested.

1.06 DELIVERY, STORAGE AND HANDLIONG

A. The Vendor shall load, transport, and handle the material in a manner which will prevent damage to the material.

PART 2 - PRODUCTS

2.01 DESIGN

A. Clips must be Pandrol® brand type e-2055 (e-2056 for left hand application) elastic rail clips or an equivalent in shape, size, function, and performance as generally described in United States Patent No. 4,413,777, and as shown on SCRRA ES2361 and ES2362. The equivalence of any alternative design, including the chemical and physical characteristics of the material, must be established through qualification by successful performance the tests described in AREMA Manual for Railway Engineering, Chapter 30, Part 2.6, Test 5A – Fastener Uplift, Test 5B – Fastener Longitudinal Restraint, Test 5C – Fastener Repeated Load, Test 5D – Fastener Lateral Load Restraint, and Test 5E – Fastener Assembly Rotation. For the purpose of conducting Test 5A – Fastener Uplift, the load “P” must be not less than 5500 pounds for each pair of fasteners.

B. 'Pandrol' Brand Rail Clips form part of a 'Pandrol' Brand Rail Fastening System and hold the rail to the tie, baseplate or other track support.

C. A new qualification test must be performed for each change in dimension or shape of the clip, or a change in the chemical, physical, and mechanical properties of the raw material used in the manufacture of the clip.

D. In lieu of performing the acceptance tests OCTA may, at its sole discretion, may accept a clip offered as an equivalent to the specified clip upon evidence of satisfactory in-track performance for 10 years or more on a North American main line carrying 40 MGT or more each year.

1. The supplier shall have a minimum of five years’ experience in supplying rail clips and other track materials.

2.02 PHYSICAL, CHEMICAL AND MECHANICAL PROPERTIES

A. The raw material must be a fine-grained chromium allow spring steel with a composition closely approximating SAE/AISI Grade 5160, or ASTM A689, or BS EN 10089. Modifications to the basic alloy by the Vendor of the steel are required to achieve the physical, mechanical, and performance requirements of this specification.

B. Shepherd fracture grain size of the raw material must be seven (7) or greater.

C. Finished clips must possess a Rockwell C surface hardness not less than 44 or more than 48 when tested in accordance with ASTM E18.

D. All pair of finished rail clips must produce a minimum resistance load of 5500 pounds before separation of the rail from the rail seat when tested in accordance with AREMA Manual for Railway Engineering, Chapter 30, Part 2.6, Test 5A Fastener Uplift.

2.03 MANUFACTURE

A. Rail clips must be formed from a round bar stock made from a fine-grained chromium allow spring steel. The steel must be quenched and tempered during manufacture to achieve the physical and mechanical characteristics specified, and meet the requirements of the qualification tests.

2.04 PERFORMANCE REQUIREMENTS

A. Five clips produced from each heat of raw steel material must be tested after manufacture for fatigue failure. In performing the test, a single clip must be fixed in the test machine and a 2750 pound load applied at the toe of the clip. The clip must then be raised 1mm above the neutral (2750 pound load point) and relaxed to a point 1 mm below the neutral (2750 pound load point) through three million (3,000,000) cycles (one cycle = neutral to raised position to lowered position to neutral position).

1. Rail fastening system shall be resilient, thread-less and adjustable in three steps without dismantling the fastener. The three steps shall be:

   a. Retracted: Permits installation or removal of rail intermediate;

   b. Permits longitudinal rail movement clamped;

   c. Provides full rail clamping force.

B. The Vendor may use a test procedure similar to that described in Chapter 30, Part 2.6, Test 5A, of the AREMA Manual for Railway Engineering, or the Vendor may the test described in Appendix I of Australian Standard 1085.19, or the Vendor may use another test procedure provided that the clip moves through a distance of 2mm, under a load of 2750 pounds at the mid-point of the range of flexure.

C. From the 5 clips selected, if two clips in a row break, all clips manufactured from

the heat of steel tested must be rejected. If two clips in a row pass, all clips from the heat of steel tested, may be accepted.

D. A failure is recorded when a tested clip exhibits a loss of elasticity, breaks, or the neutral position load drops below 2750 pounds during the test.

E. Table below lists the possible test combinations and the action to be taken:

Table

Test Number and Results					Action
1	2	3	4	5	
Pass	Pass				Heat of Steel Passes All Clips from Heat Accepted No Further Tests Required
Pass	Fail	Pass	Pass		Heat of Steel Passes All Clips from Heat Accepted No Further Tests Required
Pass	Fail	Fail			Heat Fails All Clips from Heat Rejected No Further tests permitted
Pass	Fail	Pass	Fail	Fail	Heat Fails All Clips from Heat Rejected No Further tests permitted
Pass	Fail	Pass	Fail	Pass	Heat Fails All Clips from Heat Rejected No Further tests permitted
Fail	Fail				Heat Fails All Clips from Heat Rejected No Further tests permitted
Fail	Pass	Pass			Heat of Steel Passes All Clips from Heat Accepted No Further Tests Required
Fail	Pass	Fail	Pass	Pass	Heat of Steel Passes All Clips from Heat Accepted No Further Tests Required
Fail	Pass	Fail	Pass	Fail	Heat Fails All Clips from Heat Rejected No Further tests permitted

F. At the conclusion of the fatigue test above, the pair of clips that have passed the fatigue test must prevent separation of the rail from the rail seat when a minimum uplift load “P” of 5500 pounds in accordance with AREMA Manual for Railway Engineering, Chapter 30, Part 2.6, Test 5A - Fastener Uplift.

G. The clips must not break when applied or removed with a 8 lb to 12 lb sledge hammer provided that the clips are not over-driven.

2.05 TOLERANCES

A. The clips shall conform to the dimensions on SCRRA drawing and shall fit the relevant standard 'Pandrol' inspection gauges and/or direct measuring fixture.

B. Alternatively, a Vendor may provide its standard dimensional tolerances and the means used to measure each clip for conformance to the standard to OCTA for review approval.

2.06 INSPECTION

A. All clips must be inspected for visual defects, incomplete formation, damage, or dimensional non-conformance.

2.07 NUMBER OF TESTS AND RETESTS

A. A minimum of five clips from each heat of steel used for Vendor of the clips must be tested. OCTA may, at its expense, select additional clips from any order and submit them to the fatigue test described in this specification. OCTA will provide the Vendor or supplier a minimum notice of three weeks in advance of the date on which the test will be performed. The Vendor or supplier may, at its expense, send a representative to witness the test.

2.08 WORKMANSHIP, FINISH, AND APPEARANCE

A. The clips must be free from burrs which may be considered harmful when handled or affect efficient assembly of the clip. Marks caused by the forming tools shall be smooth and free from sharp indentations.

B. All clips must be Hot Dipped Galvanized in accordance with ASTM A123.

2.09 PRODUCT MARKING

A. Each clip must be stamped with a code indicating the date of manufacture, the manufacturer, and the plant in which the clips have been made. A mark indicating the heat of steel used must also be included if the above information is not sufficient to trace the clip to a specific heat of steel.

2.10 PACKAGING AND PACKAGE MARKING

A. Clips must be packaged in sacks containing 30 fasteners (approximately 50 lbs) unless otherwise specified or approved by OCTA.

2.11 SOURCE QUALITY CONTROL

A. Vendor must be performed by companies certified to ISO 9001: 2000. Certification must be held by the plant producing the clips. Certification of a distributor for a Vendor is not sufficient to satisfy this requirement.

B. Final fatigue testing of the clips may be performed in the facility of a Vendor, or a distributor, or an independent testing laboratory. However, all fatigue testing must be performed within the coterminous United States and subject to witness by representatives of OCTA. Notice of testing must be provided to OCTA a minimum of three weeks prior to the tests. A representative of OCTA will select the samples to be tested.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with the SCRRA Engineering Standards and OCTA Contract Specifications unless specifically noted or excepted within these specifications. Promptly notify OCTA of any conflicts, omissions or needed clarifications arising from the use of the designated drawings, standards or specifications.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work associated with project item in Section 34 72 00, Trackwork or Section 34 72 20, Track Shifting, Relocation, and Resurfacing and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery and incidentals as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 34 11 40

PRECAST CONCRETE GRADE CROSSING PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the material requirements and performance criteria for the Precast Concrete Grade Crossing Panels to be furnished in accordance with Contract Documents or required by the Engineer.

1.02 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering

2. Specifications for Special Trackwork

B. American Welding Society (AWS):

1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications

2. AWS D1.1: Structural Welding Code

C. American Society for Testing of Materials (ASTM)

1. A36: Standard Specifications for Carbon Structural Steel

2. A123: Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products

3. A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

4. C227: Standard Test Method for Potential Alkali Reactivity of Cement Aggregates Combinations (Mortar-Bar Method)

5. C666: Standard test Method for Resistance of Concrete to Rapid Freezing and Thawing

6. C1260: Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

7. D257: Standard Test Methods for DC Resistance of Conductance of Insulating Materials

8. D395: Standard Test Methods for Rubber Property/Compression Test

9. D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension

10. D573: Standard Test Methods for Rubber Deterioration in an Air Oven

11. D624: Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

12. D2137: Standard test Methods for Rubber Property- Brittleness Points of Flexible Polymers and Coated Fabrics

13. D2240: Standard Test Methods for Rubber Property-Durometer Hardness

14. D2628: Standard Specifications for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

D. Association of American Railroads (AAR)

1. M-1003: Manual, Specifications for Quality Assurance

E. International Organization for Standardization (ISO)

1. 9000: An International Consensus on Good Quality Management Practices

F. Prestressed Concrete Institute (PCI)

1. MNL115: Fundamental of Prestressed Concrete Design

2. MNL124: Design and Typical Details of Connection for precast and Prestressed Concrete

3. MNL138: PCI Connections Manual for Precast and Prestressed Concrete Construction

G. SCRRA: Engineering Standards, especially ES2402.

1.03 DEFINITIONS

A. The word “Vendor” used in the Material Specifications (SS) shall mean the Contractor.

B. Field Side – End of tie plate designed to be located on the opposite side of the rail from the centerline of track

C. Gage Side – End of tie plate designed to be located closest to the centerline of track

D. OTM – A general term referring to all miscellaneous materials other than rail and ties

E. Shunt – A connection between two points in an electric circuit that forms an alternative path for a portion of the current

1.04 SUBMITTALS

A. The Vendor shall submit supporting information within 60 days of award documenting the past successful performance in furnishing the materials included in the Schedule of Quantities and Prices. Provide references and contact numbers at the railroads where the precast concrete grade crossing panels have been placed in service.

B. The Vendor shall submit certificate of compliance that the material delivered is in compliance with the specification within 60 days of approval of payment.

C. The Vendor shall submit for OCTA's review and approval quality control and quality assurance plans and related certifications such as ISO 9001, "six sigma" or equivalent demonstrating that the Vendor has the processes, personnel and systems to produce high quality precast concrete grade crossing panels included in the Schedule of Quantities and Prices.

D. The Vendor shall submit data documenting past performance and projects within the last ten (10) years furnishing precast concrete grade crossing panels material to Class 1 Freight, passenger or commuter railroads.

E. The Vendor shall include installation instructions.

F. Submit Certificates of Compliance for all precast concrete grade crossing panels. Include material qualification test reports for materials, components, and assemblies.

G. Administrative and procedural requirements for proposed changes in product and materials from those required by these specifications shall be as per OCTA's Contract Specifications Section 01 25 00, "Substitution Procedures".

1.05 QUALITY ASSURANCE

A. Vendor's Quality Control Program (QCP) shall be in accordance with the AAR M-1003 or OCTA approved equivalent quality control program.

B. Materials or partially or fully assembled products not meeting the specifications shall be rejected.

C. Equipment used for the manufacturing materials shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be certified and traceable to national standards such as the National Institute of Standards and Technology.

1.06 DELIVERY, STORAGE AND HANDLIONG

A. The Vendor shall load, transport, and handle the material in a manner which will prevent damage to the material.

1.07 WARRANTY

A. The Vendor shall warranty the precast concrete grade crossing panels for a minimum ten years against defects in materials and workmanship.

PART 2 - PRODUCTS

2.01 GENERAL

A. Precast concrete grade crossing panels shall be new and conform to SCRRA Engineering Standards ES2402.

B. Precast concrete grade crossing panels ordered to the Engineering Standards shall be produced in conformance to these specifications.

2.02 CONCRETE PANELS

A. Precast concrete grade crossing panels shall be lag-down heavy duty panels.

B. Precast concrete grade crossing panels shall be designed for use on 10 feet wood track ties and ballast track.

C. Precast concrete grade crossing panels shall have flangeways not less than 2½" in width and be electrically isolated to prevent shunt currents.

D. Precast concrete grade crossing panels shall be sized such that when installed, the top of the panels is at the top of rail elevation.

F. Panels shall be of the type which fastens to the timber ties utilizing a lagging screw system which fastens from the top down. The lagging screws shall be mechanically galvanized with zinc coating in a room temperature process, without electricity and without heat.

G. Rubber flangeway filler shall be designed to match the precast concrete crossing panels and rail fastening system.

H. Grade crossing surface systems, including any flangeway (gage and field side) filler material components, must be electrically non-conductive so as not to interfere with train control or crossing signals.

I. Each gage panel shall incorporate a 3" UHMW shunt break to assure electrical isolation. End angle for gage panels shall have 3" minimum gap to improve shunt resistance.

J. Concrete Crossing Panels shall be by Omega Industries or approved equal.

2.03 CONCRETE

A. Concrete compressive strength shall be minimum 6000 psi. The compressive strength shall be 2500 psi before panel is removed from forms and 5,000 psi at 21 days.

B. Minimum cement content shall be seven sacks per cubic yards.

C. Maximum water/cement ration shall be 0.44. Slump shall not exceed three inches.

D. Concrete sealant shall be used to prevent cracks and ion migration. Sealant shall be applied to fresh concrete as an aid in curing, hardening, water proofing, acid proofing and oil proofing each panel.

2.04 STRUCTURAL STEEL

A. Reinforcing steel shall be grade 60.

B. Steel angles shall be ASTM grade 36. The exposed steel shall receive one primer coat.

2.05 RUBBER FLANGEWAY FILLER

A. Rubber flangeway filler shall be permanently attached to the concrete panels.

B. Rubber flangeway filler shall meet the following:

1. Tensile strength – 850 psi
2. Ultimate elongation – 400% minimum
3. Tear strength at 25 degree Celsius – 150 pli minimum
4. Hardness – 75
5. Compression set 100 degrees Celsius for 70 hours
6. Accelerated aging test – 70 hours
7. Ozone resistance test – 5- PPHM for 96 hours
8. Electric resistance – 10 mega ohms minimum

C. The pre-attached flangeway filler shall allow for the removal of panels for maintenance without damaging the flangeway filler or any other components designed to hold the panel together.

2.06 FINISHES

A. All recess and minor concrete spalls are to be filled and finished to the panel dimensions using the proper bonding agent and repair material. Surface of the repaired area is to match the color and texture of the surrounding area.

B. The driving surface is to have a light broom finish or as approved by OCTA. The addition of water to the concrete surface finish during casting is not permitted.

2.07 MARKING

A. Each precast concrete grade crossing panel shall be marked with concrete imprint for size of rail, weight of panel, Manufacturer's ID, month/day/year of manufacture and crossing type. End of each panel will be stenciled painted with size of rail, weight of panel and crossing type.

2.08 SOURCE QUALITY CONTROL

A. During precast concrete grade crossing panel fabrication, perform the tests and inspections specified in these Specifications.

B. Vendor shall submit (via an independent testing laboratory to OCTA), the freeze/thaw, mortar bar method and total alkali burden (0.06%) tests on the mix design.

C. A representative sample of panels shall be checked for bottom flatness.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with the SCRRA Engineering Standards and OCTA Contract Specifications unless specifically noted or excepted within these specifications. Promptly notify OCTA of any conflicts, omissions or needed clarifications arising from the use of the designated drawings, standards or specifications.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work associated with project item in Section 34 71 50, Highway-Rail Grade Crossings and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all acceptance testing, transportation, storage, assembly, delivery and incidentals as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 34 42 18
CONDUIT AND PULL BOXES

PART 1 - GENERAL

1.01 SUMMARY

A. Furnishing conduit, pull boxes, handholes and associated materials as specified herein.

B. Material and workmanship shall be of the highest quality, assuring durability for minimum life expectancy of 40 years. All pull boxes, handholes, PVC conduits, HDPE conduits, fittings, cement and other materials to be furnished shall be suitable for use in the environment to be encountered on a railroad signal system. HPDE conduits, handholes and associated miscellaneous materials Commission Standards and Specifications except conduits and pull boxes installed to accommodate fiber optic cable installation into new control points, existing control points and grade crossing instrument enclosures. Conduits shall be used in underground, encased or exposed applications in accordance with National Electrical Code, Article 347.

1.02 SUBMITTALS

A. Manufacturer's catalog cut sheets, material descriptions, and specifications for each type of conduit, type of handhole, fittings, type of pull box and other materials the Contractor proposes to provide.

1.03 QUALITY ASSURANCE

A. Conduit manufacturer's qualifications shall be as follows:

1. Quality Assurance Program: the manufacturer of conduits, handholes and pull boxes in accordance with the requirements of the Specification shall be accomplished in compliance with a Quality Assurance Program that meets the intent of the ASQC Standard C1: general reinstatement provided for in the subparagraph shall apply only to the first replacement of repair of any such item and, in the case of failure of major importance, to the first extension of the said warranty to said affected items.

1.04 INSPECTION

A. The Commission shall have the right to make inspections and tests, as necessary, to determine if the materials meet the requirements of the Specification. The Resident Engineer shall have the right to reject material that is defective in any respect.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall immediately replace any conduit or pull box that is damaged at any time, prior to acceptance of delivery by the Commission without additional cost to the commission.

PART 2 – PRODUCTS

2.01 MATERIALS

A. 4” schedule 40 PVC conduit, in 20 ft. lengths.

B. 4” schedule 40 PVC elbows, varying from 22 ½ degree curve to 90 degree curve and 24” in length

C. 4” rigid galvanized conduit, in 10 ft. lengths.

D. 2.375” schedule 40 HDPE conduit.

E. 12/10-mm HDPE mini duct and couplers

F. 6” burial caution tape

G. PVC Cement

H. 4’-0” x 4’-0” x 4’-0” Concrete Pull Box with Bolt Down Steel Cover

I. MCI Standard handhole, 2’-6” x 5’-0” x 2’-6” made from a fiberglass polymer reinforced plastic.

2.02 SCHEDULE 40 PVC CONDUIT AND FITTINGS

A. Conduit shall be rated for use with 90 degree C Conductors, shall be UL listed, and shall comply with National Electric Manufacturers Association (NEMA) Specification TC-2 (conduit) and TC-3 (fittings).

B. Conduit and fitting shall carry a UL label and shall be identified by type and manufacturer and shall be traceable to location of plant and date manufactured. Labels shall be legible and permanent.

C. The conduit shall be made from polyvinyl chloride compound which includes inter modifiers to improve weatherability and heat distortion.

D. Conduit shall be free from visible cracks, holes or foreign inclusions. The conduit bore shall be smooth and free of blisters, nicks or other imperfections which could mar cables or conductors.

E. Conduit and fittings shall be solvent cemented in applications in accordance with instructions from the manufacturer.

F. Precast concrete vaults and access doors shall be designed for H-20 highway

vehicle loading.

G. All exposed portions of the vault shall be non-electricity conductive.

H. The minimum inside dimensions measured just below the lid support lip shall be 48” wide x 48” long.

I. The depth when measured from the top of the lid shall be 48”.

J. Covers shall be two individual galvanized diamond plate steel pieces with hex bolts to fasten in place. Covers shall have a skid resistant surface on top and equipped with lifting eyes.

2.03 RIGID GALVANIZED CONDUIT

A. Conduit shall be rated for use with 90 degree C Conductors, shall be UL listed, and shall comply with ANSI Specification C80.1.

B. Conduit shall carry a UL label and shall be identified by type and manufacturer and shall be traceable to location of plant and date manufactured. Labels shall be legible and permanent.

C. Conduit shall be hot-dipped galvanized inside and out. Conduit shall be coated with an organic layer to inhibit white rust and increase corrosion resistance.

D. Conduit shall be threaded on both ends, with a threaded coupler attached on one end to allow joining of multiple conduits.

2.04 HIGH DENSITY POLYETHYLENE CONDUIT

Conduit shall be high density polyethylene (HDPE) suitable for direct burial and plowing installation with the ballast portion of the track structural section. Corrugated innerduct is not acceptable.

A. HDPE conduit supplied shall comply with ASTM D2447, schedule 80, 2.375” O.D., black with an orange stripe in color, ribbed interior and smooth exterior. Ribbed interior wall shall be lubricated to reduce friction when installing fiber cable.

B. Equivalent material shall meet the minimum requirements of SDR 11 – ASTM D303 or SIDR 9 – ASTM D2239

C. HDPE conduit shall be an extruded coilable tube supplied on reels at a minimum of 5000 ft. lengths.

D. HDPE conduit shall be capped at both ends prevent any undesirable contaminates from entering tubes.

E. HDPE conduit shall be supplied with factory installed pull lines.

2.05 HDPE MINI DUCT AND COUPLER

A. HDPE mini duct shall be Fiber-Guard/MD as manufactured by ARNCO Corporation, or approved equal.

B. HDPE mini duct conduit shall be supplied on reels of a minimum of 5000' foot lengths.

C. HDPE mini duct conduit shall be capped at both ends with air tight blank plugs to prevent any undesirable contaminates from entering tubes.

D. HDPE mini duct conduit shall be 12/10-mm and shall be available in colors of blue, orange, yellow and green.

E. HDPE mini duct shall be factory pressure tested per the manufacturer's recommendations. Mini duct shall hold 130 psi to ensure there are no leaks.

F. Coupler for mini duct shall be as manufactured by ARNCP Corporation P/N 1-905694, or approved equal.

2.06 DETECTABLE UNDERGROUND TAPE

A. Detectable underground tape shall conform to the following specifications:

1. NTSB-PSS-73-1

2. American Gas Association 72-D-56

3. OSHA 1926-956 (c) (1)

4. DOT Office of Pipeline Safety USAS B31.8

5. API RP 1109

6. APWA Uniform Color Code

B. Tape shall be easily located with an industrial grade non-ferrous metal detector, and shall have highly visible colors to assist in location when digging.

C. The label on underground tape shall read:

CAUTION
METROLINK COMMUNICATIONS
CABLE BURIED BELOW

2.07 PVC CEMENT

A. Contractor to provide medium-bodied, fast=setting solvent cement that shall have a strong, leak-tight seal.

B. PVC cement shall conform to NEMA and UL specifications.

2.08 PULL BOXES

A. Pull Boxes shall conform to SCRRA's Engineering Standard ES8225.

B. Pull boxes shall be manufactured by Jensen or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. General

1. The installation of pull boxes, wire and cable shall conform to AREMA C& S Manual Parts 10.4.1, 10.4.30, except as specified herein.

2. All external cable runs shall be in conduit in accordance with the Metrolink Standard Drawings, and as called for in the Contract Drawings.

3. The contractor shall separate signaling cables from parallel run of ac feeder cables, where adjacent locations are fed from one ac service location.

4. Give the Resident Engineer 24 hours notice prior to installing cables.

5. Provide sufficient slack in cable conductors at all terminating posts to enable three terminations of the conductor, due to broken eyelets without re-servicing or re-potheading the cable.

6. In certain types of installation, the cable cannot be constrained; therefore, ample cable slacks shall be provided for flexibility due to vibration of such equipment.

7. Do not bend cables to a radius less than manufacturer's recommendation.

8. Distribution cable runs shall be continuous without splices between cable terminating locations. Express cable runs longer htan cable lengths shall be spliced together in junction box, instrument case, or other acceptable shelter. Prior to any cable or wire splicing, obtain the Resident Engineer's Approval. Approval will not be granted for cables damaged by the Contractor or vandalized by others. It is the responsibility of the Contractor to protect all cables until final installation.

9. Identify individual cable conductors at each cable termination with plastic tags. Identify and terminate all spare conductors in each cable.

10. Seal cable entrance openings in equipment enclosures and junction boxes with either compression type fitting or pliable sealing compound after the cable is in place. Use sealing compound to seal the area around cable where the cable emerges from the end of a conduit or pipe. Seal and plug all spare conduits.

11. Wherever multiple conductor cables are terminated, carefully remove the outer sheath of the cable to a minimum point of 3 inches from the cable entrance.

12. Terminate all cable conductors in conductor sequence from top to bottom.

13. Cable shields or sheaths shall be grounded at the entrance to signal/communications shelters and shall float when terminated in signal field apparatus.

14. Any work performed by the Contractor that impacts or involves any MCI facilities shall be done by an MCI approved contractor, and shall be governed by MCI's underground cable standards. Contractor accepts all liabilities and responsibilities when undertaking repairs, modifications and additions involving MCI ducts, handholes and cables.

B. Underground Buried Installation

1. Bury cable to a uniform depth of 36 inches as measured from bottom of tie to top of cable, unless installed in a cable trough. When paralleling the tracks, bury cable a minimum depth of 36 inches as measured from the finished grade to top of cable. Lay cable loosely in trench with a sand bed and backfill as specified in theses Specifications. Install cable within four-inch PVC schedule 80 conduit at a uniform minimum cover depth of 36 inches below grade when passing under tracks.

2. Upon request and only under extreme circumstances because of installation hardship will installation of a cable be allowed to a depth of less than 36 inches, subject to the Resident Engineer's acceptance. Protect the cable in a manner acceptable to the Resident Engineer.

3. Whenever any signal cable is to pass under pavement or roadway, if existing conduit is not provided, install cable in a 4-inch PVC Schedule 80 conduit and extend conduit 2 feet beyond the edges of pavement. Restore pavement or roadway to its original condition, subject to the Resident Engineer's acceptance.

4. Whenever any signal cable is to pass under the hot-mix asphalt concrete (HMAC) underlay installed at interlocking, install cable in conduit with pull boxes in accordance with the SCRRA Standard Drawings.

5. Where cable leaves the ground at other than buildings or in foundations, protect cable by a bootleg or other covering extending above the ground line. Fill top of such protective coverings with a sealing compound.

6. Where buried cables enter a concrete foundation, junction box, shelter or case, leave sufficient slack in each cable in the nearest pull box to allow an additional one foot of cable to be pulled into the shelter or junction box.

7. The potheading of buried cables shall be applied whenever cable is terminated in signal equipment, and such termination is within two feet of the grade level. This neoprene and seal pothead shall be installed in accordance with the manufacturer's instructions.

8. Cables shall not cross one another when they are pulled into a conduit or pipe; the conductors shall not be pulled tight or kinked in conduit fittings or boxes. All cables to be installed in a conduit or pipe shall be pulled and installed simultaneously.

9. Cables, track wire, and conduits shall be installed per Contract Drawings.

10. All cables except final connection of flex wires to rail shall be installed in a conduit system as shown on the Contract Drawings.

C. Special Protection: Provide appropriate special protection for cables in areas where cables are unavoidable exposed to hazardous conditions, such as vibration or sharp corners on equipment. Replace any cable that is installed but subsequently damaged prior to acceptance as a result of the Contractor's failure to provide such special protection

D. AC Power Cable

1. AC power cable shall be installed in dedicated conduit from the service meters to the signal/communications shelters and between signal shelters.

E. Pull Boxes

1. All pull boxes to be abandoned shall be removed completely by the Contractor and the existing sidewalk, parkway and landscaping shall be repaired.

2. All pull boxes in dirt or parkway areas shall have concrete cap around the box.

3. Pull boxes shall not be installed in any part of a driveway, wheelchair ramp or other travelled way unless specified by the Engineer.

4. The Engineer will approve the final location of all pull boxes.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Conduit and Pull Boxes will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

4.02 PAYMENT

A. Conduit and Pull Boxes furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

END OF SECTION

SECTION 34 71 50

HIGHWAY-RAIL GRADE CROSSINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Constructing new highway-rail grade crossings of OCTA railroad tracks.

2. Removing and reconstructing existing highway-rail grade crossings.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.

2. Section 03 31 00 – Structural Concrete.

3. Section 26 05 43 – Electric: Exterior Underground.

4. Section 33 42 00 – Culvert and Drainage Pipe.

5. Section 34 11 10 – Continuous Welded Rail (CWR).

6. Section 34 11 23 - Other Track Materials (OTM).

7. Section 34 11 26 – Ballast.

8. Section 34 11 34 – Wood Railroad Tie

9. Section 34 11 40 – Precast Concrete Grade Crossing Panels

10. Section 34 72 00 - Trackwork.

11. Section 34 72 20 – Track Shifting, Relocation and Resurfacing.

12. Section 34 72 30 – Field Welding Rail.

13. Section 34 80 33 – Hot Mix Asphalt (HMA) for Bridges.

14. Section 34 80 43 – Precast and Prestressed Concrete for Railroad Bridges.

1.02 REFERENCES

A. SCRRA: Engineering Standards, and Track Maintenance and Engineering Instructions.

B. ASTM International (ASTM):

1. D3776 Standard Test Methods for Mass per Unit Area (Weight) of Fabric.

2. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

3. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

C. SSPWC: Latest Edition, Standard Specifications for Public Works Construction, “Greenbook”, Public Works Standards, Inc.

D. California Public Utilities Commission (CPUC): General Order(s) for road crossing(s) being newly constructed, removed or reset under the Project.

E. State of California Department of Transportation: California Manual on Uniform Traffic Control Devices (CA MUTCD), Latest Edition.

F. WATCH: Work Area Traffic Control Handbook, Latest Edition, WATCH BOOK, APWA Southern California Chapter.

G. Federal Railroad Administration (FRA): 49 CFR Part 213, Track Safety Standards.

H. Americans with Disabilities Act (ADA).

I. Materials not meeting the requirements of this Specification shall not be used in the Work.

1.03 SUBMITTALS

A. General

1. Submittals shall be made in accordance with Division 01 requirements.

B. Plans and Procedures:

1. Traffic Detour Plan signed by a Registered Professional Engineer using SCRRA Engineering Standards ES4301 as guidelines and incorporating provisions of the State of California MUTCD and the WATCH BOOK.

2. Site Specific Work Plan (SSWP) and Operating System Interface in accordance with Division 01 requirements.

C. Certificates:

1. Material Test Reports for products purchased and used in the Project.

D. Product Data and Shop Drawings:

1. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

c. Shop Drawings detailing dimensions, reinforcement and lifting apparatus for precast crossing panels.

1) Precast concrete mix design in accordance with Section 34 80 43.

2) Structural calculations.

3) Manufacturing and curing procedures.

E. Miscellaneous Submittals:

1. Submit quality control test results for testing performed for precast concrete panels and other material. Testing shall be performed by a certified test laboratory hired by the Contactor or fabricator and approved by the Engineer.

2. Verification documentation that Contractor requested DigAlert field location of underground utilities and SCRRA clearance of underground railroad utilities prior to starting any excavation work in accordance with Division 01 requirements.

3. Contractor must submit qualifications and experience of installers of precast concrete grade crossings.

1.04 QUALITY ASSURANCE

A. Employ a skilled foreman for the Installation of grade crossings, having no less than 3 years experience in installation of the type of grade crossing panels used.

B. Track work shall be performed under the supervision of an FRA Part 213 Track Safety Qualified Foreman in accordance with requirements of Section 34 72 00.

C. The Engineer, will review test reports in accordance with the Specifications as applicable for the material item and may require additional testing to confirm requirements with the Specifications.

1.05 PROJECT SITE CONDITIONS

A. Prior to commencing Work, Contractor must examine the Contract Documents, inspect the site, obtain and review available Record Drawings of existing work and utilities and note conditions and limitations which may influence work required by this Section in accordance with Division 01 requirements.

B. Contractor must execute Work under this Specification in such a manner as to minimize impact to the daily operation of the railroad, vehicular and pedestrian traffic in accordance with Division 01 requirements and the approved Traffic Control Plans.

C. Contractor must maintain vehicular traffic and pedestrian walkways using barricades, warning signs and warning lights in accordance with Division 01 requirements.

1. Warning lights shall be set so they do not shine into the eyes of locomotive engineers in on-coming trains.

2. Temporary pedestrian walkways shall meet ADA standards.

1.06 ENVIRONMENTAL CONDITIONS

A. The Contractor must protect against erosion and uncontrolled run-off within and adjacent to right-of-way in accordance with the Project's Storm Water Pollution Prevention Plan (SWPPP) and the approved NPDES Permit in accordance with Division 01 requirements.

B. The Contractor must obtain all required permits for dewatering and legally dispose of water from dewatering operations in accordance with Division 01 requirements.

C. Contractor must provide for site cleanliness, sweeping and dust control in accordance with Division 01 requirements.

D. Contractor must provide noise abatement as required by environmental permits or local agency requirements in accordance with Division 01 requirements.

1.07 REGULATORY REQUIREMENTS

A. Furnish any required excavation drawings or traffic control plans to Engineer for review and approval by OCTA, SCRRA and jurisdictional authorities.

1. Contractor to obtain permits for performing such work as required in accordance with Division 01 requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Precast Concrete highway-rail grade crossing Panels shall be new and conform to Section SS 34 11 40:

B. Wood Ties: Ties shall be new 10 feet long and conform to Section SS 34 11 34.

C. Ballast: Ballast shall be new and conform to Section SS 34 11 26.

D. Rail: Rail size shall be 136# CWR and shall conform to Section SS 34 72 00.

E. Rail Fastening: Rail fastenings shall be new and shall conform to Section SS 34 72 00.

F. Geotextile:

1. Geotextile filter fabric used for grade crossings shall be nonwoven fabric. The filaments shall be polypropylene, polyester, or polyethylene. The filaments must be dimensionally stable (i.e., filaments must maintain their relative position with respect to each other) and resistant to delaminating. The filaments must be free from any chemical treatment or coating that might significantly reduce porosity and permeability. Nonwoven fabric may be needle-punched, heat-bonded, resin-bonded, or combinations thereof.

2. The physical properties for Geotextile shall conform to the following:

Test Method	Property	Requirement
ASTM D3776	Minimum Weight (oz./sq. yd.)	3.5
ASTM D4632	Minimum Wet Grab Tensile Strength (lbs.)	100
ASTM D4632	Minimum Grab Elongation at Break (%)	20
ASTM D4751	Apparent Opening Size(US Sieve)	30

G. Asphalt Concrete:

1. Asphalt concrete for crossing underlayment shall conform to Section 34 80 33.

2. Asphalt concrete for roadway shall conform to Section 32 12 00, Hot Mix Asphalt Concrete. Asphalt concrete for roadway approach paving shall conform to Section 32 12 00, Hot-Mix Asphalt Concrete and the Greenbook Section 203 – Bituminous Materials as noted in SCRRA Engineering Standards ES4201 for permanent crossings or ES4302 for temporary crossings or Agency requirements as specified in the Plans or Project Special Provisions.

a. Contractor must submit the proposed pavement design to the Engineer for review and acceptance. Roadway approach paving will be reviewed and accepted by OCTA and the local agency governing the crossing.

H. Cast-in-Place Concrete

1. Cast-in-Place concrete for new or replacement sidewalks, curbs, gutters and other concrete items shall conform to Section 03 31 00 or as shown in the Plans.

    a. Minimum 28-day compressive strength shall be 3250 psi (560-C-3250 –SSPWC) unless otherwise shown in the Plans.

I. Perforated Drain Pipe:

1. Perforated drain pipe shall be Schedule 80 PVC pipe in accordance with Section 33 46 00.

J. Signal Conduit:

1. Signal conduits shall be Schedule 80 PVC electrical conduit in accordance with Section 34 42 00.

PART 3 - EXECUTION

3.01 GENERAL

A. Coordinate with SCRRA Signal Department forces in accordance with Division 01 requirements.

B. Demolish and dispose of existing grade crossing material including asphalt concrete pavement, sidewalks, curbs and gutters and other items as required in the Plans in accordance with Section 31 11 50.

C. Remove and salvage existing grade crossing panels or other crossing appliances as required in the Plans in accordance with Section 31 11 50.

D. Track subgrade, asphalt underlayment, and ballast shall be constructed to extend at each end, beyond the limits shown for each grade crossing in accordance with SCRRA Engineering Standards ES4201 or as shown in the Plans, whichever is greater.

3.02 SUBGRADE AND SITE PREPARATION

A. Prepare subgrade in accordance with the Contract Documents, Section 31 20 00 and SCRRA Engineering Standards ES4201.

B. Remove existing concrete foundations, curbs, sidewalks, storm drains, pavement and traffic striping as shown in the plans in conformance with Section 31 11 50.

C. Cut lines for asphalt and concrete shall be straight and neat in accordance with Section 31 11 50 and any damage to facilities to remain shall be repaired to the approval of the Engineer at no additional cost to OCTA.

3.03 DRAINAGE AND SUBDRAINAGE

A. Drainage and subdrainage work including placement of geotextile wrap of perforated drainage pipe, shall be performed as specified in the Contract Documents and in accordance with SCRRA Standard Plans ES4201.

3.04 HOT MIX ASPHALT (HMA) CROSSING UNDERLAYMENT

A. Hot Mix Asphalt (HMA) pavement for crossing underlayment shall be placed as indicated in the Contract Documents Section 32 12 00 and as shown in SCRRA Engineering Standards ES4201.

B. Hot Mix Asphalt (HMA) pavement end ramps shall be provided at all concrete grade crossing panel installations in accordance with SCRRA Engineering Standards ES4201 if the preapproved crossing panel is used. End ramps shall be per the manufacturer's recommendation if a substitute is approved, but shall not be less than 3 feet in length.

3.05 SIDEWALKS, CURBS, GUTTERS AND OTHER ROADWAY ITEMS

A. Place new sidewalks, curbs, gutters and other roadway items as shown in the plans, the identified standards of the public agency identified in the Plans responsible for the roadway and SCRRA Engineering Standards ES4001 through ES4021.

B. Highway-Railroad Grade Crossing Crossbuck signs, when called for, shall be installed in accordance with SCRRA Standard Drawing ES4310.

C. Private, Pedestrian and Bicycle Railroad Grade Crossing Sign, when called for, shall be installed in accordance with SCRRA Engineering Standards ES4311.

D. Temporary construction crossing signs, when called for, shall be installed in accordance with SCRRA Engineering Standards ES4302.

3.06 PRECAST CONCRETE HIGHWAY-RAIL GRADE CROSSING PANELS

A. Install precast concrete grade crossing panels to the position and location shown in the Plans in accordance with manufacturer's recommendations, the approved procedures and SCRRA Engineering Standards ES4201.

1. Contractor must use SCRRA Engineering Standards ES4201 when using the preapproved crossing plank.

B. Contractor must clean dirt and debris from the flangeways before releasing the crossing for the passage of trains.

C. Re-used highway-rail grade crossing panels, when shown in the Plans, shall have hot mix asphalt (HMA) placed with proper compaction in the flangeway if a rubber filler does not exist in the flangeway.

3.07 BALLAST

A. Place and spread ballast in accordance with the details indicated on the Contract Plans, SCRRA Engineering Standards ES4201 and Section 34 72 00.

3.08 TIES

A. Grade crossing ties shall be spaced per crossing plank manufacturer's recommendations if not the pre-approved crossing plank, and spacing per SCRRA Engineering Standards ES4201 if the pre-approved crossing plank. Other tie location and layout distances shall be per the SCRRA Engineering Standards ES4201.

B. Tops of all ties within the crossing limits shall lie in the same plane. Any tie with an irregular surface dimension shall be adzed or replaced.

3.09 HIGHWAY-RAIL GRADE CROSSING TRACK CONSTRUCTION

A. Construction and fastening of track through grade crossings shall be performed in accordance with details shown on the Contract Plans, SCRRA Engineering Standards ES4201 and Section 34 72 00.

B. Rail joints or thermite welds are not permitted within the limits of the grade crossing trackwork unless approved by the Engineer.

C. Rail joints consisting of field welds are permitted at the ends of rail strings placed for crossings. Welds shall conform to Section 34 11 16.

D. Contractor must use a dynamic stabilizer after initial tamping and surfacing followed by a second surfacing pass in accordance with Section 34 72 20, prior to the final installation of the grade crossing panels.

E. Every attempt needs to be made to close the roadway for the crossing construction so that the entire crossing can be completed continuously. If the roadway cannot be closed, extra efforts shall be utilized to ensure track surface profile is maintained during and after construction, including but not limited to an extra dynamic stabilizer pass.

3.10 FIELD QUALITY CONTROL/QUALITY ASSURANCE

A. Compaction testing for subgrade, trench backfill and sub-ballast shall conform to Section 31 20 00.

B. Compaction testing for asphalt concrete crossing underlayment shall conform to Section 34 80 33.

C. Contractor must coordinate with and provide 24 hours advance notice of crossing work to SCRRA Signal Inspectors and verify that testing of all crossing signal work has been completed and accepted by SCRRA prior to opening crossing to vehicular traffic.

D. Coordinate with SCRRA Engineer in Charge (EIC) and SCRRA Communications & Signal Inspection for release of “Protect Order” following completion of construction and inspection of crossing facility by the Contractor.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Highway-rail grade crossings will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

B. All material, work and services included in Sections 34 11 10, Continuous Welded Rail (CWR); 34 11 15, Other Track Materials (OTM); 34 11 26, Ballast; 34 11 27, Sub-Ballast and Aggregate Base; 34 11 34, Wood Railroad Ties; 34 11 36, Elastic Rail Fasteners; and 34 11 40, Precast Concrete Grade Crossing Panels will be included in this Section and are considered incidental to work under this Section and will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer.

C. No separate measurement or payment will be made to the Contractor for removal and salvage of existing concrete panels.

D. No separate measurement or payment will be made to the Contractor for removal and/or salvage of existing track within the limits of payment for grade crossing installation.

4.02 PAYMENT

A. Highway-rail grade crossings furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, hot mix asphalt (HMA) crossing underlayment, 7” thick AC Pavement within 10 feet of centerline of track (within 5 feet of edge of crossing panel), and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

B. This price shall be full compensation for furnishing all labor, materials, tools, equipment, fees, supplies, supervision, and incidentals within the limits of highway-rail grade crossing work in accordance with SCRRA Engineering Standards ES4201 necessary for any highway-rail grade crossings described by the Contract Documents.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 34 72 00

TRACKWORK

PART 1 - GENERAL

1.01 SUMMARY

A. This Section consists of the Contractor, unless otherwise indicated, furnishing all labor, materials, equipment, tools, and incidentals necessary to remove, repair, modify, rehabilitate, or construct trackwork, turnouts, crossings and crossovers.

1. Work includes ballast, walkways, ties, rail, fastening systems, other track material (OTM), turnouts and other special trackwork.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 34 11 10 – Continuous Welded Rail (CWR).

4. Section 34 11 15 - Other Track Materials (OTM).

5. Section 34 11 23 – Special Trackwork.

6. Section 34 11 26 - Ballast.

7. Section 34 11 27 - Sub-Ballast and Aggregate Base.

8. Section 34 11 33 - Concrete Railroad Ties.

9. Section 34 11 34 - Wood Railroad Tie.

10. Section 34 71 50 – Highway-Rail Grade Crossings.

11. Section 34 72 30 – Field Welding Rail.

1.02 REFERENCES

A. American Railroad Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering.

B. FRA: 49 CFR Part 213, Track Safety Standards, most current and addenda, Federal Railroad Administration.

C. SCRRA: Engineering Standards.

D. SCRRA: Current Track Maintenance, Right-of-Way and Structures, Engineering Instructions.

1.03 SUBMITTALS

A. Submit, under the provisions of Division 01:

1. Materials: Submit individual certifications that all materials furnished by the Contractor conform to the specified requirements.

2. Shop Drawings:

a. Submit Shop Drawing and product data for trackwork items not specifically defined by engineering standards.

b. Shop Drawings for each size and direction of Turnout will be required.

c. Shop Drawings shall also be submitted in electronic media Microstation Intergraph DGN V8 compatible format on compact discs and shall conform to SCRRA's CADD Standards.

3. Equipment: Provide submittal for all construction equipment proposed to be used as identified in Division 01.

4. Procedure: Submit procedure for transporting, stockpiling and handling of trackwork Materials.

a. Submit proposed construction and installation procedure for new trackwork as part of the Site Specific Work Plan (SSWP) submitted under Division 01, Coordination with SCRRA.

b. Ballast stabilization shall be coordinated with OCTA and the Resident Engineer in accordance with Section 01 11 16 Work by SCRRA. Ballast Stabilization operations shall be included in SSWP.

c. Contractor may modify Installation procedure stated hereinafter, to produce the most efficient method for track construction, subject to approval by the Engineer.

5. Compliance Record: As-built compilation of actual track geometry produced in construction including curvature, length of reversing tangent, length of spirals, top of rail profile, and super elevation values.

6. Compliance Record: Rail temperature record taken during anchorage and de-stressing procedures as described in the Articles entitled "Procedures for Placement of CWR" and "Anchoring CWR" herein.

7. Compliance Record: Test results for insulated joints as described in Article entitled "Insulated Joints" in Part 3 of this Section.

8. Procedure: Quality Control / Quality Assurance Program.

9. Procedure: Submit rail end hardening procedure.

10. Procedure: Submit procedure and field welding material technical data for field welding rail.

11. Procedure: De-stressing of Rail.

12. Procedure: Installation of insulated joints.

13. Procedure: Plan for the coordinating and scheduling of a signal track support crew to protect and maintain the operating signal system.

1.04 QUALITY ASSURANCE

A. Quality Assurance:

1. Perform track construction under the supervision of Qualified personnel, as defined in Division 01.

2. Corrections by Contractor: During the Installation and testing period, Contractor must make available personnel, equipment, and Materials necessary to make required corrections to the track including such work as replacements, re-ballasting, resurfacing and realigning, or repair of constructed items, as the Engineer may require ensuring completion of the Work in accordance with the Contract.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Ties shall be lifted and supported during storage, transportation, and placing in such a manner as to prevent damage.

1. Ties shall not be dropped to the roadbed.

2. Wood ties shall be handled in accordance with AREMA Manual Volume 1, Chapter 30, Section 3.5 and Concrete Ties shall be handled in accordance with AREMA Manual Volume 1, Chapter 30, Section 4.11.

3. Refer to Sections 34 11 34 and Section 34 11 33 for on-site storage requirements.

B. Rail shall be unloaded and distributed in a manner that prevents damage to ties, rails and structures. Do not bump or strike rail.

PART 2 - PRODUCTS

2.01 CONSTRUCTION EQUIPMENT

A. If the Engineer determines that Contractor's equipment is not in good working condition or that the kind, size, capacity or quantity of equipment is incapable of contributing to the Work progress or to the requirements of the Contract Documents, Contractor must promptly replace the equipment with an improved kind, type, size, capacity, or quantity. Rejection of equipment shall not be considered justification for a delay Claim.

B. Track surfacing and alignment equipment shall be laser guided.

1. Track surfacing equipment must have all tamping tools in good repair and working order.

2. As a minimum, at least 70 percent of the original surface area of the tamping tool pad must be available and these tools must closely match adjacent and opposite tamping tool pads in the amount of wear.

C. Equipment shall be compatible with and shall be operated within the clearances indicated in SCRRA Engineering Standards.

D. Wheel contours of all rail-mounted equipment shall conform to the Association of American Railroads (AAR) wheel standards or AREMA maintenance of way equipment wheel standards.

E. All construction loads borne by equipment shall be applied between gage lines of running rails on each track unless approved by the Engineer.

F. Vibratory compaction equipment for compaction of base ballast shall be specifically manufactured for compaction purposes.

1. The self-propelled, pneumatic-tired roller shall have a gross weight of 10 to 15 tons, and the vibratory compactor shall have a weight of not less than 10 tons and shall be capable of applying a dynamic load of not less than 18,000 lbs. at 1300 to 1500 cycles per minute.

2. The proposed compaction equipment is subject to approval by the Engineer.

G. Ballast Stabilizing for compacting ballast in crib and shoulder areas will be completed by SCRRA. The Contractor shall be responsible, under the provisions stated in Section 01 11 16 Work By SCRRA, to coordinate with OCTA and the Resident Engineer.

2.02 TRACK TOOLS

A. Furnish tools and equipment necessary to construct the track.

B. Track gages, track levels, and other tools shall conform to the AREMA Volume 1, Chapter 5, Part 6, "Specifications and Plans for Tools."

C. Tools and equipment shall be maintained in such a condition as not to endanger personnel nor damage the Work and shall be subject to inspection by the Engineer.

D. Tools not conforming to standard shall be repaired to AREMA standards or shall be replaced.

1. Substitution of tools other than AREMA standard will be permitted only with approval of the Engineer.

E. Track levels and gages shall be checked for accuracy at the start of every work shift and at any time the tool is dropped or struck.

1. Adjustments shall be performed anytime it is found to have more than 0.050 inches deviation from the nominal measurement value.

2.03 SUB-BALLAST

A. Sub-Ballast shall conform to the requirements of Section 34 11 27.

2.04 BALLAST AND WALKWAY ROCK

A. Ballast shall conform to the requirements of Section 34 11 26.

B. Walkway rock shall conform to the requirements of Section 34 11 26.

2.05 TIES

A. Wood ties shall conform to the requirements of Section 34 11 34.

1. Cross ties and switch ties shall be of the lengths detailed on the Contract Documents or the designated SCRRA Engineering Standard.

2. Ties shall be new unless indicated otherwise in the Contract Documents.

B. Concrete ties, shall conform to the requirements of Section 34 11 33 and SCRRA Engineering Standard Plan ES2402 for Pre-stressed Concrete Track Tie or ES2403 and ES2407 (for bridge deck locations requiring a neoprene pad). Ties shall be new unless indicated otherwise in the Contract Documents.

2.06 RAIL

A. Rail shall conform to the requirements of Section 34 11 10.

2.07 OTHER TRACK MATERIAL (OTM)

A. OTM shall be new and conform to requirements of Section 34 11 15 and SCRRA Engineering Standards.

2.08 TURNOUTS

A. Special Trackwork shall conform to the requirements of Section 34 11 23.

B. Turnouts shall be as indicated on the Contract Plans, fabricated with all new Material, and in conformance with SCRRA Engineering Standards.

C. Derails shall be of constructed using new Material and conform to SCRRA Engineering Standards with type (double switch point derail or sliding derail with crowder) as indicated in the Contract Documents.

2.09 GRADE CROSSING PANELS

A. Road Crossings shall be of new Material and conform to Section 34 11 40 and SCRRA ES4201 and as indicated on the Contract Plans.

2.10 LUBRICANTS

A. Lubricant for special trackwork shall be Whitmore's Railmaster Curve grease except that Dixon L-5550 graphite shall be used for switch plate lubricant. Approved equals shall be submitted for approval by the Engineer.

2.11 INSULATED JOINTS

A. Insulated Joints shall be new and conform to requirements of Section 34 11 15 and SCRRA Engineering Standards.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Work shall be completed in accordance with SCRRA Engineering Standard Plans, SCRRA Track Maintenance and Engineering Instructions, AREMA Manual for Railway Engineering, and as specified herein.

1. Each fully completed segment of track, as approved in the SSWP, that is to be placed into operational service shall fully comply with the requirements of FRA 49 CFR 213 for the specific classification of train operation.

2. Track must have ballast section full to top of ties, have joints fully bolted or welded, have all anchors or elastic fasteners applied, and the rail shall be fully de-stressed.

B. Bottom of rail, fastener assemblies, and all bearing surfaces shall be broom cleaned before laying rail.

C. The low rail (inside rail of curves) on all superelevated track shall be designated as the profile rail.

D. Install track, OTM, turnouts, derails and road crossings in accordance with the Contract Plans, SCRRA Engineering Standards, Track Maintenance and Engineering Instructions and California Public Utilities Commission requirements.

3.02 SUB-BALLAST

A. Sub-ballast construction shall conform to typical cross sections as depicted in SCRRA Engineering Standards or as shown on Contract Plans and must also comply with the requirements of Specification Section 34 11 27.

3.03 CROSS TIES

A. Wood or concrete ties shall be used in special trackwork, grade crossings, turnouts, and crossing diamonds as shown on the Contract Plans.

1. Use of wood ties or concrete cross ties shall be designated on the Contract Plans for use in track construction as indicated.

B. Ties damaged as a result of improper handling or installation by Contractor and rejected by the Engineer must be removed and replaced with new ties at no additional cost to the OCTA.

C. Installation and placement of wood ties shall be as follows:

1. Place wood Crossties on 19-1/2” centers for mainline track, except through grade crossings.

2. Space cross ties for grade crossings in accordance with the applicable SCRRA Engineering Standard.

3. Space Crossties for turnouts in accordance with the applicable SCRRA Engineering Standard and the Contract Plans.

4. Obtain approval for any deviation in crossties spacing from the Engineer prior to Installation of spikes or hold down devices.

5. Place wood ties with heartwood face down and square to the rail, except as otherwise shown on the Contract Plans.

6. When handling or spacing ties, prevent damaging them with picks or spiking hammers. Tie tongs, lining bars, other suitable tools or tie spacing equipment shall be used.

7. Do not drive nails or spikes other than those called for into wood ties.

8. Do not re-spike new wood ties.

D. Place concrete Crossties as shown in the Contract Plans and SCRRA Engineering Standards.

1. Ensure that the proper rail cant is established.

2. Concrete Crosstie spacing shall be 24 inches centers.

E. Transition ties shall be installed where concrete ties abut timber track in accordance with SCRRA Track Maintenance and Engineering Instructions and SCRRA ES2351-03.

F. Bridge decks with less than 12 inches of ballast under the tie will require use of a concrete tie with embedded neoprene pad (SCRRA ES2403 or ES2407). When calculating the depth of ballast under the tie, include any HMA underlayment as a part of the ballast depth for determining the requirement for use of the concrete tie with embedded neoprene pad. Bridge decks with 12 inches or more of ballast under the ties will utilize standard concrete ties (SCRRA ES2402 or ES2406).

3.04 TIE PLATES

A. Plates shall be positioned so that the rail will cant inward towards track centerline and the plate shall be centered on tie and applied as to obtain full proper bearing on both the tie and rail.

B. Tie plates shall be installed as shown on the SCRRA Engineering Standards, in SCRRA Track Maintenance and Engineering Standards, and on approved Shop Plans.

3.05 RAIL FASTENING

A. OTM shall be installed in accordance with SCRRA Engineering Standards and where applicable, manufacturer’s recommendations.

B. Installation of screw spikes and specified resilient fasteners shall be in accordance with manufacturer's recommendations, and SCRRA Engineering Standards and SCRRA Track Maintenance and Engineering Instructions.

C. Spiking for standard cut spike fastening systems shall be performed using new cut spikes unless otherwise indicated in the Contract Plans and as follows:

1. Spiking pattern shall conform to SCRRA ES2460.

2. Spikes shall be started vertically, square to the base of rail and driven straight.

3. Shank of rail-holding spikes shall have full bearing against base of rail.

4. Do not strike rail or fastenings when driving spikes.

5. Bent spikes shall be removed and replaced with a new spike as approved by the Engineer.

6. Spikes shall not be over-driven.

D. Holes for the screw spikes shall be pre-drilled and applied perpendicular to the plane of the base of tie plate.

1. Sufficient torque shall be applied to bring the bearing face of the screw spike into flush bearing contact with the tie plate so no gap exists.

2. Not more than 2 each cut spikes per plate may be used to hold the elastic fastening system plates until the screw spikes are installed.

3. Cut spikes used in this manner as temporary fasteners may be salvaged or used material.

4. Cut spikes used as temporary fasteners in this manner shall not be removed; however, four (4) screw spikes per plate shall be provided if cut spikes are used in this manner.

3.06 RAIL ANCHOR INSTALLATION

A. Rail anchors shall be installed per SCRRA ES2351-01 through ES2351-04, as applicable.

1. In applying rail anchors, they shall be set with full bearing against the side of the tie.

2. Anchors shall not be over-driven.

3. Fractured or spread rail anchors will be rejected.

4. Rail anchors shall be applied prior to operation of trains.

5. If, in accordance with the Engineer-approved SSWP, a slow order will be required, the Contractor must submit proposed anchor pattern to the Engineer for approval prior to commencement of the rail anchor work.

6. Anchors shall be removed and re-applied at the time CWR is de-stressed.

B. Rail anchors shall be applied in accordance with manufacturer's recommendations.

3.07 INSTALLING TRACK

A. Installation, laying, raising, lining, tamping and dressing of track over ballast shall be performed as follows:

1. Ballast shall only be installed over sub-ballast, which has been prepared in accordance with Section 34 11 27 and approved by the Engineer.

2. Place base ballast in lifts not more than 6 inches in thickness before compaction.

a. Layers shall extend beyond the edge of the ties as shown on the Contract Plans before compaction.

b. Compact ballast thoroughly to form a stable section able to support the subsequent layers and loads.

3. Compaction of base ballast shall be by means of vibratory compaction equipment specified in Division 01.

    a. Each lift of ballast within the initial layer shall be uniformly spread and compacted with not less than four passes of either a self-propelled, pneumatic-tired roller or vibratory compactor.

    b. Ballast surface that exhibits ruts or crowns is not acceptable and shall be re-graded and re-compacted prior to the placement of the crossties.

4. Obtain the Engineer's verification of the compacted ballast prior to the installation of track and appurtenant Work over the ballast.

5. The track shall be assembled on the compacted ballast to permit placement of additional ballast for subsequent raising and tamping and to provide the full depth under the ties.

6. The ballast shall be tamped with a 16 tool vibrating squeeze-type mechanical tamper specified in Division 01, making a minimum of one full tamping insertion per tie for each inch of raise.

7. The final track raise shall not exceed 1 inch.

8. Ballast Stabilizing for compacting ballast in crib and shoulder areas will be completed by SCRRA. The Contractor shall be responsible, under the provisions stated in Section 01 11 16 Work By SCRRA, to coordinate with OCTA and the Resident Engineer.

9. The track shall be raised, aligned and tamped to within the specified tolerances.

10. Ballast shall be thoroughly tamped within a space from 15 inches inside either rail to the ends of the ties.

    a. In tamping ties within the above-described limits, simultaneous tamping shall be performed under each rail.

    b. Tamping is not permitted at the center of the tie except within limits of turnouts and crossings where the center of the ties shall be tamped unless prevented by trackwork components.

11. Pneumatic or electric tamping tools, either hand held or machine mounted shall be used to perform tamping at portions of turnouts not accessible to a production tamper. Hand tamping with shovels or picks will not be permitted unless authorized by the Engineer.

12. Two tamping tools shall always be used opposite each other on the same tie.

a. Tampers shall be started from a nearly vertical position and worked downward past the bottom of the tie, after which the tool should be slanted downward to force ballast under the tie.

b. Double tamp every joint tie.

13. Ballast shall be mechanically dressed to provide the section as shown on the SCRRA Engineering Standards and the Contract Plans.

14. Excess ballast shall be removed.

a. With the Engineer's permission, excess ballast may be placed as directed by the Engineer.

b. Payment will not be made for ballast in excess of dimensions shown on the Contract Plans.

15. Ballast damaged by overwork or excessive tamping or fouled by dirt or other deleterious material as determined by the Engineer must be removed and replaced at no additional cost to the OCTA.

16. Where new track joins existing track, the existing track shall be surfaced for a minimum distance of 500 feet on mainline or siding tracks, or 200 feet on industrial tracks, from the point of connection.

a. Existing track surfacing may be longer as needed to meet FRA requirements, or as shown of the Contract Plans.

17. After the track has been raised to its final elevation and super-elevation, ballast consolidation of all tracks shall be performed before the track is placed in service.

a. Each segment of track may be placed in full service, as approved in the SSWP, if that segment fully complies with FRA 49 CFR 213 for specific classification of train operation, has ballast section full to top of ties, has joints fully bolted or welded, has all anchors or elastic fasteners applied, and has the rail fully de-stressed and ballast compacted.

18. When raising track, a spot board or other approved device shall be used to maintain grade, and a level shall be used to keep track to proper crosslevel.

a. Laser guided alignment is required, and horizontal alignment must be maintained during the raising operation.

b. Use of automated controls on tampers will satisfy this requirement.

19. In addition to the other requirements specified herein, all newly constructed mainline and mainline siding tracks, upon completion of final surfacing operations, shall be mechanically stabilized using a Ballast Stabilizer as specified in Division 01. Ballast stabilization shall be coordinated with The Authority in accordance with Section 01 11 16 Work by SCRRA.

3.08 INSTALLING TURNOUTS

A. Installation of frog plates, switch plates, and plates under the closure rails shall conform to SCRRA Engineering Standards and AREMA trackwork standards.

1. Plates shall be secured by screw spikes except rehabilitation of existing turnouts with cut spikes, which shall be fully spiked.

B. Following the installation of turnouts on the initial layer of ballast, the turnouts shall be lifted, aligned and supported prior to placement of final ballast.

C. Ballast shall be uniformly placed and spread.

1. The turnout shall then be raised and the ballast tamped under both sides of each tie for the full length of the tie.

2. Tamp ballast thoroughly throughout the length of all ties in the turnout or other special trackwork.

3. Final top of ballast shall conform to the ballast section as indicated except in cribs wherein switch operating rods, locking rods or connecting rods are located and between point of switch and heel of switch where the crib ballast shall be 3 IN below the base of the rail.

D. When installing the various components of the turnout, particular attention shall be given to the following:

1. Check that alignment, gage, and surface meet Specifications.

2. Verify that bolts, nuts, cotter pins, and other fastenings are in place, in good condition, and properly tightened.

3. Verify that switch points are properly aligned and fit tightly against rail when switch is thrown in either position.

4. Verify that connecting rod and switch rod bolts are equipped with cotter pins properly applied.

5. Test-operate the switches for lost motion, difficult throw, or loose connections and adjust as necessary.

6. Examine the rod and fastenings that connect the switch point to the switch stand to see that they are in place and in good condition.

E. Joints within turnouts shall be welded.

F. Switch stands shall be so installed as to hold the switch point tightly against the stock rail when stand is in normal position, per the manufacturer's instructions.

1. Switch rods shall be adjusted to hold the opposite point tightly against the rail when stand is in reverse position.

2. Switch stands, for both switches and derails, shall be mounted on two 16 feet ties.

G. Switch stands shall be kept securely fastened to the head block ties, use approved screw spike fasteners.

1. The head block ties shall be set square with the track and kept firmly tamped.

2. Correct any walkway deficiencies adjacent to the head block ties that would impact SCRRA employee or operating personnel access to the operating levers or controls for the switch stand.

H. Switch stand target colors shall conform to SCRRA ES2106 for Derail Switch Target or to SCRRA ES2703 for standard switch target.

I. At the time of Installation, sliding surfaces of special trackwork assemblies shall be lubricated with a dry film graphite lubricant in accordance with the manufacturer's recommendations.

J. Insulated joints for non-interlocked switches shall be installed as shown on the Contract Plans and in accordance with AREMA (Former AAR) Signal Manual.

1. Install joint using manufacturer's recommended procedure.

K. Signal System Point Protection:

1. No switch point shall be installed in the main track unless it has the proper signal system point protection in place and tested.

2. No switch protection shall be removed from any normally closed signaled switch point unless the switch point is replaced by a straight rail and signal circuits have been corrected and tested.

3. All rail bonding and fouling circuit protection must be intact at all times on all signaled switches.

4. SCRRA will perform installation and testing of signal devices.

5. Contractor must coordinate installation or removal of turnout with SCRRA Engineer for required signal testing.

3.09 INSTALLING DERAILS

A. Install derails per manufacturer's instructions at locations designated in Contract Plans and in accordance with SCRRA Engineering Standards.

3.10 DRILLING

A. Rail ends for bolted joints shall be drilled in accordance with SCRRA Track Maintenance, Right-of-Way and Structures, Engineering Instructions Section 2.1.14.

1. Any additional holes in rail will be sufficient cause for rejection.

B. A variation of 1/32” in size and location of bolt holes will be allowed.

C. Holes shall be located with the proper size rail-drilling template and marked with a center punch prior to drilling.

D. Drilling through joint bars is prohibited.

3.11 RAIL ENDS

A. Rail shall be cut with rail saw to a tolerance of 1/32” from square.

1. All burrs shall be removed and ends made smooth.

2. Torch cut rails will be rejected.

B. Battered or mismatched ends shall be built up or ground off to conform to minimum tolerance of 1/16” on top and gage side to adjoining rail.

3.12 RAIL END HARDENING

A. At all rail end locations not eliminated by field welding, rail ends shall be field end hardened in accordance with the AREMA Manual, Volume 1, Chapter 4, Section 2.1.17.1, “Supplementary Requirements” including all insulated joints.

3.13 PROCEDURES FOR PLACEMENT OF CWR

A. Rail shall be laid or adjusted to the Preferred Rail Laying Temperature in accordance with SCRRA Track Maintenance and Engineering Instructions Section 2.2..

B. Tie cribs shall be filled with ballast immediately after laying rails and after each track raise.

1. Track shall be surfaced, stabilized, and lined and all ties tamped and anchored, prior to returning track to full service.

C. If the rail temperature exceeds 120˚ F, the Engineer reserves the right to suspend rail-laying operations, or direct that the rail be cooled.

1. These actions shall not entitle Contractor to any additional compensation or time.

D. Welded rails shall be positioned for installing in a manner to minimize handling and to prevent buckling.

E. The rail base and tie plate or concrete tie rail seat area shall be cleaned to remove foreign material that may interfere with the full bearing contact with the base of the rail.

1. Rails shall be placed base down, parallel with track, avoiding excessive bending or damage, using suitable mechanical equipment.

2. Do not place rails on signal equipment, manhole covers, electrical connections, or near any other installation that could be susceptible to damage.

F. An approved rail thermometer shall be used to determine rail temperature.

1. The thermometer shall be placed on the web or base of rail shaded from the sun and left long enough to record the rail temperature accurately.

2. The temperature shall be checked frequently.

3. All rail thermometers shall be calibrated.

G. Tools used for field cutting rails shall be approved rail saws.

1. Torch-cut rails shall not be installed in the track.

2. Any rail damaged by torches shall be rejected and removed before Installation in the track.

H. Rail shall be de-stressed in accordance with SCRRA Track Maintenance and Engineering Instructions Section 8.3 only after final track line and grade has been achieved and ballast stabilized, or as required by the Engineer.

1. Rail shall be re-anchored after de-stressing has been achieved.

2. Rail shall have adequate anchor patterns installed at all stages of construction.

3. Ballast stabilization shall be coordinated with The Authority in accordance with Section 01 11 16 Work by SCRRA.

4. Track/Ballast stabilization shall be performed on all tracks the contractor has disturbed.

3.14 ANCHORING CWR

A. As used in this Article the term “rail anchor” also refers to elastic rail fasteners. Install rail-anchoring devices when the rail is within the permissible anchoring temperature.

1. Anchor opposite rail only when its temperature is within 5˚ F of the previously anchored rail's temperature at the time of its anchoring.

2. Temperatures shall be measured in accordance with SCRRA Track Maintenance and Engineering Instructions Section 2.2.4, Instructions for Taking Rail Temperatures.

3. No train operation is permitted over rail that does not have a full complement of anchors per SCRRA ES2351-01 through ES2351-04.

4. If it is necessary to operate trains before de-stressing rail, following the movement of trains, anchors shall be removed for the de-stressing procedure and re-applied.

B. Prior to joining CWR strings, adjust the CWR strings to the Preferred Rail Laying temperature, vibrate to relieve internal rail stresses, and fully anchor.

C. Join CWR strings when the rail gap is at the specified gap.

1. If the rail gap is not within the recommended tolerances for joining CWR strings, and the remainder of the string has been adjusted, un-anchor the CWR strings for 400 feet on each side of the rail gap and readjust each CWR string to within the Preferred Rail Laying Temperature.

2. Re-anchor the CWR strings before installing the rail joint or weld.

3. If the recommended rail gap cannot be obtained in this manner, cut a section of rail from the end of one of the CWR strings and insert a rail plug not less than 19’-6” long on tangent track and curves less than 2˚; and not less than 30 feet long in curves of 2˚ or greater to provide the recommended rail gaps, or crop the rail as necessary to provide the recommended gap.

4. If the Contractor elects to use an artificial means of adjusting the rail for anchoring, submit the method and equipment proposed to the Engineer and obtain Engineer’s acceptance.

5. A rail vibrator shall accompany the rail heating process to assure free expansion of the rail in advance of the heated area.

6. Witness marks shall be made at four (4) or more stations on unanchored rail across the base of the rail and tie plates to confirm actual expansion of the rail in accordance with the calculations.

D. Contractor must not make any joints or welds within the body of a curve unless approved by the Engineer.

3.15 ADJUSTMENT BY MECHANICAL HEATING

A. Rail shall be adjusted for temperature after it has been laid on tie plates but before it is anchored.

B. Rail gaps shall be provided at the end of each continuous welded rail equal to the amount of the expansion that is required for that rail.

C. Heating shall begin at the end of the rail and be steadily applied moving forward and without reversing direction until the required expansion has been obtained for that rail.

D. Complete anchoring application shall follow heating as closely as possible.

1. Any deviation or delay will require reheating the rail.

E. Prevent damage to other work during the heating process.

3.16 THERMAL ADJUSTMENT CALCULATION

A. The adjustment of the rail for thermal forces shall be done as per SCRRA's Procedures for Installation, Maintenance and Inspection of CWR.

B. When it is necessary to adjust the rail already in track, the required increase or decrease may be found by taking the difference between the Preferred Rail Laying Temperature and recorded rail temperatures at each string of CWR and calculating the amount of adjustment as specified herein.

C. The number of inches by which a CWR segment shall be increased or decreased to adjust its length for a temperature higher or lower than that at which it was anchored or adjusted may be calculated using the following formula:

1. Req. Adjustment (inches) = 0.0000067 x ΔT (°F) x L (Ft.) x 12

D. Example:

1. To adjust the length (L) of a 400 feet CWR, fastened at a rail temperature of 65 degrees, to correspond to the length of this rail at a Preferred Laying Temperature (PRLT) of 110 degrees, subtract 65 from 110 to obtain a difference of 45 degrees (ΔT) and multiply as follows:

Station 1, 100 X 12 X 0.0000067 x 45 = 0.36" = 3/8"

Station 2, 100 X 12 X 0.0000067 x 45 = 0.48" = 1/2"

Station 3, 100 X 12 X 0.0000067 x 45 = 0.96" = 1"

Station 4, 400 X 12 X 0.0000067 x 45 = 1.44" = 1 1/2"

3.17 RAIL ANCHORAGE RECORD

A. Compliance record shall be kept in the format similar to that shown in SCRRA Track Maintenance and Engineering Instructions Section 2.2.4 Instructions for Taking Rail Temperatures and provided to the Engineer in an acceptable, reproducible form.

1. It shall contain the following data for each end of a CWR and at each 400 FT interval during installation:

a. Date and time.

b. Track number and rail (East or West, North or South).

c. Station location.

d. Weather, air and base of rail temperature.

e. Type of fastener.

f. Length of rail being anchored.

3.18 PROCEDURES FOR PLACEMENT OF JOINTED RAIL

A. This Article covers both the permanent construction and rehabilitation of jointed rail and the temporary use of rail joints in the CWR pending field welding.

1. When laying jointed rail, each rail shall be carefully placed on the ties with ends square, using standard expansion shims placed between the ends of adjoining rails to ensure proper opening of joint.

2. Shims shall be removed after all joint bolts are tightened.

B. Using temperatures taken on the rails when they are being laid or adjusted; the thickness of the shim to be used for 39 feet rails will be determined by the following table:

Ranges (deg. F)	Shim (Inches)
-20 - 0	3/8
0 - 25	1/4
25 - 50	3/16
50 - 75	1/8
75 - 100	1/16
Over 100	Laid Tight

C. Joint Bars shall be well oiled and with full number and correct size of bolts, nuts and spring washers.

D. Joint bolts shall be tightened before spiking rail and the two center bolts shall be tightened in advance of the end bolts.

E. Bolts shall be placed with the nuts alternatively on the inside and outside of the rail.

1. Nuts shall be placed with the flat side toward the rail.

2. Track bolts, joint bars and finishing surfaces of rails at joint bars shall be swabbed with oil.

3. Use outer four bolt holes only when installing bolted joints that will be eliminated by field welding.

4. Do not drill inside holes (holes closest to rail ends) at future field weld locations.

3.19 TRACK CRITERIA AND TOLERANCES

A. Track shall be constructed to the alignment and grade prescribed.

1. Gage shall be 4’ - 8½”.

2. Deviation from established gage and cross- level shall not exceed 1/8”, and profile grade and horizontal alignment variation shall not exceed 1/8” measured at the center of a 62 feet chord.

B. Provide vertical and horizontal control stakes every 50 feet on curves and every 100 feet on tangents.

C. Tangent track shall be level and superelevation and runoff spirals shall be provided on all curves in conformance with SCRRA ES2201 through ES2204 unless otherwise indicated in the Contract Plans.

D. Contractor must not cut rail strings except as required to fit rail to turnouts, crossings or limits of work.

E. A thermometer designed to measure rail temperature shall be used in accordance with SCRRA Track Maintenance and Engineering Instructions during rail Installation to assure compliance with the SCRRA Preferred Rail Laying Temperature.

1. Final installed or Adjusted Rail Temperature shall be within 10 degrees below or 10 degrees over the Preferred Rail Laying Temperature.

3.20 WELDING OF CONTINUOUS WELDED RAIL

A. Rail welding shall be in accordance with the approved procedure and Section 34 11 16, Field Welding Rail.

3.21 WALKWAYS

A. CPUC walkways shall be provided within track work limits in accordance with the Contract Plans, SCRRA ES2105, SCRRA Track Maintenance and Engineering Instructions, CPUC General Order No. 118.

B. Installation of walkways are incidental to installation of track.

3.22 INSULATED JOINTS

A. Each insulated joint installed by the Contractor must be tested with an insulated joint tester, either the Harmon 1501A1JC or equal approved by the Engineer.

1. Test shall measure no less than 100 ohms across the joint.

2. Test results shall be uniquely identified with a specific joint and submitted to the Engineer in Compliance Record.

B. The rail ends at each insulated joint shall be beveled and hardened in accordance with the manufacturer's procedures as approved by the Engineer.

1. Contractor must comply with rail end hardening and beveling requirements specified in this Section.

3.23 INNER GUARD RAILS

A. Inner Guard Rails will be required:

1. For all bridge spans where exposed structural steel is present above the top of rail.

2. Where individual spans are over 100 feet in length

3. Where entire structure is over 800 feet in length and at least one span crosses over a waterway that normally contains water which is at least 15 feet deep.

4. On any bridge as directed by OCTA or the Contract Documents.

B. Inner Guard Rails shall extend 50 feet beyond the span or spans to be protected as required above. SCRRA ES2302 and ES2304 indicate details for construction of Inner Guard Rails. Inner Guard Rails require use of special Concrete Ties as shown in ES2406 and ES2407.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Construct Track (type as shown on the Schedule of Quantities and Prices) will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

B. Remove and Salvage Existing Track will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

C. Furnish & Install Special Trackwork (type as shown on the Schedule of Quantities and Prices) will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement. The construction of special trackwork, from point of switch to last common tie will be measured separately from Construct Track per complete special trackwork unit as designated in the Schedule of Quantities and Prices.

D. Remove and Relocate Bumping Post will be measured by the unit or fraction thereof completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

E. Remove Insulated Joints and Furnish and Install Insulated Joints (prefabricated plug rail) will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

F. Furnish and Install Transition Rail, 115#RE/136#RE will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

G. Remove and Salvage Special Trackwork (type as shown on the Schedule of Quantities and Prices) will be measured by the unit or fraction thereof completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

H. Shift Existing Wood Tie Track will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

I. Shift Existing Concrete Tie Track will be measured by the unit or fraction thereof completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

J. Surface, Line, and Dress Track will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement. Surface, Line, and Dress Track will only be measured and paid in areas of existing track outside of performance of other trackwork items. Surfacing, lining, and dressing of track shall be considered incidental within the limits of measurement and payment for to track construction, special trackwork construction, grade crossing construction, and shift existing track.

K. The construction of track at grade crossings will be measured and paid under Section 34 71 50 Highway-Rail Grade Crossings. Track construction within the limits of measurement and payment limits for grade crossing construction will be considered included in measurement and payment for grade crossing work and will not be measured or paid under this Section.

L. Measurement limits for various trackwork items will not overlap unless otherwise specified under this Section.

M. Measurement for insulated joints, transition rails, remove and relocate bumping post, and remove crossovers may overlap with measurement for 34 72 00.02 Construct Track, 34 72 20.01 Shift Existing Wood Tie Track, and 34 72 20.02 Shift Existing Concrete Tie Track.

N. Removal of existing track will not be considered incidental to measurement and payment for track and special trackwork construction.

O. No separate measurement or payment will be made for 10’-0” timber tie transitions or for timber ties required for construction of bumping post per SCRRA ES2616. Tie transitions and timber ties for bumping post shall be considered incidental to work requiring these items.

4.02 PAYMENT

A. Trackwork furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

B. Remove and Salvage Existing Track completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, palletizing of ties and OTM, transportation and delivery of salvaged rail and track materials to SCRRA at Marine Way Yard in Irvine, removal and legal disposal of damaged/worn out wood ties, removal and legal disposal of spikes, anchors, and non-Pandrol tie plates, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications. An SCRRA Track Inspector will identify and

mark all damaged/worn out wood ties requiring removal and disposal by the Contractor.

C. Construct Track furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, rail, welds, concrete ties, OTM, ballast, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications, and as directed by the Engineer.

D. Furnish and Install Special Trackwork furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, special trackwork components, turnout ties, switch machine ties, rail, welds, OTM, insulated joints, ballast, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications. Track constructed within the limits of a crossover shall be considered incidental to special trackwork construction.

E. Insulated joints within turnouts and the three pairs of insulated joints at the tie in points of the turnout shall be considered incidental to the Contract Unit Price paid for turnout or crossover construction.

F. Asphalt underlayment for special trackwork shall be considered incidental to the Contract Unit Price paid for turnout or crossover construction

G. Remove and Relocate Bumping Post furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, furnishing and installing new timber bumping post ties, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

H. Remove Insulated Joints furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, plug rail, welds, and doing all work, as shown on the Plans, and as specified in these Specifications.

I. Furnish and Install Transition Rail furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, transition ties, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

J. Furnish and Install Insulated Joints (prefabricated plug rail) furnished and completed in accordance with the Contract Documents will be paid for at the

Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, rail removal, welds, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

K. Remove and Salvage Special Trackwork completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, palletizing of turnout, ties, and OTM, transportation and delivery of special trackwork and materials to SCRRA at Marine Way Yard in Irvine, removal and legal disposal of damaged/worn out wood ties, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications. An SCRRA Track Inspector will identify and mark all damaged/worn out wood ties requiring removal and disposal by the Contractor.

L. Shift Existing Wood Tie Track furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, replacement of up to 25% of wood ties, restoration of shifted track, OTM, ballast, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

M. Shift Existing Concrete Tie Track completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, ballast, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

N. Surface Line, and Dress Track, completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, ballast, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

O. Payment for Trackwork will be made only upon documentation of fully completed trackwork and full restoration of track speed to the design speed as shown in the Contract Plans. All work must be complete prior to payment being made, including but not limited to welding, distressing, final surfacing, and completion of punch list items related to track work

END OF SECTION

SECTION 34 72 20

TRACK SHIFTING, RELOCATION, AND RESURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Furnish all supervision, labor, materials, equipment, transportation and incidentals necessary to shift, relocate or resurface railroad track as shown on the Contract Plans and specified herein. Railroad track as used herein is defined as ”an assembly of rails, ties and fastenings over which cars, locomotives and trains are moved.” This “track” assembly includes, the rail, ties, special trackwork, other track material (OTM), ballast, and walkways although not an exclusive listing.

B. Section 34 72 00 will govern track construction work associated with this Section.

C. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 34 11 10 – Continuous Welded Rail (CWR).

4. Section 34 11 15 - Other Track Materials (OTM).

5. Section 34 11 23 – Special Trackwork.

6. Section 34 11 26 - Ballast.

7. Section 34 11 27 - Sub-Ballast and Aggregate Base.

8. Section 34 11 33 - Concrete Railroad Ties.

9. Section 34 11 34 - Wood Railroad Tie.

10. Section 34 71 50 – Highway-Rail Grade Crossings.

11. Section 34 72 00 - Trackwork.

12. Section 34 72 30 – Field Welding Rail.

1.02 REFERENCES

A. Full compliance with applicable rules, regulations, and General Orders of California Public Utilities Commission is required. Representatives of that State agency will inspect railroad related work for compliance with General Orders.

B. American Railway Engineering and Maintenance of Way Association (AREMA): Manual of Railway Engineering.

C. AREMA Portfolio, American Railway Engineering and Maintenance of Way Association, Portfolio of Trackwork Plans.

D. FRA:

1. 49 CFR Part 213, Track Safety Standards, most current and addenda, Federal Railroad Administration

2. 49 CFR Part 214, Railroad Workplace Safety, most current and addenda, Federal Railroad Administration

E. CPUC, California Public Utilities Commission General Orders.

F. SCRRA, Southern California Regional Rail Authority

1. Engineering Standards.

2. Track Maintenance and Engineering Instructions (Current Edition).

3. Maintenance of Way Safety Instructions.

G. GCOR, General Code of Operating Rules for Maintenance of Way employees.

1.03 SYSTEM DESCRIPTION

A. Perform all track shifting, relocation and resurfacing work as shown on the Contract Plans, and in accordance with this Section.

1. Prior to shifting or relocating track, all drainage structures and grading, including placement of Sub-Ballast as per Section 34 11 27 shall be completed and accepted by the Engineer.

2. In addition to the other requirements specified herein, shifted, relocated, and resurfaced track shall be stabilized using a Ballast Stabilizer coordinated with SCRRA in accordance with Section 01 11 16 Work by SCRRA.

3. Following shifting, relocating, resurfacing and stabilizing of track, rail shall be destressed in accordance with SCRRA Track Maintenance and Engineering Instructions Section 8.3.

4. Track shifting shall include all work to shift existing track more than 1 foot and less than 10 feet and providing Ballast per Section 34 11 26, resurfacing and regulating track in its new location.

5. Track relocation shall include all work to relocate existing track a distance greater than 10 feet including installation of Ballast per Section 34 11 26, resurfacing and regulating track in its new location.

6. Resurfacing, shall include shifting of existing track up to 1 foot, and involves resurfacing indicated track and all special trackwork, including lining, raising, tamping, and regulating track in conformance with SCRRA engineering standards, provisions of this specification, and to the lines and grades shown on the Contract Plans. The Ballast per Section 34 11 26 required to fill cribs and provide adequate shoulders must be provided by the Contractor.

7. Rough and final surfacing of the entire track section shall be performed as required to provide minimal profile smoothing and adjustment. This surfacing may include providing and placing Ballast per Section 34 11 26, tamping, stabilizing and regulating ballast.

B. The Contractor, as with any Work within the OCTA Right of Way, must submit a SSWP for each track segment that requires shifting, relocating, or resurfacing the active track in accordance with Division 01, Coordination with SCRRA.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures:

1. Refer to Division 01 for submittal of applicable SSWP.

a. Ballast stabilization shall be coordinated with SCRRA in accordance with Section 01 11 16 Work by SCRRA. The SSWP shall include SCRRA provided stabilization.

2. Refer to Division 01 for submittal of personnel resumes and railroad equipment list.

1.05 QUALITY ASSURANCE

A. Quality Assurance:

1. Contractor must perform track shifting, relocating, and surfacing under supervision of a qualified Railroad Construction Project Manager, Railroad Track Construction Manager, and Track Foreman. Work shall be performed by personnel experienced in similar railroad track work, as required under Division 01. The surfacing crew shall include a ground man, with a minimum of six months experience, qualified to check profile and alignment behind the tamper.

1.06 PROJECT CONDITIONS

A. This work may occur on an active railroad track.

B. The Contractor must coordinate all phases of the Work to prevent undue interference with the SCRRA daily operations, or with other phases of the Project, whether performed by SCRRA forces or another contractor’s forces.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials to be installed under this Contract must be provided by the Contractor unless indicated otherwise in the Contract Documents.

B. Materials damaged or broken prior to or during installation must be replaced at the Contractor's expense with no additional cost to OCTA.

C. Labor, material not furnished by SCRRA, or equipment required for track resurfacing but not expressly shown on the Contract Plans shall be as if shown on the Plans and included in the Contractor's bid price.

D. Material must be new, except as otherwise indicated herein, and meet the requirements stated herein and of the AREMA and SCRRA Standards.

PART 3 - EXECUTION

3.01 GENERAL

A. Contractor personnel and equipment shall meet the requirements set forth in Division 01.

B. Contractor must exercise care in his progression of work under this Contract to avoid and prevent damage to the track being shifted, relocated, or resurfaced, adjacent tracks, and structures and facilities, such as existing pavements, pavement bases, drainage structures, light poles, fire hydrants, signal facilities (track wires, bootlegs, signal masts, guy wires, signals, cables, conduits) utilities, signage and buildings. Contractor must repair or replace damaged structures or facilities to satisfaction of the owner at no cost to OCTA, except that SCRRA will repair and test signal facilities at the Contractor's sole expense. The Contractor must be responsible to coordinate his work with SCRRA to arrange for the timely and orderly removals or relocations of this signal equipment and facilities. Failure of the Contractor to provide reasonable and adequate coordination for timely removal and relocation of signal facilities will not allow for an extension of time or provide grounds for extra cost to OCTA.

C. Contractor must perform Work under this Section in accordance with these Specifications and consistent with track resurfacing standard industry practice.

D. Contractor must periodically review the supply of materials, labor and equipment to ensure a uniform flow of work. Contractor must keep the Engineer informed regarding material shortages or developing problems that require corrective action.

E. Shifted, relocated, and resurfaced track shall meet the following tolerances as well as the standards for FRA 49CFR213 class 5 track.

1. Except for pre-existing rail gauge corner rail wear,

a. Deviation from correct gage of 56-1/2” shall not exceed + or - 1/4 inch at any point.

b. Deviation measured in any section of 20 consecutive crossties shall not exceed 1/8 inches at 75 percent of the crossties, and 1/4” at the remaining 25 percent.

c. Newly installed or re-installed ties will be spiked not to exceed + or – 1/8” irrespective of pre-existing rail gauge corner wear.

TRACK SURFACE	TOLERANCE
Runoff in any 31 FT of rail at the end of a raise may not be more than	1/4”
Deviation from uniform profile on either rail at the mid-ordinate of a 62 feet chord may not be more than	3/8”
Deviation from designated elevation on spirals may not be more than	1/4”
Variations in cross levels on spirals in any 31 feet may not be more than	5/8”
Deviation from zero cross level at point on tangent or from designated elevation on curves between spirals may not be more than	3/16”
Difference in cross level between two points less than 62 feet apart on tangents and curves between spirals may not be more than	3/8”

2. Alignment - maximum deviation from uniformity measured in conformance FRA Safety Standards Section, 213.55.

a. Tangent Track 1/4” - at mid-ordinate on a 62 feet chord.

b. Curved Track 1/4” - from correct mid-ordinate on a 62 feet chord.

F. Elastic clips, rail anchors, and spikes shall be loosened prior to shifting track to prevent skewed ties. Rail, fasteners, or crossties damaged during track shifting must be replaced by the Contractor at Contractor’s expense. Rail anchors are not to be slid longitudinally along the base of the rail. They must be removed prior to shifting track and reapplied in the correct location after track is shifted to its final location.

3.02 RESURFACING, ALIGNMENT AND DRESS

A. Contractor must perform shifting and resurfacing within the stated project limit station areas as specified to bring the line and surface into compliance within the track geometry tolerances specified.

B. Contractor must resurface the track to zero crosslevel on tangent track and to the proper crosslevel elevation, with spirals, for the curves as shown on Contract Documents.

C. Ballast shall be spread and track raised in a series of lifts. No single lift shall be higher than 2 inches except in crossings and turnouts. In raising the track, jacks or equipment shall be regulated to avoid bending of angle bars or straining of joints. When jacks are used they shall be simultaneously used and properly spaced at not more than quarter points of the rail to avoid breaks or bends in the rail when the track is raised. Both rails shall be raised simultaneously and to proper crosslevel by utilizing automatic tampers or standard track level boards with each set of track raising jacks. Each tie shall be tamped from 15 inches inside the rail to the end of the tie. Tamping shall not be permitted at the middle of a tie. Both ends of a tie shall be tamped simultaneously and tamping inside and outside the rail shall be done at the same time.

D. Ties that become loose during track raise shall be placed in proper position, tie-plates properly placed, holes plugged with “Tight Spike” or approved tie plugs and spiked before tamping. During each track raise, track shall be uniformly tamped.

E. After ballasting is completed and the track is resurfaced and lined, according to the tolerances, ballast shall be mechanically stabilized using a track stabilizer and ballast shall be trimmed neatly and surplus material shall be spread evenly along the ballast shoulder. Ballast stabilization shall be coordinated with SCRRA in accordance with Section 01 11 16 Work by SCRRA.

F. After stabilizing is completed, rail shall be destressed in accordance with SCRRA Track Maintenance and Engineering Instructions Section 8.3.

G. Contractor must perform the necessary operations to ensure that all ties are at right angles to the track as practical with standard railroad procedures. Cribs between ties shall be fully ballasted and dressed.

H. Contractor must perform two tamping squeezes per tie up to two (2) inches of raise with one additional insertion and squeeze for each additional one (1) inch of raise. Joint ties shall be given one additional squeeze more than other ties. The Contractor must not cause a center-bound track condition.

I. In locations where squeeze tampers cannot fill and compact ballast, such as but not limited at frogs, guard rails, switch portions of turnouts and headblocks, mechanically tamp with approved hand-held air tools or other power tamping tools. Hand tamping shall be done simultaneously from both sides of the tie.

J. On curves, the high rail shall be used as the line rail and the low rail shall be used as the grade rail.

K. When surfacing turnouts, the straight side of the turnout shall be used as the line rail.

L. After ballast regulating in turnouts, cribs for switch points, switch rods, and guardrails shall be pocketed 3 inches and cleared of ballast to permit free operation of the switch and signal rods.

M. After the ballast is regulated, dressed and consolidated using a track stabilizer,

Contractor must ensure that track bolts and rail anchors, or elastic track fasteners are tight and in proper alignment.

N. For track resurfacing the total track raise will be the minimum amount necessary to smooth the track profile. It shall be the responsibility of the Contractor to provide smooth transitions that meet the required surfacing tolerances as listed above to grade crossings and turnouts, using the ballast stockpiled near the worksite. In addition, the Contractor must maintain vertical overhead clearances under structures by limiting the amount of track raise. Adjustment of turnouts and connecting tracks to match profile and alignment adjustments on adjacent track must be provided by Contractor at no additional expense.

O. Any temporary surfacing runoffs made to accommodate interim rail traffic prior to completion of track surfacing must meet FRA Track Class 5 Standards.

3.03 WALKWAYS

A. Walkways shall conform to SCRRA Engineering Standards ES2109 and General Order No.118-Public Utilities Commission of the State of California.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Track shifting will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement. Surfacing, stabilizing and de-stressing of shifted track is incidental to this item and will not be measured.

B. Track Relocation will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement. Surfacing, stabilizing and de-stressing of shifted track is incidental to this item and will not be measured.

C. Track Surfacing will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement. Surfacing, stabilizing and de-stressing of shifted track is incidental to this item and will not be measured.

D. All material, work and services included in Sections Other Track Materials (OTM); 34 11 26, Ballast; 34 11 27, and Sub-Ballast and Aggregate Base; will be included in this Section and are considered incidental to work under this Section and will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer.

E. Work of shifting, relocating and resurfacing existing track will include furnishing all labor, materials, tools, equipment, supplies, supervision, installation of Contractor provided ballast and walkway rock, laser aligned tamping, resurfacing, regulating, stabilizing and de-stressing to SCRRA standard cross section and any other incidental work necessary for shifting, relocating and resurfacing existing track as described in the Contract Documents.

4.02 PAYMENT

A. Track shifting, relocating and resurfacing furnished and completed in accordance with the Contract Documents will be paid for at the contract unit price, as listed on the Schedule of Quantities and Prices. This price shall be full compensation for furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

END OF SECTION

SECTION 34 72 30

FIELD WELDING RAIL

PART 1 - GENERAL

1.01 SUMMARY

A. This Section consists of the Contractor performing field welding of continuous welded rail (CWR) strings using the flash butt welding process or approved thermite-welding method.

B. The Contractor must make assessment as to the number of welds, including the method of welding for each weld, to be performed under this Contract.

C. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 34 72 00 - Trackwork.

4. Section 34 72 20 - Track Shifting, Relocating and Resurfacing.

1.02 REFERENCES

A. SCRRA: Engineering Standards, and Track Maintenance and Engineering Instructions.

B. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering

C. FRA: 49 CFR Part 213, Track Safety Standards, most current and addenda, Federal Railroad Administration.

D. ASTM International (ASTM):

1. ASTM E164 Standard Practice for Ultrasonic Contact Examination of Weldments.

1.03 SUBMITTALS

A. Submit under the provisions of Division 01:

1. Procedure: Submit proposed materials, methods and procedures to be used for mobile flash butt field welding of CWR, including:

a. Manufacturer's trade name and technical data for the welding process, including welding machine performance standards.

b. Method of welding high strength rail if different from requirements for standard rail.

c. Methods of transporting material and mobile equipment to the site and duration of welding operations.

d. Method used for cutting and cleaning to parent metal of the rail ends.

e. Minimum and maximum spacing between rail ends.

f. Method used for maintaining the rails in alignment during welding.

g. Method used for grinding and contouring rail removing weld upset following the welding process.

2. Procedure: Submit proposed methods and procedures to be used for thermite welding of CWR, including:

a. Manufacturer’s trade name and technical data for the welding process.

b. Method used for cutting and cleaning of the rail ends.

c. Minimum and maximum spacing between rail ends.

d. Method used for maintaining the rails in alignment during welding.

e. Method used for preheating the rail ends including time and temperature.

f. Tapping procedure including the minimum time required to cool the weld under the mold insulation.

g. Method used, including a description of special tools and equipment for removing the gates and risers and finishing the weld to the final contour.

3. Refer to Division 01 for submittal of resumes for individual(s) directly supervising, inspecting, and performing field welding of rail.

4. Procedure: Submit rail end hardening procedure.

5. Testing: Submit testing company qualified in use of the Ultrasonic testing method in accordance with ASTM E164.

6. Field Weld Record: Submit as specified herein.

1.04 QUALITY ASSURANCE

A. Provide qualified personnel for supervision and performance of work in accordance with Division 01.

B. Perform certification testing of all welds to ensure that Work is performed in accordance with the Contract Documents, and within the tolerances provided herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. For electric flash butt welding, materials, equipment and process shall be as provided by Holland L.P. or other approved equivalent.

B. For thermite welding, Materials and equipment shall be as manufactured by "Boutet," "Orgotherm," "Elektro-Thermite," or other approved equivalent for standard or high strength (alloy or heat treated) rail, as appropriate.

PART 3 - EXECUTION

3.01 GENERAL

A. Electric flash butt welding, methods and procedures shall comply with the AREMA Manual, Volume 1, Chapter 4, Section 2.3, Specifications for the Quality Assurance of Electric-Flash Butt Welding of Rail.

B. Thermite welding, methods and procedures shall comply with the AREMA Manual, Volume 1, Chapter 4, Section 2.5 Specification for the Quality Assurance of Thermite Welding Rail, with the welding kit manufacturer's recommendations, and as specified herein.

C. Rail ends for thermite welding shall be prepared in accordance with the recommendations of the welding kit manufacturer.

D. For thermite welding, the rail ends shall be preheated prior to welding to a sufficient temperature and for sufficient time to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

E. The completed weld shall be finished by mechanically controlled grinding to conform to the same requirements specified for shop welding.

F. Thermite welds shall not be made at the following locations:

1. Within 5 inches of the edge of any bolt hole in the rail.

2. Within 2 inches of a Cadweld or copper bond wire (If this type of bond exists, remove any presence of copper by grinding. The rail ends must be inspected and cleaned after grinding is complete).

3. Closer than 2 feet from an existing plant weld.

4. Closer than 6 feet to an existing thermite weld.

5. On both ends of a rail plug simultaneously unless the rail is 15 feet or longer on tangent track and 24 feet long or longer on curved track.

G. Follow Manufacturer recommendations for compromise welds.

H. Follow recommendations of rail manufacturer for welding high strength (alloy or heat-treated) rails.

I. Thermite welds shall be located in cribs between ties. The edge of the weld must be no closer than 3 inches from the edge of the nearest tie.

J. Electric Flash Butt welds with the base of the rail smoothly ground may be located anywhere.

3.02 FIELD WELDING RECORD AND RAIL MARKINGS

A. Field welding record shall be continuously maintained and furnished to the Engineer within seven (7) workdays of completing the weld. The record shall include the following minimum details, noting that a different recording and marking procedure will be required for free end welds or for destress welds used to close up openings in rail:

1. Date and time of weld(s).

2. Location by station, specifying track and rail.

3. Contractor foreman initials.

4. Weather, air and rail temperature for destress welds (welds made to close up rail).

5. Track condition, anchorage and rail stress for destress welds, or the word “FREE” for free end welds.

B. Rail shall be permanently marked on the web of rail in legible characters at least 1-1/2 inches high at each field weld with the above information in accordance with Section 3.1.15, Marking Thermite Welds of the SCRRA Track Maintenance and Engineering Instructions. If an existing destress weld is located within 400 feet of a new destress weld, lines shall be marked through the old weld’s marking and an arrow marked indicating the direction towards the new destressed weld.

3.03 TOLERANCES OF FIELD WELDS

A. A straight edge 36 inches in length, applied to finished welded joint area shall be used to check for the following maximum variations (measurements shall be taken with a 6 inches steel taper gauge):

1. Rail Head:

a. Vertical Offset: 0.020 inches.

b. Horizontal Offset: 0.040 inches.

c. Vertical Crown: 0.030 - 0.045 inches.

d. Horizontal Kink: 0.020 inches.

2. Rail Base:

a. Horizontal Offset: 0.060 inches.

b. Offset Bending: 0.010 inches per inch.

3.04 FINISHING OF FIELD WELDS

A. Sharp edges and burrs shall be removed, including chimneys from thermite welds. Top of base of rail shall be ground smooth at chimney locations.

B. Weld joints shall be smooth on top and sides of head and straight in line. No over grinding is permitted. Web of rail at thermite welds shall not be ground. All mold residues shall be removed from the weld area and properly discarded.

C. Finishing of welds shall be sufficient to allow testing using the Ultrasonic test method as described below. Welds rejected because of insufficient or unsatisfactory finishing of welds shall be refinished, repaired, or replaced at the Contractor's expense until the weld meets the testing criteria.

3.05 FIELD WELD TESTING

A. Fabricate CWR strings so that the branding of all individual rail section appears on the field side of installed track.

B. Rail welds must be tested by the Contractor through the use of an OCTA approved testing agency using the Ultrasonic testing method in accordance with ASTM E164, using the Two-Search-Unit Technique 4.

C. Each completed weld shall have full penetration and complete fusion and be entirely free of cracks. Total area of internal defects such as porosity and slag inclusions shall not exceed 0.060 sq in and the largest single porosity or slag defect permitted shall not exceed 1/8 inches dia.

D. Other causes for rejection of welds shall be:

1. Cracks that show in the finished weld.

2. Pit holes that show in web and base of weld after finish grinding. Pit holes in head not exceeding 1/4 inches in depth may, if approved by the Engineer, be repaired by gas welding.

3. Over-grinding of weld.

E. Welded joints not meeting these Specifications and tolerances will be replaced at no additional cost to the OCTA. The defective weld shall be cut out, and a new section of rail of a length described in Article 3.06 herein shall be inserted, welded into place as described in this Section, and retested.

3.06 CUTTING IN SHORT SECTION RAIL AND THERMITE WELDING THE ENDS

A. A short section of rail shall be cut in the CWR, when required by the Engineer, for the following reasons:

1. To repair defective rail(s).

2. To repair defective weld(s).

3. To destress rail.

4. To make a connection between rail strings or adjust rail to meet a specific point (i.e. to connect CWR to stock rail or frog).

B. The short section of rail to be cut in shall be at least 19 feet-6 inches long on tangents and curves less than 2 degrees; and 30 feet long on curves 2 degrees or greater and rail to be cut in shall be of the same weight, size, section, and class of rail being replaced or joined.

C. Before cutting out rail in CWR and inadvertently losing all thermal control, prevent remaining CWR from further movement by applying full box anchors for at least 200 feet each way from the proposed cut. After cutting CWR, a rail expander/puller or other means shall be used to prevent rail movement until a weld or temporary joint is installed.

D. The ends of the short rail section and the CWR shall be saw cut.

E. Follow manufacturer’s recommended procedures specified for completing field welding by thermite process.

F. Repair of rail due to damage by Contractor shall be at Contractor's expense.

G. When repairing a defective rail or weld, the new rail shall be the same length as rail being replaced, or as required to achieve thermal adjustment.

H. When performing field welding, rail temperature adjustments shall be made in accordance with Section 34 72 00 using either heating of rail or mechanical rail pullers. The first weld of a replacement plug may be at ambient temperature, but the second (destress weld or rail closure weld) shall be installed in accordance with Section 34 72 00.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work under other payment items and no separate measurement and payment will be made to the Contractor for Work of this Section.

B. Work of this section shall include furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals necessary for Field Welding Rail as described by the Contract Documents.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)

SECTION 34 80 11

STONE REVETMENT (RIPRAP)

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Stone revetment (riprap) for protection of slopes against erosion.

a. Drainage outflow area.

b. Slope riprap.

c. Geotextile and sand cushion base.

d. Other areas indicated and shown on the Drawings.

B. Related Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 01 - General Requirements.

3. Section 31 20 00 - Earthwork.

1.02 REFERENCES

A. Reference Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):

a. M228, Standard Specification for Geotextile Specification for Highway Applications.

b. T103, Soundness of Aggregates by Freezing and Thawing.

2. ASTM International (ASTM):

a. C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

b. C127, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.

c. C1116, Standard Specification for Fiber-Reinforced Concrete and Shotcrete.

3. Corps of Engineers (COE):

a. CRD-C100, Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing.

1.03 SUBMITTALS

A. Shop Drawings:

1. See Division 01 for requirements for the mechanics and administration of the submittal process.

2. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

3. Certifications.

4. Test reports.

5. Submit all tests and certification in a single coordinated submittal. Partial submittals will not be accepted.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stone:

1. Durable broken quarry run stone Apparent Specific Gravity minimum 2.50 ASTM C127.

2. Does not disintegrate on exposure to water or weathering.

3. Free from structural fractures and defects.

4. Not containing shale, unsound sandstone, or other material which will disintegrate.

5. Graded within limits specified.

6. Breadth and thickness of any stone: Not less than one-third of its length.

7. Ensure that dirt and fines accumulated from interledge layers or from blasting or handling operation is less than 2 percent by weight.

8. Gradation of the material:

   a. Ungrouted riprap to be loaded and quarried shall conform to the following limitations unless otherwise specified:

RIPRAP CLASS	AVERAGE WEIGHT PER STONE (LBS)	DIMENSION (IN)	MINIMUM LAYER THICKNESS
I	50 to 200	9 to 14	1' - 6 "
II	200 to 1000	14 to 24	2' - 0"
III	1000 to 4000	24 to 38	3' - 0"
IV	> 4000	> 38	4' - 0"

   b. Grouted riprap shall have the following gradation:

NOMINAL STONE SIZE (INCHES)	% OF MIX SMALLER THAN GIVEN SIZE (BY WEIGHT)
21	70 to 100
18	50 to 70
12	0 to 5

9. The following allowances shall be acceptable to produce the required ungrouted riprap protection:

   a. Riprap Class I - No allowances permitted.

   b. Riprap Class II - 15 percent of riprap Class I.

   c. Riprap Class III - 15 percent of riprap Class I and 15 percent of Class II.

   d. Riprap Class IV - 15 percent of riprap Class I, 15 percent of Class II, and 15 percent of Class III.

10. Grouted riprap:

   a. Riprap shall be angular (not rounded), each rock having its greatest dimension not greater than 3 times its least dimension. Elongated rocks shall be hand adjusted to a vertical verses horizontal position.

   b. The specific gravity of the riprap rock shall be 2.5 or greater.

   c. Broken concrete or asphalt pavement shall not be acceptable for use in the work.

d. Riprap and grout colors may be limited by local flood control districts or other regulatory entities. Contractor is responsible for ascertaining and complying with any such requirements.

B. Geotextile:

1. Geotextile shall be Class 2 Non-Woven in accordance with AASHTO M288 with an AOS of 70.

C. Sand Cushion:

1. Sand cushion shall be clean sand, free of angular gravel.

D. Grout:

1. Concrete for the grout shall be an approved batch meeting the following requirements:

a. All concrete shall develop 3,000 psi compressive strength within 28 days, the cement shall be Type II modified or Type V, the stone aggregate shall have a maximum diameter of ½", and the slump shall be within a range of 3 to 6 inches.

b. The water/cement ratio shall not exceed 0.48.

c. Add 1.5 lbs of synthetic fiber-reinforcing per cy of grout per manufacturer's instructions.

E. Synthetic Fiber-Reinforcing:

1. 100 percent virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials and specifically manufactured for use in concrete.

2. Physical characteristics:

a. Specific gravity: 0.91.

b. Fiber length: ¾".

c. Provide in accordance with ASTM C1116.

d. Acceptable manufacturers:

1) Fibermesh.

2) Grace Construction Products.

2.02 SOURCE QUALITY CONTROL

A. Perform all tests at an approved independent laboratory.

B. Obtain samples in conformance with COE CRD-C100.

C. Source Tests:

1. Supply certified tests and service records to determine acceptability and application of stone materials.

2. In event suitable test reports or a service record that is satisfactory are not available, as in case of newly operated sources, subject material to tests necessary to determine its acceptability for use.

3. Tests to which materials to be subjected include:

a. Specific gravity.

b. Soundness in magnesium sulfate.

c. Soundness in freezing and thawing.

D. Material Acceptability Tests:

1. Initial test: On material from each ledge sampled prior to start of construction.

a. Specific gravity.

b. Soundness in magnesium sulfate.

c. Soundness in freezing and thawing.

2. Control tests:

a. Perform control tests including one specific gravity, one soundness in magnesium sulfate, and one soundness in freezing and thawing for each type of stone revetment material for every 100 tons of material.

E. Specific Gravity Test:

1. Conform with ASTM C127.

2. Not less than 2.40 minimum.

F. Soundness in Magnesium Sulfate:

1. Conform with ASTM C88, except maintain samples immersed in solution at a temperature of 80˚ F (26˚ C) +2˚ F.

2. Not more than 12 percent loss at five cycles.

G. Soundness of Aggregates in Freezing and Thawing:

1. Conform with AASHTO T103 method as modified herein.

2. Ensure loss at 12 cycles of not more than 10 percent.

3. Maintain temperature of cold liquid in range of -5 to 0 deg. F (-20 to -18 deg. C).

4. Maintain thaw fluid temperature in range of 45 to 50 deg. F (7 to 10 deg. C).

5. Permit length of freezing and of thawing cycles of 2 hours with 1 hour of freezing following by 1 hour of thawing.

6. Perform thawing by circulating thaw fluid around pan containing stone immersed in a depth of ¼" rather than by total immersion.

PART 3 - EXECUTION

3.01 PREPARATION

A. Trim and dress all areas to required cross sections.

B. Bring areas that are below allowable minus tolerance limit to grade by filling with material similar to adjacent material.

C. Compact base to density specified for backfill in accordance with Section 31 20 00.

D. Do not place any stone material on prepared base prior to inspection by Engineer.

3.02 PLACING

A. Ungrouted Riprap:

1. Where indicated on Drawings, place geotextile on prepared foundation within limits indicated.

   a. Geotextile overlaps shall be a minimum of 1' – 0".

   b. Geotextile shall be secured to slope per the manufacturer's recommendation.

2. Where indicated on Drawings, place sand cushion on geotextile within limits indicated.

   a. Sand cushion shall have a minimum thickness of 4 inches.

3. Place stone revetment material on prepared base within limits indicated.

4. Place on prepared base to produce a well-graded mass of stone with minimum percentage of voids.

5. Place to required thickness and grades.

6. Place to full thickness in a single operation to avoid displacing the underlying material.

7. Distribute entire mass to conform to gradation specified.

    a. Do not place stone by dumping into chutes or by similar method likely to cause segregation.

8. Keep finished stone revetment free from objectionable pockets of small stones or clusters of larger stone.

    a. Hand place as necessary to obtain a well-graded distribution.

9. Ensure a final tolerance of within 3 inches from indicated slope and grade lines.

10. Place stone revetment in conjunction with embankment construction to prevent mixture of embankment and stone revetment materials.

11. Maintain stone revetment until accepted.

12. Replace any displaced material to lines and grades shown.

B. Grouted Riprap:

1. The Contractor must notify the OCTA a minimum of two working days of his intent to perform any grouting activities prior to placement of any grout to allow scheduling of inspection activities. Grout operation shall not proceed without the approval of the OCTA.

2. Contractor must clean with a water blast operation faces and edges of any existing to-remain structural elements such as wingwalls or abutments to which the grouted riprap will come in contact.

3. Riprap shall be placed prior to grouting. It is desirable that elongated stones along the top layer of riprap have a vertical orientation.

4. Dewatering shall be implemented to guarantee that the grout will not be placed in water or be exposed to stream flows for a period of 24 hours after the grout has been placed.

5. Contractor must keep riprap, boulders and concrete walls that are to receive grout wet at all times prior to injecting grout.

6. The concrete grout shall be placed by injection methods by pumping under low pressure, positive displacement methods, through a 2 inches maximum diameter hose to ensure complete penetration of the grout into the rock layer.

7. The voids at the surface of the riprap will not be grouted. The depth of grout measured from the prepared subgrade bed shall be 18 inches. Operator shall be able to stop the flow of grout when required, and will place grout in the voids and not on the surface of the riprap.

8. A "pencil" vibrator will be used to make sure all voids are filled between and under the riprap. The intent is to fill all voids from the subgrade level around the riprap for a minimum depth of 18 inches. In all cases, grout must penetrate to the subgrade of the riprap. The pencil vibrator may be used to smooth the appearance of the surface, but the Contractor must use a wood float to smooth and grade the grout to drain. When placing grout, it shall be placed between the riprap and against earth, rock, or concrete excavated sidewalls.

9. Contractor must clean and wash any spillage before the grout sets. The visible surfaces of the riprap will be free of grout to provide a clean natural appearance.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Rock Slope Protection:

1. Rock Slope Protection (RSP) of the various classifications will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

B. Concrete Grouted RSP:

1. Concrete Grouted RSP of the various gradations will be measured by the unit or fraction thereof furnished and completed in accordance with the Contract Documents and as measured by the Engineer. The quantities as contained on the Schedule of Quantities and Prices, or approved schedule of values, as applicable, as derived from the Plans will be used as the basis for this measurement.

4.02 PAYMENT

A. Rock Slope Protection:

1. Rock Slope Protection furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

2. The contract price paid per unit of Rock Slope Protection for each classification shall include compensation to the Contractor for furnishing riprap, all labor, materials, equipment and any other incidentals to place riprap complete-in-place, including haul from the suppliers source, necessary stockpiling at the job site, reloading for placement, placement, overestimates of salvageable boulders, disposing of any rejected riprap, excavation and removal of material, over-excavation for construction, backfilling, and any other miscellaneous items and work shown or reasonable implied on the Plans, in the Specifications for this work, and elsewhere in the Contract Documents.

3. Geotextile and sand base and other associated materials and incidentals and installation thereof shall be considered part of Rock Slope Protection and full compensation therefore shall be considered as included in the contract unit price paid for Rock Slope Protection.

B. Grouted Riprap:

1. Concrete Grouted RSP furnished and completed in accordance with the Contract Documents will be paid for at the Contract Unit Price, as listed on the Schedule of Quantities and Prices. This price shall include full compensation for furnishing all labor, Materials, tools, equipment, supplies, supervision, and incidentals, and doing all work, as shown on the Plans, and as specified in these Specifications.

2. The contract price paid per unit of Concrete Grouted RSP for each classification shall include compensation to the Contractor for furnishing riprap, all labor, materials, equipment and any other incidentals to place riprap complete-in-place, including haul from the suppliers source, necessary stockpiling at the job site, reloading for placement, placement, overestimates of salvageable boulders, disposing of any rejected riprap, excavation and removal of material, over-excavation for construction, backfilling, and any other miscellaneous items and work shown or reasonable implied on the Plans, in the Specifications for this work, and elsewhere in the Contract Documents.

3. Geotextile and sand base and other associated materials and incidentals and installation thereof shall be considered part of the Concrete Grouted RSP and full compensation therefore shall be considered as included in the contract unit price paid for Concrete Grouted RSP.

END OF SECTION

(PAGE INTENTIONALLY LEFT BLANK)