SECTION 34 11 24

DIRECT FIXATION TRACK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Direction fixation track materials.

B. Concrete surface preparation.

C. Protection.

D. Forms.

E. Pre-pour survey.

F. Concrete finishing.

G. Track installation.

1.02 RELATED SECTIONS

A. Resilient tie direct fixation (RT) trackwork construction includes independent concrete block ties with rubber boots, resilient block pads, rail fasteners and lateral adjustment shims.

B. Direct fixation (DF) trackwork construction, consisting of DF fastener assemblies, rail fasteners, shims and anchor bolt assemblies.

C. Both types of track construction includes the requirements for qualifying the construction methods; surface preparation of existing concrete; placing fastener assemblies; forming, placing, and curing track concrete; and installing continuous welded rail (CWR); and, provision for mounting the third rail and third rail assemblies and track concrete.

D. Refer to Section 34 05 17 - Common Work Results for Trackway, for related requirements.

E. Refer to Section 34 11 93 - Track Appurtenances and Accessories, for procurement and related requirements for rail fastener materials.

F. Refer to Section 34 11 32 - Resilient Ties, for procurement and related requirements for RT materials.

G. Refer to Section 34 11 37 - Direct Fixation Fasteners, for procurement and related requirements for DF materials.

1.03 MEASUREMENT AND PAYMENT

A. General: DF and resilient tie and RT track will not be measured separately for payment. All costs in connection therewith will be considered as included in the applicable Contract lump sum price or the Contract unit price per linear foot for trackwork of the different types indicated as listed in the bid item in the Bid Schedule of the Bid Form.

1.04 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T277 Standard Method of Test for Electrical Indication of Concrete's Ability to Resist Chloride

1.05 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Work Plans: Submit construction work plans for RT and DF track and special trackwork. Plans shall be prepared and sealed by a civil engineer currently registered in the State of California.

C. Product Data: Submit product data for non-shrink grout and metal preservative.

D. Provide additional submittals as required herein.

1.06 CONCRETE SURFACE

A. The concrete substrate on which the track concrete is placed shall only vary from the design elevation within the range shown in Table 1.

Table 1 - Allowable Variance Prior To Placing Track Concrete

Type of Construction	Allowable Variance
Subway, U-Wall invert or At-grade slab	Plus 1 inch to minus 2 inches
Aerial structure decks on spans up to and including 100 feet	Plus 1 inch to minus 3 inches
Aerial structure decks on spans exceeding 100 feet	Plus 1 inch to minus 5 inches.

1.07 RESILIENT TIE AND DIRECT FIXATION SPECIAL TRACKWORK CONSTRUCTION METHOD QUALIFICATION

A. In addition to the other requirements herein, the Contractor shall prepare and submit to the Engineer separate construction work plans for RT and direct fixation track and special trackwork in accordance with the track requirements and tolerances specified herein. If the work plan is acceptable, the Engineer will issue permission to proceed with a demonstration section.

B. Each work plan shall, at a minimum, include the following applicable items.

1. Step by step construction sequence.

2. Survey control plan.

3. Material handling procedure.

4. Special equipment and tools.

5. Shop Drawings of forms, jigs and supports.

6. Method of protecting supports to allow removal after concrete installation.

7. Method of treating holes in the concrete created by temporary supports.

8. Concrete surface and dowel preparation.

9. Proposed methods of repairing damaged concrete base caused by over water jetting.

10. Methods of protecting existing drainage from deleterious material during construction.

11. Methods of collected and removing washed material, debris and dust.

12. Forming, placing, finishing, and curing of track concrete.

13. Repair procedures non-conforming concrete.

14. Method of measuring and repairing any voids in the bearing area.

15. Replacement procedures for damaged or incorrectly installed anchor bolt and third rail inserts, including torque and pull out testing that ensures compliance with the requirements.

16. Installation of DF rail fastener, including the anchor bolt installation torque and the sequence of shimming, torquing anchor bolts, and applying rail clips.

17. Installation of RT assemblies and the sequence of applying rail clips.

18. Coordination between the installation of various track types, including standard and special trackwork.

19. Installation of DF rail fastener or RT, including where applicable the anchor bolt installation torque and the sequence of shimming, torquing anchor bolts, and applying rail clips; all in accordance with the manufacturer's instructions.

20. Repair procedures for deviations in track gage, surface, rail cant, alignment, skewed RT and DF fastener assemblies and for non-conforming insert locations.

21. Methods of installing switch normal to the tangent line and within location tolerances.

22. Methods of installing switch points, stock rails, and switch rods to conform to required tolerances and to provide the proper clearances between rods and track concrete.

23. Coordination of the plan for installing the switch machine and all rods with trackwork.

24. Equipment and method to be used to install the RT and DF fastener assemblies to correct surface, alignment and gage and crosslevel.

25. Shop drawings of purpose manufactured gage supports to support track, fasteners and/or inserts prior to and during concrete placement.

26. Method and equipment for holding stock rails, switch rails, or frog wing rails when welding to adjacent rails.

27. Method for purging water from rubber boots and sealing drainage holes on RT fasteners.

28. Methods for rail anchoring and rail welding.

29. CWR handling and installation.

30. CWR adjusting, rail welding, and anchoring to conform to the neutral rail temperature requirements and to protect the aerial structure girders and piers.

31. Field testing and inspection to conform to the quality requirements and tolerances specified herein.

32. A comprehensive drainage plan.

33. Each construction work plan shall include written approval of the plan by the manufacturers of the RT and DF fasteners, as applicable.

C. Demonstration Section

1. Upon receiving the Engineer's permission to proceed, the Contractor shall verify its work plan by constructing a demonstration section of track, for approval by the Engineer before beginning construction of trackwork on a production basis.

2. The exact methods the Contractor proposes to use shall be employed for the demonstration section.

3. Separate demonstration sections shall be installed for each type of track construction used.

4. Separate demonstration sections shall be provided for each type of special trackwork construction.

5. Demonstration sections for standard track shall be between 100 and 1000 feet long and for special trackwork, at least one complete turnout.

6. The manufacturers' representatives of the RT and DF fasteners, as applicable, shall be present throughout the construction of and any repairs made to the demonstration section. Each representative shall submit its approval of the demonstration section, in writing, to the Engineer. Any recommendation for changes to the work plan, by the manufacturer's representative, shall be integrated into the revised work plan.

7. If the demonstration does not meet the indicated requirements, the Contractor shall submit a revised work plan and construct another demonstration section or sections at no additional cost to the District.

8. Non-conforming demonstration sections shall be removed or repaired by methods approved by the Engineer.

9. Location of the demonstration section(s) shall be as indicated on the Contract Drawings.

10. The Engineer will approve or disapprove each demonstration section within two weeks of completion.

11. The demonstration section shall include examples of the various forms of repair described in the work plan.

D. Production Work

1. The Contractor shall use only approved methods and procedures as shown and demonstrated for production work.

2. No construction may begin for a particular track type until the Engineer approves the demonstration section for that particular type of track construction.

PART 2 - PRODUCTS

2.01 DISTRICT-FURNISHED MATERIALS

A. Refer to Section 01 64 13 - District-Furnished Materials and Equipment, of the Contract Specifications for description and quantity of District-furnished materials.

2.02 CONTRACTOR-FURNISHED MATERIALS

A. All products, tools, materials, equipment and labor required to complete all aspects of the work shall be furnished by the Contractor, and the following.

B. Reinforced Track Concrete:

1. Except for the modifications indicated herein and on the Contract Drawings, all work shall be in accordance with the following Sections: 03 15 00 - Concrete Accessories, 03 20 00 - Concrete Reinforcing, 03 30 00 - Cast-in-place Concrete, and 03 05 15 - Portland Cement Concrete.

2. Provide portland cement concrete for track concrete conforming to the following requirements:

3. Provide Class 4000-3/4 inch concrete, unless otherwise indicated.

4. Cement content shall be a minimum of six-and-a-half 94-pound sacks of portland cement per cubic yard.

5. Coarse aggregate shall be washed clean and graded within the limits shown in Table 2.

6. Grading limits for combined coarse and fine aggregates shall be within the limits shown in Table 3.

Table 2 - Coarse Aggregate Cleaning and Grading Limits	
Sieve Size	**Percentage Passing Sieve**
3/4 inch	100
1/2 inch	90-100
3/8 inch	0-100
No. 4	0-15
No. 8	0-5

Table 3 - Combined Coarse and Fine Aggregates Grading Limits	
Sieve Size	**Percentage Passing Sieve**
3/4 inch	100
1/2 inch	95-100
3/8 inch	45-100
No. 4	35-60
No. 8	30-45
No. 16	20-35
No. 30	10-25
No. 50	5-15
No. 100	2-5

7. Slump: The average slump shall not exceed 3 inches.

8. Unit water content shall not exceed 325 pounds of free water per cubic yard.

9. Conform to the aggregate reactivity requirements of Section 03 05 15 - Portland Cement Concrete, Paragraph 2.01.C, Special Aggregates for Reducing Shrinkage and Creep.

10. All reinforcing steel shall be epoxy coated as specified in Section 03 20 00 - Concrete Reinforcing.

11. All openings through the track concrete for electrical wires or drainage shall be formed from PVC electrical conduits in accordance with applicable requirements of Section 20 50 13 - Raceways for Facility Services.

12. Additional Requirements for Direct Fixation Track

a. For the purpose of increasing the electrical resistivity of the concrete in order to reduce the effect of stray currents, the concrete mix design shall incorporate the use of silica fume. The dosage rate shall be a minimum of 5 percent by weight of the portland cement used in the mix. The water cement ratio shall be calculated on the basis of the combined weight of portland cement and silica fume.

b. Provide evidence that the Rapid Chloride Permeability Test, AASHTO T-277, has been performed to the proposed concrete mix and that a rating of very low has been achieved at 56 days by discreet testing and not by interpolation of test data. Such evidence shall consist of data from the following tests: two sets of specimens shall be prepared and tested using the AASHTO T-277 procedure. The first set of specimens shall be moist cured for a period of 28 days, then placed in an air drying facility maintained at 73 degrees F, plus or minus 3 degrees, and 50 percent relative humidity, plus or minus 5 percent, until an age of 56 days, then tested. The second set of specimens shall be cured in a manner identical to that applied to the actual track concrete (damp cure for 7 days), then placed in the air-drying environment noted above until an age of 56 days. A 2-inch thick slice shall be obtained from the central portion of each cylinder and used for the test specimen. No fewer than three test specimens shall be prepared and tested for each mix to be evaluated.

PART 3 - EXECUTION

3.01 REQUIREMENTS

A. Construct RT and DF track in accordance with applicable requirements and as indicated on the Contract Drawings.

3.02 CONCRETE SURFACE PREPARATION

A. Prepare and clean the concrete substrate to receive the track concrete as a construction joint, using high-pressure water blast methods.

B. Preparation, cleaning, and high-pressure water blasting shall be performed prior to placing rail, RT or DF assemblies and formwork.

C. High-pressure water blasting shall expose a minimum 1/8” of the aggregate, without causing damage to the aggregate. The Contractor shall determine the water pressure and nozzle type. The Contractor shall demonstrate that the proposed pressure is adequate to expose the required amount of aggregate.

D. The water jetting shall be restricted solely to the area directly under the track concrete. Any over jetting shall be repaired as approved by the Engineer.

E. Immediately prior to concreting, the supporting structure concrete shall be thoroughly cleaned with clean water and compressed air to remove all loose material and dirt.

F. Deleterious material shall not be flushed down the drainage.

G. Washed material and resulting debris and dust shall be collected and removed by means proposed by the Contractor and approved by the Engineer.

3.03 PROTECTION

A. Protect dowels, drainage facilities, and electrical conduits from damage and plugging. Repair promptly all damage due to Contractor's operations.

3.04 FORMS

A. Design and install forms in accordance with Section 03 11 00 - Concrete Forming.

3.05 PRE-POUR SURVEY

A. Immediately prior to pouring track concrete, the formwork and supporting jigs shall be surveyed for readiness.

B. The survey shall take place no more than 4 hours prior to placing track concrete.

C. The survey shall be performed by, or under the direction of, a professional land surveyor or civil engineer currently licensed or registered in the State of California.

D. Measurements shall be taken at each support location and shall include, at a minimum, alignment, surface and elevation and cant of both rails, gage and crosslevel.

E. No track concrete may be placed prior to repairing any deviations found during the inspection.

F. All measurements shall be recorded and submitted to the Engineer on the same day that the measurements are made.

3.06 CONCRETE FINISHING

A. Finish the track concrete in accordance with the requirements of Section 03 35 00 - Concrete Finishing, and the following requirements:

1. Finish shall conform to "smooth form finish" on the sides and "floated finish" on the top surface.

2. Cure track concrete with waterproof sheet material or damp burlap.

3. Concrete shall be free of cracks, with particular emphasis in the vicinity of inserts; all cracks shall be repaired using the approved method, at no additional cost to the District.

4. Concrete voids due to trapped water or air in the rail fastener bearing seat shall not exceed the following limits:

   a. Single void: 1/2 inch diameter.

   b. Total voids: 10 percent of the total area.

5. No traffic whatsoever shall be permitted to run over the track nor shall manufactured gage supports be removed, for any reason, until the concrete has achieved a minimum compressive strength of 2000 psi. The Contractor shall demonstrate, to the satisfaction of the Engineer, when the concrete has reached the minimum compressive strength to allow the gage supports to be removed or traffic to run over the track.

B. Direct Fixation Track

1. The fastener assembly, including shim shall not be recessed into the concrete.

2. Remove forms and expose the entire rail fastener bearing seats for each construction cycle for the Engineer's inspection.

3. Finish all rail seat areas in accordance with a plan approved by the Engineer.

4. The concrete surface under the DF rail fastener shall be installed to a plane that provides uniform bearing under the fastener.

5. Difference in height from top of rail to top of track concrete between adjacent rail fasteners shall not exceed 1/16 inch.

6. The top of the track concrete shall be free of depressions that will cause water to pond.

7. The concrete between adjacent rail fasteners shall be uniform and not vary more 1/16 inch as measured with a 12 inch straight edge.

C. Resilient Tie Track

1. The rails and RT assemblies shall be lifted in the presence of the Engineer at a maximum of 1000 foot intervals to check for air pocket occurrence.

2. Where the voids exceed 10% across the full bearing area, further track shall be lifted until a compliant trackbase is recorded.

3. Voids in excess of 10% shall be filled by the Contractor with non-shrink grout, which shall be applied by a method approved by the Engineer.

4. The top of the track concrete shall be free of depressions that will cause water to pond.

3.07 INSTALLATION

A. Install RT and DF fasteners in accordance with the following requirements and the approved Contractor's work plan specified herein.

B. Rail and fasteners shall be clean and free of all dirt, mortar, and other substances.

C. Fasteners shall be located directly across from each other on opposite rails at the indicated spacing and tolerances.

D. Lateral adjustment of fasteners is exclusively for future BART maintenance activities. The Contractor shall not use more than plus or minus 1/8 inch of lateral adjustment during construction and defect repair.

E. All fastener components shall be installed to ensure the field side of the rail base and shoulder insulator will be tight against the outside shoulder.

F. Support Prior to and During Concreting

1. The installation support method shall ensure, prior to concreting, that track is adequately supported at the designed vertical and horizontal alignment by supports specifically manufactured for this purpose. The supports shall be spaced, at a maximum, on 10 feet centers and be fixed in location in all directions.

2. The track shall be supported for not less than 100 feet beyond a track section being concreted and in such a manner that will ensure that the track section will not be stressed.

3. The track shall be held to gage and the correct alignment, level, and cant by the supports.

4. The supports shall be capable of withstanding all applied load without any detrimental effects.

5. The supports shall be capable of withstanding thermal expansion and contraction loads, and effects of construction personnel, tools, and equipment that the Contractor uses prior to and during concrete placement.

6. The supports shall have rail-clamping devices and be fabricated from at least 3 inch by 4 inch by 3/8 inch thick hollow tube section or equivalent sections approved by the Engineer.

7. Each support shall, as a minimum, provide the following to the assembled track prior to and during concreting:

   a) Hold both rails to the required gage, grade, surface, crosslevel, alignment and cant.

   b) Allow the track to be adjusted by provision of threaded screws or similar continuous means of incremental adjustment.

   c) Be supported directly on to the support structure. The use of precast concrete, or similar, supports for the gage supports may be permitted under the superelevated rail on curves if the method is included in the approved work plan.

   d) Be removable without disturbing the track.

8. The supports shall not be removed until the track concrete has attained a compressive strength of at least 2000 psi.

9. The portion of the gage supports that will be temporarily concreted in shall be coated/protected using the approved method

10. All holes left by the gage supports in the trackbase after concreting shall be cleaned, prepared, and filled by an approved non-shrink cementitious grout. The surface finish

of the grout shall be to the same standard of surface finish as that of the finished trackbase.

G. Resilient Tie Track

1. Resilient tie track shall not be shimmed more than 1 inch for repair of surface and crosslevel defects.

2. Rubber boots, resilient block pads, and lateral adjustment shims shall be secured to the independent concrete blocks that precludes the ingress of deleterious material between the blocks and the boots and provides a tight fit of the boot base to the block pad and the concrete block base.

3. Rubber boots shall be protected during construction by placing a smooth planed timber plank, or similar protection, if work trains operate on the RT track before final adjustment and concreting. Each plank shall be fixed to the underside of the booted block and only removed immediately prior to concreting.

4. Immediately before placing concrete, the rubber boots shall be purged of any water and the drainage holes of the rubber boots sealed using the approved method and material.

H. Direct Fixation Track

1. Install polyethylene pads to separate the rail fastener from the concrete surface. The nominal design thickness of the pad shall be 3/8 inch; however, the Contractor may vary the total thickness from 1/8 to 1/2 inch. Not more than two pads shall be used to achieve the total thickness under each rail fastener.

2. Set anchor bolts with calibrated wrenches according to the bolt tension values recommended by the manufacturer. The Contractor shall calibrate the wrenches by tightening, in a device capable of indicating actual bolt tension, not less than three typical bolts from each lot to be installed. Power wrenches shall be adjusted to stall or cutout at the selected tension. If manual torque wrenches are used, the torque indication corresponding to the calibrating tension shall be noted and used in the installation of all bolts of the tested lot. Bolts shall be in tightening motion when torque is measured. All bolts shall be coated with metal preservative.

3. Anchor Bolt Inserts: Install the fastener inserts in accordance with the manufacturer's instructions, and the following requirements.

   a. Inserts shall be cast-in-place with the top of insert flush with the top of the concrete bearing surface.

   b. Handle and install the inserts with care to avoid surface contamination or damage to the epoxy coating. Damaged inserts shall be replaced by the Contractor at no additional cost to the District.

   c. Secure the inserts to the form to prevent any movement during concrete placement.

d. Upon removal of forms or supports, install a plastic plug in each insert to seal the threaded hole.

END OF SECTION 34 11 24