

SECTION 02300 EARTHWORK

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Section includes specifications for earthwork including excavation, trench excavation for underground utilities, ballast and subballast removal, placement of backfill, and construction of embankments. Section also includes requirements for placement of detectable tape for underground utilities.

1.02 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM International):
 - 1. C131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - 2. C136 Sieve Analysis of Fine and Coarse Aggregates
 - 3. D422 Particle-Size Analysis of Soils
 - 4. D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - 5. D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb./cu. ft.)
 - 6. D2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - 7. D2922 Test Method for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
 - 8. D3017 Test for Moisture Content of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
 - 9. D3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction
- B. State of California, Department of Transportation, Standard Specifications (Caltrans):
 - 1. Section 19 Earthwork

1.03 DEFINITIONS

- A. Existing Ballast: Granular material in areas of existing tracks, between top of tie and existing subgrade. The depth of existing ballast varies.
- B. Degree of Compaction: A percentage of the maximum density obtained by the test procedure presented in ASTM D1557, Method C.

- C. Satisfactory Materials: Any material classified by ASTM D2487 as GW, GP, SW, SP, SC, GM, GC, and SM.
- D. Unsatisfactory Materials: Materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include those materials containing roots and other organic matter, trash, debris, stones larger than 3 inches, and materials classified in ASTM D2487 as PR, OH, OL, CH, MH, and ML. Unsatisfactory material also includes refuse and other material.

1.04 SUBMITTALS

- A. Submit the following pothole shop drawings if specifically required in the Special Conditions. Submit shop drawings of potholed pipes, sewers, utilities and other facilities a minimum of two (2) weeks before beginning shoring excavation or underground construction. Show survey information at each location, and accurately establish the size, location, elevation, and alignment of the facility as well as the existing grade elevations in the vicinity of the potholes. Include the bearing of the facility alignment, coordinates at the centerline of the facility for pipelines, and the coordinates of the corners of boxes, manholes, and other similar types of facilities. Label pertinent information relating to the bent, column, footing, track alignment, and other proposed improvements including new or relocated underground facilities (waterline, sewer, storm drain, combined system duct bank, and underdrain). Include footing dimensions, bent skew, stationing, column offsets, and footing elevations. Proceed with no trenching, excavation, or shoring work until the Engineer has accepted potholing shop drawings. Shop drawings shall be prepared at 1:20 or 1:60 scale, sufficient to show the following information:
 - 1. Topography
 - 2. The entire bent and footings
 - 3. Columns adjacent to the potholes
 - 4. The track alignment
 - 5. Other proposed improvements in the vicinity that might be affected by the location of the existing pipe, sewer, utility or other facility

1.05 DELIVERABLES

- A. Submit copies of test reports for material properties and compaction as required in this Section.

1.06 QUALITY ASSURANCE

- A. Inspection and Testing Agency retained for inspection and testing specified in this Section shall meet the requirements of ASTM D3740.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Imported Backfill shall consist of well-graded sand, gravel, crushed gravel, crushed stone composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than

95 percent by weight passing the 3/4-inch sieve. The maximum allowable aggregate size shall be 1 inch. Gradation shall be determined in accordance with ASTM C136 or D422, as applicable.

- B. The following materials shall be as specified in the respective Sections of the Caltrans Standard Specifications, except as otherwise indicated:
 - 1. Structure Backfill: Section 19-3.06, Structure Backfill
 - 2. Pervious Backfill: Section 19-3.065, Pervious Backfill Material
 - 3. Slurry Cement Backfill: Section 19-3.062, Slurry Cement Backfill
- C. Soil Stabilization Geotextile: Tensar Bi-Axial Geogrid reinforcement or Engineer approved equal.
- D. Bedding Material for Culverts, Pipes, and Utilities: Sand conforming to Caltrans Standard Specifications, Section 19-3.025B, Sand Bedding.
- E. Underground Warning or Detectable Tracer Tape: Terra Tape Reinforced Sentry-Line as manufactured by Reef Industries, or Engineer approved equal. Extra stretch is acceptable if Reinforced type is not available for the color. Uniform color code (per APWA) as follows:

Identification	Type	Color
Gas Line	12" wide Reinforced	Yellow
Water Line	6" wide Reinforced	Blue
Electrical Line	12" wide Reinforced	Red
Sewer, Drain, Irrigation Line	6" wide Reinforced	Green
Fiber Optics, Signal, Communications Line	12" wide Reinforced	Orange

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Existing Underground Lines and Services: Remove or abandon in place unclaimed, abandoned utilities as indicated on the Contract Drawings.
- B. Utilization of Excavated Materials: Use material removed from excavations for backfill, embankment, subgrade, and similar purposes, unless the material is unsatisfactory. Refer to Article entitled "Excess Material" herein for disposal of excess materials.
- C. Use existing salvaged ballast for backfill, bedding, embankment, or fill as designated by the Engineer.
- D. Erosion Protection: Refer to Section 01560, Temporary Controls, for storm water pollution prevention, dust control, and related requirements. Protect exposed graded areas from wind and water erosion until stabilization is achieved.
- E. Perform dewatering as necessary. Refer to Section 02210, Dewatering.
- F. Use Soil Stabilization Geotextile for soil stabilization where indicated in the Contract Drawings.

3.02 EXCAVATION

- A. Excavate material encountered within the limits of the work, to the lines, grades, and elevations as indicated on the Contract Drawings and as specified herein.
 - 1. In areas where track is to be constructed in the location of an existing track, excavate to the subgrade indicated on the Contract Drawings or bottom of existing ties, whichever is lower.
- B. General construction excavation shall not exceed 1 vertical to 1 horizontal slope. If this cannot be accomplished, provide temporary shoring, sheeting and bracing as necessary to retain excavations, maintain banks securely, withstand water pressure, and prevent cave-ins in accordance with Section 02200, Support of Excavation.
- C. Perform excavation and placement of fill in a manner and sequence that will provide proper drainage at all times.
- D. Surfaces shall be level, or sloped if required, clean, and clear of loose soil. Maintain in good condition until overlying materials are placed.
- E. Perform measures to correct over-excavation due to error or careless excavation procedures.
- F. Perform structure excavation in accordance with Caltrans Standard Specifications, Section 19-3, Structure Excavation and Backfill.
- G. Maintenance of Excavation: When backfill is placed, remove sheeting and bracing in stages so that the walls are supported by the shoring or by newly placed backfill.

3.03 BACKFILL (GENERAL)

- A. Place backfill in layers not to exceed 8 inches of loose material, and compact each layer to at least 95 percent laboratory maximum density, in such a manner as to prevent wedging action or eccentric loading.
- B. Backfill excavations when installations have been completed, inspected, and approved. Ensure that the following conditions are satisfied prior to proceeding with backfill operations:
 - 1. Concrete has attained sufficient strength to withstand pressure of earth and compacting operation.
 - 2. Excavations are free of forms, debris, and other foreign materials.
- C. Place structure, pervious, and slurry cement backfill as specified in the following respective Sections of the Caltrans Standard Specifications, except as otherwise indicated:
 - 1. Structure Backfill: Section 19-3.06, Structure Backfill
 - 2. Pervious Backfill: Section 19-3.065, Pervious Backfill Material
 - 3. Slurry Cement Backfill: Section 19-3.062, Slurry Cement Backfill

3.04 BACKFILL, BEDDING AND FILL FOR CULVERTS, PIPES, AND UTILITIES

- A. Bottom of Trench Compaction. Bottoms of excavations shall be firm, undisturbed earth or cut subgrade, clean and free from loose materials, debris, and foreign matter. When bottoms of excavations or trenches are a soft or unstable materials, make bed firm and solid by removing said unstable materials to a sufficient depth and replace same with sand or pea gravel, and compact to a minimum of 90 percent relative compaction. If during construction, soft soils are encountered at depths that make removal impractical, notify the Engineer.
 - 1. Refer to Section 02650, Precast Concrete Culverts, for specific requirements for precast culvert trenches. Refer to Section 15550, Storm Water Lift Stations, for specific requirements for precast vault manhole for pump station.

- B. Bedding and Backfill Around Pipes:
 - 1. Before the initial layer of bedding is placed, tamp the bottom surface of the trench or compact bottom surface by plate or other means to provide a base for the bedding.
 - 2. Before the pipe or conduit is laid, place and compact bedding material in conformance to the provisions in Caltrans Standard Specifications, Section 19-3.025, Culvert Beddings. Do not use jetting.

- C. Unless specified elsewhere, backfilling for underground utilities shall comply with the following:
 - 1. Replace any unsuitable material with approved backfill material and compact as specified herein. Approved backfill material shall include:
 - a. Native excavated material approved to the Engineer
 - b. Salvaged track ballast approved by the Engineer
 - c. Imported Backfill (if native material or reclaimed track ballast is not available)
 - 2. Place and compact initial lifts in six (6) inch layers maximum uncompacted thickness until 12 inches over pipe. Subsequent lifts may be up to 12 inches in depth prior to compaction. Bring up uniformly on both sides of pipe.
 - 3. Compact foundations for underground utilities and associated structures to not less than 95 percent of the maximum density as determined by ASTM D1557.
 - 4. Place tracer tape (detection tape) one foot above new and recently exposed buried utilities including conduits, fiber optics, communication and signal cables, gas lines, petroleum lines, water lines, and electrical lines. Lay tape flat with three foot of overlap at the end of rolls. If tracer tape depth will exceed tape manufacturer's recommendation, obtain additional instructions from the Engineer before proceeding.

- D. Place and compact structure backfill at culverts as specified in this Section under Backfill (General) and as follows:

1. When the level of fill reaches the top of the structure, spread and hand compact two lifts over the structure without traversing the structure with heavy equipment. Begin no compaction with heavy equipment until a minimum of two lifts have been placed, hand compacted, and tested.
 2. Back and compact backfill to the same elevation on both sides of the culvert before proceeding to the next layer.
 3. When the height of cover indicated on the approved shop drawings or Contract Drawings, as applicable, is 12 inches or less, backfill structure with slurry cement backfill to the top of the structure.
 4. In regard to precast concrete culverts, operate equipment over the culvert in accordance with the culvert manufacturer's recommendation.
- E. Keep construction equipment away from edges of excavation a distance equal to the depth of the excavation.
- F. Do not place stones larger than 3 inches in backfill around pipes.
- G. Refer to compaction and field quality control requirements specified herein for additional requirements.

3.05 EMBANKMENTS

- A. Clear and grub ground surface on which embankment fill is to be placed of live, dead, or decayed vegetation including trees; rubbish; debris; and other unsatisfactory material in accordance with Section 02110, Site Clearing.
- B. Scarify prepared ground surface and moisten or aerate as required just prior to placement of embankment materials to ensure bond between embankment material and the prepared ground surface.
- C. Construct earth embankments from satisfactory materials free of organic or frozen material. Use no rocks greater than 3 inches. Place material in successive horizontal lifts of loose material not more than 12 inches in depth. Prior to placement of each layer, moisten or aerate soil surface as necessary and scarified or otherwise broken up in such a manner that the fill will bond with the surface on which it is placed. Uniformly spread layer. After spreading each layer, plow, disk, or otherwise break up layer; moistened or aerated as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density, if more than two (2) feet below subgrade elevation, and 95 percent if within two (2) feet of subgrade elevation.

3.06 GRADING

- A. Grading shall conform to the Contract Drawings and the tolerances specified herein. Transport satisfactory excavated materials to and place in fill or embankment within the limits of grading work. Excavate unsatisfactory materials encountered within the limits of the work and replace with satisfactory materials. Remove unsatisfactory materials and dispose of as specified in the Article entitled "Excess Materials" herein.
- B. Finish the surface of excavations, embankments, and subgrade to a smooth and compact surface in accordance with the lines, grades, and cross sections or

elevations shown on the Contract Drawings. Finish grade to within 1/2 inch of the grades and elevations indicated. Finish ditches in a manner that will result in effective drainage.

- C. Preparation of Subgrade: Shape subgrade to line, grade, and cross section, and compacted as specified. Shaping subgrade shall include plowing, disking, scarifying existing track subgrade and moistening or aerating required to obtain specified compaction. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Bring low areas resulting from removal of unsatisfactory material up to required grade with satisfactory materials, shape entire subgrade to line, grade, and cross section, and compact as specified. After rolling, the surface of the subgrade shall not show deviation greater than 1/2 inch when tested with a 10-foot straightedge applied both parallel and at right angles to the centerline of the area.
- D. Protection and Maintenance of Subgrade:
 - 1. Maintain ditches and drains along subgrade at all times as required to effectively drain the subgrade. Do not disturb finished subgrade by traffic or other operations. Protect and maintain subgrade in a satisfactory condition until ballast, subballast, base, or pavement is placed. Do not store or stockpile materials on the finished subgrade.
 - 2. Obtain Engineer's inspection and approval of subgrade prior to laying base, subballast, ballast, or pavement. Place no base, subballast, ballast, surfacing, or pavement on a muddy, spongy, or frozen subgrade.

3.07 COMPACTION

- A. Do not compact fill or backfill until it has attained the required moisture content. Add an accurately determined and carefully measured amount of water to the materials or surfaces which are too dry. Dry material containing an excess of moisture by manipulation, aeration, drainage, or other means before being compacted. Refer to Field Quality Control field moisture and related testing.
- B. When subgrade has been prepared and has reached required grade, proof-roll surfaces to determine if soft spots exist in the material using a 50-ton pneumatic-tired roller or similar approved equipment. If wet or spongy areas are revealed, notify the Engineer so that corrective measures may be determined. Remove soft spots and refill until they meet the required compaction. Proof-roll areas which support the track structure, paving, utility structures, buildings, or other structures in the presence of the Engineer and obtain the Engineer's approval before further earthwork operations are performed.
- C. In addition to proof-rolling, perform field density tests as specified under Field Quality Control herein.
- D. Use power-operated or power-driven hand operated equipment wherever possible to compact to requirements specified herein. Do not operate mobile equipment closer to foundation than a horizontal distance equal to the height of backfill above bottom of wall. Accomplish compaction using sheep foot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibrator compactors, or other approved equipment well suited to the type of material being compacted.

- E. If the degree of compaction is unsatisfactory, make necessary adjustments until specifications are met. Remove material placed over layers not satisfactorily compacted and re-compact unsatisfactory areas.
- F. Unless otherwise noted, relative compaction of fill materials composing each layer of fill shall not be less than 95 percent as determined by ASTM D1556.
- G. These compaction requirements do not apply to material placed in stockpiles or waste areas.

3.08 EXCESS MATERIAL

- A. Dispose of material authorized to be wasted outside the work site in accordance with GP7.16, Disposal of Material Outside the Work Site, or at waste areas designated on the Contract Drawings, if applicable. Do not dispose of any excavated material in such a manner as to obstruct the flow of any stream, impact wetlands, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.
- B. The following requirements apply to waste sites designated in the Contract Documents for the Contractor's use:
 - 1. The limits of the storage location will be designated by the Engineer. Keep stockpiles clear of tracks and other facilities, and preventing erosion. Create stockpiles in a manner that does not disturb or damage other work.
 - 2. Construct discrete stockpiles that measure no more than 1000 cubic yards and in a shape that is easily measured by the Engineer or surveyor.
 - 3. Avoid mixing of dissimilar materials. Construct each stockpile of similar material, such as non-impacted overburden soil, obviously compacted soil, or debris. Segregate dissimilar debris materials to facilitate salvage or recycling.
 - 4. Move soil impacted by contaminants around the work site only with the approval of the Engineer.
 - 5. Protect stockpiled soil in accordance with Section 01560, Temporary Controls. Cover stockpiles with plastic sheeting secured against removal by wind or rain. On a daily basis, inspect plastic sheeting covering stockpiles and make necessary repairs.
 - 6. Inform the Engineer each day of the number and locations of stockpiles created that day.
 - 7. When the Engineer has completed sampling from a stockpile, the Engineer will place an identification sign in the stockpile. From that date forward, add no soil to nor remove soil from the stockpile without the approval of the Engineer.

3.09 FIELD QUALITY CONTROL

- A. Testing shall be performed by an approved Inspection and Testing Agency retained by the Contractor.

- B. Unless otherwise indicated, perform field in-place density testing in accordance with ASTM D1556. Perform field density tests in accordance with ASTM D1556 (Sand-Cone Method). Periodically verify density tests by the nuclear probe method in accordance with ASTM D2922 with density tests from the Sand-Cone method. Minimum number of field density tests shall be as follows:
 - 1. One field density test shall be taken for every 300 linear feet of track for each lift of soil placed and at each grade crossing.
 - 2. One field density test shall be performed for each 1,000 square feet of embankment for each layer of compacted fill.
- C. Determine the relative compaction of fill materials composing each layer of fill in accordance with ASTM D1556. Perform testing at same frequency as specified for field in-place density testing.
- D. Maximum Dry Density and Optimum Moisture Content: The maximum dry density and optimum moisture content of non-granular soils (greater than 12 percent by weight passing through a No. 200 sieve) shall be determined by one of the methods described in ASTM D1557.
- E. Moisture Control: Perform field moisture tests in accordance with ASTM D3017 (Nuclear Probe Method). At the time of compacting, backfill material and the surface on which it is to be placed shall be within plus or minus two (2) percent optimum moisture content and meet specified compaction requirements.

END OF SECTION