STANDARD SPECIFICATIONS

SECTION 02223

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation for trench excavation, backfilling, and compacting.

B. Related Work Specified Elsewhere

All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).

Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

C. Testing for Compaction

1. Determine the density of soil in place by the use of a sand cone, drive tube, or nuclear tester.

2. Determine laboratory moisture-density relations of existing soils by ASTM D 1557.

3. Determine the relative density of cohesionless soils by ASTM D 2049.

4. Sample backfill materials by ASTM D 75.

5. Express "relative compaction" as the ratio, expressed as a percentage, of the in place dry density to the laboratory maximum dry density.

6. Compaction shall be deemed to comply with the specifications when no test falls below the specified relative compaction.

7. The developer will secure the services of a soils tester and pay the costs of all compaction testing. On capital projects, the District will secure the service of a soils tester and pay the cost of initial testing. The contractor will be responsible for the cost of all retests in failed areas. Test results will be furnished by the District representative.

D. Pavement Zone

The pavement zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

E. Street Zone

The street zone is the top 18 inches of the trench or depth determined by the jurisdictional agency immediately below the pavement zone in paved areas.

F. Trench Zone

The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas.

G. Pipe Zone

The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12 inches above the top of the pipe. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level 12 inches above the top of the highest or topmost pipe.

H. Pipe Bedding

The pipe bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe bedding shall be as shown on the drawings or as described in these specifications for the particular type of pipe installed.

I. Excess Excavated Material

1. The contractor shall make the necessary arrangements for and shall remove and dispose of all excess excavated material unless indicated differently in the special provisions for any job.

2. It is the intent of these specifications that all surplus material not required for backfill or fill shall be properly disposed of by the contractor at his expense at a proper disposal site.

3. No excavated material shall be deposited on private property unless written permission from the owner thereof is secured by the contractor. Before the District will accept the work, the contractor shall file a written release signed by all property owners with whom he has entered into agreements for disposing excess excavated material, absolving the District from any liability connected therewith.

4. The contractor shall obtain a haul route permit from the city or agency having jurisdiction.

J. Safety

1. All excavations shall be performed, protected, and supported as required for safety and in the manner set forth in the operation rules, orders, and regulations prescribed by the Division of Industrial Safety of the State of California.

2. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrians and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled.

3. No trench or excavation shall remain open during non-working hours. The trench or excavation shall be covered with steel plates, spiked in place, or secured with temporary A.C. pavement around the edges, or backfilled.

4. The contractor shall notify the District of all work-related accidents which may occur to persons or property at or near the project site, and shall provide the District with a copy of all accident reports. All accident reports shall be signed by the contractor or its authorized representative and submitted to the District's authorized representative within twenty-four (24) hours of the accident's occurrence.

K. Access

Unobstructed access must be provided to all driveways, water valves, hydrants, or other property or facilities that require routine use.

L. Permits

All work shall conform to the specifications and requirements of the State of California Department of Transportation, the Orange County PFRD, the city having jurisdiction, or and other agencies involved. The contractor shall keep a copy of all the required permits in the job site and comply with all the terms and conditions of said permits.

M. Slope Protection

Slope protection shall be installed where shown on the plans in accordance with MNWD standard drawing W-18, wherever the profile of the ground surface above the water or sewer main exceeds 20%, and where no pavement of other surfacing is to be laid over the facility. The installation of the slope protection shall be considered a part of the work, and the contractor shall include the expense in his cost.

PART 2 - MATERIALS

A. Native Earth Backfill

1. The use of native earth as backfill material will require the approval of the District representative in all cases.

2. Native earth backfill, acceptable for use, shall be fine-grained material free from roots, debris, and rocks with a maximum dimension not larger than 4 inches.

3. Native backfill shall not be used in the pipe zone.

B. Imported Backfill Material

1. Whenever the excavated material is not suitable for backfill, the contractor shall arrange for and furnish suitable imported backfill material that is capable of attaining the required relative density.

2. The contractor shall dispose of the excess trench excavation as specified in the preceding section. Backfilling with imported material shall be done in accordance with the methods described herein.

C. Granular Material

Granular material shall be defined as soil having a minimum sand equivalent of 30 as determined in accordance with State of California, Division of Highways, Test "California 217," with not more than 20% passing a 200-mesh sieve.

D. Imported Sand

Imported sand shall have a minimum sand equivalent of 30 per State of California, Division of Highways, Test "California 217" with 100% passing a 3/8-inch sieve and not more than 20% passing a 200-mesh sieve. Certification that the sand meets this requirement shall be provided.

E. Crushed Rock and Gravel

1. Crushed rock shall be the product of crushing rock or gravel. Fifty percent of the particles retained on a 3/8-inch sieve shall have their entire surface area composed of faces resulting from fracture due to mechanical crushing. Not over 5% shall be particles that show no faces resulting from crushing. Less than 10% of the particles that pass the 3/8-inch sieve and are retained on the No. 4 sieve shall be weatherworn particles. Gravel shall not be added to crushed rock.

2. Gravel shall be defined as particles that show no evidence of mechanical crushing, are fully weatherworn, and are rounded. For pipe bedding, where gravel is specified, crushed rock may be substituted or added.

3. Where crushed rock or gravel is specified in the bedding details on the plans, the material shall have the following gradations:

Sieve Size	1-1/2 Inch Max Gravel % Passing	1-inch Max Gravel % Passing	¾ Inch Max Crushed Rock % Passing
2”	100		
1-1/2”	90 – 100	100	
1”	20 – 55	90 – 100	100
¾”	0 – 15	60 – 80	90-100
½”	-	-	30 – 60
3/8”	0 –5	0 – 15	0 – 20
No. 4	-	0 – 5	0 – 5
No. 8	-	-	-

F. Sand-Cement Slurry

Sand-cement slurry shall consist of one sack (94 pounds) of portland cement per cubic yard of sand and sufficient moisture for workability.

PART 3 - EXECUTION

A. Compaction Requirements

1. The developer will engage the services of a qualified soils engineering firm to determine the relative compaction of the trench backfill. On capital projects, the District will engage the services of a qualified soils engineering firm to determine the relative compaction of the trench backfill.

2. If the backfill fails to meet the specified relative compaction requirements, the contractor shall rework the backfill until the requirements are met. The contractor shall make all necessary excavations for density tests as directed by the District representative. Orange County PFRD, city having jurisdiction, or CalTrans compaction requirements shall prevail in all public roads. The developer or contractor will be responsible for the cost of all additional compaction tests in the reworked areas.

3. Compaction tests shall be performed at random depths and at 200-foot intervals and as directed by the District representative.

4. Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as described below:

   a. Pipe zone and pipe base: 90% relative compaction

   b. Trench zone not beneath paving: 90% relative compaction

   c. Trench zone to street zone in paved areas: 90% relative compaction

   d. Street zone in paved areas: per agency requirements. The most stringent agency requirements shall prevail

   e. Rock refill material for foundation stabilization: 90% relative density

   f. Rock refill for over excavation: 90% relative density

B. Material Replacement

Removal and replacement of any trench and backfill material which does not meet the specifications shall be the contractor's responsibility.

C. Clearing and Grubbing

1. Areas where work is to be performed shall be cleared of all trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.

2. Organic material from clearing and grubbing operations will not be incorporated in the trench backfill.

3. Organic material from clearing and grubbing operations will be disposed of at a proper waste disposal facility.

D. Sidewalk, Pavement, and Curb Removal

1. Saw cut bituminous or concrete pavements regardless of their thickness, and curbs and sidewalks prior to excavation for the structure in accordance with the requirements of the city, or agency having jurisdiction. Curbs and sidewalks, that are damaged in the course of construction, are to be cut and removed from joint to joint.

2. Haul removed pavement and concrete materials from the site, to a proper disposal facility. These materials are not permitted for use as trench backfill. If the material to be removed exceeds 50 cubic yards, the contractor shall obtain a haul route permit from the city(s) having jurisdiction.

E. Trenching and Tunneling

1. Excavation for pipe, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the facilities as shown on the plans.

2. Trench banks shall be kept as near to vertical as possible and shall be properly braced and sheeted.

3. Tunneling will not be permitted.

4. The use of a jack and bore or hydraulic ram may be employed.

F. Bracing

1. The contractor's design and installation of bracing and shoring shall be consistent with the rules, orders, and regulations of the State of California Construction Safety Orders.

2. Excavations shall be so braced, sheeted, and supported that they will be safe such that the walls of the excavation will not slide or settle and all existing improvements of any kind, either on public or private property, will be fully protected from damage.

3. The sheeting, shoring, and bracing shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

4. Care shall be exercised in the drawing or removal of sheeting, shoring, bracing, and timbering to prevent the caving or collapse of the excavation faces being supported.

G. Trench Widths

1. Excavation and trenching shall be true to line so that a clear space of not more than 8 inches or less than 6 inches in width is provided on each side of the largest outside diameter of the pipe in place measured at a point 12 inches above the top of the pipe. For the purpose of this article, the largest outside diameter shall be the outside diameter of the bell on bell and spigot pipe or the pipe collar.

2. Where the sewer trench width, measured at a point 12 inches above the top of the bell of the pipe, is wider than the maximum set forth above, the trench area around the pipe shall be backfilled with crushed rock, Class B concrete, or slurry to form a cradle for the pipe as shown on the MNWD standard drawing S-8 at the discretion of the District representative.

H. Length of Open Trench

The maximum allowable length of open trench shall be 600 feet, or the distance necessary to accommodate the amount of pipe installed in a single day , whichever is less. Within developed areas, the length of open trench may be restricted as determined by the encroachment permit from the city or the agency having jurisdiction.

I. Grade

1. Excavate the trench to the lines and grades shown on the drawings with allowance for pipe thickness and for pipe base or special bedding.

2. The trench bottom shall be graded to provide a smooth, firm, and stable foundation that is free from rocks and other obstructions and shall be at a reasonably uniform grade.

J. Correction of Over Excavation

1. Where excavation is inadvertently carried below the design trench depth, suitable provision shall be made by the contractor to adjust the excavation, as directed by the District representative, to meet requirements incurred by the deeper excavation.

2. Over excavations shall be corrected by backfilling with approved graded crushed rock or gravel and shall be compacted to provide a firm and unyielding subgrade or foundation, as directed by the District representative.

K. De-watering

1. The contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. De-watering shall be done by methods that will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. De-watering methods may include well points, sump points, suitable rock or gravel placed below the required bedding for drainage and pumping, temporary pipelines, and other means, all subject to the approval of the District representative. Water shall be discharged in accordance with the requirements of the District's NPDES permit.

2. In no event shall the sewer system be used as drains for de-watering the construction trenches.

3. De-watering shall commence when groundwater is first encountered and shall be continuous until such times as water can be allowed to rise. No concrete shall be poured in water, nor shall water be allowed to rise around the concrete or mortar until it has set at least eight hours.

L. Foundation Stabilization

1. Whenever the trench bottom does not afford a sufficiently solid and stable base to support the pipe or appurtenances, the contractor shall excavate to a depth below the design trench bottom, as directed by the District representative, and the trench bottom shall be backfilled with 3/4-inch rock and compacted to provide uniform support and a firm foundation.

2. Where rock is encountered, it shall be removed to a depth at least 6 inches below grade and the trench shall be backfilled with 3/4-inch crushed rock to provide a compacted foundation cushion.

3. If excessively wet, soft, spongy, unstable, or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall removed to a depth as determined in the field by the District representative and replaced by crushed rock.

M. Excavated Material

1. All excavated material shall not be stockpiled in a manner that will create an unsafe work area or obstruct sidewalks or driveways. Gutters shall be kept clear or other satisfactory measures shall be taken to maintain street or other drainage.

2. In confined work areas, the contractor may be required to stockpile the excavated material off-site, as determined by the project permits.

N. Placing Pipe Bedding

1. Place the thickness of pipe bedding material over the full width of trench necessary to produce the required bedding thickness when the material is compacted to the specified relative density. Grade the top of the pipe bedding ahead of the pipe to provide firm, uniform support along the full length of pipe.

2. Excavate bell holes at each joint to permit assembly and inspection of the entire joint.

O. Placing Mounds to Support Pipe (DIP Only)

1. As an alternate to placing continuous imported sand pipe bedding material, the ductile iron pipe may be supported on mounds of imported sand.

2. The mounds shall be of imported sand and extend the full trench width. The mounds shall provide a minimum of 6 inches of contact with the pipe.

3. The pipe shall be supported to maintain its design line and grade.

4. The mounds shall be located 2½ feet from the bell/spigot of the pipe.

P. Backfilling within Pipe Zone

1. Backfill per the detailed piping specification for the particular type of pipe and per the following.

2. After pipe has been installed in the trench, place pipe zone material simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

3. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.

Q. Backfill within Trench Zone

1. Compact per the detailed piping specification for the particular type of pipe and per the following.

2. Push the backfill material carefully onto the backfill previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

3. The remaining portion of the trench to the street zone or ground surface, as the case may be, shall be backfilled, compacted and/or consolidated by approved methods to obtain the specified relative compaction.

    a. Compaction using vibratory equipment, tamping rollers, pneumatic tire rollers, or other mechanical tampers shall be done with the type and size of equipment necessary to accomplish the work. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened, and compacted to the specified relative density. The contractor shall repair or replace any pipe, fittings, manholes, or structures as directed by the District representative damaged by the contractor's operations.

    b. Consolidation of backfill performed by flooding, poling, or jetting shall obtain a relative compaction of the backfill material at least equal to that specified. When flooding, poling, or jetting methods are used, material for use as backfill shall be placed and consolidated in layers not exceeding 3-feet thick. Flooding, poling, or jetting methods shall be supplemented by the use of vibratory or other compaction equipment when necessary to obtain the required relative compaction. Care shall be taken in all consolidating operations to prevent the movement or floating of the pipe. Consolidation methods shall not be used where the backfill material is not sufficiently granular to be self-draining during and after consolidation, or where foundation materials may be softened or otherwise damaged by the quantities of water applied. The contractor shall rectify any misalignment of the pipe because of consolidation operations as directed by the District representative.

R. Backfill within Street Zone

1. The street zone within roadbed areas shall be compacted using approved hand, pneumatic, or mechanical type tampers to obtain the required relative compaction.

2. All work shall be done in accordance with the requirements and to the satisfaction of the city or the agency having jurisdiction.

3. Flooding and jetting will not be permitted in this Zone.

S. Sidewalk, Pavement, and Curb Replacement

Replace bituminous and concrete pavement, curbs, and sidewalks damaged or removed during construction in accordance with the requirements of the city or the agency having jurisdiction.

T. Slope Protection

1. Where cutoff walls or concrete anchors are required, they shall be in accordance with MNWD standard drawing W-18, with a minimum thickness of 12 inches. The wall shall extend at least 12 inches to undisturbed material on each side of the trench as excavated. Cemented rubble and concrete surface slope protection shall be a minimum of 4-inches thick.

2. Wall or anchors shall be placed with a minimum horizontal spacing of:

a. Not over 36 feet center to center on grades 25% to 35%

b. Not over 24 feet center to center on grades 35% to 50%

c. Not over 16 feet center to center on grades 50% and over

3. Material used for construction of cutoff walls or concrete anchors shall consist of cast-in-place reinforced concrete or reinforced hollow unit masonry. When reinforced hollow unit masonry is used, all cells in the block shall be filled solidly with grout. A No. 4 reinforcing bar shall be placed in vertically in each row of cells and No. 9-gage wall mesh shall be placed in each horizontal joint. In addition, a bond beam shall be placed at the top with two No. 4 bars.

   Where cutoff walls or concrete anchors are constructed of reinforced concrete, they shall have No. 4 reinforcing bars placed at 6-inches on center each way in the center of the wall. The bars shall extend full length and height of the wall.

END OF SECTION