

SECTION 12

ROADWAY AND DRAINAGE EXCAVATION AND EMBANKMENT

12.1 DESCRIPTION

A. General: This work consists of excavation, placement and disposal of material necessary for the construction of the roadway including hauling, watering, and when required, the placement of select subgrade topping.

B. Related Work:

Section 11	Utility Excavation and Backfill
Section 13	Removal Items
Section 17	Salvaging, Stockpiling, and Placing Topsoil
Section 19	Incidental Work
Section 203	Submittals

12.2 MATERIALS

A. Unclassified Excavation: All materials except those classified as rock excavation; muck excavation; unclassified excavation, digouts; contractor furnished borrow excavation; and other removal items paid for under Section 13 encountered during the construction of the work, regardless of the nature of the material or manner in which the material is removed, will be considered unclassified excavation.

B. Rock Excavation: Rock excavation shall consist of a sound, solid mass of mineral matter in place and of such hardness and texture that the mass cannot be loosened or broken down by ripping in a single pass with a tractor mounted hydraulic ripper equipped with one digging point. The ripper and tooth shall be of a standard design, adequately sized and used with a large crawler type tractor rated between 370 and 460 net fly wheel horsepower, operating in low gear, with sufficient downward force on the ripper.

The Contractor shall keep accurate records of the quantity of rock removed so that a comparison can be made with the City's records.

C. Muck Excavation: Muck excavation consists of the removal and disposal of saturated mixtures of soils and organic matter which requires additional work or equipment not normally required for unclassified excavation. The Engineer shall have the sole authority to determine what material is considered muck.

D. Unclassified Excavation, Digouts: Unclassified excavation, digouts consists of the removal and disposal of unstable material below an existing surface on which surfacing material is to be placed. When granular material is used for backfill, the

excavated area shall extend to a daylight point or points such that lateral drainage is provided. The exposed undercut surface shall be satisfactorily compacted prior to backfilling. Unless otherwise permitted by the Engineer, existing surface gravel shall be salvaged before and replaced after the unsatisfactory material has been removed.

- E. Contractor Furnished Borrow Excavation:** Material, furnished by the Contractor, from a pit or other source procured by the contractor.
- F. Undercutting:** Undercutting shall consist of excavating, replacing, and compacting the material immediately below the finished subgrade surface, at locations specified and to the depth specified.
- G. Water:** Water for compaction shall be furnished by the Contractor and shall be free from injurious matter. See section 190.

12.3 CONSTRUCTION REQUIREMENTS

- A. General:** The excavation and embankments for the roadway, intersections, and entrances shall be finished to smooth and uniform surfaces. Materials shall not be wasted without written permission. Grading operations shall be conducted so that material outside of the limits of slopes will not be disturbed. Prior to beginning grading operations in any area, clearing and grubbing shall have been performed in accordance with Section 10.

Borrow material shall not be used until all roadway excavation has been placed in the embankment unless otherwise directed by the Engineer.

Unsuitable material encountered in the subgrade or slopes shall be removed and the area backfilled to the finished graded section with approved material. Unsuitable material shall be disposed of at locations acceptable to the Engineer.

The subgrade shall be finished to within minus 0.08 feet to plus 0.02 feet from the design grade and typical section shown in the plans and to within $\pm 0.5\%$ of the typical section cross slope. The quarter crown within any 12 foot transverse length shall not exceed 0.04 feet above or below a straight edge, string line, or by other suitable equipment measuring between the crown and edge of roadway. The centerline shall be finished to a transverse distance within ± 0.25 feet of the plans shown location of centerline.

The Contractor shall not begin earth moving operations until all sediment control measures are placed beyond the work limits but within the right-of-way and easements.

- B. Classification of Excavation:** Roadway and drainage excavation will be designated as unclassified excavation, rock excavation, muck excavation, or unclassified excavation, digouts. Authority to identify and define the physical characteristics, which determine classification, shall be vested solely in the Engineer.

- C. Salvage of Topsoil:** Topsoil shall be removed from designated areas as described in Section 17. Topsoil that is not designated to be used as topping shall be salvaged to the Owner.
- D. Undercutting and Subgrade Preparation:** When specified, select materials shall be utilized to improve the roadbed. The work shall be performed in such manner that suitable materials may be selected, removed separately, and deposited in the roadbed within the limits and elevation required.

Where undercut is shown in the plans, the Contractor shall undercut to the limits specified. Undercut dimensions shall be to the minimum dimensions shown on the plans, unless otherwise directed by the Engineer. If the Engineer determines field conditions warrant change, the plan limits of the undercutting may be increased, decreased, or eliminated. The excavated material shall be used for backfill and embankment or disposed of as directed by the Engineer.

Where no undercut is specified, the Contractor shall scarify the exposed subgrade surface for the width of the subgrade to a depth of 6 inches below the subgrade and recompact to the required density in cut sections. In embankments less than 1½ feet, not including subbase gravel, the Contractor shall scarify the width of the subgrade, to a depth of 6 inches below the existing ground surface and recompact. Sod existing in the top 6 inches of subgrade shall be removed and replaced with satisfactory material.

E. Embankment:

- 1. Preparation of Embankment Areas:** When undercutting is not required and a compacted road surface containing granular material lies within three (3) feet of the subgrade surface, such old road surfacing shall be scarified or loosened with a disc or hydraulic ripper to a depth of at least six (6) inches. This scarified material shall be re-compacted to specified density.
- 2. Benching Embankment:** When embankment is to be placed and compacted on hillsides, against existing embankments, or when embankment is built one-half (1/2) width at a time, the slopes that are steeper than 4:1, when measured at right angles to the roadway centerline, shall be continuously benched as the work is brought up on horizontal layers. Benching shall be of sufficient width to permit operations of placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous bench cuts. Material thus cut out shall be recompact to the specified density, along with the new embankment material at the Contractor's expense.
- 3. Placing Embankment:** Embankment materials shall be placed in horizontal layers not exceeding a loose depth of eight (8) inches and shall be compacted as specified before the next layer is placed. Material may be placed in lifts greater than eight (8) inches provided it has been demonstrated that the compacting equipment in use has the ability to compact such material to the required density for the entire depth of the lift.

Sod, topsoil, and other organics shall not be used in embankment.

Rocks, broken concrete, or other solid materials shall not be placed in areas where piling is to be driven, underground utilities are to be installed or in other areas as determined by the Engineer.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of 8 inch maximum lift thickness without crushing, pulverizing, or further breaking down the pieces resulting from excavation methods, such material may be placed in the embankment in layers not to exceed the thickness of the approximate average size of rocks. Use of rocks over 2 feet in diameter for embankments shall be approved by the Engineer. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments or earth. Specified density will not be required for these layers; however, the material shall be compacted to the satisfaction of the Engineer. These layers shall not be constructed above an elevation one (1) foot below the finished subgrade.

Excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed on the project, with the permission of the Engineer. In cases where it is impossible to dispose of onsite, excess material shall be treated as waste and hauled off by the contractor.

The top six (6) inches of embankments shall be essentially free of rock fragments or stone that cannot be hand-passed through a four (4) inch square opening.

Each lift shall be thoroughly mixed to provide uniform moisture distribution. Effective spreading equipment shall be used to obtain uniform thickness prior to compacting. As the compaction of each lift progresses, continuous leveling and manipulating will be required to assure uniform density and moisture distribution. Construction equipment shall be routed uniformly over the entire surface of each layer.

When specified moisture contents are not met, the Contractor has the options of drying wet soil, furnishing approved soil meeting specifications at their expense, or adding water to dry soil as necessary to meet specifications. If water is added to dry soil, it must be thoroughly mixed with the soil to provide uniform moisture content prior to backfilling.

Embankment moisture and density shall be determined at least every 200 feet horizontally and every three (3) feet vertically. Engineer reserves the right to require additional testing. Embankment shall be properly compacted at all depths. The Contractor shall not place the finished surface (asphalt, curb & gutter, grass, etc.) until the specified densities are met at each location and the Engineer gives his approval. Backfill material not meeting specified densities shall receive additional compaction or shall be removed and replaced at no extra cost to the City as necessary to meet specifications.

In areas composed mainly of bentonite or unstable material, the Engineer may require additional undercutting to a depth necessary to stabilize the area.

Berms for structures requiring slope protection shall be finished to grade with ± 0.1 foot tolerance to provide a positive support for the slope protection. Other berms will be neatly finished to the same tolerance specified for embankment. When portions of foundations for box culverts are constructed of embankment, the embankment shall be constructed to the flow line grade, as specified.

The Contractor shall provide for positive drainage away from the excavation and embankment or otherwise take steps to protect the excavation and embankment from becoming excessively wet prior to placing the finished surface.

Should the Engineer determine that any portion of the backfill or excavation has become excessively wet after placement, the Contractor shall remove and furnish an approved backfill material or dry onsite material to the satisfaction of the Engineer.

The Contractor shall be responsible for the stability of constructed embankments prior to acceptance and shall replace or reconstruct any portions, which have failed at no additional cost to the City.

Watering, and the work incidental thereto, shall be done as set forth in Section 190.

Embankment shall not be constructed on frozen ground and frozen material shall not be used in construction of embankments.

- F. Compaction:** Unless the plan notes indicate otherwise, Specified Density Method shall be the method of compaction used.
- 1. Specified Density Method:** Soil shall be compacted within the moisture specification range in accordance with Table 1, unless otherwise specified in detailed plans and specifications. Optimum moisture will be determined by the AASHTO T 180 (Modified Proctor).

Table 1

Soil Type	Density Specification (Percent of Maximum Dry Density)	Moisture Specification (Percent of Optimum Moisture)
Cohesive	92% or Greater	-3% to +8%
Non-cohesive	95% or Greater	Workable

2. Soil Tests:

- a) **AASHTO T 180 (Modified Proctor):** The Contractor shall provide the Engineer with the results of the modified proctor soil compaction test, as determined by AASHTO T-180. If no locations are indicated on the plans, proctor test results shall be provided for locations determined by the Engineer. Should it become apparent during construction that the soil types encountered are significantly different from the initial samples, additional sampling and testing may be required.

If requested by the Engineer, the Contractor shall provide the Engineer with no less than 25 pounds of each sample appropriately labeled with the project title, the location from which the sample was obtained, the date of sample collection, and name of the person who collected the sample, and the name of the person or firm who conducted with compaction test. A City Inspector shall be present during sample collection.

- b) **AASHTO T 238 (In-place Nuclear Density):** Unless otherwise specified in the Detailed Specifications, field density tests, will be performed by the Engineer. The field density shall be measured with a nuclear density machine in accordance with SD DOT Materials Manual SD114 (AASHTO T 238). Contractor will be required to provide a prepared surface in the embankment shaped to facilitate testing at locations requested by the Engineer.

When embankment contains over 40% by weight of durable material passing an 8 inch square opening and retained on a 3/4 inch sieve, specified density requirements will be waived. Material retained on a 3/4 inch sieve will be considered durable when, after soaking in water for 24 hours, this retained material cannot readily be broken with the fingers and passed through the sieve. The embankment shall be compacted with sheepsfoot or other approved rollers to the satisfaction of the Engineer. Moisture requirements will be determined in accordance with SD DOT Materials Manual SD104, except the optimum and field moisture will be determined using material passing a 3/4 inch sieve.

For non-cohesive soil, embankment shall be spread in layers not exceeding an 8 inch loose depth and adequately compacted, with approved vibratory or pneumatic rollers, at the moisture content needed to obtain stability.

- c) **Proof Rolling:** Proof rolling shall be performed prior to placing base course. Equipment shall be a tandem-axle dump truck or tri-axle dump truck with the third axle raised, and shall have a minimum gross weight of 24 tons. Tires shall be properly inflated to the recommended pressure. Rolling operations shall be done in the center of each driving lane at walking speed. Inspection of the subgrade response at the rear axle shall be performed by the Engineer. To achieve passing results, no more than 1 inch of deflection shall be observed, and no cracking or pumping of the subgrade shall be present.

- G. Waste and Surplus Excavation:** Surplus excavation and waste material shall be disposed of as specified in plans or as directed by the Engineer. All waste material shall be disposed of at the contractor's sole expense.

Excavated material which contains bentonite shall be treated as waste.

Authority to designate what is surplus and waste shall be vested solely in the Engineer.

- H. Unclassified Excavation-Digouts:** This excavation consists of the removal and disposal of unstable material below an existing surface on which surfacing material is to be placed. Where possible, compacted suitable backfill material shall be utilized to achieve final grade.

When granular material is necessary for stability and is used as backfill, the excavated area shall extend to a daylight point or points such that lateral drainage is provided. The exposed undercut surface shall be satisfactorily compacted prior to backfilling. Unless otherwise permitted by the Engineer, existing surface gravel shall be salvaged before and replaced after the unsatisfactory material has been removed.

- I. Contractor Furnished Borrow Excavation:** Suitable materials removed from borrow sources shall be used in the formulation of embankments. Borrow sources shall be left and maintained in a suitable condition for accurate measurement and a natural appearance. Unless otherwise specified contractor shall be responsible to provide a suitable borrow source. Determination of the suitability of the borrow material shall be at the discretion of the Engineer.

Replacement of topsoil, fertilizing, seeding, and other operations necessary for restoration of the borrow source shall be incidental to the contractor provided borrow excavation, or as specified in the contract.

- J. Water:** Sufficient equipment shall be available to apply the quantity of water required to secure the proper compaction before evaporation, absorption, or drainage prevents or interferes with the specified results. Moisture content of material shall be uniform for the full depth and extent of each layer.

12.4 METHOD OF MEASUREMENT

- A. AASHTO T 180 (Modified Proctor):** AASHTO T 180 tests shall be measured by each test. If the contractor elects to import soil for the contractor's convenience which is not required by the contract and not ordered by the Engineer, the contractor shall provide the AASHTO T 180 test and it will not be measured for payment.
- B. Excavation:** Excavation shall be measured to the nearest cubic yard. Plans quantity will be the basis of measurement of excavation unless otherwise noted.

When payment is to be made on a plans quantity basis, whether provided in the contract or by written agreement, measurements will not be made except those necessary to determine that the work has been performed in conformance with the plans and to measure changes in plans or borrow pits which increase or decrease quantities of excavation.

When payment is to be made on a basis other than plans quantity, accepted quantities of various types of excavation will be measured in their original and excavated position by cross sectioning. Quantities of excavation, which conform to the staked lines and grades, may be computed using the original cross-sections and the staked section. Quantities of excavation that do not conform to the original plans lines and grades due to: changes in plans and grades, as directed by the Engineer, will be measured separately and added to the area of the excavation.

The plan-shown quantity of undercutting excavation as described in this section, with deductions made for portions not accomplished and with additions for portions not shown on the plans and ordered by the Engineer, will be measured separately.

Measurement of excavation will include unsuitable material excavated and removed to obtain proper compaction in cut or fill sections. Suitable material temporarily removed and replaced to facilitate compaction, except that removed for undercutting, will not be measured for payment.

Such affected areas will be measured, differences in quantities computed, and deductions or additions made as determined by the Engineer. Volume will be computed in cubic yards by the average end area method.

Where it is impractical to measure material by the cross-section method, acceptable methods involving three-dimensional measurements or measurement in the hauling vehicle may be used.

- C. Embankment:** Measurement of embankments will not be made.
- D. Waste:** This work will not be measured, but shall be incidental work to the associated bid item.
- E. Contractor Furnished Borrow Excavation:** Contractor furnished borrow excavation will be measured in its original position by cross sectioning, or surveyed volume calculation. Volumes will be computed in cubic yards.

Original cross sections or survey will be taken by Contractor prior to removal of any material and final cross sections will be taken following replacement of topsoil. Salvaged topsoil will not be measured.

Vegetation and stabilization of the borrow site will not be measured and shall be incidental to the associated borrow bid item.

- F. Water:** Water will not be measured. See Section 190.

12.5 BASIS OF PAYMENT

A. AASHTO T 180 (Modified Proctor): AASHTO T 180 tests will be paid for at the contract unit price per test. Payment shall be full compensation for obtaining the soil sample, delivering it to the certified lab, conducting the test, and providing the Engineer with the results. If the contractor elects to import soil for the contractor's convenience which is not required by the contract and not ordered by the Engineer, the contractor shall provide the AASHTO T 180 at the contractor's sole expense.

B. Excavation: Completed and accepted work will be paid for at the contract unit price per cubic yard for the class of excavation involved. Payment will be full compensation for excavation; construction and compaction of cuts and embankments; shaping of slopes; finishing of surface; disposal of surplus materials; completion of subgrade, shoulders, and roadway; and maintenance.

Scarifying, shaping, and recompacting, as required, shall be incidental to the unit price bid for excavation. Separate payment will not be made.

1. Unclassified Excavation: Excavation will be paid for at the contract unit price for unclassified excavation unless contract items provide for other classes of excavation.

When no bid item or other mention of Rock Excavation is shown on the plans and rock is encountered, such rock excavation as defined in this specification will be paid for at a negotiated price. Notification shall be given to the Engineer far enough in advance to enable him to ascertain the extent and nature of the rock formation before removal of such rock is begun. Payment as rock excavation will not be made unless such notification is given.

2. Rock Excavation: When an item for rock excavation is provided, payment will be made at the contract unit price.

3. Muck Excavation: When an item for muck excavation is provided, payment will be made at the contract unit price.

4. Unclassified Excavation, Digouts: When an item for unclassified excavation, digout is provided, payment will be made at the contract unit price.

5. Undercutting: Undercutting as described in this specification with corrections made for portions not accomplished and for portions not shown in the plans but ordered by the Engineer will be paid for at the contract unit price. Payment will be full compensation for all work to perform undercutting.

C. Embankment: Embankment will not be paid for directly, but shall be subsidiary work pertaining to several classes of excavation.

D. Waste: Waste will not be paid for directly, but shall be incidental to the associated

bid items.

E. Contractor Furnished Borrow Excavation: Contractor furnished borrow excavation will be paid for at the contract unit price per cubic yard. Payment will be full compensation for excavation and furnishing the material on the project; construction and compaction of embankments; shaping of slopes; finishing of surface; completion of subgrade, shoulders, and roadway; maintenance, and for furnishing materials, labor, and incidentals required for restoration of the borrow site. Topsoil, seed, fertilizer, and mulch for the restoration of the borrow site shall be incidental to the unit price per cubic yard of Contractor furnished borrow excavation.

F. Water: Water will not be paid for.

END OF SECTION