

## SECTION 120 ROADWAY AND DRAINAGE EXCAVATION AND EMBANKMENT CONSTRUCTION

### 120.1 DESCRIPTION

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.

### 120.2 MATERIALS

- A. **Unclassified Excavation:** All materials except those classified as rock excavation, or muck excavation, encountered during the construction of the work, regardless of their nature or manner in which they are removed, will be considered unclassified excavation.
- B. **Rock Excavation:** Rock excavation shall consist of, a sound and solid mass of mineral matter in place and of such hardness and texture that it can not 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 (276 and 343 kilowatts at the fly wheel), operating in low gear, with sufficient downward force on the ripper.
- C. **Muck Excavation:** Muck Excavation consists of the removal and disposal of saturated organic mixtures of soils and organic matter which requires additional work or equipment not normally required for Unclassified Excavation.
- D. **Digout Excavation:** Digout excavation 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 so that lateral drainage is provided. The exposed undercut surface shall be compacted prior to backfilling. The existing gravel shall be salvaged before and replaced after the unstable material has been removed.
- E. **Select Subgrade Topping:** Sources of selected subgrade topping material will be confined to the areas specified. The upper 6 inches (150 mm) of sodded areas, materials with high humus or silt content and outwashed material in poorly drained areas will not be acceptable. Unsatisfactory material found within the specified sources shall not be used as select subgrade topping.
- 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 shall be furnished by the Contractor and shall be free from injurious matter.

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### 120.3 CONSTRUCTION REQUIREMENTS

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 100.

Borrow material **shall** not be used until all roadway excavation has been placed in the embankment **unless otherwise directed by the Engineer**. If using borrow causes a waste of **mainline** excavation, the volume wasted shall be deducted from the volume measured in the borrow area.

Unsuitable material encountered in the subgrade or slopes shall be removed and the area backfilled to the finished graded section with approved material. Operations shall be conducted so the Engineer can take necessary cross sectional measurements before the backfill is placed. Unsuitable material shall be disposed of at locations acceptable to the Engineer.

The subgrade shall be finished to within minus 0.04 feet (13 mm) to plus 0.08 feet (25 mm) from the design grade and typical section shown in the plans. The quarter crown within any 12 foot (3.6 m) transverse length shall not exceed 0.08 feet (25 mm) when measured with a straight edge, stringline, or by other suitable equipment.

The following are definitions for the succeeding three paragraphs only:

**Earth moving operations** - The removal of surfacing or topsoil.

**Erosion control** - Erosion control shall include placing seed, erosion control blanket, erosion bales and spreading topsoil. Silt fence shall be placed before earth moving operations begin.

The Contractor shall not begin earth moving operations in a third mile (fifth kilometer) until placement of granular base material has begun in the first mile (1.6 kilometer), or as specified in the plans.

On two-lane construction, the Contractor shall not begin earth moving operations in a third mile (fifth kilometer) until erosion control measures have begun in the first mile (1.6 kilometer).

On four-lane construction, the Contractor shall not begin earth moving operations, in the second mile (third kilometer) until erosion control measures have begun in the first mile (1.6 kilometer).

When plans call for prime, the prime application shall closely follow the base finishing operation and at no time shall the prime operation be more than three miles (5 kilometers) from the base finishing operation. The cure time for the processed base, prime, and blotting sand application will be determined by the Engineer.

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**A. Excavation:** The unclassified excavation quantities will not be increased or decreased to reflect whether salvaged material was taken from cut or fill sections.

1. **Classification of Excavation:** Authority to identify and define the physical characteristics which determine classification shall be the Engineers.
2. **Salvage of Topsoil:** Topsoil shall be removed from designated areas as described in Section 230. Topsoil that is not designated to be used as topping shall be placed in the embankment as described in Section 120.3 B.2.
3. **Undercutting and Material Selection:** 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.

On specified density projects, the Contractor shall undercut to the limits specified.

On ordinary compaction projects, the Contractor shall scarify the exposed subgrade surface for the width of the subgrade to a depth of 6 inches (150 mm) below the subgrade and recompact to the required density in cut sections. In embankments less than 1-1/2 feet (450 mm), not including subbase gravel the Contractor shall scarify the width of the subgrade, to a depth 6 inches (150 mm) below the existing ground surface. Sod existing in the top 6 inches (150 mm) of subgrade shall be removed and replaced with satisfactory material.

**B. Embankment:**

1. **Preparation of Embankment Areas:** Sod which is not removed with the undercutting shall be thoroughly disked. When undercutting is not required and an existing compacted road surface containing granular material lies within 3 feet (one meter) of the subgrade surface, the old road surfacing shall be scarified to a depth of at least 6 inches (150 mm) and recompact.

When embankment is placed and compacted on hillsides, against existing embankments, or when embankment is built half width at a time, the slopes that are steeper than 4:1 shall be continuously benched as the embankment is built in 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 cuts. Excavated benching material shall be recompact along with the new embankment material.

2. **Placing Embankment:** Sod or topsoil used in the embankment shall be thoroughly disked and pulverized. It shall be placed in the fill slopes outside the shoulders of the subgrade or spread in the lower 1 foot (300 mm) of the fill between the roadbed shoulder lines, provided it is at least 4 feet (1.2 meters)

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below the top of the subgrade. Sod or topsoil shall not be placed within 10 feet (three meters) of pipe or within 50 feet (15 meters) of box culverts or bridges.

Rocks, broken concrete, or other solid materials shall not be placed in areas where piling is to be driven or in areas that would interfere with the construction of other structures.

Embankments constructed through lakes or swamps shall be constructed by end dump methods to an elevation that permits the use of normal construction methods. This elevation will be determined by the Engineer and will be subject to moisture and density requirements.

Roadway embankment of earth material shall be placed in horizontal layers not exceeding a loose depth of 8 inches (200 mm) and shall be compacted before the next layer is placed. Material may be placed in lifts greater than 8 inches (200 mm) provided test results verify that the specified density for the entire depth of the lift is obtained.

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

When excavated material consists predominantly of rock that cannot be placed in 8 inch (200 mm) layers without crushing, pulverizing, or further breaking down the rock, such material may be placed in the embankment in layers not to exceed the thickness of the average size of the larger rocks or 3 feet (one meter) whichever is less. Each layer shall be leveled and smoothed by distribution of spalls and finer fragments of earth. Specified density will not be required. The material shall be satisfactorily compacted. These layers shall not be constructed above an elevation 1 foot (300 mm) below the finished subgrade.

In excavated areas composed mainly of bentonite or unstable material, additional undercutting to a depth necessary to stabilize the areas shall be required.

Excavated material which does not contain bentonite may be used to reconstruct undercut sections below the selected subgrade topping zone, and the entire section when no selected subgrade topping is specified.

Rock, 3 inches (75 mm) in diameter or larger, within the right-of-way and easement areas shall be disposed of. The top 6 inches (150 mm) of embankments shall be free of rock fragments or stone that cannot be hand-passed through a 4 inch (100 mm) square opening.

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Field and farm entrances, ditch and channel blocks, and dikes shall be constructed and compacted as directed.

Berms for structures **requiring slope** protection shall be finished to grade with  $\pm 0.1$  foot ( $\pm 30$  mm) 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 an elevation between the bedding and flow line grades, as specified.

The Contractor shall be responsible for the stability of embankments prior to acceptance and shall repair any portions which have failed.

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

### 3. **Compaction**

**Unless the plan notes indicate otherwise, Specified Density Method shall be the method of compaction used.**

- a. **Specified Density Method:** Soil shall be compacted at not lower than four percent below optimum moisture, unless otherwise specified. Optimum moisture will be determined in accordance with SD 104 (AASHTO T99). Moisture tests will be determined by SD 108.

Excess moisture in the embankment material shall be removed by drying operations. The drying shall be carried on until the moisture content is such that the specified density can be attained.

Earth embankment shall be compacted to 95 percent of maximum dry density as determined by SD 104 (AASHTO T99) unless otherwise specified.

Density shall be determined in accordance with SD 105 (AASHTO T 191), SD 106 (AASHTO T 205) or SD 114 (AASHTO T 238). The percent compaction shall be calculated after making the proper adjustment for the weight and volume of any aggregate larger than that used in the laboratory compaction procedure.

Prior to placement of granular surfacing materials, the upper 6 inches (150 mm) of subgrade shall be reworked and recompacted to moisture and density requirements. This requirement shall be waived for A-3 and A-2-4(0) soils.

Roadway embankment within the area bounded by the toe of the berm

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slope and extending to a line 100 feet (30 meters) from the bridge end shall be compacted to 97 percent of maximum dry density as determined by SD 104 (AASHTO T99).

Material retained on a 3/4 inch (19.0 mm) sieve will be considered durable when, after soaking in water for 24 hours, it cannot readily be broken with the fingers and passed through the sieve. When embankment contains over 40 percent by weight of durable material passing an eight inch square (200 mm square) opening and retained on a 3/4 inch (19.0 mm) sieve, specified density requirements will be waived. 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 104, except the optimum and field moisture will be determined using material passing a No. 4 (4.75 mm) sieve.

When A-1 soil (gravelly) is encountered, density requirements shall be adhered to, the moisture content shall be as needed to obtain density.

When A-3 soil (fine sand) or A-2-4 (0) soil consisting of primarily fine one grain size sandy material is encountered, specified density requirements will be waived. Embankment shall be spread in layers not exceeding an 8 inch (200 mm) loose depth and adequately compacted, with approved vibratory or pneumatic rollers, at the moisture content needed to obtain stability.

- b. Ordinary Compaction Method:** Compaction may be accomplished with any type of equipment which, with adequate moisture content, will give uniform satisfactory results.

A rolling procedure shall be established which will produce densities conforming to Section 120.3 B.3. Sufficient tests will be taken during establishment of the rolling procedure to insure that the required density is being obtained.

Excess moisture in the embankment material shall be removed by drying operations. The drying under such circumstances shall be carried on until the moisture content is such that the required density can be attained.

Each layer shall be satisfactorily compacted before the next layer is placed. Compaction shall be extended to cover the subgrade width in completed cut sections under the same requirements, without additional compensation. Cut sections excavated below grade and refilled with the removed excavation or with selected soils shall be compacted in the same manner as embankments.

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- C. Select Subgrade Topping:** The Contractor shall develop a plan which demonstrates that an adequate quantity of the designated material will be salvaged or reserved for select subgrade topping. It will be the responsibility of the Contractor to follow the established grading plan to the extent that an adequate quantity of material for select subgrade topping will be conserved for use.

The surface upon which the select subgrade topping will be placed shall be constructed to within  $\pm 0.2$  foot ( $\pm 60$  mm) of the required elevation. Compaction of select subgrade topping shall be by the specified density method.

- D. Waste and Surplus Excavation:** Surplus excavation and waste material shall be disposed of as specified or directed. Unless a disposal site is specified, the Contractor will not be required to haul material in excess of the average plan shown haul for the entire project.

Excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed on the side slopes of the nearest fill and placed to maintain a distinct shoulder line. Waste material shall be placed the maximum distance possible and at least 1 foot (300 mm) outside and below the finished shoulder elevation.

Excavated material which contains bentonite shall be placed in that portion of an embankment section which is more than 20 feet (six meters) below the finished subgrade surface, in embankment slopes which are outside the subgrade shoulder line, or in designated waste areas. During placement of this material in the embankment, the thickness of the total placement in any one area shall be as directed.

- E. Option Borrow Excavation:** Suitable materials removed from optioned borrow sources shall be used in the embankments. Optioned borrow sources shall be graded to a neat and sightly appearance in accordance with grades, slopes, and requirements of the option agreement and to permit accurate measurement of quantities.
- F. 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.

### **120.4 METHOD OF MEASUREMENT**

- A. Excavation:** Excavation will be measured in cubic yards (cubic meters) by the average end area method. Measurement of excavation will include unsuitable material excavated and removed to obtain proper compaction in cut sections and in foundations for fill sections. Suitable material temporarily removed and replaced to facilitate compaction, except undercutting required in Section 120.3 A.4, second paragraph, will not be measured for payment.

Accepted quantities of excavation will be measured in its original position by cross

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sectioning. The area excavated will include overbreakage or slides not due to carelessness of the Contractor. Where it is impractical to measure material by this method, acceptable methods involving three dimensional measurements or measurement in the hauling vehicle may be used.

With written agreement between the Contractor and the Department, excavation which conforms to the staked lines and grades may be computed using original cross sections and staked sections.

When specified, plan quantity will be the measurement for payment, provided the project is constructed to the lines and grades specified. 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 which increase or decrease quantities. Such areas will be measured, differences in quantities computed and deductions or additions made.

When no provisions exist for payment on a contract quantity basis, final settlement may be made on a contract quantity basis provided a written agreement between the Contractor and the Department is executed prior to final measurement.

Unclassified excavation to be performed in connection with box culvert construction will be limited to that within the right-of-way limits. The quantity for this unclassified excavation will be plans quantity except as otherwise specified.

- B. Embankment:** Measurement of embankments will not be made.
- C. Select Subgrade Topping:** Measurement will be by plan quantity. Quantities will be based on computed embankment volume plus shrinkage. If changes in plan dimensions or locations are authorized, the final quantity will be determined by the as constructed volume using the shrinkage factor shown on the plans for the particular area of work. Final field measurement will not be made except that required to determine that the work was completed in accordance with plans and to document changes.  
  
Material used for construction of the select subgrade topping will also be measured as unclassified excavation.
- D. Waste:** This work will not be measured, but shall be subsidiary work pertaining to the several classes of excavation.
- E. Option Borrow Excavation:** Option borrow excavation will be measured in its original position by cross sectioning. Volumes will be computed in cubic yards (cubic meters) by the average end area method.

Original cross sections will be taken prior to removal of any material and final sections will be taken following replacement of topsoil. Salvaged topsoil which is stockpiled from the optioned borrow sources will be included as option borrow excavation.

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The quantity of topsoil stockpiled and respread on optioned borrow sources will be determined by measuring the stockpiles just prior to removal of the material from the stockpiles.

- F. Contractor Furnished Borrow:** Contractor furnished borrow will be measured in its original position by cross sectioning. Volumes will be computed in cubic yards (cubic meters) by the average end area method.

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

- G. Haul:** Measurement of authorized haul will be made based on material being taken from excavation and hauled the shortest distance possible. The haul distance for material moved from outside the roadway will be measured along the shortest satisfactory route. The haul distance for material obtained from the roadway and placed inside the roadway shall be measured along the centerline of the roadway.

Haul shall be the product obtained by multiplying the number of units of excavation removed from its original position by the mean distance hauled. The distance between the center of gravity of the excavation and the center of gravity of the embankment shall be the haul distance.

- H. Water:** Water will be measured by the thousand gallon (MGal.) (cubic meter) to the nearest 0.1 MGal. (0.5 cubic meters). Measurement will be by use of calibrated tanks or an approved water metering device which record in U.S. gallons (cubic meters).

Prior to using any water metering device the Contractor shall furnish a certified statement that such device conforms to AWWA requirements. The statement shall show that the device has been calibrated within the past year. Should subsequent measurements prove the measurements are unreliable another certified device producing satisfactory measurements shall be furnished. The head of each device shall be sealed when calibrated and the absence of such seal shall be cause to prohibit its use.

### 120.5 BASIS OF PAYMENT

- A. Excavation:** Completed and accepted work will be paid for at the contract unit price per cubic yard (cubic meter) 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.

**Undercutting** as described in Section 120.3 A.4, with corrections made for portions not accomplished and for portions not shown and ordered by the Engineer will be paid for at the contract unit price per cubic yard (cubic meter).

Scarifying, shaping, and recompacting, as required under Section 120.3 A.4 shall be

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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 in the contract and rock is encountered, such rock excavation will be paid for at the price established in the price schedule for miscellaneous items. Notification shall be given far enough in advance to ascertain the extent and nature of the rock formation before removal is begun. Payment as rock excavation will not be made unless notification is given. When rock excavation is shown on the plans and no item is provided, payment will be made at the contract unit price for unclassified excavation, regardless of whether or not rock is encountered at locations other than those shown or if the total rock removed is greater than the estimated quantity.

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. **Digout Excavation:** When an item for digout excavation, is provided, payment will be made at the contract unit price.
5. **Undercutting:** Undercutting will be paid for at the contract unit price per cubic yard (cubic meter). Payment will be full compensation for work over and above that normally required for unclassified excavation.

- B. **Embankment:** Embankment will not be paid for directly, but shall be subsidiary work pertaining to the several classes of excavation.
- C. **Select Subgrade Topping:** Select subgrade topping will be paid for at the contract unit price per cubic yard (cubic meter). Payment will be full compensation for work over and above that normally required for embankment construction.
- D. **Waste:** Waste will not be paid for directly, but shall be subsidiary work pertaining to the several classes of excavation.
- E. **Option Borrow Excavation:** Option borrow excavation will be paid for at the contract unit price per cubic yard (cubic meter). Payment will be full compensation for furnishing the material on the project and for furnishing materials (except topsoil), labor, and incidentals required for restoration of the pit.

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Topsoil which is stockpiled from the option borrow source will be respread and paid for at the contract unit price per cubic yard (cubic meter) of **option borrow excavation and placing topsoil**.

When the Contractor uses a pit not designated on the plans, the payment for topsoil, seeding, fertilizing and mulching shall be plans quantity of the pit designated on the plans.

- F. Contractor Furnished Borrow:** Contractor Furnished Borrow will be paid for at the contract unit price per cubic yard (cubic meter). Payment will be full compensation for furnishing the material on the project and for furnishing materials, labor, and incidentals required for restoration of the pit. Topsoil, seed, fertilizer and mulch shall be incidental to the unit price per cubic yard (cubic meter) of contractor furnished borrow.
  
- G. Haul:** This work will not be paid for directly, but shall be subsidiary work pertaining to the several classes of excavation. When, through no fault of the Contractor, changes cause an increase in the necessary haul, the resulting additional haul (total length of haul less average plan shown haul for the entire project) will be paid at the price established in the price schedule for miscellaneous items.
  
- H. Water:** Water will be paid for at the contract unit price per thousand gallons (MGal) (cubic meter).