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| REVIEW OF NEW SPECIFICATION OR SPECIFICATION CHANGE | | | | 203-10 |
| **Specification Section No.:** 203 | | | **Item:** Excavation and Embankment | |
| **Originating Office:** MAC | | | **By:** Christopher Russell | |
| **Date Sent For Review:** 09.26.16 | | | **Date Comments Due: 10.24.16** | |
| Submit response to: STANDARDS AND SPECIFICATIONS UNIT, DIVISION OF PROJECT SUPPORT 4TH FLOOR, CDOT HEADQUARTERS | | | | |
| **Vote**  **/N** | **Concurrent Reviews – Others Commenting** | | The attached Draft Specification is submitted for your review and comments. If not returned by Date Comments Due, the draft specification will be considered to be approved unless the Standards and Specifications Unit of the Project Development Branch [(303) 757-9474, (303) 757-9402] is advised otherwise.  **REMARKS:**  If these proposed changes are approved, our unit will issue them in a new standard special provision. In addition, the language from the Standard Special Provision, Revision of Section 203, Imported Material for Embankment, will be deleted, its content merged into this proposed new special provision. | |
|  | **Spec Committee Members:** | **✓** |
|  | Co-Chairman: Lacey |  |
|  | Region 1: Quirk |  |
|  | Region 1: Stratton |  |
|  | Region 2: Phillips |  |
|  | Region 3: Jean |  |
|  | Region 4: Boespflug |  |
|  | Region 5: Valentinelli |  |
|  | Project Development: Vacant |  |
|  | Specifications: Brinck |  |
|  | Bridge: Hasan |  |
|  | Contracts & Market Analysis: Eddy |  |
|  | Materials: Schiebel |  |
|  | Traffic Engineering: Matthews |  | REVIEWER COMMENTS:  ( ) Approved ( ) Disapproved ( ) Modified  If disapproved or modified, give reason why and show any modifications on the attached draft copy:    \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_  Name/Signature Date | |
|  | Maintenance: Weldon |  |
|  | FHWA: Feery |  |
|  | Attorney General: Milan |  |
|  |  |  |
|  | **Others:** |  |
|  | Colorado Contractors Assoc.: Moody |  |
|  |  |  |
|  | **Technical Committees:** |  |
|  | PDAC |  |
|  | Drainage Advisory Committee (DAC) |  |
|  | Water Quality Advisory Committee (WQAC) |  |

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| **COLORADO DEPARTMENT OF TRANSPORTATION** **SUBMITTAL OF NEW SPECIFICATION OR SPECIFICATION CHANGE** | | | Log No. (Assigned by Standards and Specifications Unit)  203-10 | |
| TO: Standards and Specifications Unit, Project Development, Suite 290 | | FROM: Materials Advisory Committee  (Region, Branch or Technical Committee) | | |
| SPECIFICATION SECTION NO.  203 | ITEM  Excavation and Embankment | | | Priority  Routine Fast |
| Reason for this new or changed specification:  The specification was updated to change material definitions and compaction methods for different soil types for construction of embankment. The changes were developed under a Materials Advisory Committee (MAC) Task Force TF 2015-01 involving the Colorado Contractors Association. The specification changes were approve by the MAC. | | | | |
| New or Revised Specification:  See Attached. | | | | |
| Note: See Procedural Directive 513.1 for a description of appropriate specification development procedures. | | | | |

**CDOT Form 1215 10/01**

**SECTION 203**

**EXCAVATION AND EMBANKMENT**

**DESCRIPTION**

**203.01 General.**

This work consists of excavation, hauling, disposal, placement, and compaction of all material encountered within the limits of the work, including construction of dikes and the excavation for ditches and channels, necessary for the construction of the roadway in accordance with the Contract.

**203.02 Excavation.**

All excavation will be defined as, “unclassified excavation”, “stripping”, “removal of unsuitable material”, “rock excavation”, “borrow”, or “potholing” as described below.

(a) *Unclassified Excavation.* Unclassified Excavation shall consist of the excavation of all materials of whatever character required for the work, obtained within the right of way, including surface boulders and excavation for ditches and channels that is not removed under some other item.

(b) *Stripping.* Stripping shall consist of removing overburden or other specified material from borrow pits, and the replacement of overburden or other specified material over the disturbed area of the site or pit after the underlying material has been removed.

(c) *Removal of Unsuitable Material.* Removal of Unsuitable Material shall consist of the removal of soils and/or mixtures of soil and organic matter identified in the Contract or as directed by the Engineer that would be detrimental to the roadway or embankment if left in place in its existing condition.

(d) *Rock Excavation.* Rock Excavation shall consist of igneous, metamorphic, and sedimentary rock which cannot be excavated without blasting or with the use of rippers, including all boulders or other detached stones having a volume of ½ cubic yard or more. Unless specified in the Contract, Rock Excavation is material that meets one of the following field test criteria to be conducted by the Contractor:

1. Ripping Test: Material that cannot be broken down by one pass with a single tooth ripper mounted on a crawler type tractor in low gear with a minimum net flywheel power rating of 255 horsepower; or material that cannot be broken down with a tracked excavator with a minimum net flywheel power rating of 380 horsepower that can exert a minimum of 39,000 pounds of digging force utilizing a 2-foot wide bucket with rock teeth.

2. Seismic Test: Material that has a seismic velocity of 6,000 feet per second or greater. The Contractor shall submit the qualifications of the individual performing or interpreting the seismic testing to the Engineer a minimum of 14 days prior to testing. The ripping test will be used to resolve differences if seismic velocities fall below 6,000 feet per second.

3. Handling Test: Any boulder or detached stone having a volume of ½-cubic yard or more that cannot be readily broken down with excavation equipment.

(e) *Borrow.* Borrow shall consist of approved material obtained from outside the right of way, required for the construction of the project.

(f) *Potholing.* Potholing consists of exposing and verifying the location of existing utilities at locations as directed.

**203.03 Embankment Materials.**

Embankment Material shall consist of approved material acquired from excavations or borrow pits, and hauled and placed in embankments. Approval of Embankment Material shall be contingent on the material meeting the Atterberg Limit and gradation requirements specified in the Contract. Approval of the Embankment Material in the upper 2 feet of embankment below the subgrade elevation will be contingent on the material having at least the specified resistance value when tested by the Hveem Stabilometer, or equivalent resilient modulus value, and/or shall meet Atterberg Limit and gradation requirements specified in the Contract.

Embankment Material shall be classified into one of the material groups listed below, and placed and compacted in accordance with the appropriate methods specified in Section 203.07. If any material does not meet the criteria for one of the following classifications, it shall be processed on site to meet the requirements for one of the material groups listed below, or disposed of at the Contractor’s expense.

1. Soil Embankment: Soil Embankment shall have all particle sizes less than 6 inches. The material shall be classified in accordance with AASHTO M 145 and placed and compacted in accordance with Section 203.07 a.
2. Rock Embankment: Rock Embankment shall meet all of the following requirements:

* Contains 50 percent or more retained on the No. 4 sieve.
* Contains > 30 percent retained on the ¾-inch sieve.
* Classifies as an AASHTO A-1 soil type.
* All particle sizes shall be less than 6 inches.
* Particles retained on the No. 4 sieve shall not be composed of non-durable bedrock types.

Rock Embankment can be placed without moisture density control as described in Section 203.07 b.

1. Rock Fill: Rock Fill shall meet all of the following requirements:

* A minimum of 50 percent of the material shall be retained on a 4-inch sieve.
* Maximum dimension of any particle permitted is 36 inches.
* Shall be well-graded by visual inspection.
* Shall contain less than 20 percent by volume of material passing the No. 200 sieve based on visual inspection. This requirement shall be at the discretion of the Engineer.
* Particles retained on the No. 4 sieve shall not be composed of non-durable bedrock types.

Rock Fill can be placed without moisture density control as described in Section 203.07 b.

Non-durable bedrock: Non-durable bedrock will be identified and classified using Colorado Procedure CP-L 3104. Any material that classifies as Soil-like Non-durable (S-N) as defined in the procedure shall be pulverized, broken down and processed to 6-inch maximum particle sizes before incorporation into embankment fill. These materials shall be placed and compacted as “Soil Embankment” in accordance with Section 203.07 a. Non-durable bedrock particles in excess of 6 inches shall not be placed into embankment fill.

Recycled concrete and asphalt: If recycled concrete or asphalt are to be incorporated into embankment fill; the maximum dimension permitted for concrete is 24 inches and the maximum dimension permitted for asphalt is 12 inches.

Embankment Material imported onto the project will be tested for water soluble sulfates using CP-L 2103 Method B. The average of three consecutive tests shall show that the sulfate content is not greater than that corresponding to the sulfate exposure level specified in the Contract. No single test shall have a sulfate content more than 20 percent greater than that corresponding to the sulfate exposure level specified in the Contract. A single failing test shall have the remaining sample split into four equal portions. CDOT Region Lab shall receive one portion, the Contractor shall receive one portion and the remaining two portions shall go to the CDOT Central lab. The CDOT Region Lab, CDOT Central Lab and the Contractor’s Lab shall retest the sample. If the results from the three Labs are within 10 percent of each other, the results will be averaged. The averaged result will be used for determining Contract compliance. If the results from the Labs are not within 10 percent of each other, the remaining split sample will be sent to an independent laboratory for testing using CP-L 2103. The independent laboratory will be mutually agreed upon by the Department and the Contractor. The Independent Lab’s test result will be used for determining Contract compliance.  
  
If the water soluble sulfate content is less than that corresponding to the sulfate exposure level specified in the Contract, CDOT will bear all costs associated with the independent lab test. If the soluble sulfate content is greater than that corresponding to the sulfate exposure level specified in the Contract, all costs associated with independent lab testing shall be at the Contractor’s expense. Embankment represented by failing tests shall be removed from the project and replaced at the Contractor’s expense.

Imported Material used for backfilling pipes (storm sewer, cross culverts, side drains, etc) shall be tested for compatibility with the selected pipe material. When Non-reinforced Concrete Pipe or Reinforced Concrete Pipe is used, the imported material shall be tested for sulfate and pH. When Corrugated Steel Pipe, Bituminous Coated Corrugated Steel Pipe or Pre-coated Corrugated Steel Pipe is used, the imported material shall be tested for sulfates, chlorides, pH and resistivity. When Aramid Fiber Bonded Corrugated Steel Pipe or Corrugated Aluminum Pipe is used, the imported material shall be tested for pH and resistivity. When Plastic pipe is selected, the imported material does not need to be tested for sulfates, chlorides, pH or resistivity.

Sulfates, chlorides, pH and resistivity shall be determined by the following procedures:

1. Water soluble sulfates using CP-L 2103 Method B
2. Chlorides using CPL 2104
3. Resistivity using ASTM G57
4. pH using ASTM G51

The average of three consecutive tests shall show the imported material’s sulfate, chloride, pH and resistivity is not greater than the limits corresponding to the Pipe Class in Table 203-1 or 203-2 for the pipe class specified in the Contract. No single test shall have a result more than 20 percent greater than that corresponding to the limit in Table 203-1 or Table 203-2 for sulfates, chlorides and resistivity. No single test shall have a result more than 5 percent outside the limit in Table 203-1 for pH. The remaining sample material from a single failing test shall be split into three equal portions. CDOT shall receive one portion, the Contractor shall receive one portion and the remaining portion shall be retained by the Project. CDOT and the Contractor’s Lab shall retest the failed sample; if the results from those tests are within 10 percent of each other, the results will be averaged. The averaged result will be used for Contract compliance. If the results from the Labs are not within 10 percent of each other, the remaining sample portion will be sent to an independent laboratory for testing using the testing requirements specified above. The independent laboratory will be mutually agreed upon by the Department and the Contractor. The Independent Lab’s test result will be used for Contract compliance.

If the imported material’s sulfates, chlorides, and resistivity are less than the limits and the pH is within the limits in Table 203-1 or 203-2, CDOT will bear all costs associated with the independent lab test. If the imported material’s sulfates, chlorides, and resistivity is greater than the limits and the pH is outside the limits in Table 203-1 or 203-2, all costs associated with independent lab testing shall be at the Contractor’s expense.

Embankment represented by failing tests shall be removed from the project and replaced at the Contractor’s expense.

**Table 203-1**

**SULFATE, CHLORIDE AND PH OF IMPORTED MATERIAL**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **SOIL** | | |
| Pipe Class | Sulfate | Chloride |  |
| (SO4) | (Cl) | pH |
| % max | % max |  |
| 0 , 7 | 0.05 | 0.05 | 6.0-8.5 |
| 1, 7 | 0.10 | 0.10 | 6.0-8.5 |
| 2, 8 | 0.20 | 0.20 | 6.0-8.5 |
| 3, 9 | 0.50 | 0.50 | 6.0-8.5 |
| 4, 9 | 1.00 | 1.00 | 5.0-9.0 |
| 5, 10 | 2.00 | 2.00 | 5.0-9.0 |
| 6, 10 | >2.00 | >2.00 | <5 or >9 |

**Table 203-2**

**RESISTIVITY AND PH OF IMPORTED MATERIAL**

|  |  |
| --- | --- |
| **SOIL SIDE** | |
| Resistivity, R (Ohm – cm) |  |
| pH |
|  |
| ≥1,500 | 5.0-9.0 |
| ≥250 | 3.0-12.0 |

**CONSTRUCTION REQUIREMENTS**

**203.04 General.**

The excavations and embankments shall be finished to smooth and uniform surfaces conforming to the typical sections specified. Variation from the subgrade plan elevations specified shall not be more than 0.08 foot. Where asphalt or concrete surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04 foot. Materials shall not be wasted without written permission of the Engineer. Excavation operations shall be conducted so material outside of the slope limits will not be disturbed. Prior to beginning grading operations, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 201.

The Contractor shall notify the Engineer not less than five working days prior to beginning excavation so the necessary cross sections may be taken. The Contractor shall not excavate beyond the dimensions and elevations established.

Archaeological and paleontological materials encountered during the work shall be dealt with in accordance with subsection 107.23.

All excavation activities in areas where asbestos is encountered or expected to be encountered shall conform to the Colorado Department of Public Health and Environment’s Asbestos-Contaminated Soil Guidance Document or the State of Colorado’s Asbestos Contaminated Soil Statewide Management Plan (ACS), whichever is more recent at the time of advertisement and in accordance with subsection 250.07(d) and the Air Process Control Commission Regulation No. 8 Part B or Section 5.5 of the solid Waste Regulation 6 CCR 1007-2, as applicable.

**203.05 Excavation.**

(a) *Rock.* Unless otherwise specified, rock shall be excavated to a minimum depth of 0.5 foot and a maximum depth of 1 foot below subgrade, within the limits of the roadbed. Rock removed in excess of 1 foot below subgrade will not be paid for. Backfilling of the depth in excess of 1 foot below subgrade shall be at the Contractor’s expense. Approved embankment material shall be used to bring the rock-excavated areas to subgrade elevations within the tolerances specified in subsection 203.04.  
  
Undrained pockets shall not be left in the rock surface and depressions shall be drained at the Contractor’s expense.   
  
Any change to cut slopes by the Department will be made prior to the next drilling operations.  
  
When required for rock excavation, controlled blasting shall be conducted in accordance with the Contract.

(b) *Unclassified.* 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 as approved.   
  
Unless otherwise specified by the Engineer, intercepting ditches shall be made above the top of cut slopes and carried to outlets near the ends of the cuts. In order to blend the intersection of cut slopes with the slope of the adjacent natural ground surfaces in a uniform manner, the tops of all cut slopes, except those in solid rock, shall be flattened and rounded in accordance with typical sections and details specified. Earth overburden lying above solid rock cuts shall be treated in the same manner as earth cuts.   
  
The Department reserves the right to change cut slopes during the progress of excavation.

(c) *Unsuitable Material.* Unsuitable materials encountered in the subgrade that are determined to be detrimental to the roadway or embankment shall be removed to the depth and extents as directed by the Engineer. The excavated area shall be backfilled to the finished graded section with approved material. Payment for approved material shall be for the volume that is placed in the excavated area at the respective unit price for the material approved by the Engineer and used. Materials that contain organics or that cannot be dried or moisture conditioned, then compacted to the required density will be disposed of and cannot be reused as embankment fill. Materials not containing organics and that can be dried or moisture conditioned and compacted to the required density can be reused as embankment fill as approved by the Engineer.

(d) *Borrow.* If the Contractor places more borrow than is specified or approved and causes a waste of roadway excavation, the quantity of waste will be deducted from the borrow volume. All borrow areas shall be bladed and shaped to permit accurate measurements after excavation is completed. The finished borrow areas shall be graded to a smooth and uniform surface and shall be finished so water will not collect or stand therein, unless otherwise specified.

(e) *Stripping.* Overburden shall be removed to the depth required for the production of acceptable material, and at least 5 feet beyond the working limits of the area being excavated.

(f) *Potholing.* All necessary potholing as determined by the Contractor and agreed to by the Engineer shall be completed under this item with appropriate equipment as approved.  
  
The Contractor shall acquire necessary permits, locate utilities, excavate all materials of whatever character required to expose the utilities, survey the location of the utilities, and backfill the excavation to existing grade lines with the excavated or other approved materials. Backfilling shall be accomplished in accordance with subsection 206.03.  
  
The Contractor shall use extreme caution during this work. All damage to existing utility lines or adjacent facilities shall be repaired promptly at the Contractor’s expense.

**203.06 General Embankment Construction Requirements.**

When Contractor Process Control is required, the Contractor’s Process Control Representative shall be certified for WAQTC Embankment and Base Testing and CDOT’s Excavation, Embankment, and Soil Inspection certification course.

Embankment construction shall include preparation of the areas upon which embankments are to be placed, construction of dikes, placing and compacting of approved material within roadway areas including holes, pits, and other depressions within the roadway area. Only approved materials shall be used in the construction of embankments and fills.

All sod, vegetable and other organic matter, stumps, and roots shall be removed from the surface upon which the embankment is to be placed in accordance with Section 201. Unless a thickness is otherwise specified in the Contract, the upper 4 inches of the ground surface will be considered top soil and shall be removed in accordance with Section 207 prior to placement of Embankment Fill.

The cleared surface shall be completely broken up by plowing or scarifying to a minimum depth of 6 inches or as specified in the Contract, the moisture content increased or reduced as necessary, and compacted to the specified embankment density for the material type present.

When embankment is placed on a slope that is steeper than 4H:1V, as measured in the steepest direction, the existing slope shall be benched as the embankment is placed in layers. A 2-foot deep, 8-foot wide key shall be excavated at the base of the existing slope and backfilled with approved and compacted material. The embankment shall be placed in layers from that key. Benching as the work progresses up the existing slope shall be a minimum of 8 feet wide. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous bench. Excavated material from benching may be placed and compacted with the embankment material at the Contractor’s expense.

During the course of construction, embankment side slopes shall be built a minimum of 12 inches beyond the final grade indicated in the Contract to allow for compaction equipment to compact the outer edges of the embankment. Once the specified level of compaction is achieved, the side slopes shall be trimmed back to final grade. Excess material placement and removal to satisfy this requirement shall be at the Contractor’s expense.

Cross hauling may be used to insure that the best available material is placed in the top 2 feet of all embankments. When directed by the Engineer, cross haul will be paid for in accordance with subsection 109.04.

If embankment can be placed on only one side of structures such as retaining walls, abutments, wing walls, piers, or culvert headwalls, compaction shall be accomplished without initiating movement or deformation of the structure and without placing excessive pressure against the structure. When noted in the Contract, the fill adjacent to the abutment of a bridge shall not be placed higher than the bottom of the backwall until the superstructure is in place. When embankment is placed on both sides of a concrete wall or box type structure, the embankment shall be brought up equally on both sides of the structure.

Where embankment is to be placed and compacted and end dumping is permitted, the slopes of the original ground or embankment shall be deeply plowed or scarified before starting end dumping.

Embankment fill other than A-1 soil types shall not be placed within standing water, unless otherwise noted in the Contract. During the construction of the embankment, the top surface shall be maintained so that it is well drained at all times.

Frozen materials shall not be used in construction of embankments. Frozen material will be identified by the visual observation of ice crystals within the foundation or embankment material, or by measuring the surface temperature of the ground surface.

**203.07 Embankment Placement and Compaction Requirements.**

Materials incorporated into embankment fill shall be placed and compacted according to the following requirements:

1. Soil Embankment: All Soil Embankment shall be placed in horizontal layers not to exceed 8 inches in loose lift thickness. Each layer shall be compacted prior to the placement of subsequent layers. Spreading equipment shall be used to obtain uniform thickness prior to compaction. As the compaction progresses, continuous mixing, leveling, and manipulating shall be done to assure uniform moisture and density. Additional work involved in drying Soil Embankment to the required moisture content shall be included in the contract price paid for excavating or furnishing the material with no additional compensation.   
     
   Soil Embankment that classifies as A-1 material can be used to bridge across standing water or swampy ground within the embankment foundation, and can be placed in lift thicknesses greater than 8 inches if used for this purpose as approved by the Engineer.   
     
   Soil Embankment with less than or equal to 30 percent retained on the ¾-inch sieve shall be tested for compaction using CP 80. Materials that classify as AASHTO A-1, A-2-4, A-2-5, and A-3 soils shall be compacted at ± 2 percent of Optimum Moisture Content (OMC) and to at least 95 percent of maximum dry density determined in accordance with AASHTO T 180 as modified by CP 23. All other soil types will be compacted to 95 percent of the maximum dry density determined in accordance with AASHTO T 99 as modified by CP 23. Soils with 35 percent fines or less shall be compacted at ± 2 percent of OMC. Soils with greater than 35 percent fines shall be compacted at a moisture content equal to or above OMC to achieve stability of the compacted lift. Stability is defined as the absence of rutting or pumping as observed and documented by the Contractor’s Process Control Representative and as approved by the Engineer. If the soils cannot be compacted and prove to be unstable at a moisture content equal to or above OMC, then the required moisture content for compaction can be reduced below OMC as approved by the Engineer.

Prior to placing any Soil Embankment with greater than 30 percent retained on the ¾-inch sieve, the Contractor will be required to construct a test strip to the dimensions specified in the Contract, or as directed by the Engineer. The test strip can be incorporated into the final embankment. The Contractor will be responsible for determining the moisture conditioning necessary to achieve compaction, and will determine the equipment and number of passes necessary to achieve adequate compaction. The Contractor is required to use compression-type or vibratory rollers on granular materials and sheepsfoot rollers on cohesive soils. Adequate compaction will be demonstrated by the absence of rutting, pumping, or deflection following a proof roll of the test strip using any piece of construction equipment that exerts a minimum 18-kip per axle load. The proof roll will be observed and accepted by the Engineer. Once the test strip passes a proof roll, the Contractor can resume embankment construction with the same moisture conditioning and compaction methods as the test strip was constructed.

Placement, moisture conditioning, and compaction of every lift of soil embankment with greater than 30 percent retained on the ¾-inch sieve will be observed by the Contractor’s Process Control Representative, and accepted by the Engineer. Adequate compaction of each lift will be demonstrated as the absence of rutting, pumping, or deflection as construction equipment is routed over a lift following the compactive efforts that were used and accepted for the respective test strip. The Engineer may request a proof roll at any time to document the condition of a lift.   
  
Significant changes in the material being hauled for soil embankment with greater than 30 percent retained on the ¾-inch sieve will require construction of a new test strip, and demonstration of adequate compaction methods using a proof roll. The Contractor’s Process Control representative shall be authorized to require additional test strips at their discretion. However, the requirement for an additional test strip shall not be waived without the written approval of the Engineer.

Non-durable Bedrock: Non-durable bedrock shall be watered to promote slaking and break down, and pulverized/processed to a maximum particle size of 6 inches. These materials shall be placed and compacted as Soil Embankment; except they shall be compacted with a heavy tamping foot roller, weighing at least 30 tons. Each tamping foot shall protrude from the drum a minimum of 4 inches. Each embankment layer shall receive a minimum of four passes with the tamping foot roller. The roller shall be operated at a uniform speed not exceeding 3 miles per hour. No additional compensation will be made for additional roller passes to achieve specified density requirements.  
  
Non-durable Bedrock shall not be used to bridge over standing water or swampy ground within an embankment foundation. Non-durable bedrock shall also not be placed within 2 feet of the final subgrade elevation.

1. Rock Embankment and Rock Fill:   
     
   Rock Embankment shall be placed in horizontal layers not to exceed 8 inches in loose lift thickness. The lift thickness can be increased when bridging over standing water or swampy ground in the embankment foundation as directed by the Engineer. Each layer shall be compacted prior to the placement of subsequent layers. Spreading equipment shall be used to obtain uniform thickness prior to compaction.   
     
   Rock Fill shall be placed in horizontal layers not to exceed a loose lift thickness equivalent to the average particle size up to a maximum permitted lift thickness of 18 inches. Particles with a maximum dimension of 36 inches are permitted; however, rocks larger than the lift thickness shall be separated enough to allow compaction equipment to operate in between. Material shall be placed to fill in voids between larger stones with finer particle sizes and to avoid nesting. Spreading equipment shall be used to obtain uniform thickness prior to compaction. If the use of leveling equipment is not practical, the Engineer may permit rock fill material to be cast or end dumped. In such cases sufficient hand or machine work will be required to construct a compact, stable fill and to finish the slopes to a neat and smooth appearance. Rock Fill shall not be placed within 2 feet of the final subgrade elevation. When a Rock Fill is placed over any structure, the structure shall be covered with a minimum of 2 feet of compacted Soil or Rock Embankment material before the Rock Fill is placed.  
     
   The Contractor will be responsible for determining the moisture conditioning necessary to achieve compaction for Rock Embankment or Rock Fill. Vibratory or compression-type rollers will be used to compact these materials. At a minimum, compression-type rollers weighing 20 tons shall complete 4 passes over the entire width of a lift at a speed not to exceed 3 miles per hour. Vibratory rollers shall exert a minimum dynamic force of 30,000 pounds of impact per vibration, and achieve a minimum 1,000 vibrations per minute. Vibratory rollers shall complete a minimum of 4 passes over the entire width of a lift at a speed not to exceed 1.5 miles per hour.  
     
   Prior to placing Rock Embankment or Rock Fill, the Contractor will be required to construct a test strip to the dimensions specified in the Contract, or as directed by the Engineer. The test strip can be incorporated into the final embankment. Adequate compaction of the Rock Embankment or Rock Fill test strip will be demonstrated by the absence of rutting, pumping, or deflection following a proof roll of the test strip using any piece of construction equipment that exerts a minimum 18-kip per axle load. The proof roll will be observed and accepted by the Engineer. Once the test strip passes a proof roll, the Contractor can resume Rock Embankment or Rock Fill construction with the same moisture conditioning and compaction methods as the test strip was constructed. Placement, moisture conditioning, and compaction of every lift of Rock Embankment and Rock Fill will be observed by the Contractor’s Process Control Representative, and accepted by the Engineer. Adequate compaction of each lift will be demonstrated as the absence of rutting, pumping, or deflection as construction equipment is routed over a lift following the compactive efforts that were used and accepted for the respective test strip. The Engineer may request a proof roll at any time to document the condition of a lift.   
     
   Significant changes in the characteristics of material being hauled for Rock Embankment or Rock Fill will require construction of a new test strip, and demonstration of adequate compaction methods using a proof roll. The Contractor’s Process Control representative shall be authorized to require additional test strips at their discretion. However, the requirement for an additional test strip shall not be waived without the written approval of the Engineer.   
     
   If the Contractor wishes to deviate from the minimum equipment and compactive efforts specified above for Rock Embankment or Rock Fill, the Contractor must first demonstrate the adequacy of their proposed methods with a test strip and passing proof roll. In addition, a proof roll will be required for every lift placed for the first 2,000 cubic yards of Rock Embankment or Rock Fill placed. The proof rolls used to demonstrate adequate compaction of the first 2,000 cubic yards placed will not be measured and paid separately, but will be performed at the Contractor’s expense.

Recycled Concrete and Asphalt: Recycled concrete and asphalt can be incorporated into embankment material, and shall be processed, placed, and compacted in accordance with 203.07 a or b; depending on the overall classification of the embankment material once the recycled material is incorporated. Rebar shall not extend more than one inch beyond the edges of recycled concrete particles. Recycled concrete or asphalt shall not be permitted in the upper 2 feet of the final subgrade elevation or within 2 feet of the final finished side slopes unless otherwise noted in the Contract.

**203.08 Proof Rolling.**

Proof rolling with pneumatic tire equipment shall be performed using a minimum axle load of 18 kips per axle. A weigh ticket from an approved scale shall be furnished by the Contractor to substantiate this weight.

The subgrade shall be proof rolled after the required compaction has been obtained and the subgrade has been shaped to the required cross section.

The proof roller shall be operated in a systematic manner so that a record may be readily kept of the area tested and the working time required for the testing. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Engineer, shall be ripped, scarified, dried or wetted as necessary and recompacted to the requirements for density and moisture at the Contractor’s expense. After recompaction, these areas shall be proof rolled again and all failures again corrected at the Contractor’s expense.

Upon approval of the proof rolling, the sub base, base course, or initial pavement course shall be placed within 48 hours. If the Contractor fails to place the sub base, base course, or initial pavement course within 48 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction shall be performed again at the Contractor’s expense.

**203.09 Blading.**

Blading shall consist of furnishing motor graders of the specified horsepower rating, with operators, for shaping roadway, shoulders, or other areas as designated by the Engineer.

When scarifying is specified the motor grader shall be equipped with an independently operated “V” type scarifier and attachments.

**203.10 Dozing.**

Dozing shall consist of furnishing crawler-type tractors of the specified horsepower rating, complete with operators and bulldozer blades. Rippers, if specified, will not be measured and paid for separately, but shall be included in the work.

**METHOD OF MEASUREMENT**

**203.11**

Items paid for by volume will not be remeasured but will be the quantities designated in the Contract. Exceptions will be made when field changes are ordered or when it is determined that there are discrepancies in the Contract in an amount of at least plus or minus two percent of the plan quantity.

(a) *Excavation.* When payment is specified on a volume basis, all accepted excavation and borrow will be measured in its original position by cross-sectioning the area excavated. These measurements will include authorized excavation of rock, shale, or other unsuitable material. All accepted stripping will be measured in stockpiled locations by cross-sectioning.  
  
When the excavation conforms to the staked lines and grades, the original cross-sections and the staked sections shall be used for the determination of volumes excavated. Volumes will be computed from the cross-sections by the average end area or other acceptable method.  
  
When topsoil or wetland topsoil is included as an additional pay item and is specified, the measured volume of excavation will be reduced by the volume of topsoil or wetland topsoil removed from the area shown as excavation in the Contract.  
  
Measurements will include over-breakage in rock excavation from the back slopes to an amount not to exceed, in any half station of 50 feet, 10 percent of the actual quantity required for that half station.  
  
Costs associated with ripping tests or seismic tests to evaluate if a material meets the criteria for “Rock Excavation” shall not be measured or payed separately, but shall be incurred by the Contractor and included in the cost for excavation.

(b) *Embankment.* If provided in the Contract, embankment material will be measured in its final compacted position in the roadway. Measurement will be made upward from the original ground line without any allowance for subsidence due to compaction of the base under the embankment. The original cross-sections will be used for determination of volumes of embankment material placed, unless changes have been directed.  
  
The measured volume of embankment material will be increased by the volume of topsoil or wetland topsoil removed from the area below the original ground line and under the embankment

(c) *Rock Fill.* Rock fill will be measured as the volume in cubic yards in its final position, unless otherwise specified, and shall be limited to the elevations specified.

(d) *Blading and Dozing.* The quantity measured under blading and dozing will be the number of hours that each motor grader or bulldozer is actually used as ordered. A minimum of four hours for any half shift or part thereof will be paid for unless the equipment is inoperative due to breakdown or other causes determined to be the Contractor’s responsibility. Time involved in moving onto or off the project will not be measured and paid for.  
  
Time will be paid for moving motor graders or bulldozers from one location on the project to another, if directed; but time will not be allowed for moves which are made for the convenience of the Contractor.  
  
Payment for a minimum of four hours will not be allowed in cases where the motor grader, bulldozer, or operator is assigned to work on other pay items connected with the project.

(e) *Potholing.* Potholing will be measured by the total number of hours that excavation and backfilling equipment is actually used as directed. All other related work, including removal of existing pavement, backfilling, shoring, and labor will not be measured and paid for separately, but shall be included in the work.

(f) *Proof Rolling.* Proof rolling will be measured by the actual number of hours that the pneumatic equipment is used as a proof roller.  
  
The time to be measured under this item will be the number of hours that each piece of equipment is actually used as ordered.  
  
Proof rolling will be measured and paid for only once for each test strip required during construction; for final verification of subgrade prior to placement of subbase, base coarse, or pavement; or for each incident where the Engineer directs it through the course of construction. Additional proof rolling that is required due to failure of embankment fill; due to the Contractor’s failure to place sub base, base course, or initial pavement course within 48 hours of the initial proof roll; or due to the condition of the subgrade changing due to weather; or additional proof rolls deemed necessary due to the Contractor’s choice to deviate from minimum equipment and compaction efforts specified herein, shall be at the Contractor’s expense.

**BASIS OF PAYMENT**

**203.14**

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

|  |  |
| --- | --- |
| **Pay Item** | **Pay Unit** |
| Rock Excavation | Cubic Yard |
| Rock Fill | Cubic Yard |
| Unclassified Excavation | Cubic Yard |
| Unclassified Excavation (Complete in Place) | Cubic Yard |
| Unsuitable Materials | Cubic Yard |
| Borrow | Cubic Yard |
| Borrow (Complete in Place) | Cubic Yard |
| Embankment Material (Complete in Place) | Cubic Yard |
| Stripping | Cubic Yard |
| Blading | Hour |
| Dozing | Hour |
| Potholing | Hour |
| Proof Rolling | Hour |

Water will not be measured and paid for separately but shall be included in the work.

Compaction will not be measured and paid for separately, but shall be included in the work.

Excavated materials which, when specified, require more than one handling prior to final placement will be paid for at the contract unit price for unclassified excavation, rock excavation, stripping, excavation of unsuitable material, or borrow as appropriate, for the first approved handling. Payment for the second approved handling will be made at the same unit price as the first handling, except that material used in conjunction with another pay item will be paid for in that pay item.

Payment for Unclassified Excavation (Complete in Place), Embankment Material (Complete in Place), and Borrow (Complete in Place) shall be full compensation for all work necessary to complete the item including construction of embankments, rework of existing materials to satisfy benching requirements, unclassified excavation, borrow, compaction, compaction of bases of cuts and fills, all work in available materials pits, and disposal of excess excavated material.

All costs associated with reducing the size of the claystone particles, removing the oversized particles, and disposal of the oversized particles will not be paid for separately but shall be included in the work.

Pavement replacement if required due to potholing, shall be accomplished, measured, and paid for in accordance with appropriate sections of the Contract.

Pneumatic tire equipment and load required to achieve the desired weight of proof rolling equipment will not be measured and paid for separately, but shall be included in the work.