

## SECTION 2110

### EXCAVATION AND EMBANKMENT

#### 1.00 GENERAL

1.01 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all clearing and grubbing, excavation, backfilling, compacting, testing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.

All work within the rights-of-way of the Federal Government, the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof.

#### 1.02 Related Work Specified Elsewhere.

Section 2120 - Excavation and Backfill For Structures  
Section 2140 - Embedment and Base Course Aggregate

#### 1.03 Reference Standards.

- A. State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction," latest edition.

#### 1.04 Field Conditions.

- A. **Existing Utilities.** Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction limits.

Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation.

- B. **Existing Improvements.** The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged as a result of this work shall be restored to original condition or better, as

determined by the Engineer.

Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

- C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater, that will be encountered within the limits of construction.

#### 1.05 Protection of Work.

- A. Safety. All excavations shall be protected by barricades, lights, signs, etc. as required by governing federal, state and local safety codes and regulations.
- B. Sheeting, shoring and bracing. Except where banks are cut back on a stable slope, provide and maintain sheeting, shoring and bracing systems necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury, all in accordance with applicable codes and governing authorities.

Remove sheeting and shoring systems as excavations are backfilled in a manner to protect the construction or other structures, utilities or property. Do not remove any sheeting after backfilling.

Sheeting and shoring systems shall be structurally designed and sufficiently braced to provide necessary restraining of retained backfill. Prior to installation of such systems, methods of installation and materials proposed shall be discussed with and approved by Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for non-compliance.

- C. Site Drainage. Excavation to be protected from surface water drainage at all times.

1.06 Blasting. No blasting shall be permitted without written consent of the Town. Blasting shall be done only after the Town receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris.

Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by the Town prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Town. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction. It is advised to make preblasting evaluations of adjacent properties when possible.

1.07 Construction in Streets. When construction operations are located within streets, make provisions at cross streets and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval.

## 2.00 MATERIALS

All materials for construction fills and backfills shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free from perishable matter, debris, frozen material and stones and/or cemented pieces larger than

permitted by the specified gradation. Classification of materials shall be as follows:

2.01 Excavation. 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 and not being removed under some other item.

2.02 Materials for Embankment. Embankment material shall consist of approved material acquired from excavations, hauled and placed in embankments in reasonably close conformity with the line, grades, thicknesses and typical cross sections shown on the plans or as designated.

When source of embankment material is not designated on the plans, approval of the source will be contingent on the material having a resistance value of at least that shown on the plans, when tested by the Hveem Stabilometer, and a maximum dry density of not less than 90 pounds per cubic foot.

2.03 Topsoil. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of sub-soil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth; topsoil to be free of any stone or rock greater than 3" in size.

### 3.00 METHODS AND PROCEDURES

#### 3.01 Clearing and Grubbing.

##### A. Preservation of Existing Conditions.

The Engineer will establish right-of-way lines and construction lines and designate all trees, shrubs, plants and other things to remain. The Contractor shall preserve all things designated to remain.

##### B. Clearing and Grubbing.

Clear and/or grub all surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, including mowing, as required, except undisturbed stumps and roots and non-perishable solid objects which will be a minimum of two feet below subgrade or slope embankment. Outside cut or fill limits, but within construction limits, stumps may be left at finish grade if allowed by Engineer.

Except in areas to be excavated, backfill stump holes and other holes from which obstructions are removed, with embankment material and compacted in accordance with Section 3.05.

##### C. Disposal.

If perishable material is burned, burn under the constant care of competent watchmen at such times and in such a manner that the surrounding vegetation, the other adjacent property or anything designated to remain on the right-of-way, will not be jeopardized. Burning shall be done in accordance with applicable laws and ordinances.

When permitted, materials and debris which cannot be burned and perishable

materials may be removed from the right-of-way and disposed of at locations off the project outside the limits of view from the project with the written permission of the property owner on whose property the materials and debris are placed. The Contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations and the cost involved shall be included in the unit price bid.

All merchantable timber in the clearing area which has not been removed from the right-of-way prior to the beginning of construction, shall become the property of the Contractor, unless otherwise specified.

D. Scalping.

Scalp areas where excavation or embankment is to be made. Scalping shall include the removal of material such as brush, roots, sod, grass, residue or agricultural crops, sawdust, and other vegetable matter from the surface of the ground.

E. Hedges.

Hedges shall be pulled or grubbed in such a manner as to assure complete and permanent removal. Scattered hedge or shrubs not classified as hedge shall be removed as specified for hedge.

F. Topsoil.

Strip topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.

3.02 Construction Requirements. The excavation and embankments required shall be finished to smooth and uniform surfaces. Materials shall not be wasted without permission of the Engineer. The Engineer reserves the right to change grade lines, cut slopes or fill lines during the progress of the work.

3.03 Excavation. Material outside of the limits of excavation will not be disturbed. Prior to beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these Specifications. The Contractor shall not excavate beyond the dimensions and elevations established. Common excavation shall include all materials of whatever nature encountered in the work for construction of excavations to the lines and grades called for on the Drawings. Structure excavation shall include all earthwork required for the construction of structures to the lines and grades called for on the Drawings. If any areas are inadvertently over-excavated, fill such over-excavation with embankment material and compact in accordance with Section 3.05.

A. Tolerances. In those areas upon which a subbase material is required, upon which finished landscaping improvements, including sodding or lawn seeding, or upon which a structure is to be constructed directly, deviation of not more than 1 inch shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 1 inch at any point.

In those areas upon which a base course material is required, deviation of not more than 0.04 foot shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 0.04 foot at any point.

In those areas where no additional construction, other than topsoil addition and native seeding will occur, the finished surface shall be smooth and shall not deviate from grade by more than 0.5 foot at any point.

- B. Groundwater Control. Contractor to maintain facilities on site to remove all groundwater from excavated area and keep water below the bottom of the excavation to a point such that a firm base for equipment or concrete installation exists. Facilities shall be maintained until all backfilling is in place at least 24 inches above anticipated water levels before water removal. All water removal shall be subject to approval by the Engineer.
- C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.

Backfill material to be segregated from stock piled topsoil and unusable backfill materials.

- D. Over-excavation. Whenever the site is over-excavated more than 0.1' to eliminate point bearing by rocks or stones beneath proposed structures or when grade tolerances are exceeded, the Contractor is to re-establish grade using material recommended by the project engineer and accepted by the Town. Compaction shall be to 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.
- E. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, than a contract price for Unstable Soil Excavation shall be negotiated between Owner & Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

- F. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards or solid or fractured rock, which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor had in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for Rock Excavation shall be negotiated between the Contractor and the Owner. No payment shall be

made for excavation performed prior to determination of a negotiated price.

Rock shall be removed to a 4" depth below grade. In addition, all rock loosened during jacking, blasting, etc. shall be removed from the site. For payment purposes, maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, D.

Inclusion of a bid item for Rock Excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavation; no payment shall be made for excavation prior to notification.

- G. Disposal of Excess Excavation. Contractor to dispose of excess excavation off-site. The Owner shall have the right to elect to have the excess excavation disposed of at a designated site within the Work limits. Excavation may be wasted on site only if approved by the Engineer and shall be done at the direction of the Engineer. Disposal in any case shall be the sole responsibility of the Contractor.

3.04 Pavement Materials. Prior to placing pavement materials, fabric or any embankment, the entire subgrade shall be scarified to a depth of 8 eight inches (8") adjusted to a moisture content near optimum and compacted to at least 95% of the maximum standard Proctor Density. The final subgrade shall be proof-rolled with a heavy loaded pneumatic-tire vehicle. Areas which deform excessively under wheel loading are not stable and should be improved prior to placing pavement materials.

In unstable and wet subgrade areas, a stiff synthetic geogrid equal to Tensar SS-1 fabric may be used to improve the subgrade. Use of a geogrid material shall be designed and submitted to the Town by a licensed soils engineer. The final subgrade should then be proof-rolled similar to the remaining on-deflecting natural subgrade areas.

3.05 Embankment and Backfilling. Do not begin embankments until construction below grade has been approved, underground utility systems have been inspected, tested and approved and trash and debris have been cleaned from the excavation.

Place approved excavated material in successive uniform maximum loose layers not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of self propelled rollers or vibrators. Do not place fill on muddy or frozen subgrade, or until subgrade is approved by the Engineer.

Plow, step, or bench sloped surfaces steeper than 4 to 1 on which fill or backfill is to be placed in such a manner that fill material will adequately bond with existing surfaces. Scarify all surfaces to receive backfill to a depth of 6" before filling.

Construct fills and embankments to the lines and grades indicated on the Drawings within tolerances stated in Section 3.03, A above.

Use suitable materials removed from the excavation prior to obtaining material from borrow areas.

Where otherwise suitable material is too wet, aerate, dry or blend to provide the moisture content specified for compaction.

3.06 Compaction. During placing and/or compacting operations of earth or earth-and-rock

mixtures, the moisture content of materials in the layers being compacted shall be near optimum and uniform throughout the layer. In general, maintain the moisture content of the material being placed and compacted within 2% of optimum condition as determined as ASTM Standard D698.

- A. **Compaction Equipment.** Perform all compaction with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers or sheepsfoot rollers where heavy equipment is authorized. Do not operate heavy equipment closer to structures than a horizontal distance equal to height of backfill above bottom of structure foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99:

1. Structure fill under or within 5' horizontally of all concrete structures: 95%.
  2. Backfill beneath or within 5' horizontally or within the area defined by a line extended at an angle of 1:1 of existing or proposed pavements, roadways, sidewalks, curbs, utility lines or other improvements: 95%
  3. Backfill within lagoon berm: 95%
  4. Backfill within public or designated rights-of-way: 90% or as shown on the Drawings.
  5. Backfill within undeveloped, green or undesignated area: 85%.
- B. **Jetting.** Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. Techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be at the direction of the Engineer. No jetting will be allowed on materials with a 200-minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and compaction testing and any retesting or additional compaction required. No jetting shall be done prior to written approval and direction of the Engineer.
- C. **Maintenance.** Contractor to maintain all embankment in satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

3.07 **Proof Rolling.** Proof rolling with a heavy rubber-tired roller will be required as designated on the plans or when ordered. Proof rolling shall be done after specified compaction has been obtained. Areas found to be weak and those areas which failed shall be ripped, scarified, wetted if necessary and recompacted to the requirements for density and moisture at the Contractor's expense. Equipment to be used for proof rolling may also be fully loaded, tandem axle dump truck or water truck or rubber-tired roller with equivalent loading characteristics.

3.08 **Surface Restoration.** All existing surface improvements and site conditions disturbed or

damaged during construction to be restored to a condition equal to preconstruction condition. All restoration costs are considered incidental to excavation and backfill.

- A. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners.
- B. Final Grading. The Contractor is to re-establish existing final grade or finish to final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.
- C. Roadways. All roadways to be restored to original condition with material types removed. Materials and methods to conform to Section 2140 - Embedment and Base Course Aggregate and Section 2500 - Hot Bituminous Pavement. Additional requirements are:
  - 1. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways to be 8".
  - 2. Minimum asphalt pavement surfacing to be 3".
  - 3. Minimum concrete pavement surfacing to be 6".

The above are minimums. Replacement shall be equal to these minimums or to the depth of the existing materials, whichever is greater.

All repairs to streets shall be same day or as approved by the Town in writing.

- D. Green Areas. Place excavated topsoil from the roadway or from pits directly upon constructed cut and fill slopes without the use of stockpiles whenever conditions and the progress of construction will permit.

Do not place topsoil until the areas to be covered have been properly prepared and grading operations in the area have been completed.

Place and spread topsoil at locations and to the thickness shown on the plans. Key to the underlying material by the use of harrows, rollers or other equipment suitable for the purpose.

Apply water to the topsoil at the locations and in the amounts designated. Apply in a fine spray by nozzles or spray bars in such manner that it will not wash or erode the topsoil areas.

All loose exposed rock larger than six inches shall be removed from slopes that are to receive topsoil.

See Section 2730," Revegetation - Seeding, Sodding, Hydroseeding".

#### 4.00 QUALITY CONTROL - FIELD

- 4.01 Inspection and Testing. Inspection and testing to be performed at the direction of the

Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance with these Specifications.

4.02 Density Testing and Control.

- A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.
- B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.
- C. Frequency of Testing. Frequency of testing to be done at the direction of the Engineer.
- D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

End of Section