

SECTION 02201

EXCAVATION AND BACKFILL FOR STRUCTURES

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, 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 permits and pay all costs thereof to complete the Work.

1.02 Related Work Specified Elsewhere.

Section 02222 - Embedment and Base Course Aggregate
Section 03300 - Cast-In-Place Concrete

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 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 pre-construction 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, which 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 and to assure complete removal of system components unless otherwise provided for in the construction drawings.

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 the Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for the installation and performance of their systems and for non-compliance with appropriate safety regulations.

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

- 1.06 Blasting. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer 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 Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

- 1.07 Construction in Streets. When construction operations are located within streets or pedestrian ways, make provisions for free passage of vehicles and pedestrians. Do not block

streets or walks without prior approval. Pedestrian routing plans shall be shown on Traffic Control Plans.

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 Materials for Structure Backfill. Structure backfill shall be composed of materials designated as Class 2 or Class 6.

1. Class 2 Structure Backfill (CDOH Section 703.08 - Class 2). Class 2 structure backfill shall be composed of suitable materials developed from excavation, borrow areas or other sources. If the material contains rock fragments which, in the opinion of the Engineer, will be injurious to the structure, the material will not be used for backfilling. In addition, no rock larger than 4" shall be placed within the structure backfill zones shown in CDOH M-Standards M-206-1 and M-206-2.
2. Class 6 Backfill (CDOH Section 703.03 - Class 6). Class 6 backfill shall consist of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the following requirements when tested with laboratory sieves.

<u>Sieve Designation</u>	<u>% by Weight Passing</u>
3/4 inch	100
No. 4	30-65
No. 8	25-55
No. 200	5-12

In addition, this material shall have a liquid limit not exceeding 30 and a plasticity index of not over 6 when determined in conformity with AASHTO T89 and T 90.

3. 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.
4. Flow-fill. Flow-fill meeting the following requirements shall be used to backfill pipes. The Contractor may substitute flow-fill for structure backfill Class 2 or structure backfill Class 6 to backfill culverts, sewer pipes and shallow utilities when approved by the utility provider.
 - a. Ingredients
 - 1) Cement 50 Lbs./Cu.Yd.
 - 2) Coarse Aggregate 1700 Lbs./Cu.Yd. (AASHTO No. 57 or 67)
 - 3) Fine Aggregate 1845 Lbs./Cu.Yd. (AASHTO M 6)
 - 4) Water 325 Lbs./Cu.Yd. (or as needed)

- b. The amount of water shall be such that the structure backfill (flow-fill) flows into place properly without excessive segregation. Approximately 39 gallons of water per cubic yard of structure backfill (flow-fill) is normally needed.
- c. The Contractor may use aggregate which does not meet the above specifications if the cement is increased to 100 pounds per cubic yard and the aggregate conforms to the following gradation:
 - 1) 100% Passing the 25.0 mm (1 inch) Sieve
 - 2) 0-10% Passing the 75 um (No. 200) Sieve
- d. The Contractor may substitute 30 pounds per cubic yard of cement and 30 pounds per cubic yard of fly ash for 50 pounds per cubic yard of cement or may substitute 60 pounds per cubic yard of cement and 60 pounds per cubic yard of fly ash for 100 pounds per cubic yard of cement.

2.02 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.

3.00 METHODS AND PROCEDURES

3.01 Site Preparation.

- A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from work site. Dispose of off-site.
- B. Topsoil Removal. Strip existing topsoil from all areas to be distributed by construction. Topsoil is to be stockpiled separately from excavated materials.
- C. Pavement Removal. See Section 02101 - Removal of Structures and Obstructions.
- D. Preservation of Trees. The Owner shall field mark all trees, shrubs, plants and other things to remain. Do not remove trees outside of excavated or filled areas, unless their removal is authorized by the Engineer. Protect trees left standing from permanent damage by construction operations.

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 Structure 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.

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 Class 1 or Class 3 backfill.

- A. Tolerances. In those areas upon which a subbase or base course material is required, 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 where no additional construction, other than topsoil addition, 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 is 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.

Removal of water by bucketing, sump or trench diversions, intermittent pumping, or sump or submersible pumps is considered incidental to excavation work. Inclusion of a bid item for dewatering indicates dewatering by continuous pumping, well-point type systems is expected. If such dewatering system is required, in the opinion of the Engineer, this work to be paid for as indicated in the bid schedule, or if not included in the bid schedule to be considered extra work paid for at a price negotiated between Contractor and Owner prior to the start of dewatering.

- C. Stockpile Excavated Material. Excavated material is 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 Class 1 backfill. 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 is 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 project 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 Backfilling. Do not begin backfilling 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.

Construct fills 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.

3.05 Compaction. During placing and/or compacting operations with 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 by Engineer. 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 as shown on the Drawings or as follows:

1. Structure fill under or within 5' horizontally of all concrete structures: 95%.
 2. Backfill beneath or within 5' horizontally of existing or proposed pavements, roadways, sidewalks, curbs, utility lines or other improvements: 95%
 3. Backfill within public or designated rights-of-way: 95% or as shown on the Drawings.
 4. Backfill within undeveloped, green or undesignated area: 90%.
- B. **Jetting.** Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. If jetting is allowed; techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be submitted to the Engineer for approval. The contractor remains solely responsible for the results gained when using this method. Any areas of compaction that do not meet the requirements of the Contract will be removed and recompacted at the Contractor's expense. 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 recompaction required. No jetting shall be done prior to written approval and direction of the Engineer.
 - C. **Maintenance.** Contractor is to maintain all backfill 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.

3.06 Surface Restoration. All existing surface improvements and site conditions disturbed or damaged during construction are to be restored to a condition equal to pre-construction 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. Materials and methods to conform to Section 02222 - Embedment and Base Course Aggregate; Section 02612 - Hot Bituminous Pavement; and Section 02614 - Portland Cement Concrete Paving. All roadways to be restored to pre-construction condition with material types removed. Replacement materials shall match adjacent pavement structures in type and thickness with the following minimum requirements.
 - 1. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways to be 8" or as specified on the PLANS.
 - 2. Minimum asphalt pavement surfacing to be 4" or as specified on the PLANS.
 - 3. Minimum concrete pavement surfacing to be 6" or as specified on the PLANS.

- D. Green Areas. Restore all green areas as specified in Section 02700- Trees, Plants and Ground Cover.

4.00 QUALITY CONTROL - FIELD

4.01 Inspection and Testing. Inspection and testing are 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 is to be done in accordance with ASTM D2922 using nuclear density methods.
- C. Frequency of Testing. Frequency of testing is 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 is to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

4.03 Payment for Testing. Owner is responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

5.00 MEASUREMENT AND PAYMENT

Where items are specifically included on the bid schedule, they will be paid for by the unit given. All other items in this section that are essential to the project but for which there are no specific pay items, will not be measured and paid for separately but shall be included in the project.

END OF SECTION