



SECTION 31 23 00
EXCAVATION AND FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This WORK shall consist of excavation, embankment fill, disposal of excess material, shaping, and compaction of all material encountered within the limits of WORK, including excavation and fill for structures. The excavation shall include, but is not limited to, the native soils which shall be excavated for the PROJECT WORK. All WORK shall be completed in accordance with these SPECIFICATIONS, the lines and grades, and typical cross-sections shown on the DRAWINGS.
- B. All excavation shall be classified, “unclassified excavation,” or “muck excavation” or “rock excavation,” as hereafter described. All embankment shall be classified “embankment material” as hereafter described.

1.02 RELATED SECTIONS

- A. The following is a list of SPECIFICATIONS which may be related to this section:
 - 1. Section 01 57 19, Temporary Environmental Controls
 - 2. Section 31 11 00, Clearing and Grubbing.
 - 3. Section 31 23 19, Dewatering.
 - 4. Section 31 25 00, Erosion and Sedimentation Control

1.03 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
 - b. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

1.04 DEFINITIONS

- A. Embankment Material shall consist of approved material acquired from excavation or from outside sources, hauled and placed in embankments.
- B. Muck Excavation shall consist of the removal of mixtures of soils and organic matter not suitable for foundation material and replacement with approved material.
- C. Rock Excavation shall consist of igneous, metamorphic and sedimentary rock which cannot be excavated without the use of rippers, and all boulders or other detached



stones each having a volume of one-half (1/2) cubic yard or more, as determined by physical or visual measurement. It shall also include replacement with approved material as required.

- D. Unclassified Excavation shall consist of the excavation of all materials of whatever character required of the WORK, obtained within the PROJECT limits.

1.05 QUALITY ASSURANCE

- A. Final topography and/or cross-sections shall be surveyed of areas that are to finished grade and compared to the design section for accuracy.
- B. Final grade shall match design grades within the tolerances discussed in PART 3 EXECUTION.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Embankment Material may consist of approved material acquired from excavations or material hauled from outside the PROJECT limits.
- B. Suitable material identified onsite shall be used first for embankments and backfill.
- C. Excess excavated native soils which are not used as embankment or backfill shall become the property of CONTRACTOR and shall be disposed of offsite by CONTRACTOR, in a location acceptable to ENGINEER.
- D. Muck Excavation shall also include the replacement of excavated muck with uniformly graded rock, riprap, onsite or imported soils, or other material, whichever is most suitable for the specific situation encountered.
- E. ENGINEER will determine which type of aggregate or other material which shall be used after observing the specific site conditions.
- F. Structural Backfill:
 - 1. When specified on the DRAWINGS or as required by ENGINEER, Class I structural backfill shall meet the following gradation requirements:

Sieve Size	% By Weight Passing Square Mesh Sieves
2-inch	100
No. 4	30 - 100
No. 50	10 - 60
No. 200	5 - 20

- 2. In addition, this material shall have a liquid limit not exceeding thirty five (35) and a plasticity index of not over six (6).



3. Impervious structural backfill, where shown or specified, shall consist of material having one hundred percent (100%) finer than two (2) inches in diameter and a minimum of thirty-five percent (35%) passing a No. 200 U.S. Standard Sieve.

PART 3 EXECUTION

3.01 GENERAL EXCAVATION/EMBANKMENT

A. General:

1. The excavation and embankment shall be finished to reasonably smooth and uniform surfaces.
2. Variation from the subgrade plane shall not be more than eight-tenths (0.08) foot in soil or more than eight-tenths (0.08) foot above or one-half (0.50) foot below in rock.
3. Where bituminous or concrete surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than four-tenths (0.04) foot.
4. Materials shall not be wasted without permission of ENGINEER.
5. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed.
6. Prior to beginning grading operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 31 11 00, Clearing and Grubbing, of these SPECIFICATIONS.
7. CONTRACTOR shall notify ENGINEER in sufficient time before beginning excavation or embankment such that the necessary topography and/or cross-sections may be taken. CONTRACTOR shall not excavate beyond the dimensions and elevations established, and material shall not be removed prior to surveying the site.
8. When CONTRACTOR's excavating operations encounter remains of prehistoric people's dwelling sites or artifacts of historical or archaeological significance, the operations shall be temporarily discontinued.
 - a. ENGINEER will contact archaeological authorities to determine the disposition thereof.
 - b. When directed, CONTRACTOR shall excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for delivery to the custody of the proper state authorities.
 - c. Such excavation will be considered and paid for as extra WORK.



B. Excavation:

1. Unclassified:

- a. All excess suitable material excavated from the PROJECT site and not used for embankment shall be removed from the PROJECT site and become the property of CONTRACTOR.
- b. Where material encountered within the limits of the WORK is considered unsuitable for embankment (fills) on any portion of this PROJECT WORK, such material shall be excavated as directed by ENGINEER and replaced with suitable fill material.
- c. All unsuitable excavated material from excavation consisting of any type of debris (surface or buried), excavated rock, bedrock or rocks larger than six (6) inches in diameter, and boulders shall be hauled from the PROJECT site and disposed of by CONTRACTOR at CONTRACTOR's expense.
- d. Debris is defined as "anything that is not earth which exists at the job site."

2. Muck:

- a. Where excavation to the finished grade section results in a subgrade or slopes of unsuitable soil, ENGINEER may require CONTRACTOR to remove the unsuitable materials and backfill to the finished graded section with approved material.
- b. Disposal of the unsuitable material and replacement with suitable material shall be at CONTRACTOR's expense.

3. Good surface drainage shall be provided around all permanent cuts to direct surface runoff away from the cut face.

4. Rock:

- a. Unless otherwise specified, rock shall be excavated to a minimum depth of 0.5 foot below subgrade within the limits of the channel area, and the excavation shall be backfilled with material shown on the DRAWINGS or as designated by ENGINEER.
- b. Disposal of material and replacement with suitable approved material shall be at CONTRACTOR's expense.

C. Embankment Construction:

1. Embankment construction shall consist of constructing all fill areas, including preparation of the areas upon which they are to be placed, the placing and compacting of approved material within areas where unsuitable materials have been removed, and the placing and compacting of Embankment Material in holes, pits and other depressions within the PROJECT area.
2. Only approved materials shall be used in the construction of embankments and backfills.



3. Approved materials shall consist of clean onsite cohesive soils or approved imported soils.
4. Onsite cohesive soils or imported soils shall be placed and compacted in horizontal lifts, using equipment and procedures that produce recommended moisture contents and densities throughout the lift and embankment height. Onsite or imported cohesive soils shall be compacted within a moisture content range of two percent (2%) below, to two percent (2%) above optimum moisture content and compacted to ninety-five percent (95%) of the Maximum Standard Proctor Density (ASTM D698).
5. When embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when embankment is built one-half (1/2) width at a time, the slopes that are steeper than four-to-one (4:1) when measured longitudinally or at right angles to the adjacent ground shall be continuously benched over those areas where it is required as the WORK is brought up in layers.
 - a. Benching shall be well "keyed" and where practical a minimum of eight (8) feet. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts.
 - b. Material thus cut out shall be recompacted along with the new Embankment Material at CONTRACTOR's expense.
6. The ground surface underlying all fills shall be carefully prepared by removing all organic matter, scarification to a depth of eight (8) inches and recompacting to ninety-five percent (95%) of the Maximum Standard Proctor Density (ASTM D698) at optimum moisture content + or - two percent (2%) prior to fill placement.
7. Embankment Material shall be placed in horizontal layers not exceeding 8 inches (loose measurement) and shall be compacted to ninety five percent (95%) of the Maximum Standard Proctor Density (ASTM D698) at optimum moisture content + or - two percent (2%).
 - a. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting.
 - b. As the compaction of each layer progresses, continuous leveling and manipulating required to ensure uniform density.
8. For embankments which serve as berms, the downstream portion shall be keyed into the subsurface soils a minimum of three (3) feet to enhance the stability of the slope.
9. Materials which are removed from excavations beneath the water table may be over the optimum moisture content and shall be required to be dried out prior to reusing them.
10. Cross hauling or other action as appropriate will be ordered when necessary to ensure that the best available material is placed in critical areas of embankments,



including the top two (2) feet of all embankments. No additional payment will be made for cross hauling ordered by ENGINEER.

11. Frozen materials shall not be used in construction of embankments.
12. During the construction of the channels, the channel bottom shall be maintained in such condition that it will be well drained at all times.
13. Excavation or embankment (fill), and structural backfill WORK either completed or in a stage of completion that is either eroded or washed away or becomes unstable as a result of either rains, snow, snow melt, channel flows, or lack of proper water control shall be either removed and replaced, recompact, or reshaped as directed by ENGINEER and in accordance with the DRAWINGS and SPECIFICATIONS at CONTRACTOR's sole expense.
14. Removed unsuitable materials shall be hauled away and disposed of at CONTRACTOR's expense. Placing of replacement materials for removed unsuitable materials shall be purchased, placed, and compacted at CONTRACTOR's expense.

D. Proof Rolling:

1. Proof rolling with a heavy rubber tired roller shall be required, if designated on the DRAWINGS or when ordered by ENGINEER.
2. 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 recompact to the requirements for density and moisture at CONTRACTOR's expense.
3. Proof rolling shall be done with equipment and in a manner acceptable to ENGINEER. Proof rolling as shown on the DRAWINGS or as ordered by ENGINEER shall not be measured and paid for separately, but shall be included in the unit prices bid for the WORK.

3.02 EXCAVATION AND BACKFILL FOR STRUCTURES

- A. Poor foundation material for any of the WORK shall be removed, by CONTRACTOR, as directed by ENGINEER.
 1. CONTRACTOR will be compensated for removal and replacement of such materials in accordance with Muck Excavation.
- B. CONTRACTOR is cautioned that construction equipment may cause the natural soils to pump or deform while performing excavation WORK inside and on footings, structural floor slabs, or other structure foundation areas.
- C. CONTRACTOR shall remove and replace at CONTRACTOR's expense any foundation materials which are:
 1. Saturated by either surface or subsurface flows because of the lack of adequate water control or dewatering work by CONTRACTOR;



2. Frozen for any reason; or
 3. Disturbed by CONTRACTOR's WORK or caused to become unacceptable for foundation material purposes by means of CONTRACTOR's equipment, manpower, or methods of WORK.
- D. Dewatering shall not be conducted by pumping from inside footings, structural floor slabs, or other structure foundation limits. This may decrease the supporting capacity of the soils.
- E. Care shall be taken when excavating the foundations to avoid disturbing the supporting materials. Excavation by either hand or careful backhoe soil removal, may be required in excavating the last few inches of material to obtain the subgrade of any item of the concrete WORK.
- F. Any over-excavated subgrades that are due to CONTRACTOR's actions, shall be brought back to subgrade elevations, as indicated on the DRAWINGS, by CONTRACTOR and at CONTRACTOR's expense in the following manner:
- G. For over-excavations of two (2) inches or less, either backfill and compact with approved granular materials; backfill with one-half (1/2) inch crushed rock; or fill with concrete at the time of the appurtenant structure concrete pour.
- H. For over-excavations greater than two (2) inches, backfill and compact with an approved granular material.
1. All granular footings, structural floor slabs, or other structure areas shall be compacted with a vibratory plate compactor prior to placement of concrete, reinforcing, or bedding materials.
 2. Backfill, and fill within three (3) feet adjacent to all structures and for the full height of walls, shall be selected non-swelling material.
 - a. It shall be granular, well graded, and free from stones larger than two (2) inches.
 - b. Material may be job excavated, but shall selectivity be required as determined by ENGINEER.
 - c. Stockpiled material, other than topsoil from the excavation, shall be used for backfilling unless an impervious structural backfill is specified.
 - d. The backfill material shall consist of either clean onsite granular material free of stones larger than two (2) inches in diameter with no more than twenty percent (20%) passing the No. 200 sieve, or equivalent imported materials.
 - e. All backfill around the structures shall be consolidated by mechanical tamping.
 - f. The material shall be placed in six-inch (6") loose lifts within a range of two percent (2%) above to two percent (2%) below the optimum moisture content and compacted to ninety-five percent (95%) of Maximum Standard



Proctor Density (ASTM D698) for cohesive soils, or to seventy-five percent (75%) relative density for pervious material as determined by the relative density of cohesionless soils test, ASTM D4253.

3. Impervious structural backfill shall be placed in six-inch (6") loose lifts within a range of two percent (2%) above to two percent (2%) below the optimum moisture content and compacted to ninety-five percent (95%) of Maximum Standard Proctor Density for cohesive soils as determined by ASTM D698.

END OF SECTION