

NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION
North Dakota

EARTHFILL
(Code 108)

1. Scope

The work consists of the construction of earth embankments, other earthfills, and earth backfills required by the drawings and specifications. Any materials or construction details contained within the design package supersede those of this construction specification.

Earthfill is composed of natural earth materials that can be placed and compacted by construction equipment operated in a conventional manner.

Earth backfill is composed of natural earth material placed and compacted in confined spaces or adjacent to structures (including pipes) by hand tamping, manually directed power tampers or vibrating plates, or their equivalent.

2. Material

All fill material shall be obtained from required excavations and designated borrow areas. The selection, blending, routing, and disposition of material in the various fills shall be subject to approval by the NRCS. Fill materials shall contain no frozen soil, sod, brush, roots, or other perishable material. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to compaction of the fill. The types of material used in the various fills shall be as listed and described in the Items of Construction Detail and drawings.

3. Foundation preparation

Foundations for earthfill shall be stripped to remove vegetation and other unsuitable material or shall be excavated as specified. Stripping or excavation shall meet the requirements of North Dakota Construction Specification 107, Excavation.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the earthfill, and the surface material of the foundation shall be compacted and bonded with the first layer of earthfill as specified for subsequent layers of earthfill.

Earth abutment surfaces shall be free of loose, un-compacted earth in excess of 2 inches in depth normal to the slope and shall be at such a moisture content that the earthfill can be compacted against them to produce a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose material by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earthfill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

Foundation and abutment surfaces shall be no steeper than one horizontal to one vertical unless otherwise specified.

4. Placement

Earthfill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the NRCS. Earthfill shall not be placed upon a frozen surface nor shall snow, ice, or frozen material be incorporated in the earthfill matrix.

Earthfill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exceed the maximum thickness specified in Items of Construction Detail or shown on the drawings. If not specified, the maximum thickness shall not be more than 6-inches. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted.

Hand compacted earth backfill shall be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of earth backfill compacted by manually directed power tampers, or 3-inches if not specified.

Earth backfill shall be placed in a manner that prevents damage to the structures and allows the structures to assume the loads from the earth backfill gradually and uniformly. The height of the earth backfill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earthfill and earth backfill in dams, levees, and other structures designed to restrain the movement of water shall be placed to meet the following additional requirements:

- a) The distribution of materials throughout each zone shall be essentially uniform, and the earthfill shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material. Zone earthfills shall be constructed concurrently unless otherwise specified.
- b) If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.
- c) The top surface of embankments shall be maintained approximately level during construction. In addition, a crown or cross-slope of approximately 2 percent shall be maintained to ensure effective drainage, or as otherwise specified for drainfill or sectional zones.
- d) Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of streamflow during construction are specified in the Items of Construction Detail or drawings.
- e) Embankments built at different levels as described under (c) or (d) above shall be constructed so that the slope of the bonding surfaces between embankment in place and embankment to be placed is not steeper than 3 feet horizontal to 1 foot vertical. The bonding surface of the embankment in place shall be stripped of all material not meeting the requirements of this specification and shall be scarified, moistened, and re-compacted when the new earthfill is placed against it. This ensures a good bond with the new earthfill and obtains the specified moisture content and density at the contact of the in-place and new earthfills.

5. Control of moisture content

Unless otherwise specified in the Items of Construction Detail, the moisture content of the fill material shall be maintained within the range required to permit maximum compaction. The moisture content in plastic clays and silts should be such that when kneaded in the hand it will form a ball which does not readily separate when struck sharply with a pencil or which refuses to separate when pressed between the hands. When working with sandy materials, the moisture content should be such that the material tends to form a weak ball under pressure but breaks apart easily.

The application of water to the earthfill material shall be accomplished at the borrow areas as practical. Water may be applied by sprinkling the material after placement on the earthfill, if necessary. Uniform moisture distribution shall be obtained by disking. Material that is too wet when deposited on the earthfill shall either be removed or be dried to the specified moisture content prior to compaction.

If the top surface of the preceding layer of compacted earthfill or a foundation or abutment surface in the zone of contact with the earthfill becomes too dry to permit suitable bond, it shall either be removed or scarified and moistened by sprinkling to an acceptable moisture content before placement of the next layer of earthfill.

6. Compaction

Earthfill—Earthfill shall be compacted according to the following requirements for the class of compaction specified. The compaction method to be used is specified in the Items of Construction Detail.

Class A compaction – Each layer of earthfill shall be compacted as necessary to provide the density of the earthfill matrix not less than the minimum density specified in Items of Construction Detail or identified on the drawings. The earthfill matrix is defined as the portion of the earthfill material finer than the maximum particle size used in the compaction test method specified.

Class B compaction – Each layer of earthfill shall be compacted to a mass density not less than the minimum density specified.

Class C compaction – Each layer of earthfill shall be compacted by the specified number of passes of the type and weight of roller or other equipment as specified in the Items of Construction Detail or by one of the following methods:

- Controlled movement of the hauling and spreading equipment over the area so that the entire surface area of each lift will be traversed by not less than 1 tread track of the loaded earth-moving equipment traveling in a direction parallel to the axis of the fill.
- Each lift shall be compacted by not less than two complete passes of a padfoot/tamping foot style roller exerting a minimum pressure of 100 pounds per square inch.

Earth backfill—Earth backfill adjacent to structures shall be compacted to a density equivalent to that of the surrounding in-place earth material or adjacent required earthfill or earth backfill. Compaction shall be accomplished by hand tamping or manually directed power tampers, plate vibrators, walk-behind, miniature, or self-propelled rollers. Unless otherwise specified, heavy equipment including backhoe mounted power tampers or vibrating compactors and manually directed vibrating rollers shall not be operated within 2 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist is not permitted.

The passage of heavy equipment will not be allowed:

- Over cast-in-place conduits within 14-days after placement of the concrete
- Over cradled or bedded precast conduits within 7 days after placement of the concrete cradle or bedding
- Over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 2 feet, whichever is greater.

Compacting of earth backfill adjacent to concrete structures shall not be started until the concrete has attained the strength specified. The strength is determined by compression testing of test cylinders cast by the NRCS for this purpose and cured at the work site in the manner specified in ASTM C 31 for determining when a structure may be put into service.

When the required strength of the concrete is not specified as described above, compaction of earth backfill adjacent to structures shall not be started until the time intervals in Table 1 have elapsed after placement of the concrete.

Table 1

Structure	Time interval (days)
Vertical or near-vertical walls with earth loading on one side only	14
Walls backfilled on both sides simultaneously	7
Conduits and spillway risers, cast-in-place (with inside forms in place)	7
Conduits and spillway risers, cast-in-place (inside forms removed)	14
Conduits, pre-cast, cradled	2
Conduits, pre-cast, bedded	1
Cantilever outlet bents (backfilled both sides simultaneously)	3

7. Reworking or removal and replacement of defective earthfill

Earthfill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable earthfill. The replacement earthfill and the foundation, abutment, and earthfill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control, and compaction.

8. Testing

During the course of the work, the NRCS may perform tests as required to identify materials, determine compaction characteristics, determine moisture content, or determine density of earthfill in place. Tests performed by the NRCS are used to verify that the earthfills conform to requirements of the specifications. Such tests are not intended to provide the operator/contractor with the information required by them for the proper execution of the work and their performance shall not relieve the operator/contractor of the necessity to perform tests for that purpose.

Protocol for testing shall follow the following ASTMs unless otherwise specified in the Items of Construction Detail.

In-Place Densities of Earth Fill

ASTM D1556: Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

ASTM D2167: Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D2937: Standard Test Method for Density and Unit Weight of Soil in Place by the Drive-Cylinder Method

ASTM D6938: Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)

Moisture Content at the Time of Compaction

ASTM D2216: Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D4643: Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating

ASTM D6938: Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)

9. Items of Construction Detail

Items of work to be performed in accordance with this specification and construction details are:

a.