

## CHAPTER 8 - EARTHWORK

### 8.1 GENERAL

This section defines the requirements for excavation and backfill for manholes, boxes and other structures, and construction requirements of earth embankments and earth fills, as required by the Standard Drawings and other sections of these specifications.

### 8.2 EXCAVATION FOR MANHOLES, BOXES, AND OTHER STRUCTURES

Manholes, boxes and other structures shall be placed on a stable coarse gravel foundation.

Wherever the subgrade material does not afford a sufficiently solid foundation to support structures and superimposed loads, and where groundwater must be drained, the subgrade shall be excavated to such depth as may be necessary and replaced with crushed rock or gravel compacted into place. Coarse gravel or crushed stone shall be used for subsoil reinforcement if satisfactory results can be obtained thereby.

### 8.3 GRANULAR FOUNDATION BORROW

Granular foundation borrow shall be compacted to not less than 95% of maximum dry density as determined by ASTM D1557.

### 8.4 BACKFILL AROUND STRUCTURES

No backfilling around or behind structures shall be initiated until the concrete is fully cured for **seven days**. Backfill around structures shall be placed to the lines shown on the drawings, or as directed. After completion of foundation footings and walls and other construction below the elevation of the final grades, and prior to backfilling, all forms shall be removed and the excavation shall be cleaned of all trash and debris. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction is not greater than twelve inches (12”). Material for backfilling shall consist of three-inch to four-inch (3”- 4”) well-graded engineered fill meeting A-1-a, (AASHTO M 145 or ASTM D3282). Recycled concrete will not be allowed for backfill around structures.

Sieve	Percent Passing by Weight
4”	100
2”	80 -95
1”	55- 85
3/8”	40 – 70
No. 4	25 – 55
No. 10	20 – 50
No. 40	10 – 30
No. 200	2 - 15

Fill shall be placed in a manner that will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure. Each layer shall be compacted by hand or machine tampers or by other suitable equipment to a density equal to 95% of maximum dry density as measured by ASTM D1557.

### 8.5 CONSTRUCTION OF EMBANKMENTS AND FILLS

#### 8.5.1 Foundation Preparation:

Foundations for earth fill shall have all unsuitable materials (such as weeds, sod, roots larger than 1/4-inch in diameter, vegetation, or other organic material) removed by clearing, stripping, and/or grubbing. 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 six inches. The moisture content of the loosened material shall be controlled as specified for the earth fill, and the surface materials of the foundation shall be compacted and bonded with the first layer of earth fill as specified for subsequent layers of earth fill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of two inches (2") in depth normal to the slope and shall be at such a moisture content that the earth fill can be compacted against them to affect 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 earth fill, 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.

### **8.5.2 Placement:**

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the City Engineer / Public Works Representative and any Regulatory Agency having authority over the project. Fill shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exceed twelve inches (12"). Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted. Hand compacted fill, including fill compacted by manually-directed power tampers, shall be placed in layers whose thickness before compaction is not greater than eight inches (8"). All rock whose greatest dimension is larger than three-inch (3") shall be removed from the material receiving compaction by manually directed power tampers.

Earth fill designed to restrain the movement of water shall be placed so as to meet the following additional requirements:

- 1) The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material.
- 2) 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 two inches (2") before the next layer is placed.
- 3) The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of not less than two percent (2%) shall be maintained to ensure effective drainage, and except as otherwise specified for drain fill zones. If the drawings or specifications require, or the City Engineer / Public Works Representative directs, that fill be placed at a higher level in one part of the embankment than another is, the top surface of each part shall be maintained as specified above.
- 4) Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction of inlet and outlet pipes are specifically authorized in the contract.
- 5) Embankments built at different levels as described in 3 and 4 shall be constructed so that the slope of the bonding surfaces between the embankment in place and embankment to be placed is not steeper than 2-feet horizontal to 1-foot vertical (2:1). The bonding surface of the embankment in place shall be

stripped of all loose material, scarified, moistened and recompactd when the new fill is placed against it. This is needed to ensure a good bond with the new fill, to obtain the specified moisture content and specified density at the junction of the in-place and new fill.

### **8.5.3 Borrow:**

When the embankment or fill exceeds the amount of excavation, sufficient additional material shall be obtained from borrow pits provided by the Developer/Contractor. All material proposed to be imported shall be subject to the review and approval of the City Engineer / Public Works Representative prior to starting of hauling operations.

The materials used for embankment and fill construction shall be free from sod, grass, roots larger than 1/4-inch diameter, trash, clods, rocks larger than six inches (6") in diameter, and all other material unsuitable for construction of compacted fills. Rotomilled asphalt meeting the large rock requirement may be used as borrow.

Grading of completed embankments and fills shall bring the surfaces to a smooth, uniform condition with final grades being within 0.1 foot of the design grade.

## **8.6 COMPACTION OF MATERIALS**

The material shall be deposited in horizontal layers having a thickness of not more than twelve inches (12") prior to being compacted as hereinafter specified. The distribution of materials shall be such that the compacted material will be homogeneous and free from lenses, pockets, or other imperfections.

During placement and compaction of fill, the moisture content of the materials being placed shall be maintained within the specified range, and the moisture content shall be uniform throughout the layers. Disking, blading or other approved methods prior to compaction of the layer shall obtain uniform moisture distribution. The moisture shall be controlled at a level to permit compaction of the fill as specified, but in no case greater or less than two percent (2%) plus or minus of the optimum moisture as determined by AASHTO T-180 (Modified Proctor).

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement on the fill, if necessary.

Material that is too wet when deposited on the fill shall either be removed or dried to specified moisture content prior to compaction.

If the top surface of the preceding layer, a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall be scarified and moistened by sprinkling to the required moisture content prior to placement of the next layer of fill.

When the material has been conditioned as here in before specified the backfill or embankment shall be compacted to a minimum of 95% of maximum dry density as determined by AASHTO T-180 (Modified Proctor). Densification of earth fill shall be performed by equipment designated solely for that purpose. Each layer of fill shall be compacted as necessary to make the density of the fill matrix not less than the minimum density specified. The fill matrix is defined as the portion of the fill material finer than the maximum particle size used in the compaction test method specified.

### **8.6.1 Under Roadways:**

Under roadways and extending one foot beyond the proposed curb-line the fill or embankment material shall be compacted to a minimum of 95% of maximum density specified above.

### **8.6.2 Under Sidewalks and Driveways:**

Under sidewalks extending one foot each side of the edge of slab the fill or embankment material shall be compacted to a minimum of 95% of maximum density specified above.

## **8.7                    REMOVAL OF DEFECTIVE FILL AND PLACEMENT OF                               ACCEPTABLE FILL**

Fill placed that does not conform to the specifications shall be reworked to meet the requirements or removed and replaced with acceptable fill. The replacement fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.