

ITEM 3 EMBANKMENT

3.1 DESCRIPTION

This work consists of the placement and compaction of all materials necessary for the construction of a pavement structure including foundation preparation, dikes, ditch berms, and approaches within or outside of the right-of-way or any designated section of the roadway.

3.2 MATERIAL

Materials may be furnished from required excavation of the areas shown in the plans or from off right-of-way sources obtained by the **CONTRACTOR** and meeting the requirements shown on the plans. All materials used in embankments shall be free from vegetation, objectionable matter, and other deleterious material. Frozen material will not be allowed.

Rock fill is only allowed where shown on the plans. Rock fill shall consist of sound, durable stones, boulders or broken rock not less than 6 inches in least dimension. Material must be graded and placed so as to not have significant voids in the matrix. Where rock fill is used in the embankment, the upper 5 feet of the roadbed shall be formed of approved embankment material. A stabilization fabric (Item 8) shall be placed between the rock fill and A-6 and A-7-6 embankment subgrade. Claystone or non-durable shale, shall not be treated as sound rock and shall be broken, placed and compacted as embankment material. Rock shall be defined as in Item 2.3.1

If the **CONTRACTOR** desires to use borrow material from off-site sources, the material shall meet the requirements shown on the plans and shall be free from vegetation, objectionable matter, and other deleterious material. The **AGENCY** shall be notified 14 days in advance of opening any material source to allow performance of any required testing.

Water shall be furnished by the **CONTRACTOR** and shall be clean and free from industrial wastes and other objectionable matter.

3.3 EQUIPMENT

The **CONTRACTOR** shall provide equipment in good operating condition that is specifically designed and manufactured for the purpose of excavating, hauling, leveling and compacting embankment materials. Compaction equipment shall be adequately designed to obtain compaction requirements without adverse shoving, rutting, displacement or loosening of embankment material. The equipment shall be available to perform the work specified within the time frames required and to be coordinated with the other work activities. The equipment shall be operated by skilled workman at a normal production rate for the specified type of work.

Hauling and compacting equipment shall be approved by the **AGENCY**. All equipment and machinery shall be kept in good working order, free of leaks and properly muffled. All taxes, licenses and fees shall have been paid and proper licenses and permits shall be posted as required by law.

3.4 CONSTRUCTION METHODS

3.4.1 General

Prior to placing any embankment, the right-of-way shall have been prepared by the removal and disposal of all obstructions in the areas, which the embankment is to be placed. Tree stump holes or other excavations in the limits of the embankment shall be backfilled with material described in 3.2 and compacted in accordance with Table 3.4.2.4 before commencing embankment construction. The surface of the ground, including disk loosened ground or any surface roughened, shall be restored to its original slope by blading or other methods. Where shown on the plans or required by the **AGENCY**, the ground surface thus prepared shall be compacted by moisture conditioning and compaction (Item 3.4.2.4).

3.4.1.1 Subgrade Preparation

Unless otherwise shown on the plans, the surfaces of unpaved areas (except rock) which are to receive embankment shall be loosened by scarifying to a depth of at least 12 inches, moisture conditioned and compacted in accordance with Table 3.4.2.4.

3.4.1.2 Benching

Embankment material that is to be placed and compacted adjacent to existing embankment or existing slopes steeper than 5:1 shall be continuously benched as the new embankment material is placed up in layers. Each bench shall be keyed a minimum of 3 feet (0.9 m) into the existing ground and shall begin at the intersection of existing ground and the vertical sides of the previous cut. The configuration of the benches shall be as shown on the plans or at least 4 feet in height. Materials from the benching shall be compacted with the embankment material. Placement of embankment materials shall begin at the low point of slopes. Materials, which have been loosened, shall be recompacted with the embankment materials.

3.4.2 Construction of Embankments

Embankments shall be constructed to the grade and sections shown on the plans or as established by the **AGENCY**. Each section of the embankment shall correspond to the detailed section or slopes established by the **AGENCY**. After completion of the roadway, it shall be continuously maintained to its finished section and grade until the project is accepted.

3.4.2.1 Earth Embankments

Earth embankments shall be defined as those composed principally of soil or soil-like material other than rock, and shall be constructed of acceptable material from approved sources. Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in embankment. Material shall not be placed in embankment when either the foundation or the embankment is frozen. Unless otherwise shown on the plans, all embankment shall be constructed in layers parallel to the finished grade of the roadbed and not more than 8 inches in loose thickness.

Unless otherwise specified, earth embankments shall be constructed in successive layers for the full width of the individual roadway cross section and in such lengths as are best suited to the moisture conditioning and compaction methods utilized.

Layers of embankment shall be formed by utilizing equipment and methods, which will evenly distribute the material.

Rock or broken concrete encountered in the construction of this project may be incorporated in the lower layers of the embankment with prior approval of the **AGENCY**. Rock or broken concrete may also be placed in deep fills in accordance with the requirements for the construction of rock embankments, provided such placement of rock is not immediately adjacent to structures or in areas where foundations are to be constructed. Any rock or broken concrete within the right-of-way may not exceed 6 inches in any dimension. Also, rock or broken concrete may be placed in the portions of embankments outside the limits of the completed roadbed width where the size of the rock or broken concrete prohibits its incorporation in the normal embankment layers. Exposed reinforced steel shall be cut and removed from the broken concrete.

Each layer of embankment shall be uniform material at or above optimum moisture content prior to compaction. Where layers of unlike materials abut, each layer shall be featheredged for at least 100 feet, or the materials shall be mixed as to prevent abrupt changes in the soil. No material placed in the embankment by dumping in a pile or windrow shall be incorporated without mixing and moisture conditioning prior to compaction. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking or similar methods until a uniform material is achieved in each layer.

The water used to achieve the moisture content necessary for compaction shall be provided by the **CONTRACTOR**. It shall be the responsibility of the **CONTRACTOR** to secure a uniform, optimum or higher, moisture content throughout the layer by such methods as may be necessary. In order to facilitate uniform moisture conditioning of the embankment material, the **CONTRACTOR**

may apply water at the material source. Such procedures shall be subject to the approval of the **AGENCY**. Cost of necessary water is included in this item.

3.4.2.2 Rock Embankments

Rock embankments shall be defined as those composed principally of rock as defined in Item 2.3.1, and shall be constructed of acceptable material.

Unless otherwise specified, rock embankments normally shall be constructed in successive layers for the full width of the individual roadway cross section and 18 inches or less in depth. When, in the opinion of the **AGENCY**, the rock sizes necessitate a greater depth of layer, the layer depth may be increased as necessary, but in no case shall the depth of layer exceed 30 inches. Each layer shall be constructed in such a manner that the interstices between the stones are filled with smaller stones and soils. As placed material shall be relatively uniform in moisture and shall not contain voids in the opinion of the **AGENCY**.

The maximum dimension of any rock used in embankment shall be less than the depth of the embankment layer, and in no case shall any rock over 24 inches in its greatest dimension be placed in the embankment unless otherwise approved by the **AGENCY**. The upper or final 5 feet of the embankment shall be composed of material as specified for the subgrade as shown on the plans.

Each layer shall be compacted to the required density as outlined in Item 3.4.2.4. In rock layers when density testing is inappropriate, the **AGENCY** shall require the layer to be proof rolled to ensure proper compaction.

3.4.2.3 Embankment Adjacent to Culverts and Bridges

Embankments adjacent to culverts and bridges shall be compacted to the same standards as earth embankments. Embankment material placed adjacent to any portion of any structure and in the first two layers above the top of any culvert or similar structure shall be free of any appreciable amount of gravel or stone particles more than 3 inches in greatest dimension. The percentage of fines shall be sufficient to fill all voids and ensure a uniform and thoroughly compacted mass of proper density. Where the culvert is within 3 feet of the finished subgrade elevation and for all bridge abutments, the upper 5 feet shall consist of

Flowable Backfill as described within Item 18. The material and placement shall be as discussed in Item 18, Street Cut and Backfill.

3.4.2.4 Compaction

Each layer shall be moisture conditioned and compacted to the required density by any method, type and size of equipment, which will give the required compaction. The maximum depth of each layer, prior to compaction, shall be 8 inches (loose). Prior to and in conjunction with the rolling operation, each layer shall be brought to the required moisture content and shall be kept level with suitable equipment to ensure uniform compaction over the entire layer.

Each layer shall be moisture conditioned and be compacted to provide the density and moisture specified below, unless otherwise shown on the plans.

TABLE 3.4.2.4

SOIL TYPE	COMPACTION	MOISTURE
A-1, A-2-5, A-2-7, A-3, A-4, & A-5	95% Min. of AASHTO T 180	-2 to +2
A-2-4, A-2-6, A-6	95% Min. of AASHTO T 99	0 to +2

Note: Layers shown on the plans as "moisture treated" shall be placed and compacted in accordance with Item 4, Moisture Treatment.

3.4.2.5 Embankment Testing and Proof Roll

After each layer of earth, embankment is complete, tests may be made by the **AGENCY**. If the material fails to meet the moisture or density requirements or should the material lose the required density or moisture before accepted, the layer shall be reworked as necessary.

The **CONTRACTOR** may be required to excavate an area of the layer in order to facilitate the taking of density tests. Excavation, replacement and compaction of the removed material in the area shall be at the **CONTRACTOR**'s expense.

The **CONTRACTOR** shall proof roll the completed embankment to determine if any soft, yielding or otherwise unacceptable areas exist. The **AGENCY** may

require a witness be present during the proof roll. These areas shall be removed and replaced without additional payment. The proof roller shall be a pneumatic tired vehicle with tire pressures of at least 100 psi capable of applying ground loads of not less than 18,000 pounds per axle, provided by the CONTRACTOR. Complete coverage of the proof roller will be required. Rollers shall be operated at between 2 and 6 miles per hour.

3.5 TOLERANCES

The tolerances shall be as follows:

3.5.1 Grade Tolerances

Any deviation in excess of 1.0 inches in cross section and 1.0 inches in 16 feet measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping, moisture conditioning and recompacting. Deviations in excess of this tolerance shall be corrected by the **CONTRACTOR**, at the **CONTRACTOR'S** expense, in a manner satisfactory to the **AGENCY**.

3.5.2 Density Tolerances

Density below the specified minimum or moisture contents outside of the required deviation set in Item 3.4.2.4 shall be corrected. Inadequate compaction shall be corrected by the **CONTRACTOR**, at the **CONTRACTOR'S** expense, in a manner satisfactory to the **AGENCY**.

3.6 MEASUREMENT

This Item will be measured as follows:

Shrinkage or swell factors will not be considered in determining the calculated quantities.

Embankment will be measured by the cubic yard in its final position as the volume of embankment computed in place between (1) the original ground surfaces or the surface or cut elevation shown on the plans, and (2) the lines, grades and slopes of the accepted embankment, using the average end area method.

This is a plan quantity measurement item and the quantity to be paid for will be that quantity shown on the contract plans. If no adjustments of quantities, as required by the AGENCY, are required, additional measurements or calculations will not be required.

3.7 TESTING AND INSPECTION

Testing of embankment shall be performed in accordance with Table 3.7.

TABLE 3.7
SCHEDULE FOR MINIMUM MATERIALS SAMPLING AND TESTING

In Place Soil Density and Moisture Content	AASHTO T 191, ASTM D 2167, AASHTO T 238, ASTM D 2216, AASHTO T 191, and ASTM D 2216	One test for each 200 lane feet, each layer (not less than one test per day)
	AASHTO T 239	shall be performed every tenth nuclear method density test.
Liquid Limit	AASHTO T 89	One test per soil type.
Plastic Limit	AASHTO T90	One test per soil type.
Moisture-Density Relationships	AASHTO T99 AASHTO T180	One test per soil type.

3.8 PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for Embankment". This price will be full compensation for all excavation, including blading, scarifying, shaping, dragging and finishing of subgrade; for hauling and disposing of excess excavated material; for all manipulations, labor, tools, equipment and incidentals necessary to complete the work. Proof rolling will be considered a part of this Item. When subgrade is constructed under this project, correction of soft or yielding areas in the subgrade will be at the **CONTRACTOR'S** expense.

<u>Item</u>	<u>Description</u>	<u>Payment</u>
3.1	Embankment	\$/yd ³
3.2	Water	\$/gal