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CONSTRUCTION SPECIFICATION  
INSTRUCTION FOR USE  
CS-I-OR-023 EARTHFILL

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023.1 APPLICABILITY

Construction Specification CS-OR-023 is applicable to all types of earthfill including fill sections constructed of rocky soils and embankments constructed of soft or friable rock that is expected to break down during compaction.

023.2 MATERIAL SPECIFICATIONS

No material specifications complement Construction Specification CS-OR-023.

023.3 INCLUDED ITEMS

Items to be included in the contract specifications and drawings:

- a) Complete plans and cross sections of the required earthfills and earth backfills.
- b) Borrow areas or other sources of material.
- c) Designation and description of the types of material required in the various parts of the work.
- d) Maximum allowable size of rock particles.
- e) Special requirements for foundation preparation.
- f) Maximum layer thickness before compaction for earthfill. (Table 023-1 at the end of these instructions, may be used as a guide. This table gives upper limits for the general classes of material listed. The specified maximum layer thickness may need to be substantially less than the tabulated value to obtain adequate compaction.)
- g) Maximum layer thickness before compaction for earth backfill by manually directed power tampers. (The maximum thickness that can be adequately compacted depends upon the tampers and upon the soil being placed. It varies from about 4 inches for plastic clays to about 8 inches for coarse grained material of low plasticity.)
- h) Special instructions for sectional or phased construction, where applicable.

- i) Allowable range of moisture content for each item. For example:
  1. "The moisture content of the fill matrix at the time of compaction shall be neither less than 2 percent below optimum moisture content nor more than 2 percent above optimum moisture content."
  2. "The moisture content of the fill material shall be maintained within the limits required to: (a) prevent bulking or dilatance of the material under the action of the hauling or compacting equipment, (b) prevent the adherence of the earthfill material to the treads and tracks of the equipment, and (c) ensure the crushing and blending of the soil clods and aggregations into a reasonably homogeneous mass."
- j) Compaction class for each item. (Table 023-1 at the end of these instructions may be used as a guide.)
- k) For Class A compaction—Compaction test method and required percent of maximum density. Typical compaction test results, if applicable.
- l) For Class B compaction—Contact NDCSMC for methodology for testing minimum mass density which shall be included in section 023.9 Items of Work and Construction Details.
- m) For Class C compaction—Type of roller, minimum weight or contact pressure of roller, minimum vibrating force and frequency for vibrating roller, and minimum number of passes.
- n) When the *family of curves* and the one-point Proctor is the intended method for soil density standard determination and verification, it should be referenced and so specified in Section 023.9 Items of Work and Construction Details.
- o) Special requirements, where applicable, for placing earth backfill adjacent to structures, such as reduced compactive effort for high, thin walled structures. This may include monitoring stresses and wall movements and/or specifying minimum in-place concrete strength requirements before the forms or other supports are removed or earth backfilling commences. Minimum in-place concrete strength requirements shall be determined by the designer and clearly stated.
- p) Required minimum strength of concrete, determined according to Section 023.6 Compaction, for starting compaction of backfill adjacent to structures, if applicable. Use of minimum strength is encouraged over minimum times listed in section 023.6 Compaction.
- q) Embedded structures or other elements whose volume will be excluded from the earthfill volume for payment. Major items may be listed for exclusion. The cost of measuring, computing, checking, recordkeeping, and other similar activities must clearly justify the exclusion.
- r) Special requirements pertaining to furnishing and applying water including designated source and details of ownership and water rights, if applicable, and water quality requirements if quality may be a concern.

- s) Special requirements for control of erosion, water pollution, and air pollution, with appropriate cross reference to Construction Specification CS-OR-005, Pollution Control.
- t) Surface finish requirements, such as completed surface grade tolerances.

023.4 ITEMS OF WORK AND CONSTRUCTION DETAILS

Starting at the top of page 023–6, prepare and outline job specific "Items of Work and Construction Details" (IWCD) in accordance with these instructions.

<b>TABLE 023-1 COMPACTION CLASS</b>						
<b>Grading characteristics of soil fill material</b>		<b>Appropriate compaction classes</b>	<b>----- Maximum layer thickness ----- (before compaction)</b>			
<b>% &gt; no. 4</b>	<b>% fines (passing #200)</b>		<b>Tamping Roller (in)</b>	<b>Pneum. Roller (in)</b>	<b>Vibrating Roller (in)</b>	<b>40,000 lb Track Trctr (in)</b>
0 – 35	Over 5	A	9	9	---	---
	Under 5	A	9	12	24	---
		B, C	---	18	30	12
35 – 65	25 – 50	A	9	12	24	---
		B, C	9	18	24	---
	5 – 25	A	---	12	24	---
		B, C	---	18	24	---
		B, C	---	24	24	18
Over 65	Over 5	B, C	---	18	24	---
	Under 5	B, C	---	24	24	18

**Note: Tabulated values are upper limits.** Actual maximum layer thickness for uniform compaction of a given soil material may be substantially lower. Maximum size of rock or rock fragments should not exceed two-thirds of the layer thickness prior to compaction. Soil plasticity should be a consideration.

**For weathered or weakly indurated rock materials:**

For material, such as shales, schists, disintegrated granite, soft sandstone, and siltstone, the appropriate compaction classes depend upon the degree of breakdown under the action of the excavating and compacting equipment. The maximum layer thickness before compaction must be determined on the basis of special laboratory tests or field compaction tests, or both. Field test fills should be considered to determine the least effort required to meet minimum density requirements.