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USACE / NAVFAC / AFCEC | **UFGS-31 00 00 (August 2023)**

Preparing Activity: USACE | **Superseding**
UFGS-31 00 00 (August 2008)
UFGS-31 23 00.00 20 (February 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2025

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DIVISION 31 - EARTHWORK

SECTION 31 00 00

EARTHWORK

08/23

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SECTION 31 00 00

EARTHWORK
08/23

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NOTE: This guide specification covers the requirements for earthwork activities for buildings, utilities, roadways, railroads, and airfields.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

****

NOTE: Consult with an engineer while editing this section to determine specific requirements for each job.

The following information will be indicated on the project drawings:

1. Surface elevations, existing and new;

2. Location of underground obstructions and existing utilities;

3. Location and record of soil borings and test

pits. Include ground water observations and topsoil thickness encountered in boring, soil classifications, and properties such as moisture content and Atterberg limit determinations;

4. Location of borrow and disposal area if located on Government property;

5. Clearing stripping and grubbing limits, if different from clearing limits;

6. Areas to be seeded;

7. Hydrological data where available;

8. Shoring and sheeting required (trench protection is specified in Corps of Engineers Manual EM 385-1-1); and

9. Pipe trench excavation details;

10. Location and limits of hard material (obstructions or bedrock);

11. Details of special construction such as under railroad and highways right-of-way requirements for jacking and boring;

12. Details of sewage absorption trenches, absorption pits, and subsurface drains.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2025) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2023) Installation of Ductile-Iron Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2024a) Standard Specification for Concrete Aggregates
ASTM C117	(2023) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C150/C150M	(2024) Standard Specification for Portland Cement
ASTM C260/C260M	(2024) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C618	(2025a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989/C989M	(2025) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D698	(2012; R 2021) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D1140	(2017) Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000

	ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2216	(2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	(2017; R 2025) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2974	(2020; E 2020) Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
ASTM D4253	(2016; E 2019) Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	(2016) Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4829	(2021) Standard Test Method for Expansion Index of Soils
ASTM D4832	(2016; E 2018) Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D5268	(2019) Topsoil Used for Landscaping Purposes
ASTM D6023	(2016) Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)
ASTM D6103/D6103M	(2017; E 2021) Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D8167/D8167M	(2023) Standard Test Method for In-Place Bulk Density of Soil and Soil-Aggregate by

	a Low-Activity Nuclear Method (Shallow Depth)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2024) Safety -- Safety and Occupational Health (SOH) Requirements

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-203	(Rev C; Notice 3) Paper, Kraft, Untreated

1.2 DEFINITIONS

****
NOTE: Delete definitions that will not be used in the specification text or shown on the drawings for a specific project.

All materials called out in the project plan set must be defined in this section.

This list is not exhaustive, therefore will need to be tailored for each project.
****

1.2.1 Structural Fill

Soil material placed to support buildings, walls, pads, and other similar facilities.

1.2.2 Embankment Fill

Soil material placed to construct embankment.

1.2.3 Porous Fill

Free-draining material placed for subsurface drainage, as a capillary break, or another specific purpose.

1.2.4 Topsoil

Surface layer of primarily organic soil capable of supporting vegetation growth.

1.2.5 Utility Bedding Material

Fill placed to directly support pipes, conduits, cables, and appurtenant structures. Bedding may also be used to provide a cushion between utilities and bedrock, obstacles, obstructions and other unyielding materials.

1.2.6 Flowable Fill

Fill placed in a plastic or liquid form that flows to near its final placement location with limited assistance and subsequently cures or solidifies to provide a stable or impermeable barrier.

1.2.7 Satisfactory Materials

****

NOTE: Satisfactory material will be defined in accordance with locally available materials, design slopes, etc., and suitable classes, based on the geotechnical report, will be listed in the project specification in accordance with the Unified Soil Classification System, ASTM D2487. Maximum rock size will be determined based on how thick the fill is and how it is going to be accomplished. As a rule of thumb, it should be no larger than 1/2 the allowable lift thickness. Clay material should be checked for expansive characteristics and this section should be edited accordingly.

****

Satisfactory materials for fill, backfill, and/or any in-situ soils to remain in place comprise any materials classified by ASTM D2487 as [GW], [GP], [GM], [GP-GM], [GW-GM], [GC], [GP-GC], [GM-GC], [SW], [SP], [SM], [SW-SM], [SC],[SW-SC], [SP-SM], [SP-SC], [CL], [ML], [CL-ML], [CH], [MH]. Maximum particle size to be no greater than [one-half of the allowable lift thickness] [[_____] mm inches] in any dimension.

1.2.8 Unsatisfactory Materials

****

NOTE: Unsatisfactory material will be defined in accordance with locally available materials, design slopes, etc., and unsuitable classes will be listed in the project specifications as not being in accordance with ASTM D2487. This paragraph should be edited to delete inapplicable materials. Paragraphs UNSATISFACTORY MATERIALS and COHESIONLESS MATERIALS should only be utilized where are very limited variety of materials are to be used or where project soil parameter requirements are not necessary.

****

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; roots and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.2.9 Cohesionless Materials

****

NOTE: When classification will be necessary during construction, determination of grain size for classification will be specified to be made in conformance with ASTM C117, ASTM C136/C136M, and

ASTM D1140. This paragraph should only be used where soil materials can be categorized as either cohesionless or cohesive without any other limiting parameters.

****

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C117, ASTM C136/C136M and ASTM D1140.

1.2.10 Cohesive Materials

****

NOTE: When classification will be necessary during construction, determination of grain size for classification will be specified to be made in conformance with ASTM C117, ASTM C136/C136M, and ASTM D1140. This paragraph should only be used where soil materials can be categorized as either cohesionless or cohesive without any other limiting parameters.

****

Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines are plastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C117, ASTM C136/C136M and ASTM D1140.

1.2.11 Hard/Unyielding Materials

****

NOTE: Stones should generally not exceed 75 mm 3 inches in diameter. However, pipe manufacturer's criteria, if any, should be used.

****

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than [_____] mm inch in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.12 Unstable Material

Unstable materials are too weak to adequately support the utility pipe, conduit, equipment, or appurtenant structure. Satisfactory material may become unstable due to ineffective drainage, dewatering, becoming frozen, excessive loading.

1.2.13 Expansive Soils

****

NOTE: Additional laboratory testing and analysis might be needed to better define site specific expansive soils. If expansive soils are anticipated

at the construction site, this specification should be edited to ensure proper construction techniques are undertaken per UFC 3-220-01.

****

Expansive soils are defined as soils that have an expansion index greater than 20 when tested in accordance with ASTM D4829.

1.2.14 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding [0.375] [_____] cubic meter [1/2] [_____] cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.15 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.2.16 Degree of Compaction (Proctor)

****

NOTE: ASTM D1557 will be used for maximum dry density determinations, unless soil borings indicate a gradation that may include coarse material where more than 30 percent is retained on the 19 mm 3/4 inch sieve; in that case, the Contractor will be required to use AASHTO T 180, Method D and corrected with AASHTO T-180-21 Annex A for the maximum dry density determinations. The designer should determine if AASHTO T 180 is appropriate for the existing soil gradation. If maximum dry density cannot be determined by either method, the specification may need to require a test section and the COR to determine the number of compaction coverages and equipment type.

****

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum dry density obtained by the test procedure presented in [ASTM D1557] [ASTM D698] abbreviated as a percent of laboratory maximum dry density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 19.0 mm 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 19.0 mm 3/4 inch sieve as a percentage of the maximum dry density in accordance with AASHTO T 180-21 paragraph 1.5, Note 1.

1.2.17 Degree of Compaction (Relative Density)

Degree of compaction required for soils with less than 5 percent passing

the No. 200 sieve, is expressed as a relative percentage of the maximum index density/dry unit weight and minimum index density/dry unit weight, obtained by the test procedures in accordance with ASTM D4253 and ASTM D4254, respectively, abbreviated as a percent of laboratory relative density.

1.2.18 Overhaul

****

NOTE: This paragraph is to be deleted when the earthwork is to be paid for under a lump sum contract. The blank will be filled with the appropriate number of stations.

****

Overhaul is the authorized transportation of satisfactory excavation or borrow materials in excess of the free-haul limit of [_____] stations. Overhaul is the product of the quantity of materials hauled beyond the free-haul limit, and the distance such materials are hauled beyond the free-haul limit, expressed in station meters yards.

1.2.19 Borrow

Soil brought to the project site from an external location for the purposes of project construction.

1.2.20 Subgrade

Earth materials directly below foundations and directly below granular base materials in building slab and pavement areas including shoulders.

1.3 SUBSURFACE DATA

Subsurface soil boring logs are shown [in project plans] [in an Attachment to these specifications] [_____]. These data represent available subsurface information; however, variations may exist between boring locations.

1.4 CRITERIA FOR BIDDING

****

NOTE: For most projects, the scope of earthwork can accurately be determined. However, if earthwork is approximately known, a unit price for earth work should be provided in the Bid Schedule.

Measurement and Payment should be addressed with Section 01 20 00 PRICE AND PAYMENT PROCEDURES.

Unit-price items are multiplied by the approximated and stated quantity giving a sum that is then added to the price for the rest of the work. The result is a lump sum bid with automatic provision for payment or credit due to variations in earthwork within 15 percent of that shown and bid upon.

Variations exceeding 15 percent of that shown and bid upon will become the subject of negotiations in accordance with FAR 52.211-18 Variation in Estimated

Quantity.

****

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. [Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.][Ground water elevation is [_____] meters feet below existing surface elevation.]

d. Ground water elevation is [_____] meters feet below existing surface elevation.

e. Material character is indicated by the boring logs.

****

NOTE: Choose the following option if no boring information is available, or if the boring information is insufficient to permit a bidder to develop an accurate estimate of hard material or rock to be encountered. If hard material or rock is to be encountered, the following option should be modified to include a percent figure or an approximate depth at which hard material or rock will be encountered.

****

f. Hard materials[and rock] [will not] [will] be encountered[in [_____] percent of the excavations][at [_____] meters feet below existing surface elevations].

1.5 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office

(Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Excavation and Trenching Plan; G, [_____]

[Borrow Plan; G, [_____]

][Dewatering Work Plan; G, [_____]

] Jacking, Boring, and Tunneling Plan; G, [_____]

[Rock Excavation Plan; G, [_____]

][Blasting Plan; G, [_____]

] Disposition of Surplus Materials; G, [_____]

Preconstruction Meeting; G

SD-03 Product Data

Flowable Fill Mix Design; G, [_____]

Geotextiles

SD-04 Samples

Geotextiles

SD-06 Test Reports

[Dewatering Performance Records; G, [_____]

] Material Test Report; G, [_____]

Borrow Site Testing; G, [_____]

Pipe Inspection Report; G, [_____]

Geotechnical Evaluation Report; G, [_____]

1.6 QUALITY CONTROL

1.6.1 Geotechnical Engineer

****
NOTE: Where site conditions require extensive monitoring of excavations and water levels, include the following requirement.
****

Provide a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for preparing and updating the Excavation and Trenching Plan and Dewatering Work Plan as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly Geotechnical Evaluation report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contractor is responsible for arranging meetings with the Geotechnical Engineer and Contracting Officer throughout the contract duration.

1.6.2 Qualified Technician

Provide a Qualified Technician to inspect, monitor, sample, and performing field testing. The technician qualifications need to be one of the following: a current National Institute for Certification in Engineering Technologies (NICET) Level II minimum certification in Construction Materials Testing Soils; a Geologist-in-Training with minimum one-year experience; an Engineer-in-Training with minimum one-year experience; a Registered Geologist; or a Professional Engineer.

1.6.3 Lab Validation

Perform testing by a Corps validated commercial testing laboratory or Contractor established testing laboratory meeting the requirements of Section 01 45 00 (or similar number) entitled QUALITY CONTROL and approved by the Contracting Officer. Submit testing laboratory validation for the testing to be performed. Do not permit work requiring testing until testing facilities have been inspected, Corps validated and approved by the Contracting Officer.

1.6.4 Preconstruction Meeting

Conduct a preconstruction meeting at the jobsite at least five business days prior to the start of earthwork operations on the project. The preconstruction meeting is to be arranged by the Contractor and is to follow the written agenda submitted prior to the meeting. The purpose of this meeting is to review the requirements of this specification and the associated plans. The following individuals must be in attendance at this meeting: Contractor's Project Manager and Project Superintendent, earthwork subcontractor's Project Manager and Site Foreman, Contractor's Geotechnical Engineer and Testing Agency, Government Geotechnical Engineer and Civil Engineer, and Government Construction Manager and Engineering Technician.

The minutes of this meeting are to be recorded by the Contractor and published via email within 48 hours to all attendees. The minutes must be re-published within 48 hours via email pending any subsequent comments from the attendees.

PART 2 PRODUCTS

****

NOTE: All PRODUCTS included must have an associated definition in PART 1.

****

2.1 SOIL MATERIALS

****

NOTE: All SOIL MATERIALS included must have an associated definition in PART 1. Soil materials as described in this subpart should be called out where applicable on project plan sets. Soil materials should expand upon definition to include required classifications and parameters.

For example, the following is a list of material properties/criteria that could be considered for specific soil materials such as Embankment Fill:

a. Liquid limit less than [_____];
b. Plasticity index [greater than] [less than] [_____];
c. Hydraulic conductivity (ASTM D5084) to be [less than] [greater than] or equal to [_____]; and
d. Grain size analysis resulting in greater than [_____] percent of material [passing] [retained on] the [_____] sieve.

****

2.1.1 Structural Fill

Materials classified as [GW], [GP],[GM], [GC], [GW-GM], [GW-GC], [GP-GM], [GP-GC], [GC-GM], [SW], [SP], [SM], [SW-SM], [SC], [SW-SC], [SP-SM], [SP-SC], [CL], or [CH] in accordance with ASTM D2487. Select material type appropriate for the intended purpose.

2.1.2 Embankment Fill

Materials classified as [GW], [GP], [GM], [GC], [GW-GM], [GW-GC], [GP-GM], [GP-GC], [GC-GM], [SW], [SP], [SM], [SW-SM], [SC], [SW-SC], [SP-SM], [SP-SC], [CL], or [CH] in accordance with ASTM D2487. Select material type appropriate for the intended purpose.

2.1.3 Porous Fill

Materials containing less than 5 percent passing the No. 200 sieve. Provide the gradation as appropriate for the intended purpose.

2.1.4 Topsoil

****

NOTE: Additional requirements such as pH value and necessary soil conditioning, according to applicable provisions of Sections 32 92 19 SEEDING through 32 92 26 SPRIGGING, should be inserted in this paragraph. The depth of the topsoil should be given in the text of the specification, preferably in this paragraph.

****

Material suitable for topsoil obtained from [offsite areas] [excavations] [areas indicated on the drawings] is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than 25 mm one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth.[Amend topsoil pH range to obtain a pH of [5.5 to 7] [_____].][Topsoil material will be in accordance with ASTM D5268.]

2.1.5 Capillary Water Barrier

Conform to ASTM C33/C33M for fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, 75 micrometers No. 200 sieve,[or][37.5 mm 1-1/2 inch and no more than 2 percent by weight passing the 4.75 mm No. 4 size sieve][or coarse aggregate Size 57, 67, or 77].

2.1.6 Utility Bedding Material

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with [AWWA C600] [ASTM D2321]. Install bedding for plastic piping to spring line of pipe.[Provide geotextile fabric below bedding layer where indicated.] Utility bedding material may include the following:

2.1.6.1 Class I

Angular, 6 to 40 mm 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

2.1.6.2 Class II

Coarse sands and gravels with maximum particle size of 40 mm 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

2.1.6.3 Sand

Clean, coarse-grained sand classified as [_____], [gradation [_____] of the [DOT] [State Standard] or [SW] [or] [SP] by ASTM D2487 for [bedding] [and] [backfill] [as indicated]].

2.1.6.4 Gravel and Crushed Stone

Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as [_____], [gradation [_____] of the [DOT] [State Standard]] or having a classification of [GW] [GP] in accordance with ASTM D2487 for [bedding] [and] [backfill] [as indicated].[Do not exceed maximum particle size of [75] [_____] mm [3] [_____] inches.]

2.2 FLOWABLE FILL

Design and submit flowable fill mix design to consist of Portland cement, fly ash, and/or slag cement and fine aggregate. Include the dry weights of cementitious material(s); quality and gradation of aggregates in the saturated surface-dry weights along with gradation tests; quantities, types, and names of admixtures; and quantity of water per cubic yard. The [minimum] [maximum] unconfined compressive strength to be [_____] [psi] [psf] at [_____] days in accordance with ASTM D4832. The aggregates in accordance with ASTM C33/C33M Fine Aggregates. Air-entrain fill in accordance with ASTM C260/C260M. The air content to be between [8 and 15 percent] in accordance with ASTM D6023. The flow to be between [17 to 25 mm] [8 and 12 inches] [_____] in accordance with ASTM D6103/D6103M. Portland cement to be Type I or II in accordance with ASTM C150/C150M. Fly ash to be Class C in accordance with ASTM C618. Provide slag cement in Grade 100 or 120 in accordance with ASTM C989/C989M.

2.3 BURIED WARNING AND IDENTIFICATION MARKERS

****

NOTE: Delete paragraph if tape is not required in the project. The use of a plastic warning tape for identification is mandatory for buried hazardous utilities such as electrical conduit, gas lines, fuel lines, high pressure nitrogen, high pressure water and steam lines, domestic sewage force mains, industrial waste force mains and industrial sewers carrying hazardous, explosive, or toxic waste. Coordinate color codes with other specification sections and conform, if possible, to local practice for identifying buried utilities.

****

Provide [polyethylene plastic] [and] [metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic] warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 75 mm 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes	
Red	Electric
Yellow	Gas, Oil; Dangerous Materials
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems
White	Steam Systems

Warning Tape Color Codes	
Gray	Compressed Air

2.3.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.08 mm 0.003 inch and a minimum strength of 10.3 MPa 1500 psi lengthwise, and 8.6 MPa 1250 psi crosswise, with a maximum 350 percent elongation.

2.3.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.10 mm 0.004 inch, and a minimum strength of 10.3 MPa 1500 psi lengthwise and 8.6 MPa 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 920 mm 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3.3 Detection Wire for Non-Metallic Piping

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 MATERIAL FOR RIP-RAP

****

NOTE: Make sure there is no duplication of rip-rap requirements between this and other specification sections. In this paragraph refer to standard specifications for rip-rap if local specifications are satisfactory and available. Delete this paragraph or subparagraphs not required in the project. Large scale riprap applications should consider Section 35 31 19.40 STONE REVETMENTS or another similar specification where riprap placement is a major component of a project's scope.

****

Provide [bedding material] [grout] [filter fabric] and rock conforming to [these requirements] [DOT] [_____ State Standard] for construction indicated.

2.4.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, [or poorly graded] with a maximum particle size of 50 mm 2 inches. Compose material of tough, durable particles. Allow fines passing the 75 micrometers No. 200 standard sieve with a plasticity index less than [6] [_____].

2.4.2 Grout

Provide durable grout composed of cement, water, an air-entraining

admixture, and sand mixed in proportions of one-part Portland cement to [two] [_____] parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air, as determined by the Contracting Officer. Mix grout in a concrete mixer. Allow a sufficient mixing time to produce a mixture having a consistency permitting gravity flow into the interstices of the riprap with limited spading and brooming.

2.4.3 Rock

****
NOTE: Adjust weights in brackets to fit application. Take local practice into consideration.
****

Provide rock fragments which ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized such that no individual fragment exceeds a weight of [68] [_____] kg [150] [_____] pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 0.91 kg 2 pounds or less each. Provide rock with a minimum specific gravity of [2.50] [_____]. Do not permit the inclusion of more than trace [1 percent] [_____] quantities of dirt, sand, clay and rock fines.

2.5 BORROW

Provide borrow materials from sources located [within] [and/or] [outside of Government] property meeting the requirements of paragraph [STRUCTURAL FILL] [EMBANKMENT FILL] [TOPSOIL].

2.6 GEOTEXTILE

****
NOTE: FILTER FABRIC should only be included for relatively small projects that have a scope limited such that a separate section is not warranted.
****

Provide a pervious sheet of polyester, nylon, glass or polypropylene ultraviolet resistant filaments woven, spun bonded, fused, or otherwise manufactured into a non-raveling fabric with uniform thickness and strength. Fabric must have manufacturer certified minimum average roll properties that conform with [_____]. Submit a sample and material product data for all Geotextiles utilized.

PART 3 EXECUTION

3.1 PROTECTION

****
NOTE: Include this paragraph when scope of work requires excavations which are greater than 1.5 m 5 feet or where it is known that in-situ soils lack the stability to hold near vertical faces. Where sufficient room is available, the Contractor may slope back trench walls rather than having to use a shoring system. However, the Contractor should not

be given the opportunity to slope the faces of excavations in lieu of providing shoring unless all the following conditions are met:

The excavation is less than 6 m 20 feet in depth.

There are no adjacent structures, roads, or pavements that will affect the excavation.

No equipment, stored material, or overlying material will affect the excavation.

Vibration from equipment, traffic, or blasting will not affect the excavation.

There will be no ground water problems.

Surcharges will not affect the excavation.

Operational considerations permit laying back the slopes of the excavation.

In conditions requiring engineering expertise to assess or design, include requirement for Geotechnical Engineer in paragraph QUALITY CONTROL.

****

Perform all work specified in accordance with applicable requirements of the Corps of Engineers publication EM 385-1-1 Safety and Health Requirements Manual.[Provide a Geotechnical Engineer to monitor construction activities and to prepare necessary work plans and reports; see paragraph QUALITY CONTROL.]

Use equipment of type and size appropriate for the site conditions (soil character and moisture content). Maintenance of exposed subgrades and fills is the responsibility of the Contractor. The Contractor is required to prevent damage by ineffective drainage, dewatering, and heavy loads and equipment by implementing precautionary measures. Repair or replace any defects or damage.

3.1.1 Underground Utilities

Location of the existing utilities indicated is approximate. Physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor is responsible for protecting utilities from damage during construction.

3.1.2 Drainage and Dewatering

****

NOTE: Sentence can be used instead of paragraphs DRAINAGE and DEWATERING for minor, low consequence situations related to impacts from surface or groundwater.

****

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity [and][or] provide temporary ditches, swales, and other drainage features and equipment as required to keep soils from becoming unstable, prevent erosion, or undermining of foundations. Remove unstable material from working platforms for equipment operation and soil support for subsequent construction features and provide new material as specified herein. It is the responsibility of the Contractor to assess the site conditions to employ necessary measures to permit construction to proceed.

3.1.2.2 Dewatering

****
NOTE: UFC 3-220-01 only requires 300 mm 12 inches for temporary dewatering during construction.
****

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches are not allowed within one meter 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Perform control measures by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, maintain the water level continuously, at least [_____] meters feet below the working level.[Submit a Dewatering Work Plan outlining procedures for accomplishing dewatering work.][Operate dewatering system continuously until construction work below existing water levels is complete. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Submit dewatering performance records weekly.]

3.1.3 Shoring and Sheeting

Submit an Excavation and Trenching Plan to stabilize features, prevent undermining or unintended horizontal and vertical movement of adjacent structures, and prevent slippage or movement in banks or slopes adjacent to the excavation. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Drawings to include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations are to include data and references used.

3.1.4 Protection of Graded Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.2 BORROW

****

NOTE: Where a substantial quantity of borrow excavation is anticipated, the drawings and specifications will indicate the location or locations within the project site, and the conditions under which borrow may be obtained.

****

Select borrow material to meet the requirements and conditions of the fill or embankment for which it is to be used. Obtain borrow material from [the borrow areas shown] [within the limits of the project site, selected by the Contractor] [from approved private sources].[Submit a Borrow Plan that includes materials to be excavated, stockpile locations, proposed slopes, drainage, and closure.] Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval.

3.2.1 Government Furnished Borrow Area(s)

****

NOTE: Verify materials from Government furnished borrow are suitable for intended use. Alternatively, indicate that Contractor needs to determine suitability. Provide available information on material properties. Include in paragraph any Installation or Government requirements, conditions, and restrictions.

Utilize this paragraph where borrow site for the project will be furnished by the Government. Delete and utilize paragraph CONTRACTOR FURNISHED BORROW AREA(S) where borrow is furnished by the Contractor. In the event that a combination of multiple borrow sites is required for the project, maintain both paragraphs.

****

Obtain approved borrow materials from [_____]. The rights-of-way and earth materials for constructing the work have been furnished, without cost, to the Contractor at locations as [specified] [shown]. Submit a Borrow Plan to the Government of intention to use the specified Government-furnished borrow areas.

3.2.1.1 Stripping and Stockpiling Operations in Borrow Area

Strip in accordance with paragraph STRIPPING. Strip at least 1.5 meters 5 feet beyond the limits of the borrow excavation and any stockpiles of fill and embankment materials.

Stockpile materials within the borrow area work limits such that the stockpiles does not interfere with borrow operations. Stockpile borrow material awaiting transport in approved segregated piles. Maintain a minimum of 10 meters 30 feet between all stockpile toes and the top of the borrow cut.

3.2.1.2 Drainage of Borrow Excavations

Provide adequate drainage of borrow area. Ensure that borrow operations result in minimum detrimental effects on natural environmental conditions.

3.2.1.3 Borrow Area Closure

Complete borrow areas final grading, so that slopes are not steeper than [_____] vertical on [_____] horizontal, except as otherwise indicated. Avoid abrupt changes in grade. Distribute stripped material and stockpiles of unstable materials over the disturbed borrow area, as directed. Final grade the borrow area to drain.

3.2.2 Contractor Furnished Borrow Area(s)

****

NOTE: Utilize this paragraph where borrow site for project will be furnished by the Contractor. Delete and utilize paragraph GOVERNMENT FURNISHED BORROW AREA(S) where borrow is furnished by the Government. In the event that a multiple borrow sites are required for the project, maintain both paragraphs.

****

Obtain approved borrow materials from approved offsite sources. If a borrow source is selected that is not a commercial entity from which soil material is directly purchased, submit a Borrow Plan that includes the borrow source location, geotechnical test results showing the fill material meets the Contract requirements, environmental test results in accordance with paragraph ENVIRONMENTAL REQUIREMENTS FOR OFF-SITE SOIL, and any Federal, State, and local permits required for excavation and reclamation of the borrow area.

3.2.3 Environmental Requirements for Off-Site Soil

****

NOTE: Check with regional and local authorities as well as the facility/installation manager to determine actual requirements of bracketed items; values shown come from the Commonwealth of Virginia. Remove this paragraph if not required by the project.

Generally, Government Furnished Borrow Area(s)should be tested before contract award.

****

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill may not contain concentrations above [appropriate State and EPA criteria, and for hazardous waste characteristics] [10] [_____] parts per million (ppm) of total petroleum hydrocarbons (TPH) and [10] [_____] ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and pass the TCLP test. Determine TPH concentrations by using [EPA Method 8015][applicable State TPH Testing Requirements]. Determine BTEX concentrations by using

EPA SW-846.3-3 Method 5030/8020/8260B. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Perform hazardous waste characteristic tests for ignitability, corrosivity, and reactivity in accordance with accepted standard methods. Perform PCB testing in accordance with accepted standard methods for sampling and analysis of bulk solid samples. Provide borrow site testing for petroleum hydrocarbons and BTEX from a grab sample of material from the area most likely to be contaminated at the borrow site (as indicated by visual or olfactory evidence), with at least one test from each borrow site. Provide borrow site testing for hazardous waste characteristics (TPH, BTEX and TCLP) from a composite sample of material, collected in accordance with standard soil sampling techniques. Do not bring borrow material to project site until Borrow Plan containing environmental test results has been received and approved by the Contracting Officer.

3.3 SURFACE PREPARATION

3.3.1 Clearing and Grubbing

[Clear and grub as specified in Section 31 11 00 CLEARING AND GRUBBING.

] Remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations. Remove stumps entirely. Grub out matted roots and roots over 75 mm 3 inches in diameter to at least 500 mm 18 inches below existing surface.

3.3.2 Stripping

****
NOTE: Topsoil will be separately excavated, stored, and used for surface finish in preparation for seeding, sodding, or other planting, only where topsoil is definitely superior for grass and plant growth as compared with the remainder of the excavated material. Surface soil that is a heavy clay, predominantly sandy, or is lean in grass- and plant-growth qualities, will not be saved. The hauling, spreading, smoothing, and maintenance of the topsoil in preparation for the seeding and planting operations are generally considered under a separate section, and therefore are not considered in this specification. The blank will be filled with the appropriate depth dimension.
****

Strip site where indicated on the plans. Strip existing surface materials to a depth of [100] [_____] mm [4] [_____] inches below the existing ground surface in areas designated as Clear and Grub on the plans. Strip existing surficial soils to a depth of [_____] mm inches in all other areas. Strip in all areas within the planned limits of disturbance. All stripped materials not suitable for reuse as topsoil will be wasted in specified disposal area. Screen all stripped soils to remove roots and organic materials prior disposal.

[Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Protect topsoil and keep in segregated piles until needed.

]3.3.3 Proof Rolling

****

NOTE: Specify proof rolling when the quality of the existing subgrade is questionable. Proof rolling can be used to verify that material in question is acceptable for constructing a project feature (no bid quantity required, location shown or specified) or to locate suspected areas where material is not acceptable for project features (indicate a bid quantity to be removed). Remove this paragraph if not required in the project.

****

Perform proof rolling on exposed subgrade that is unfrozen and free of surface water (wet conditions resulting from rainfall).[Notify the Contracting Officer a minimum of three days prior to proof rolling.][Perform proof rolling in the presence of the Contracting Officer.]

[After stripping, excavating, and rough grading to the planned elevation,]proof roll the existing subgrade of all building, pavement and embankment locations with six passes of a [loaded tandem axle dump truck] [15 ton, pneumatic-tired or smooth drum roller]. Operate the [roller] [truck] in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km per hour 2.5 to 3.5 miles per hour. Subgrade materials that exhibit excessive deflection and/or rutting during proof rolling need to be scarified, aerated, and re-compacted to specified density at [plus or minus] [2][_____] percent of optimum moisture content prior to being considered for remedial action by the Contracting Officer. When proof rolling under buildings, the building subgrade is considered to extend 1.5 meters 5 feet beyond the building lines, and make one-half of the passes with the roller in a direction perpendicular to the other passes.

3.3.4 Stockpiling Operations

****

NOTE: When spoil areas or borrow areas are within the limits of Government-controlled land, additional requirements based on the following, and as appropriate for the project, will be included in the contract document. Locations of areas will be indicated, or the approximate distances from the project site will be specified. Generally, unburned vegetative material and surplus excavated material will be disposed of in inconspicuous spoil areas where no future construction is planned. If economically justifiable, surplus suitable excavated material may be stockpiled or may be disposed of in areas where future construction is planned and where fill will be required. Spoil materials will be so placed and the worked portions of spoil areas and borrow areas will be so graded and shaped as to minimize soil erosion, siltation of drainage channels, and damage to existing vegetation.

****

Place and grade stockpiles of satisfactory [and unsatisfactory] [and wasted materials] as specified. Keep stockpiles in a neat and well

drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. Do not create stockpiles that could obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.4 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Excavate soil disturbed or weakened by Contractor's operations, and soils softened or made unstable for subsequent construction due to exposure to weather. Use material removed from excavations meeting the specified requirements in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes to minimize surplus material and to minimize additional material to brought on site. Do not excavate below indicated depths except to remove unstable material as determined by the [Government] [Geotechnical Engineer] and confirmed by the Contracting Officer. Remove and replace excavations below the grades shown with appropriate materials as directed by the Contracting Officer.

If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock or as hard/unyielding material, uncover such material, and notify the Contracting Officer. Do not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow sufficient time for classification and delineation of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

3.4.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown. Do not excavate below grades shown. Backfill excessive excavation as directed by the Contracting Officer, with satisfactory, compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed. Do not allow material to be deposited within one meter 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.4.2 Trench Excavation Requirements

****

NOTE: The width of the trench below the top of the pipe will depend on the type of pipe used and soil conditions. The pipe manufacturer's installation manual should provide this information, and if so, it will be followed. In general, the width of

trench will be 300 mm to 600 mm 12 inches to 24 inches, plus pipe O.D. for smaller pipe sizes, and 600 mm to 900 mm 24 inches to 36 inches plus pipe O.D. for larger pipe sizes. Sloping walls below the top of the pipe are allowed for certain types of pipe in special ground conditions.

****

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended by the manufacturer. Provide vertical trench walls where no manufacturer installation instructions are available. Do not exceed the trench width of 600 mm 24 inches below the top pipe plus pipe outside diameter (O.D.) for pipes of less than 600 mm 24 inches inside diameter, and do not exceed 900 mm 36 inches plus pipe outside diameter for pipe sizes larger than 600 mm 24 inches inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.4.2.1 Bottom Preparation

****

NOTE: Stones 75 mm 3 inches or greater should be removed. However, pipe manufacturer's criteria, if any, should be used.

****

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of [_____] mm inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.4.2.2 Removal of Unyielding Material

****

NOTE: Minimum of 100 mm 4 inches should be removed to produce a suitable cushion for the pipe.

****

Where [overdepth is not indicated and]unyielding material is encountered in the bottom of the trench, notify the Contracting Officer. Following approval, remove such material [_____] mm inch below the required grade and replaced with suitable materials as provided in paragraph FILLING AND COMPACTION.

3.4.2.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with suitable material as provided in paragraph FILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.4.2.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures [sufficient to leave at least 300 mm 12 inches clear between the outer structure surfaces and the face of the excavation or support members.] [of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown.]

3.4.2.5 Gas Distribution

Excavate trenches to a depth that will provide a minimum 450 mm 18 inches of cover in rock excavation and a minimum 600 mm 24 inches of cover in other excavation.

3.4.2.6 Water Lines

****

NOTE: Minimum depth of cover will be that required for frost penetration in the region and for safe operation of the utility. For fire protection yard mains, reference is made to NFPA 24 for recommended depth of cover.

****

Excavate trenches to a depth that provides a minimum cover of [_____] meters feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.[For fire protection yard mains or piping, an additional [_____] mm inch of cover is required.]

3.4.3 Jacking, Boring, and Tunneling

****

NOTE: Generally, Section 33 05 23 TRENCHLESS UTILITY INSTALLATION should be used instead. This section should only be considered for minor, low risk, and relatively simple situations.

In situations where utility lines must be installed more than 5 to 7 meters 15 to 20 feet below ground surface, through embankments, under minor roads or parking areas, or where surface conditions make it difficult or impractical to excavate open trenches, utility lines may be installed by jacking, boring, or tunneling as a Contractor option. Where operational requirements preclude installation by trenching, the use of jacking, boring, or tunneling should be specified as mandatory alternatives. This requirement will normally exist where utilities must cross railroads, highways, primary access roads and airfield pavements. Pipe and conduit smaller than 900 mm 36 inches in diameter will normally be installed in smooth steel pipe casing. Designing engineers must coordinate with installation facility engineers to identify and validate utility crossings where jacking, boring, or tunneling will be specified as mandatory.

Where the above conditions/requirements are not present, and where the existing subsurface conditions would prove difficult and costly to bore/tunnel (e.g., large boulders/cobbles or shallow rock), delete this paragraph in its entirety.

****

Unless otherwise indicated, provide excavation by open cut except those sections requested and if, in the opinion of the Contracting Officer, can be safely and properly installed and backfill. Provide a Jacking, Boring, and Tunneling Plan, signed and sealed by a licensed Professional Engineer that includes a work site layout, methods and procedures, equipment, alignment control, monitoring, and contingency for responding to unplanned movements.

3.4.3.1 Pipeline Casing

Provide new smooth wall steel pipeline casing under [new] [existing] [railroad] [and] [pavement] [in a trench] [by the boring and jacking method of installation]. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated.[Install pipeline casing by dry boring and jacking method as follows:]

3.4.3.2 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.4.3.3 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.4.3.4 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight [end seals as indicated.] [segmented elastomeric end seals.]

3.4.4 Underground Utilities

****

NOTE: Delete this paragraph in its entirety if no known utilities or subsurface construction is located below or adjacent to work covered in this specification.

****

[Perform work adjacent to utilities [as indicated] [in accordance with procedures outlined by utility owner].] [Excavation made with power-driven equipment is not permitted within [600] [_____] mm [2] [_____] feet of known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction,

excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer.] Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.4.5 Structural Excavation

****
NOTE: For projects requiring over-excavation and replacement of near-surface materials below building and/or pavement areas, retain and edit the bracketed text.
****

[Following general excavation and rough grading activities, excavate the entire building footprint area and at least 1.5 meters 5 feet beyond, to the deeper of [1200] [_____] mm [4] [_____] feet below existing grade or [600] [_____] mm [2] [_____] feet below bottom of footings. Scarify the exposed surface to a depth of [150 to 200 mm] [6 to 8 inches], moisture-condition, and compact to at least 95 percent of laboratory maximum dry density.][Do not excavate to final grade until just before concrete is to be placed. Roughen level surfaces. Cut sloped surfaces as indicated into rough steps or benches to provide a satisfactory bond for compacting materials.][For new pavement areas including exterior concrete pads, over-excavate to a minimum of 300 mm 12 inches below bottom of new pavement/pad base course, scarify, moisture-condition, and compact to at least 95 percent.]

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata.

Concrete placement is not allowed until footing subgrades have been inspected and approved by the Contracting Officer.

3.4.6 Pile Cap Excavation

[Stop the excavation at an elevation 150 to 300 mm 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown.] [Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer.] After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry. Backfill and compact over-excavations and changes in grade due to pile driving operations to 95 percent of [ASTM D698] [ASTM D1557] maximum dry density.

3.4.7 Rock Excavation and Blasting

Excavate rock encountered in the cut section to a depth of 150 mm 6 inches below finished grade and replace with [satisfactory material] [_____].[Submit a Rock Excavation Plan, prepared and sealed by a registered professional engineer.][Perform blasting in accordance with EM 385-1-1

and in conformance with Federal, State, and local safety regulations. Submit notice 15 days prior to starting work. Submit a Blasting Plan, prepared and sealed by a registered professional engineer that includes calculations for overpressure and debris hazard. Provide blasting mats and use the non-electric blasting caps. Obtain written approval prior to performing any blasting and notify the Contracting Officer 24 hours prior to blasting. Include provisions for storing, handling and transporting explosives as well as for the blasting operations in the plan. The Contractor is responsible for damage caused by blasting operations.][Blasting will not be permitted.]

3.5 SUBGRADE PREPARATION

3.5.1 General Requirements

****

NOTE: Moisture content limits for compaction should be included in these paragraphs when necessary for obtaining strength and stability in embankments and fill, for controlling movement of expansive soils and when, in the opinion of the project geotechnical engineer, moisture control is required for the soils being used.

****

Shape subgrade to line, grade, and cross section as indicated. Remove unsatisfactory and unstable material in surfaces to receive fill or in excavated areas, [as determined by proof rolling,]and replaced with [satisfactory materials] [structural fill] [_____]. Do not place material on surfaces that are muddy, frozen, contain frost, or otherwise containing unstable material. Scarify the surface to a depth of 100 mm 4 inches prior to placing fill. Step or bench sloped surfaces steeper than 1 vertical to 4 horizontal prior to scarifying. Place 100 mm 4 inches of loose fill and blend with scarified material. When subgrade is part fill and part excavation or natural ground, scarify to a depth of 200 mm 8 inches.

3.5.2 Subgrade for Structures, Spread Footings, and Concrete Slabs

Do not excavate below depth shown for structures, spread footings, and concrete slabs. If over excavation occurs, [notify the Contracting Officer and remove, replace, and compact as directed.] [compact disturbed material to [95] [_____] percent of [ASTM D698] [ASTM D1557].] After final rolling, the surface of the subgrade for buildings and pavements must not show deviations greater than 15 mm 0.05 foot when tested with a 4 meter 12-foot straightedge applied both parallel and at right angles to the centerline of the area.

3.5.3 Subgrade for Railroads

Compact subgrade for railroads to at least 90 percent laboratory maximum dry density for cohesive materials or 95 percent laboratory maximum dry density for cohesionless materials.

3.5.4 Subgrade for Pavements

Compact top 300 mm 12 inches of subgrade for pavements to at least 95 percent of [ASTM D698] [ASTM D1557]. After final rolling, the surface of the subgrade for buildings and pavements must not show deviations greater than 15 mm 0.05 foot when tested with a 4 meter 12-foot straightedge

applied both parallel and at right angles to the centerline of the area.

3.5.5 Subgrade for Shoulders

Compact the upper [150] [_____] mm [6] [_____] inches of subgrade for shoulders to at least [95][_____] percent of [ASTM D698] [ASTM D1557] for the [depth below the surface of shoulder shown] [full depth of the shoulder].

3.5.6 Subgrade for Airfield Pavements

****

NOTE: Refer to UFC 3-260-02 for specific requirements for compaction of Airfield Pavement subgrade and modify paragraph as necessary.

****

Compact top [_____] mm inches of subgrade, to [95] [_____] percent of ASTM D1557. After final rolling, the surface of the subgrade for buildings and pavements must not show deviations greater than 15 mm 0.05 foot when tested with a 4 meter 12-foot straightedge applied both parallel and at right angles to the centerline of the area.

3.5.7 Subgrade Filter Fabric

Place filter fabric as indicated directly on prepared subgrade free of vegetation, stumps, rocks larger than 50 mm 2 inch diameter and other debris which may puncture or otherwise damage the fabric. Repair damaged fabric by placing an additional layer of fabric to cover the damaged area a minimum of one meter 3 feet overlap in all directions. Overlap fabric at joints a minimum of one meter 3 feet. Obtain approval of filter fabric installation before placing fill or backfill. Place fill or backfill on fabric in the direction of overlaps and compact as specified herein. Follow manufacturer's recommended installation procedures.

3.6 FILLING AND COMPACTION

****

It is imperative to specify a high degree of compaction in fills under structures to minimize settlement and to ensure stability of a structure. In addition to the criteria set forth in UFC 3-220-01, the following factors will be considered in establishing the specific requirements:

a. The sensitivity of the structure to total and differential settlement as related to the structural design. This is particularly true of structures to be founded partly on fill and partly on natural ground.

b. The ability of normal compaction equipment to produce the desired densities in existing or locally available materials within a reasonable range of molding moisture content. If considered essential, special equipment will be specified.

c. The compaction requirements for clean, cohesionless, granular materials will be generally

higher than those for cohesive materials because cohesionless materials readily consolidate when subjected to vibration. For structures with critical stability requirements and settlement limitations, the minimum density requirements may be altered. If only a cohesionless soil or only a cohesive soil is used, the inapplicable values will be deleted.

d. The exception to required high degree of compaction in fills and backfills is in expansive soils (see UFC 3-220-01). Where it is necessary to use materials having swelling characteristics, usually CL or CH classifications, the specified degree of compaction will be related to laboratory test results for swelling under a considerable range of molding moisture and compactive effort. In swelling soils, it is important to specify a density and molding moisture range that will enable the soil to stay stable, striking a reasonable balance between potential swell and excessive settlement under load, even at the expense of accepting a reduced bearing capacity. A maximum permissible density should be established to minimize swelling. If possible, soils with swelling characteristics will be classified as unsatisfactory material, particularly under critical stability structures.

e. ASTM D1557 is satisfactory for establishing moisture density characteristics of a material in most cases. However, other modifications may be necessary as discussed in this ASTM and under soil tests in DM 21.3/ UFC 3-260-02. The procedures and precautions in the subgrade compaction paragraphs of DM 21.3/UFC 3-260-02, will be considered in establishing minimum density requirements for a particular project.

Modifications will be made to meet the backfill requirements for deep-seated or subsurface structures as discussed in UFC 3-220-04FA.

****

Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs for SUBGRADE PREPARATION. Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary [to plus or minus [_____] percent of optimum moisture] [to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used]. Fill and backfill to contours, elevations, and dimensions indicated. Compact and test each lift before placing overlaying lift.

3.6.1 Trench Backfill

****

NOTE: Most pressure tests require backfilling to at

least 600 mm 2 feet over the pipe with the joints and couplings left open for inspection.

****

Backfill trenches to the grade shown. [Backfill the trench to [_____] meters feet above the top of pipe prior to performing the required pressure tests. Leave the joints and couplings uncovered during the pressure test.] [Do not backfill the trench until all specified tests are performed.]

3.6.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with satisfactory material or initial backfill material.

3.6.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with satisfactory material placed in layers not exceeding 150 mm 6 inches loose thickness.

3.6.1.3 Bedding and Initial Backfill

****

NOTE: Bedding is provided to level out any irregularities in the foundation and to assure uniform support along the barrel of each pipe section. Bedding is also constructed to distribute the load bearing reaction, due to the weight of the backfill material, around the lower portion of the pipe. If the pipe or conduit is placed directly on a flat or shaped foundation, delete "bedding" from the title and from any reference in the paragraph. If bedding will be specified, determine type and thickness and show on the plans. Specify compaction to 95 percent maximum dry density for cohesionless soils, and 90 percent maximum dry density for cohesive soils.

Any locally available fine aggregate for concrete or asphalt mixtures will qualify as sand and may be specified by local gradation and specification number in lieu of "SW" or "SP." Drawings (details) should clearly show where sand backfill or bedding is required.

Locally available coarse aggregate for concrete will suffice and may be specified by local gradation and specification number in lieu of "GW" or "GP." Maximum size of aggregate should not be more than 25 mm per 300 mm one inch per foot of pipe diameter or 75 mm 3 inches maximum. Refer to pipe manufacturer's criteria for more stringent requirements, if any, on aggregate size and gradation. On drawings (details), clearly show where gravel backfill or bedding is required.

****

[Provide bedding of the type and thickness shown.]Place initial backfill

material and compact it with approved tampers to a height of at least 300 mm one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except where shown or when specified otherwise in the individual piping section, provide bedding for buried piping in accordance with PART 2 paragraph UTILITY BEDDING MATERIAL. Compact backfill to top of pipe to [95 percent of ASTM D698 maximum dry density] [85 percent of ASTM D1557]. Provide plastic piping with bedding to spring line of pipe.

3.6.1.4 Final Backfill

Do not begin backfill until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Bring backfill to indicated finish grade. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 600 mm 2 feet above sewer lines and 300 mm one foot above other utility lines need to be free from stones larger than 25 mm one inch in any dimension. Heavy equipment for spreading and compacting backfill are not to be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; compact remaining area in layers not more than 100 mm 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Place backfill carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Do not place backfill against foundation walls prior to 7 days after completion of the walls. As far as practicable, bring backfill up evenly on each side of the wall and sloped to drain away from the wall.

Fill the remainder of the trench, except for special materials for buildings[, railroads][, airfields] and pavements with satisfactory material. Place backfill material and compact as follows:

3.6.1.4.1 Buildings[, Railroads][, Airfields] and Pavements

Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction. Compact as specified for Structural Fill.

3.6.1.4.2 Turfed or Seeded Areas and Miscellaneous Areas

Deposit backfill in layers of a maximum of 300 mm 12 inches loose thickness, and compact it to 85 percent maximum dry density for cohesive soils and 90 percent maximum dry density for cohesionless soils.[Allow water flooding or jetting methods of compaction for granular noncohesive backfill material. Do not allow water jetting to penetrate the initial backfill.][Do not permit compaction by water flooding or jetting.] Apply this requirement to all other areas not specifically designated above.

3.6.1.5 Heat Distribution System

Free initial backfill material of stones larger than 6.3 mm 1/4 inch in any dimension.

3.6.1.6 Electrical Distribution System

Provide a minimum cover of 600 mm 24 inches from the finished grade to

direct burial cable and conduit or duct line, unless otherwise indicated.

3.6.1.7 Sewage Absorption Trenches or Pits

****
NOTE: Delete these paragraphs when sewage absorption trenches or pits are not included in the project. Consult a geotechnical engineer and local standards in selecting bracketed information.
****

3.6.1.7.1 Porous Fill

Provide backfill consisting of porous fill material in the locations and thickness as shown on the drawings. No compaction is required.

3.6.1.7.2 Cover

****
NOTE: Select appropriate bracketed information to correspond to the design indicated on the drawings.
****

[Filter fabric][Concrete][Kraft paper conforming to CID A-A-203, Grade B, No. 2, 22.7 kg 50 pound weight][or a layer of straw at least 50 mm 2 inches thick]as indicated.

3.6.1.8 Displacement of Features

****
NOTE: The trench should be backfilled to at least 600 mm 2 feet.
****

After other required tests have been performed and the trench backfill compacted to [[_____] meters feet above the top of the pipe] [the finished grade surface], inspect the pipe to determine whether unexpected or damaging displacement has occurred. Conduct walk-through inspection of pipe sizes larger than 1200 mm 48 inches. Inspect pipes smaller than 1200 mm 48 inches using remote methods using closed circuit television, sonar, or hybrid that can provide a 360-degree inspection of the pipe. Prepare and submit a pipe inspection report consisting of digital video or photos. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.6.1.9 Buried Tape And Detection Wire

3.6.1.9.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 300 mm 12 inches below finished grade; under pavements and slabs, bury tape 150 mm 6 inches below top of subgrade.

3.6.1.9.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm 12 inches above the top of pipe. Extend the wire

continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 0.9 meters 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over its entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.6.2 Structural Fill Placement

Place fill and backfill beneath and adjacent to structures in successive horizontal layers of loose material not more than 200 mm 8 inches in depth, or in loose layers not more than 100 mm 4 inches in depth when using hand-operated compaction equipment. Do not place over wet or frozen materials. Compact to at least 90 percent of laboratory maximum dry density for cohesive materials or 95 percent of laboratory maximum dry density for cohesionless materials, except as otherwise specified. Perform compaction in such a manner as to prevent wedging action or eccentric loading upon or other damage to the structure. Moisture condition fill and backfill material to [a moisture content that will readily facilitate obtaining the specified compaction][within range of plus 2 or minus 2 percent of optimum moisture content at the time of compaction].

3.6.3 Backfill for Appurtenances

****
NOTE: The number of days the concrete is allowed to cure before backfilling the structure will depend on the type of mix and the concrete strength requirements specified. Three days would be considered as a minimum. Seven days is more common.
****

After the manhole, catchbasin, inlet, or similar structure has been constructed[and the concrete has been allowed to cure for [7][_____] days], place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.6.4 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in a single lift and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.6.5 Flowable Fill

Place fill in a manner to completely fill voids in the location indicated. Do not place when atmospheric temperatures are expected to be below one degree C 33 degrees F at any time during the 3 day period following placement.

3.6.6 Compaction

****
NOTE: In general for most projects, use ASTM D698

for compaction. Use ASTM D1557 for roads, airfields, and other heavily loaded areas or locations needing a greater density or compressive strength. Specify compaction in terms of one method of compaction effort (ASTM D698 or ASTM D1557) for a contract, if possible. Use 90 percent of ASTM D698 or ASTM D1557 for general site compaction of cohesionless materials on Army projects and 85 percent for Navy projects. For airfield projects see UFC 3-260-02 for criteria and design guidelines.

****

3.6.6.1 General Site

Compact underneath areas designated for vegetation and areas outside the 1.5 meter 5 foot line of the paved area or structure to [85] [90] percent of [ASTM D698] [ASTM D1557].

3.6.6.2 Adjacent Areas

Compact areas within 1.5 meters 5 feet of structures to 95 percent of [ASTM D698] [ASTM D1557].

3.7 EMBANKMENTS

3.7.1 Earth Embankments

****

NOTE: Moisture content limits for compaction should be included in these paragraphs when necessary for obtaining strength and stability in embankments and fill, for controlling movement of expansive soils and when, in the opinion of the project geotechnical engineer, moisture control is required for the soils being used.

This paragraph should be omitted from projects where specialized earthwork controls not specified in EXCAVATION, SUBGRADE PREPARATION and FILLING AND COMPACTION.

****

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 75 mm 3 inches. Place the material in successive horizontal layers of loose material not more than 200 mm 8 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum dry density for cohesive materials or 95 percent laboratory maximum dry density for cohesionless materials. Backfill and fill material are to be [within the range of minus 2 to plus 2 percent of optimum moisture] [to a moisture content that will readily facilitate obtaining the specified compaction].

Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers,

pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.7.2 Rock Embankments

****

NOTE: The designer will determine the appropriate values for all blank spaces, except the last one, on the basis of recent experience on similar construction or of test results obtained from construction and testing of a test section. The specific method by which density will be determined in the laboratory and measured in the field will be described in the project specification. The total thickness of the pavement structure, including subbase, base, and pavement will be placed in the last blank space in this paragraph.

The first blank space applies to rock fill of small maximum dimension and maximum lift placement of 200 to 250 mm 8 to 10 inches. Coordinate maximum size with satisfactory material definition. If it is necessary to use larger rock and thicker lifts, the second expression in brackets is applicable. When thicker lifts are used, it may be necessary to specify a minimum number of passes of the compactor. Delete last sentence, unless the rock excavation is engineered to be used under pavements with sufficient fines to prevent consolidation of the embankment.

This paragraph should be omitted from projects where specialized earthwork controls not specified in EXCAVATION, SUBGRADE PREPARATION, and FILLING AND COMPACTION.

****

Construct rock embankments from material classified as rock excavation, as defined above, placed in successive horizontal layers of loose material not more than [_____] mm inch in depth. Do not use pieces of rock larger than [_____] mm inch in the greatest dimension. Spread each layer of material uniformly, completely saturate, and compact to a minimum density of [_____] kg/cubic meter pounds per cubic foot. Adequately bond each successive layer of material to the material on which it is placed. Finish compaction with vibratory compactors weighing at least [_____] metric tons tons, heavy rubber-tired rollers weighing at least [_____] metric tons tons, or steel-wheeled rollers weighing at least [_____] metric tons tons.[Do not use rock excavation as fill material for the construction of pavements.][In embankments on which pavements are to be constructed, do not use rock above a point [_____] mm inch below the surface of the pavement.]

3.8 RIP-RAP CONSTRUCTION

****

NOTE: Select information in brackets to best describe rip-rap construction. Provide detail or typical section through rip-rap on drawings as well as all dimensions necessary for estimating and

construction. If DOT standard specifications are referenced for rip-rap construction, paragraphs PREPARATION through GROUTING may be deleted.

****

Construct rip-rap [on bedding material] [on filter fabric] [with grout] [in accordance with [DOT] [_____] State Standard, paragraph [_____]] in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 30 mm 0.1 foot.

3.8.1 Bedding Placement

Spread [filter fabric and] bedding material uniformly to a thickness of at least [75] [_____] mm [3] [_____] inches on prepared subgrade as indicated.[Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.]

3.8.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.[For grouted rip-rap, hand-place surface rock with open joints to facilitate grouting and do not fill smaller spaces between surface rock with finer material. Provide at least one "weep hole" through grouted rip-rap for every 4.65 square meters 50 square feet of finished surface. Provide weep holes with columns of bedding material, 100 mm 4 inches in diameter, extending up to the rip-rap surface without grout.]

[3.8.3 Grouting

Prior to grouting, wet rip-rap surfaces. Grout rip-rap in successive longitudinal strips, approximately 3 meters 10 feet in width, commencing at the lowest strip and working up the slope. Distribute grout to place of final deposit and work into place between stones with brooms, spades, trowels, or vibrating equipment. Take precautions to prevent grout from penetrating bedding layer. Protect and cure surface for a minimum of 7 days.

]3.9 FINISHING/FINISH OPERATIONS

****

NOTE: Special smoothness tolerances are not required for subgrades for railroads; therefore, both sets of brackets will be removed when writing specifications for preparation of railroad subgrade only. When writing specifications for preparation of roadway and/or airfield pavement subgrade, the brackets will be removed from the applicable sentences and the smoothness tolerances showing permissible deviations in fractions of a millimeter inch and the length of straightedge in meters feet will be inserted in the blanks as appropriate.

****

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, frozen or otherwise unstable subgrade.

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 30 mm 0.1 foot of the grades and elevations indicated except as indicated for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.9.1 Capillary Water Barrier

****
NOTE: The compacted thickness and locations requiring a capillary water barrier must be indicated on the drawings. The thickness will not be less than 100 mm 4 inches. The paragraph will be deleted where site conditions make the barrier unnecessary.
****

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.9.2 Grading Around Structures

Construct areas within 1.5 meters 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.9.3 Shoulder Construction

****
NOTE: Shoulder construction will form a part of the work to be performed under this section of the specifications except when shoulder construction is specified under the subbase, base-course, wearing course, or pavement sections of the specifications and is designated in the contract to be performed and paid for under one of these sections.
****

Construct shoulders of [satisfactory material] [_____]. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid

pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum dry density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.9.4 Grading

Finish grades as indicated within 30 mm one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.9.5 Topsoil and Seed

****
NOTE: Topsoil will be separated, excavated, stored, and used for surface finish in preparation for seeding, sodding, or other planting only where the topsoil is definitely superior for grass and other plant growth as compared to the balance of the excavated materials. Generally, topsoil will be spread after other operations have been completed. When topsoil spreading is covered under a separate section of the specifications, this paragraph will be deleted.
****

[Provide as specified in Section 32 92 19 SEEDING [32 92 23 SODDING].]

On areas to receive topsoil, prepare the compacted subgrade soil to a 50 mm 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of [_____] mm inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 50 mm 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. [Stockpile in locations indicated][Remove from the site]any surplus of topsoil from excavations and gradings. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from [offsite areas] [areas indicated].

3.10 DISPOSITION OF SURPLUS MATERIAL

****
NOTE: Coordinate with Installation POC for on-site disposition of materials. Ensure requirements are consistent with Environmental specification.
****

Remove from Government property all surplus or other soil material not required or not suitable for filling or backfilling, along with brush, refuse, stumps, roots, and timber. Properly disposed of in accordance

with all applicable laws and regulations. Prepare plan for Disposition of Surplus Materials to include permissions document to dispose of nonsalable products.

3.11 TESTING

NOTE: Modify Table 1 to identify each material type to be subject to quality control testing. List materials in paragraph DEFINITIONS. For each material type, list each test method and test frequency appropriate for required work. If numerous tests required for different materials, allowable to create separate tables for each material for clarity.

Density test frequency can vary from one test per 10 square meters 100 square feet for small areas up to one test per 900 square meters 10,000 square feet. The following table is to help establish test frequency for various situations:

Material Type	Location of Material	Test Frequency
Undisturbed native soil	Structures	Two random tests in building footings and two tests on subgrade within building line
Fills and backfills	Structures (adjacent to)	One test per structure per 200 sq m 2000 sq ft taken 300 mm 1 foot below finished grade
Subgrades	Site (except airfields)	One test per 250 sq m 2500 sq ft
Embankments or borrow	Any	One test per lift per 400 cubic m 500 cubic yds placed
Native soil subgrade other than structures and parking	Any	One test or one test per 900 sq m 10,000 sq ft whichever is greater
Borrow	Any	One test per lift per 400 cubic m 500 cubic yds placed

For projects having extensive amounts or a critical need for test data to verify design or other urgent needs, consider using Section 01 31 20 PROJECT TECHNICAL DATA MANAGEMENT AND VISUALIZATION and require Contractor to submit data to specified Data Management system in addition normal submission requirements.

Perform testing as indicated in Table 1. Submit Material Test Reports within [24 hours] [7 days] of tests being completed.[In addition, submit test data in accordance with Section 01 31 20 PROJECT TECHNICAL DATA MANAGEMENT AND VISUALIZATION.]

Material Type [list materials to be tested as identified in paragraph DEFINITIONS]	Location of Material	Test Method	Test Frequency
		Density - [ASTM D1556/D1556M] [ASTM D2167] [ASTM D6938] [ASTM D8167/D8167M]. [When ASTM D6938 or ASTM D8167/D8167M is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556/D1556M.	One test per [2000] [_____] square meters feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines. Double testing frequency for areas compacted by hand-operated machines. [If ASTM D6938 or ASTM D8167/D8167M is used, check in-place densities by ASTM D1556/D1556M as follows: One check test per lift for every [6] [10] tests.] [Where ASTM D8167/D8167M is used, provide water content verification in accordance with ASTM D2216 for each test.]
		Moisture Content - ASTM D2216	Two tests per day for each type of fill and backfill. Sample taken immediately prior to compaction after moisture conditioning.

Material Type [list materials to be tested as identified in paragraph DEFINITIONS]	Location of Material	Test Method	Test Frequency
		Moisture Density Relationship - [ASTM D698][ASTM D1557]	One representative test per [500][_____] cubic meters yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum dry density. Sample to be taken from stockpile or location of placement.
		Relative Density - ASTM D4253 and ASTM D4254	One test per [2000] [_____] square meters feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines. Double testing frequency for areas compacted by hand-operated machines.

Material Type [list materials to be tested as identified in paragraph DEFINITIONS]	Location of Material	Test Method	Test Frequency
		Gradation - ASTM C136/C136M	One representative test per [500][_____] cubic meters yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum dry density. Sample to be taken from stockpile or location of placement.
		Atterberg Limits - ASTM D4318	One representative test per [500][_____] cubic meters yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum dry density. Sample to be taken from stockpile or location of placement.

Material Type [list materials to be tested as identified in paragraph DEFINITIONS]	Location of Material	Test Method	Test Frequency
		Organic Content Test - ASTM D2974, Method C	One representative test per [200] [_____] lineal [meters] [feet] of embankment.

-- End of Section --