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# PIP CVS02100
Site Preparation, Excavation, and Backfill Specification

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1. Introduction

1.1 Purpose

This Practice provides the requirements for site preparation, excavation, and backfill.

1.2 Scope

This Practice describes the requirements for excavation, placement, inspection, and management of materials during the site preparation, excavation, and backfill phase of a construction project.

This document is a complete revision of PIP CVS02100, and therefore revision markings are not provided.

2. References

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 Process Industry Practices (PIP)

- PIP CVS02350 - Roadway and Area Paving Construction Specification
- PIP CVS02700 - Underground Gravity Sewers Specification

2.2 Industry Codes and Standards

- American Concrete Institute (ACI)
  - ACI 229R - Controlled Low-Strength Materials
- ASTM International
  - ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils
  - ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³))
  - ASTM D1140 - Standard Test Methods for Amount of Material in Soils Finer Than the No. 200 (75-μm) Sieve
  - ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
  - ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³ (2700 kN-m/m³))
  - ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
  - ASTM D2937 - Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
  - ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
– ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
– ASTM D4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
– ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
– ASTM D5268 - Standard Specification for Topsoil used for Landscaping Purposes
– ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

2.3 Government Regulations

- U.S. Department of Labor, Occupational Safety and Health Administration (OSHA)
  – 29 CFR 1926 - Safety and Health Regulations for Construction
- U.S. Environmental Protection Agency (EPA)
  – 40 CFR 122 National Pollutant Discharge Elimination System (NPDES) General Permit for Point Source Discharge to Public Waterways (Permit)

2.4 Other References

– EPA 833-R-92-001 Storm Water Management for Construction Activities Storm Water Pollution Prevention Program (SWPPP)

3. Definitions

*Best Management Practices (BMP):* The techniques (e.g., buffers, silt fences, detention ponds, swales, etc.), schedules of activities, prohibitions of practices, and maintenance procedures used to prevent or reduce the discharge of pollutants

*constructor:* The party responsible for supplying the materials, equipment, tools, supervision, and labor for performing site preparation, excavation, fill, and backfill in accordance with the contract documents. The term constructor shall apply also to constructor’s subcontractor(s) and vendor(s).

*contract documents:* Any and all documents, including codes, studies, design drawings, specifications, sketches, practices, and data sheets that purchaser or engineer of record has transmitted or otherwise communicated, either by incorporation or reference, and made part of the legal contract agreement or purchase order between purchaser and constructor.

*engineer of record:* Purchaser’s authorized representative with overall authority and responsibility for the engineering design, quality, and performance of the civil works, structure, foundations, materials, and appurtenances described in the contract documents. The engineer of record shall be licensed as defined by the laws of the locality in which the work is to be constructed, and be qualified to practice in the specialty discipline required for the work described in the contract documents.

*impermeable fill:* Compacted clay fill which has a permeability of less than one foot per year (1x10^-6 cm/second) using the fluids to be retained.
owner: The party who has authority through ownership, lease, or other legal agreement over the project site

professional engineer: An engineer, other than the engineer of record licensed as defined by the laws of the locality in which the work is to be performed, and qualified to practice in the specialty discipline required for the work described in the contract documents.

purchaser: The party who awards the contract to constructor. The purchaser may be the owner or the owner’s authorized agent.

Storm Water Pollution Prevention Plan (SWPPP): Written plan that defines erosion and sediment control practices in accordance with the independent requirements of the federal construction general permits

4. **Requirements**

4.1 **General**

4.1.1 **Quality Control and Submittals**

4.1.1.1 A written Quality Control Program document that provides details of how compliance with the requirements of this Practice and contract documents shall be achieved shall be submitted by constructor to purchaser for approval a minimum of 15 days before start of construction.

4.1.1.2 Certified laboratory test data for the materials and products to be used in the work shall be submitted to purchaser for approval a minimum of 15 days before shipping of materials and products.

4.1.1.3 Results of the quality control tests required during the performance of the work shall be submitted to purchaser within 48 hours of completion.

4.1.1.4 An independent testing/inspection firm (see Section 4.1.2.1), shall provide the following submittals to purchaser and constructor:

- a. A statement attesting that constructor’s work is in accordance with the requirements of this Practice and the contract documents
- b. Informal daily “pass” or “fail” reports
- c. Formal weekly reports including all test logs and comments. These formal reports shall include density and moisture content test logs, indicating location of tests by coordinates and elevation and all appropriate comments.
- d. Upon earthwork completion, all density and moisture content test logs and comments compiled and submitted for permanent project records
- e. Sources and test results of all borrow materials used for fill

4.1.1.5 The following submittals shall be provided to purchaser. Data shall include horizontal dimensions, elevations, size, and slope gradients, as appropriate for the utility and as required by purchaser:
a. Accurately recorded as-built locations of project-installed underground utilities

b. Tie-in points/interferences encountered during project construction

### 4.1.1.6 Notify purchaser not less than five days in advance of any blasting operation. Blasting shall commence only after owner approval provided by purchaser.

### 4.1.1.7 If excavation bracing (i.e., shoring and sheeting, manufactured systems) is required, the following submittals shall be provided to purchaser:

a. Plans, sketches, and/or details of the materials and shoring system to be used, including sequence and method of installation

b. Supporting calculations prepared by a professional engineer

c. Identification of any bracing components that shall remain after filling or backfilling

### 4.1.1.8 If dewatering of an excavation is required, proposed methods and details shall be submitted to purchaser for review before beginning excavation.

### 4.1.1.9 If required by an authority having jurisdiction, a soil erosion control plan and/or a storm water runoff pollution prevention plan shall be provided to purchaser and the appropriate authority.

### 4.1.2 Quality Assurance

### 4.1.2.1 Unless otherwise specified in the contract documents, a qualified independent inspection and testing agency will be retained by purchaser to perform field and laboratory testing and/or evaluations in accordance with the criteria of ASTM D3740 to verify compliance of the work with the requirements of this Practice and to ensure the achievement of the intents and purposes of the work.

### 4.1.2.2 The performance or lack of performance of the tests and inspections by purchaser’s inspector shall not be construed as granting relief from the requirements of this Practice or the other contract documents.

### 4.1.2.3 During construction, purchaser shall have access to all constructor’s facilities and records for the purpose of conducting performance inspection/audits.

### 4.1.2.4 During an audit by purchaser, all inspection and test reports, and/or engineering analyses and calculations associated with the scope of work shall be provided to purchaser upon request.

### 4.1.3 Surveying

### 4.1.3.1 All lines and grades shall be determined by constructor for constructor’s operations from horizontal and vertical control points furnished by purchaser.
4.1.4 Inspection

4.1.4.1 Unless otherwise specified in the contract documents, the inspection/testing firm described in Section 4.1.2.1 shall be responsible for quality assurance inspection and testing to ensure that the work is in accordance with the requirements of this Practice and the contract documents.

4.1.4.2 The inspection/testing firm shall perform tests as outlined in Section 4.1.5 or as otherwise specified in the contract documents.

4.1.4.3 If purchaser furnishes the testing and inspection, constructor shall not be relieved of the responsibility to meet all requirements of this Practice and the contract documents.

4.1.4.4 If completed work is not in accordance with this Practice, constructor shall be responsible for repairing or reconstructing the deficiencies to meet this Practice and the other contract documents at constructor’s expense.

4.1.5 Testing

4.1.5.1 Unless otherwise specified in the contract documents, the inspection/testing firm described in Section 4.1.2.1 shall be responsible for the quality assurance testing requirements in this section to ensure that the work is in accordance with the requirements of this Practice and the other contract documents.

4.1.5.2 Tests of gradation, plasticity, density, and moisture content shall be performed for each type of fill material. These tests shall include the following:

a. One standard sieve analysis in accordance with ASTM C136, ASTM D422, or ASTM D1140

b. One liquid and plastic limit determination in accordance with ASTM D4318

c. One Modified Proctor Test in accordance with ASTM D1557 or one Standard Proctor Test in accordance with ASTM D698

4.1.5.3 For granular soils that do not exhibit a well-defined moisture-density relationship, index density, unit weight, and relative density shall be determined in accordance with ASTM D4253 and ASTM D4254.

4.1.5.4 If the type or the source of fill material changes, the control tests shall be performed again with the new material.

4.1.5.5 Unless otherwise specified in the contract documents, the following in-place dry density and moisture content testing (i.e., field density testing) on compacted fill shall be performed using one of the following methods:

a. Sand-cone method in accordance with ASTM D1556

b. Nuclear methods in accordance with ASTM D6938

c. Rubber balloon method in accordance with ASTM D2167
d. Drive-cylinder method in accordance with ASTM D2937

4.1.5.6 Unless otherwise specified in the contract documents, the field density testing shall be performed at the following frequencies:

a. Structural fill under foundations and building slabs – one test every 1000 square feet (90 square m) of each lift

b. Structural fill under roadways, railroads, area pavement and parking areas – one test every 2000 square feet (180 square m) of each lift

c. Road base and sub-base – one test every 2000 square feet (180 square m) of each lift

d. Backfill of trenches – one test for every 150 linear feet (45 m) of each lift and one test within each segment between changes in direction.

e. Backfill over foundations – one test for every 1000 square feet (90 square m) of each lift.

f. General fill – one test every 5000 square feet (460 square m) of each lift

4.1.5.7 As a minimum, one in-place moisture content and one density test shall be performed on every lift of fill.

4.1.5.8 Until the required dry density has been achieved, further placement of fill or backfill shall not be permitted.

4.1.5.9 The number of field density tests shall be increased by 50% if more than 4% of tests fail to meet the specified dry density. When failed tests become less than 2%, the number of tests shall revert to original specified frequency in Section 4.1.5.6.

4.1.6 Protection

4.1.6.1 Temporary fences, guardrails, barricades, lights, and other protective measures required for the safety of personnel and the premises shall be installed and maintained in good condition.

4.1.6.2 All reference points (e.g., property markers, benchmarks, etc.) shall be carefully maintained during excavation, backfilling, compaction, and earthwork.

4.1.6.3 If a reference point is damaged during performance of the work, the reference point shall be repaired or replaced in accordance with the requirements of owner.

4.1.6.4 Unless otherwise specified in the contract documents, before earthwork begins, purchaser shall locate and mark all known utilities within the project limits or note them in the contract documents.

4.1.6.5 If other utility locations become evident as earthwork progresses, work stoppages may be required by owner until utilities are identified and until owner provides specific direction.

4.1.6.6 Utilities scheduled to remain shall be protected and preserved.
4.1.6.7 Bracing and shoring shall be used to protect excavations adjacent to existing underground installations (e.g., foundations, piping manholes, electrical, and duct banks) and personnel performing excavation activities during construction.

4.1.6.8 Unless otherwise specified in the contract documents, excavation under foundations shall not be permitted.

4.1.6.9 Damage to structures, utility lines, or graded areas caused by erosion shall be repaired to the original condition at constructor’s expense. This includes areas that are seeded until such time that the vegetation prevents erosion.

4.1.6.10 During the performance of the work, constructor shall prevent dust from harming individuals and damaging adjacent properties and equipment.

4.1.7 Environmental

4.1.7.1 Contaminated Soils and Water

1. Known contaminated soils within the construction limits shall be managed in accordance with the soil management plan in accordance with contract documents.

2. If unexpected soil contamination is encountered during the work, the work shall be stopped and owner shall be notified immediately.

3. Water to be discharged that is potentially contaminated shall be managed in accordance with contract documents.

4.1.7.2 Erosion/Sediment Control

1. All procedures and work shall be in accordance with local, state, and federal regulations including the NPDES General Permit for Point Source Discharge to Public Waterways, and other EPA documents such as Storm Water Management for Construction Activities, or project specific permit.

2. Construction affected areas shall be maintained using temporary erosion and sediment control measures, in accordance with the Storm Water Pollution Prevention Plan (SWPPP) requirements until permanent measures are completed and functioning.

3. Inspections and reporting shall be performed as specified by the SWPPP.

4. If a project specific SWPPP is not required in the contract documents, the following minimum prevention measures shall be provided:
   a. Silt Fence
      Silt fence shall be installed in accordance with drawings provided in the contract documents and on downslope sides of the following areas:
      (1) All disturbed areas
      (2) All stockpile areas
b. Inspections
   (1) Daily inspections shall be performed in areas of active construction or equipment operation.
   (2) Weekly inspections shall be performed in areas with no construction or equipment operation.
   (3) Area inspections shall be performed within 24 hours of each 0.5-inch (13 mm) or greater rainfall event.
   (4) Inspection reports shall be prepared after each inspection and submitted to purchaser within 2 working days.

c. Maintenance
   (1) Sediment shall be removed from behind silt fence if it exceeds 6-inches (150 mm) in height. Removed sediment shall be placed in topsoil stockpile areas.
   (2) Any silt fence damaged so it cannot perform its intended function shall be replaced.
   (3) Silt fence shall be removed after area has been surfaced or seeded and has been approved by purchaser.
   (4) Soil that is spilled or washed onto paved areas or streets shall be removed from the surface daily.
   (5) Soil that breaches constructor’s erosion and sediment control measures and spills or washes into drains, pipes, gutters, or ditches or onto adjacent property shall be removed at least daily. Measures shall be provided to prevent recurrence.
   (6) Erosion/sediment controls shall be revised as conditions change during construction or if the minimum sediment control measures are not effective in controlling erosion and sediment.
   (7) The construction site shall be kept free of trash, and storage bins shall be kept covered.

4.1.8 Safety

4.1.8.1 General
   1. Work shall be in accordance with OSHA 29 CFR 1926 and other applicable federal, state, and local codes and with safety requirements of owner.
   2. Unless otherwise specified in the contract documents, a work permit shall be obtained from owner before performing earthwork.

4.1.8.2 Excavation Safety
   1. Constructor is solely responsible for designing and constructing stable excavations as mandated by OSHA 29 CFR 1926, Subpart P.
2. Excavation and trench safety systems include, but are not limited to, sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

3. Constructor’s “competent” representative, as defined in OSHA 29 CFR Part 1926.650 to 652 shall evaluate the soil exposed in the excavations and verify that excavation and trench safety systems, are certified for the actual installation conditions as part of constructor’s safety procedures.

4. Excavation slope height, slope inclination, and depth, including utility trench excavation depth, shall not be greater than specified in local, state, and federal safety regulations.

5. If evidence of possible cave-ins or slides is apparent, constructor shall immediately stop work in the excavation or trench and move personnel to safe locations until the necessary precautions have been taken by Constructor to safeguard personnel entering the trench.

6. Confined space entry permits shall be required for trenches and excavations qualifying as OSHA “permit required confined spaces”.

4.1.8.3 Rock Blasting

1. If rock blasting is required, a written rock-blasting safety plan shall be submitted for owner’s approval.

2. Permits for blasting shall be obtained by constructor from authorities having jurisdiction.

3. Copies of blasting permits shall be submitted to purchaser.

4. Written permission shall be obtained from owner before explosives are brought to the site and before drilling is started.

5. Explosives shall be stored, handled, and used in accordance with local regulations and owner’s safety practices. These criteria shall be addressed in the rock-blasting safety plan.

6. Constructor shall be responsible for all blasting operations.

4.2 Materials – Fill and Backfill

4.2.1 Basic Requirements

4.2.1.1 Fill and backfill materials shall be from either on-site excavation, designated borrow areas, or off-site sources in accordance with the requirements of Sections 4.2.1.3, 4.2.3, and 4.2.4.

4.2.1.2 All borrow material and all supply sources shall be submitted to the purchaser and approved by engineer of record.

4.2.1.3 Fill and backfill shall contain no rocks or stones larger than 3 inches (75 mm) and shall be free of frozen lumps, organic matter, trash, chunks of highly plastic clay, snow, ice, contamination, or other deleterious material.
4.2.1.4 Liquid limit and plastic limit of the materials shall be determined in accordance with ASTM D4318.

4.2.2 TopSoil
4.2.2.1 Topsoil shall conform to ASTM D5268 or contract documents.

4.2.3 General Fill Material
4.2.3.1 Fill and backfill to be used as general fill shall be material capable of being compacted to the requirements of Section 4.3.7.8 (2).

4.2.4 Structural Fill Material
4.2.4.1 Fill and backfill to be used as structural fill shall be gravel, sand, clay, or silt, or a mixture of these constituents capable of being compacted to the requirements of Section 4.3.7.8 (1).
4.2.4.2 Except for sands or gravels that exhibit no plasticity characteristics, the structural fill material shall be in accordance with the following requirements:
   a. Liquid limit – 40 maximum
   b. Plasticity index – 6 through 20

4.2.5 Controlled Low-Strength Material (CLSM)
4.2.5.1 CLSM may be substituted for either structural fill material or general fill material, if approved by purchaser.
4.2.5.2 CLSM shall be in accordance with ACI 229R.
4.2.5.3 The mix design shall be proportioned to produce a 28-day compressive strength between 50 and 100 psi (0.3 and 0.7 Mpa) for general fill and 100 and 200 psi (0.7 and 1.4 Mpa) for structural fill, pre-tested using the actual raw materials, and approved by the engineer of record before use on the project.
4.2.5.4 Compressive strength tests shall be performed in accordance with ASTM D4832.

4.2.6 Impermeable Fill
4.2.6.1 Earthen dikes, dams or levees shall use impermeable fill material for the compacted clay core. Channel or pond linings shall have a minimum of 12 inches (300 mm) thick layer of compacted clay unless the channel is engineered to be permeable.

4.3. Construction

4.3.1 Site Preparation
4.3.1.1 Clearing and Grubbing
   1. Clearing and grubbing shall consist of the removal and disposal of trees, stumps, roots, vegetation, logs, rubbish, and other unsuitable material.
2. Except for trees and shrubs in areas designated in the contract documents for preservation, areas designated for clearing and grubbing shall be cleared.

3. During construction operations, trees, shrubs, and other landscape features specifically designated in the contract documents for preservation shall be carefully protected from abuse, marring, or damage.

4. Trees and other vegetation outside the construction area shall not be damaged in any manner.

5. Trees, stumps, and other vegetation in the areas designated for clearing and grubbing shall be removed to the bottom of their root zone.

6. Depressions made by clearing and grubbing operations shall be filled in accordance with Section 4.3.7 and compacted to conform to the adjacent surface of the original ground.

4.3.1.2 Stripping

1. Before any soil is removed, the area shall be cleared of all debris.

2. Stripping shall consist of the excavation, removal, and satisfactory disposal of all topsoil and soil containing organic material. Such stripped materials shall not be used as structural fill material under any circumstances.

3. Topsoil shall be removed to full-depth or as specified in the contract documents.

4. Reusable materials shall be stockpiled as necessary for constructor’s operations in areas approved by purchaser.

4.3.1.3 Rough Grading

1. General area grading shall be completed to within a tolerance of plus or minus 0.20 feet (60 mm) of the elevations shown in the contract documents, but shall not be uniformly high or low.

2. Roads, parking areas, and building areas shall be excavated or filled to subgrade elevations shown in the contract documents.

3. Rock encountered through cut sections shall be excavated to 1 foot (0.3 m) below subgrade elevation and shall be backfilled to the specified elevation.

4. If unsatisfactory field conditions caused by rain, inclement weather, or other circumstances prevent satisfactory performance of the work, earthwork operations shall be suspended and the purchaser notified.

5. After completing grading operations and before grassing operations, the graded areas that are not to be further improved shall be overlaid with topsoil of a compacted thickness of 4 inches (100 mm) minimum.
4.3.2 Excavation

4.3.2.1 Structural Excavation

1. Structural excavation shall include excavations for area paving, roadways, railways, foundations, grade beams, sumps, basements, retaining walls, manholes, catch basins, trenches, and all other in-ground and below-ground facilities, and areas to be used in the future to support structural loads as specified in the contract documents.

2. Structural excavation shall be performed in accordance with the contract documents to the dimensions, grades, and elevations as noted and as required for formwork.

3. Over excavation shall not be permitted unless otherwise specified in the contract documents or approved by engineer of record.

4. Soils encountered at the bottom of excavation elevation specified in the contract documents which do not meet the compaction requirements of Section 4.3.6.3 or 4.3.6.4 shall be removed and replaced with compacted structural fill or CLSM.

4.3.2.2 Earthen Structures

1. Earthen structures include, but are not limited to, ponds, canals, ditches, retention basins, levees, and dikes.

2. Excavation for earthen structures shall be made to the lines, grades, and cross sections as specified in the contract documents.

3. Side slopes of excavations shall be cut and graded to the specified cross section.

4. Unstable soil in the slopes shall be removed, and the slopes repaired using material and methods in accordance with Sections 4.2 and 4.3.7.

5. The bottoms of excavations shall be graded to the elevations and configurations as specified in the contract documents.

6. Over-excavation shall be backfilled and compacted in accordance with Sections 4.2 and 4.3.7.

4.3.2.3 Trenching

1. Trenches are excavations made for placement of, but not limited to, underground piping, electrical cables, duct banks, and drainage ditches.

2. The bottom of trenches shall be graded to the elevations as specified in the contract documents.

3. When applicable install shoring in advance of or simultaneously with trench excavation so that soils within full height of trench excavation walls will remain laterally supported at all times.
4. Unstable soil in the bottom of trenches shall be removed and replaced using material and methods in accordance with Sections 4.2 and 4.3.7.

5. Over excavation of trenches shall not be permitted unless otherwise specified in the contract documents or approved by engineer of record.

4.3.2.4 Rock Excavation

1. Rock excavation shall consist of excavation of boulders or pieces of detached rock measuring 1 cubic yard (0.76 cubic m) in volume or greater, or rock in ledges, bedded deposits, and conglomerate deposits so firmly cemented that they present all the characteristics of solid rock, which cannot be excavated with earth moving, heavy equipment. All other excavation shall be earth excavation.

2. If blasting is not permitted, rock shall be excavated with mechanical rippers, mechanical breakers, or mechanical drills with non-explosive demolition agents.

3. If blasting is permitted and required, blasting operations shall be managed in accordance with the rock-blasting plan (see Section 4.1.8.3).

4. If unexpected hard rock is encountered during the work, the work shall be stopped until a blasting plan is developed or until owner provides specific direction.

4.3.3 Stockpiling

4.3.3.1 Material shall be stockpiled in a location specified by owner.

4.3.3.2 Stockpiles shall be placed, graded, and shaped for drainage.

4.3.3.3 Storage or stockpiling of material shall not be permitted on a completed subgrade.

4.3.3.4 Stockpiling of contaminated soils shall be in accordance with an owner approved contaminated soils management plan or as specified by owner.

4.3.4 Drainage

4.3.4.1 Drainage of cuts, excavations, fills, stockpiles, spoil areas, surcharge embankments, and borrow areas shall be maintained at all times to prevent ponding of surface water because of ground water or rainfall by providing temporary ditches, swales, culverts, and/or pumping systems as required in each respective site area.

4.3.4.2 Temporary drainage facilities shall be removed at the completion of the project or as specified by owner.

4.3.4.3 A temporary surface seal (e.g., sealing with a smooth drum roller) shall be constructed as required to prevent saturation during wet weather or temporary shutdown of operations.
4.3.4.4 Soil that becomes saturated shall be removed completely or reconditioned in accordance with Section 4.3.7.

4.3.5 Disposal of Excess and Waste Materials

4.3.5.1 If practicable, all suitable materials removed by excavation shall be used as fill.

4.3.5.2 Excavated material, in excess of that required for normal embankment construction, shall be stockpiled within the construction limits or shall be placed in a designated spoil area beyond the construction limits as specified by owner.

4.3.5.3 Material unsuitable for fill and debris, removed by clearing, grubbing, stripping, and excavation, shall be removed to a disposal area approved by owner.

4.3.5.4 Burning of combustible materials shall be performed only with the approval of owner and only if permitted by local authorities.

4.3.6 Preparation of Areas for Structural Fill or Loading

4.3.6.1 Areas of structural excavation to receive structural fill or loading shall be free of frozen subgrade, roots, trash, snow, ice, or other deleterious material.

4.3.6.2 Areas shall be prepared for structural fill or loading as follows:

a. Drained of standing water

b. Proof-rolled by crossing the area repeatedly and methodically with a 10-ton (9-tonne) minimum weight pneumatic tire compactor or a fully loaded dump truck. See PIP CVS02350 for proof-rolling requirements for roadways and area paving.

c. If proof-rolling demonstrates ruts between 1 and 2 inches (25 to 50 mm) deep after localized soft spots have been repaired, the top 6 inches (150 mm) of the overall area shall be scarified and re-compacted. For areas where ruts exceed 2 inches deep, the top 12 inches (300 mm) shall be scarified and re-compacted.

d. For enclosed areas or tightly spaced areas, if access by proof rolling equipment is limited, hand operated rollers or plate compactors may be used if approved by owner.

e. In accordance with any other requirements specified in the contract documents including but not limited to over-excavation, moisture conditioning and re-compacting of the upper soils, and chemical stabilization or other methods of improving soil conditions.

4.3.6.3 The density of the top 6 inches (150 mm) in areas for structural fill or loading shall not be less than 90% of the maximum Modified Proctor density in accordance with ASTM D1557, or 95% of the maximum Standard Proctor density in accordance with ASTM D698.

4.3.6.4 The density of the top 6 inches (150 mm) in areas of structural fill or loading, where granular soils exist that do not exhibit well-defined
moisture-density relationship, shall be compacted to at least 80% relative density in accordance with ASTM D4253 and ASTM D4254.

4.3.7 Filling and Backfilling

4.3.7.1 Unless otherwise specified in the contract documents, the following areas shall be filled or backfilled using structural fill:

a. For foundations that require fill for subgrade improvement or to raise elevation, directly beneath and 3 feet (1m) beyond perimeter of foundations.

b. Beneath slabs, roadways, railroads, area pavement, and parking areas directly beneath and 3 feet (1m) beyond the perimeter of improved area.

4.3.7.2 All other areas not designated above may be filled or backfilled using general fill, unless otherwise specified in the contract documents.

4.3.7.3 Before placement of structural fill or backfill, the area to receive the fill shall be prepared in accordance with Section 4.3.6.

4.3.7.4 Compacting shall begin only after the fill or backfill has been properly placed and the material is at the specified moisture content.

4.3.7.5 When air temperature is below freezing, earth fill shall not be placed on frozen soil. Earth fill shall be free draining and be placed at temperatures above 2°C.

4.3.7.6 Unless otherwise specified in the contract documents, material shall be placed in loose lifts not exceeding the following criteria, provided that the specified compaction is achieved for the full depth:

1. Structural fill shall be placed in lifts of 8 inches (200 mm) maximum in loose depth.

2. General fill shall be placed in lifts of 12 inches (300 mm) maximum in loose depth.

3. General and structural fill materials placed as backfill and compacted with hand-operated equipment shall be placed in lifts of 4 inches (100 mm) maximum in loose depth unless otherwise approved by purchaser.

4.3.7.7 Compaction shall be performed with equipment compatible with soil type.

4.3.7.8 Unless otherwise specified in the contract documents, fill and backfill layers shall be uniformly compacted in accordance with the following density and moisture content requirements:

1. Structural Fill Compaction Densities

   a. Structural fill shall be compacted to at least 90% of the maximum Modified Proctor density in accordance with ASTM D1557, or 95% of the maximum Standard Proctor density in accordance with ASTM D698.
b. Granular soil used as structural fill that does not exhibit well-defined moisture-density relationship shall be compacted to at least 80% relative density in accordance with ASTM D4253 and ASTM D4254.

2. General Fill Compaction Densities
   a. General fill shall be compacted to at least 85% of the maximum Modified Proctor density in accordance with ASTM D1557, or 90% of the maximum Standard Proctor density in accordance with ASTM D698.
   b. Granular soil used as general fill that does not exhibit well-defined moisture-density relationship shall be compacted to 70% to 75% relative density in accordance with ASTM D4253 and ASTM D4254.

3. The moisture content of the material being compacted shall be within plus or minus 3% of the optimum moisture content in accordance with the applicable ASTM D1557 or ASTM D698. Fill materials shall be conditioned as necessary to achieve the required moisture content, without additional cost to purchaser.

4. Chemical stabilization may be used provided the Engineer of Record approves the modifications necessary to obtain satisfactory compaction.

4.3.7.9 Topsoil shall be placed, leveled to grade and lightly rolled to produce a firm surface suitable for landscape purposes.

4.3.7.10 Compaction by water jetting or flooding shall not be permitted.

4.3.7.11 Fill and backfill adjacent to structures (e.g., retaining walls, pits, and basements) shall not be compacted with heavy equipment, but with hand-operated equipment to a distance of 4 feet (1.2 m) or greater beyond the sides of the structures.

4.3.7.12 To prevent unnecessary eccentric loading on a structure or foundation, every effort shall be made to place backfill materials symmetrically and in uniform layers.

4.3.7.13 Unless otherwise permitted by purchaser, backfill around or over cast-in-place concrete shall not be permitted until the concrete has attained 75% of its specified strength.

4.3.7.14 Compacted surfaces of fill and backfill shall be finish-graded to the cross sections, lines, grades, elevations and tolerances specified in the contract documents.

4.3.8 **Installation of Base Course**

4.3.8.1 The base course for roads, parking areas, and other areas to be surfaced shall be prepared in accordance with this section and PIP CVS02350.

4.3.8.2 The existing ground to the toe of fill slopes shall be cleared, grubbed, and stripped in accordance with Sections 4.3.1.1 and 4.3.1.2.
4.3.8.3 Excavation of areas in cut shall be in accordance with Section 4.3.2.

4.3.8.4 Backfill of base course shall be in accordance with Sections 4.3.6 and 4.3.7, with the following exceptions:

a. Compaction shall be to at least 95% of the maximum Modified Proctor density in accordance with ASTM D1557, or 100% of the maximum Standard Proctor density in accordance with ASTM D698.

b. If base course materials are clean granular material, compaction shall be to 85% of relative density in accordance with ASTM D4253 and ASTM D4254.

4.3.8.5 Geosynthetic materials shall be installed in accordance with manufacturer’s written instructions and/or as specified in the contract documents.

4.3.8.6 The compacted base course shall be shaped to a smooth and even surface, free of voids, and to the required elevation.

4.3.8.7 Deviation greater than ½ inch (12 mm) in cross section or ½ inch (12 mm) in length as measured with a 16-foot (5-m) straightedge shall be corrected by loosening, adding, or removing material and then reshaping and re-compacting by sprinkling and rolling.

4.3.8.8 The base course shall be maintained in a smooth, true-to-grade, compacted condition until it is covered by other construction.

4.3.9 Dewatering

4.3.9.1 All dewatering methods and disposal of water shall be approved by owner.

4.3.9.2 If required for construction, before excavation, an approved dewatering system shall be installed and operated when necessary to lower the groundwater.

4.3.9.3 Design of the dewatering system shall be the responsibility of constructor.

4.3.9.4 Constructor shall be responsible for any effects of dewatering on adjacent facilities.

4.3.9.5 Surface water shall be prevented from flowing into excavations by installing ditches, trenches, protective swales, pumps, or other purchaser approved measures.

4.3.9.6 All diverted and pumped non-contaminated water shall flow to existing drainage system in accordance with Section 4.1.7.1.

4.3.9.7 Excavations for foundations and other underground installations shall not be used as temporary drainage ditches.