

SECTION 31 23 33 – TRENCHING AND BACKFILLING**PART 1 – GENERAL**

1.01 SUMMARY

- A. Section Includes
 - 1. Excavating trenches for utilities.
 - 2. Compacted fill from top of utility bedding to subgrade elevations.
 - 3. Backfilling and compaction of utility trenches.

- B. Related Sections:
 - 1. Section 02 41 00 - Demolition.
 - 2. Section 31 05 13 - Soils for Earthwork: Soils for fill.
 - 3. Section 31 05 16 - Aggregates for Earthwork: Aggregates for fill.
 - 4. Section 31 10 00 - Site Clearing: Excavating topsoil.
 - 5. Section 31 22 13 - Rough Grading: Subsoil removal from site surface.
 - 6. Section 31 23 23 - Fill: General building area backfilling.
 - 7. Section 32 91 19 - Landscape Grading: Finish grading with topsoil to contours.

1.02 REFERENCES

- A. Pennsylvania Department of Transportation (PennDOT):
 - 1. Publication 408 - Specifications, latest edition, as amended.
 - 2. PennDOT Chapter 459, Occupancy of Highways by Utilities, latest edition
 - 3. PennDOT Chapter 203, Work Zone Traffic Control, latest edition

- B. Department of Environmental Protection, Bureau of Waste Management:
 - 1. "Clean Fill" Policy (Effective August 7, 2010).

- C. American Society for Testing and Materials:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - 3. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
 - 4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Informational Submittal:
 - 1. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- C. Samples: Submit aggregate samples when requested by Engineer and other required submissions to the Engineer's field office.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.
 - 3. Laboratory compaction curve according to ASTM D 1557 for each aggregate material proposed for fill and backfill.
 - 4. Density and moisture test reports for subgrades, fills and backfills.

1.04 QUALITY ASSURANCE

- A. Qualifications
 - 1. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed to practice at Project location.
 - 2. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct materials, as documented according to ASTM D 3740.
- B. Field Quality Control
 - 1. All field quality control testing must be supervised by a Professional Engineer.
 - 2. Reports of independent testing laboratory shall be considered as sufficient evidence of noncompliance with specifications.

1.05 PROJECT CONDITIONS

- A. Removal of Obstructions:
 - 1. Remove, realign or change the direction of above or below ground utilities and their appurtenant supports, if such is required in the opinion of the Engineer. Perform such work as additional work unless the Owner of the obstruction does such work without cost to the Contractor; however, Contractor shall uncover and sustain the obstruction at own expense prior to the final disposition of obstruction. The Contractor is not entitled to claims for damage or extra compensation due to the presence of such obstruction or delay in the removal or

rearrangement of same. Additional precautions concerning obstructions as follows:

- a. Without relieving Contractors responsibilities, allow utility owners to take such measures necessary under the circumstances. Do not interfere with utility owner employing protective measures, removing, modifying or replacing their property or structures.
 - b. Without extra compensation, break through and reconstruct if necessary, the invert or arch of a sewer, culvert or conduit that may be encountered if the said structure is in such a position, in the judgment of the Engineer, as not to require its removal, realignment or complete reconstruction.
- B. Existing Utilities and Services
1. Known underground services and utilities are indicated on the Contract Drawings. No guarantee is given to completeness or accuracy. Contractor shall be responsible for verifying the location and/or depth of all utilities and services indicated within the areas of work.
 2. Maintain existing utilities which must remain in service in the area of the excavation.
 3. Record locations of underground utilities encountered. Location should include horizontal and vertical distance from grade and existing structures.
- C. Unclassified Excavation: No consideration will be given to the nature of materials encountered in trenching operations. Therefore, as unclassified excavation, no additional payment will be made for difficulties occurring in excavating and handling of materials.
- D. Borrow Excavation: If the required quantity of backfill exceeds the quantity of suitable material excavated within the limits of the project site, obtain sufficient material to complete the backfill at no additional cost to Owner. Any tests required by Engineer to assist in determining suitability of the borrow materials shall be responsibility of Contractor and completed at no increase in Contract Price.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Bedding Material:
- B. Subbase Material (Bedding for structures, slabs-on-grade, sidewalks, and paving): Coarse aggregate meeting the requirements of PennDOT Publication 408 for No. 2A material and Owner supplied pavement millings as indicated on the contract drawings.
- C. Structural Fill: Select fill material meeting the requirements of PennDOT Publication 408 for No. 2A material.
- D. Suitable Backfill and Embankment Material: Material of maximum size that can be readily placed in loose, 8-inch layers; conforming to the requirements below. Frozen material

shall not be utilized.

1. Soil. Includes earth material with the following physical characteristics:
 - a. Gradation—More than 35% passing No. 200 sieve.
 - b. Minimum dry mass density—95 pounds per cubic foot determined according to PennDOT PTM No. 106, Method B.
 - c. Maximum liquid limit—65, determined according to AASHTO T 89.
 - d. Plasticity index—Not less than liquid limit minus 30, determined according to AASHTO T 90 for soils with liquid limits of 41 to 65.
 2. Granular Material. Includes natural or synthetic mineral aggregates having 35% or less passing the No. 200 sieve.
 3. Shale. Includes rock-like material formed by natural consolidation of mud, clay, silt, and fine sand; usually thinly laminated, comparatively soft, and easily split.
 4. Rock. Includes natural material that cannot be excavated without blasting or using rippers; also boulders and detached stones of a size that cannot be readily placed and compacted in loose, 8-inch layers and having insufficient soil to fill the voids in each layer.
 5. Random Material. Includes any accepted combination of the above classifications and may include concrete, brick, stone, or masonry units from demolition.
 6. Suitable Material. Reasonably free of organic matter, coal or coal blossom, or other objectionable matter. Wet, dry, or frozen material may be suitable when dried, wetted, or thawed, respectively.
- E. Clean Fill: Fill material consisting of soil, rock, stone, dredged material, used asphalt, and brick, block or concrete from construction and demolition activities. The evaluation of fill materials shall be in accordance with DEP’s “Clean Fill” regulations and procedures for determining whether material is clean or regulated.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Verify site conditions:
 1. Sedimentation and erosion control facilities in accordance with the requirements of Section 31 25 00.
 2. Excavation support and protection in accordance with the requirements of Section 31 50 00.
 3. Dewatering, as required, in accordance with the requirements of Section 31 23 19.
 4. Topsoil excavated and stockpiled in accordance with the requirements of Section 31 10 00.
- B. Notify PA One Call System at least 3 days prior to any excavation in order that all utility locations may be marked.
- C. Identify required lines, levels, contours, and datum.
- D. Notify utility owners to remove and/or relocate utilities.

- E. Protect utilities indicated to remain from damage.
- F. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- G. Verify and protect survey bench mark and intended elevations for the Work are as indicated on Drawings. Protect existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.02 REQUIREMENTS AND RESTRICTIONS

- A. Keep excavations free from water. Build diversions and all other devices necessary. If required, lower water table below excavation bottom by deep wells. Dispose of water removed from excavations in a manner that will not cause injury to the public health, to public or private property, to the work of other Contractors, to any portion of the Work completed or in progress, or to produce impediment to the use of highways, roads, lanes and streets by the public. No additional payment will be made for pumping or other difficulties encountered due to water.
- B. Maintain storm sewers, drains and ditches free of debris to convey surface drainage. No damming or ponding of water in gutters or other waterways will be permitted. Do not direct flow of water across pavements except through approved pipes or properly constructed troughs. Provide pipes or troughs of such sizes and lengths as may be required. Control grading in the vicinity of excavations so the ground surface is properly pitched to prevent water from running into excavated areas.
- C. Control groundwater and surface water during construction in order to maintain soil stability. Maintain the water table elevation sufficiently below the levels of excavations that slopes will remain stable and bottoms of excavations will not become loosened by flow of water. If the foundation material loses its strength due to improper dewatering techniques, over excavate the material and replace it with Structural Fill at no additional cost to Owner.
- D. Do not perform excavating when weather conditions or the condition of materials are such that the Work cannot be completed in accordance with the Specifications.
- E. Prevent spread of dust during performance of work by thoroughly moistening excavation areas by sprinkling or other methods approved by Engineer.
- F. No right of ownership of excavated materials is granted to Contractor prior to backfilling. This provision does not relieve Contractor of his responsibility to remove and dispose of surplus excavated material.
- G. Assume sole responsibility for the condition and results of excavations. Slides and cave-ins shall be removed without additional compensation at whatever time and under whatever circumstances they may occur.

3.03 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or regraded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- D. Remove excess subsoil not intended for reuse, from site.
- E. Storage of Approved Materials:
 - 1. Store on site all unused approved materials.
 - 2. Do not mix unused approved materials of differing types.
 - 3. Do not mix unused approved materials with unapproved materials.
- F. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key placed fill material to slope to provide firm bearing.
- G. Stability: Replace damaged or displaced subsoil as specified for fill.
- H. Excavation Below Planned Subgrade:
 - 1. Do not excavate below depths indicated on the Contract Drawings or such depths as required for the proper installation of the Work, unless otherwise directed by Engineer.
 - 2. Excavation below depths indicated on the Contract Drawings or as required for the proper installation of the Work through the fault of the Contractor, shall be restored to the indicated or required depths with Structural Fill at the expense of Contractor.
 - 3. If the foundation for any structure is required by Engineer to be carried lower than the planned subgrade elevation shown on the Contract Drawings, the voids caused by this excavation shall be backfilled with Structural Fill up to subgrade elevation. Payment for the additional work will be made in accordance with the applicable General Conditions.

3.04 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place material in continuous layers as follows:
 - 1. Subsoil Fill: Maximum 8 inches compacted depth.
 - 2. Structural Fill: Maximum 8 inches compacted depth.
 - 3. Granular Fill: Maximum 8 inches compacted depth.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.

- D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Repair or replace items indicated to remain damaged by excavation or filling.

3.05 SUBGRADE PREPARATION

- A. General Procedures:
 - 1. Where subgrade consists of an excavated soil surface, thoroughly machine-tamp or proof-roll the existing material. Compact the exposed soils until no movement is observed or as directed by the Engineer. Remove and replace soft, loose, and disturbed zones disclosed by the tamping or proof-rolling. Overexcavate to the depth directed by Engineer and replace with Structural Fill; compact as indicated in these specifications.
 - 2. Where subgrade consists of an excavated rock surface, thoroughly inspect the bedrock bearing surfaces, and clean any exposed soil-filled seams with water jets or compressed air to a minimum depth of two (2) times the seam width. Fill the open joints with concrete during placement of the structure foundation.
 - 3. Where subgrade consists of an elevated fill surface, compact the fill as indicated elsewhere in these specifications. Shape the surface to the required lines and grades.
 - 4. Do not place fill materials on surfaces that are muddy, frozen, or contain frost.
 - 5. Trim bottoms to indicated lines and grades to leave solid base to receive other work.
 - 6. Place geotextile material on the subgrade prior to placing fill materials.
- B. Approval of Subgrade
 - 1. Notify Geotechnical Engineer when excavations have reached required subgrade.
 - 2. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 3. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
 - 4. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer.

3.06 STRUCTURAL FILL

- A. Placement and Compaction:
 - 1. Spread material uniformly without segregation of coarse and fine material.
 - 2. Place material in 8-inch maximum loose lifts if full-size compaction equipment will be used, and 6-inch maximum loose lifts if hand compaction equipment will be used.
 - 3. Maintain the moisture content of the material within 2% plus or minus of the

optimum moisture content as determined by the Standard Compaction Test, ASTM D698.

4. Compact the material to at least 100% of the maximum dry density as determined by ASTM D6938.

3.07 SUBBASE

- A. General: Do not place subbase material on soft, muddy or frozen subgrades. Satisfactorily correct irregularities or soft zones in the prepared area.
- B. Placement and Compaction: Place subbase material in maximum 6" lifts. When using PennDOT No. 2A material, compact to 100% of the maximum dry-weight density.

3.08 BACKFILLING

- A. General Procedures:
 1. Perform backfilling using machinery, except where hand backfilling is required to prevent damage to walls, foundations, utilities, electrical conduits, sanitary sewer or force main piping. No additional compensation will be paid where backfilling by hand is required.
 2. Clean excavation free of trash and debris prior to backfilling.
 3. Do not place backfill material prior to seven days after completion of structure walls, and then only if the concrete has achieved 80% of the specified 28-day compressive strength.
 4. Do not place backfill material on wet or frozen areas.
 5. Do not operate heavy equipment closer to walls than a distance equal to the height of backfill material above the top of the structure footing.
 6. Do not place backfill material against exterior walls until supporting floors, other reinforcing or supporting members, or slabs at top of walls are in place.
 7. Do not place backfill material against water-containing concrete structures or manholes until water testing has been satisfactorily completed.
 8. Perform compaction using power driven tampers or compactors suitable for material being placed.
- B. Suitable Backfill:
 1. Use suitable backfill where structure backfill is not required or specified. Use of structure backfill in lieu of suitable backfill is allowed.
 2. Place backfill in loose, uniform horizontal layers not exceeding 8-inches in depth.
 3. Maintain moisture content of backfill at compaction within 2% plus or minus of optimum moisture as determined by ASTM D698.
 4. Compact backfill to at least 95% of the maximum dry density based on ASTM D698.
- C. Structure Backfill:
 1. Place structure backfill behind structure walls. Place structure backfill in 8-inch lifts and thoroughly compact each lift with a vibratory compactor to the satisfaction of Engineer.

3.09 EMBANKMENTS AND FILLS

- A. General:
1. Construct in accordance with these Specifications to line and grades on Contract Drawings.
 2. All material excavated within the limits of site, which conforms to the specified herein requirements for fill may be used for construction of embankment. Any additional materials required shall be provided by Contractor from approved offsite source(s) at no additional cost to Owner. Any test required by Engineer to assist in determining suitability of offsite materials shall be responsibility of Contractor and completed at no increase in Contract Price.
- B. Preparation:
1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or breakup sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface. Scarify all lesser sloped surfaces to a depth of 8 inches.
 2. When existing ground surface has a density less than that specified for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.
 3. Surface to receive embankment shall be inspected and approved by Engineer before any fill material is placed. Do not place fill material on surfaces that are muddy, frozen or contain frost or ice.
- C. Placement and Compaction:
1. Embankment material (other than rock) shall be spread in horizontal layers of not more than 8 inches (loose) and compacted with pneumatic tire tamping, or other approved type rollers weighing ten tons or more. Material placement in area subject to compaction by hand-operated tampers shall not be greater than 4 inches. Compact material to a minimum density of 95% of its maximum dry-weight density as measured by the Standard Compaction Test, ASTM D 698. Adjust the moisture content of the material prior to compaction to within two (2) percentage points of the optimum moisture content as determined by ASTM D 698. When material is too coarse (more than 20% retained on the $\frac{3}{4}$ " sieve) for these methods, satisfactory compaction will be based on non-movement of the material.
 2. Rock embankment shall be placed in uniform loose layers of 24 inches or less and shall be thoroughly compacted. Rock which cannot be readily incorporated in a 24 inch layer shall be wasted or reduced in size until it can be so incorporated. The top 12 inches of all embankments shall be formed of granular materials or soil and in no case shall material larger than 3 inches be placed in the top 6 inches of embankments.
 3. Shape the top layer of embankment to drain during construction.
 4. Contractor shall be responsible for the stability of all embankments and shall replace all sections, which, in the opinion of Engineer, have been damaged or displaced due to carelessness or negligence on the part of Contractor.

- D. Fill Under Floor Slabs On Grade:
1. Where fill is required to raise the subgrade for concrete floor slabs to the elevations indicated on the Contract Drawings, such fills shall be made with proper materials, equipment, and workmanship, and under control and supervision of an approved testing laboratory. Where such fills exceed 12 inches in depth, the fill shall be constructed before proceeding with foundation work. Contractor is responsible to for cost of all laboratory testing.
 2. Construction:
 - a. Areas to be filled shall be cleared of all loose material. The surface shall then be loosened to a depth of at least 4 inches and satisfactorily compacted. Fill material shall be free from frost and shall not be placed on frozen ground. It shall be deposited in layers of such thickness as required by the nature of the soil or as directed, but the un-compacted thickness of each layer shall not exceed 8 inches. Each layer shall be separately compacted to a uniform solid mass by machine rolling or other approved means. Fill shall be placed in horizontal layers, beginning with the lowest areas and building up until the entire area to be filled is at a uniform elevation. Contractor shall control the moisture content of the fill material, to insure maximum density by either the addition of water, or by harrowing and working the soil prior to compacting. Maintain moisture content with 2% plus or minus of the optimum moisture content as determined by ASTM D 698. Each layer shall be free of ruts and shall meet compaction requirements before a succeeding layer is placed. Compaction of each layer shall continue until no weaving or creeping takes place.
 - b. Field tests of moisture content prior to compaction and density after compaction shall be made to insure thorough and uniform compaction.
 3. Required Results: All fills under concrete floor slabs shall be compacted to not less than 100% of the maximum dry-weight density at optimum moisture as specified above. Whenever in-place density, according to the test noted above, is found to be below acceptable limits, additional compaction will be required to produce the specified density, as shown by additional tests.

3.10 FIELD QUALITY CONTROL

- A. Testing
1. Contractor shall have field density tests performed in accordance with ASTM D 6938.
 2. Engineer shall inspect and approve subgrades and fill layers before further construction work is performed.
 3. All testing to be completed by independent testing agency and paid for by the Contractor.
 4. Structure Foundations: For each strata of soil on which a structure foundation will be placed, conduct at least three tests to verify required design bearing capacities. Subsequent verification and approval of bearing material may be based on a visual comparison of each subsurface bearing material with related tested strata, when acceptable to Engineer.

5. Building Slab Subgrade: Make at least one field density test of subgrade for every 500 sq. ft. of building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 500 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.
 6. Suitable Backfill at Embankment: Take at least 2 field density tests, at locations and elevations as directed.
- B. Corrective Measures:
1. Whenever tests indicate that the field moisture or density does not meet specified requirements, take corrective action as approved by Engineer.
 2. Corrective measures may include loosening the soil and wetting or drying it prior to re-compaction, additional compaction, or removing and replacing the material.
 3. Retest material that did not meet the moisture and density requirements after corrective measures have been performed.
- C. Retesting: Engineer may at any time require retesting of any material, whether in stockpiles or being placed, if it appears that the material differs from that which has previously been approved for use.
- D. Surface Tolerance:
1. Check finished subgrade for smoothness and elevation in accordance with the following:
 - a. Use approved template conforming the required design requirement indicated on the Drawings for checking crown, contour and sideslopes.
 - b. Use approved 10-foot straight edge to check longitudinal irregularities in the subgrade.
 - c. Use string lines for controlling the finished elevation.
 2. Required Subgrade Grading Tolerances
 - a. Foundations: ± 0.02 feet of indicated grade
 - b. Vehicular Traffic Areas: ± 0.10 feet of indicated grade
 - c. Topsoiled Areas: ± 0.15 feet of indicated grade
 - d. Swales or Stormwater Management Areas: ± 0.10 feet of indicated grade

END OF SECTION