

Section 2100

Earthwork

PART 1: General

- 1.1 *Related Documents* – Drawings and general provisions of contract, including General and Supplementary Conditions and other Specification Sections within this project manual, apply to this section.
- 1.2 *Summary* – This section includes the following:
 - 1.2.1 Extent of earthwork is indicated on drawings. This work consists of grading in order to achieve finished elevations shown on the construction plans.
 - 1.2.2 Preparation of subgrade for slabs, walks, concrete swales and pavements is included as part of this work.
 - 1.2.3 All graded surfaces shall be smooth and uniform, without abrupt changes in slope or grade. Areas to be covered with paving shall be fine graded to the required elevations and slopes. Finished surfaces in all other areas may vary up to 0.1 feet from the required elevations.
 - 1.2.4 Excavating and Backfilling of trenches for storm sewer is included in the work of this section.
 - 1.2.5 Excavation and backfill required in conjunction with underground mechanical and electrical utilities and buried mechanical and electrical appurtenances is included as work of this section.
- 1.3 *Definitions* –
 - 1.3.1 *Excavation* – Removal of material encountered to subgrade elevations indicated or below subgrade elevations as directed by the Engineer and subsequent disposal of materials removed.
 - 1.3.2 *Unauthorized Excavation* – Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect/Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be at Contractor's expense. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill maybe used to bring elevations to proper position, when acceptable to Architect/Engineer.
 - 1.3.3 *Additional Excavation* – When excavation has reached required subgrade elevations, notify Architect/Engineer, who will make an inspection of conditions. If Architect/Engineer determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Architect/Engineer.

- 1.3.4 *Subgrade* – The undisturbed earth or the compacted soil layer immediately below base, fill, or topsoil materials.
- 1.3.5 *Structure* – Buildings, foundations, slabs, tanks, curbs, end walls, mitered end sections, inlets, manholes, or other man-made stationary features occurring above or below ground surface.
- 1.4 *Submittals* – Submit the following reports directly to Architect/Engineer from the testing services, with copy to the Contractor:
 - 1.4.1 Test reports on borrow material.
 - 1.4.2 Verification of suitability of each footing subgrade material, in accordance with specified requirements.
 - 1.4.3 Field reports; in-place soil density tests.
 - 1.4.3.1 One optimum moisture-maximum density curve for each type of soil encountered.
 - 1.4.3.2 Report of actual unconfirmed compressive strength and/or results of bearing tests of each strata tested.
- 1.5 *Quality Assurance* –
 - 1.5.1 *Codes and Standards* – Perform excavation work in compliance with applicable requirements of authorities having jurisdiction. All material and construction methods shall be in accordance with Section 120 of the Standard Specification of Roads and Bridges, State of Florida, Department of Transportation, latest edition.
 - 1.5.2 *Testing and Inspection* – Employ, at the Contractor's expense, a geotechnical testing laboratory, acceptable to the Owner, to perform soil testing and inspection service for quality control testing during earthwork operations. Contractor shall replace materials removed for testing purposes. Should any work of materials fail to meet the requirements set forth in the plans and specifications, Contractor shall pay for re-testing of same.
- 1.6 *Project Conditions* –
 - 1.6.1 *Site Information* –
 - 1.6.1.1 Data in subsurface investigation reports were used for the basis of the design and are available to the Contractor for information only. Conditions are not considered representations or warranties of accuracy or continuity between soil borings. The Architect/Engineer and the Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.
 - 1.6.1.2 Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

1.6.2 *Existing Utilities –*

- 1.6.2.1 Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
- 1.6.2.2 Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult Utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of Architect/Engineer and Utility Owner.
- 1.6.2.3 Do not interrupt existing utilities serving any facility during occupied hours, except when permitted in writing by Architect/Engineer and then only after acceptable temporary utility services have been provided.
- 1.6.2.4 Provide minimum of 48-hour notice to Architect/Engineer, and appropriate utility company and receive written notice to proceed before interrupting any utility.
- 1.6.2.5 Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.
- 1.6.2.6 Perform Excavation by hand within drip line of trees to remain. Protect root systems from damage or dry out to the greatest extent possible. Maintain moist conditions for root system and cover exposed roots with moistened burlap.

1.6.3 *Use of Explosives –* Use of explosives is not permitted.

1.6.4 *Protection of Persons and Property –*

- 1.6.4.1 Barricade open excavations occurring as part of this work and post with warning lights.
- 1.6.4.2 Operate warning lights as recommended by authorities having jurisdiction.
- 1.6.4.3 Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

PART 2: Products

2.1 *Fill –*

- 2.1.1 Soils used as fill shall be clean sands. Non-structural fill shall contain less than 5 percent material passing the No. 200 sieve, and structural fill shall contain less than 12 percent material passing the No. 200 sieve. The sand shall have a maximum dry density of at least 100 pounds per cubic foot according to the Standard Proctor Compaction Test, (ASTM D 698). Soil materials shall be free of debris, waste, frozen materials, vegetation and other deleterious matter.

- 2.1.2 In order to insure proper bond and prevent slipping between the original ground and fill, the surface of the original ground shall be scarified to a depth of at least three inches. Each layer of fill material shall be compacted until the required density is achieved.
- 2.2 *Cut* – Where required, the site shall be excavated to the grades depicted upon the plans. Excavated material that is suitable shall be used in the fill sections of the site. Any excess material shall be hauled away from site.

PART 3: Execution

- 3.1 *General* – The site shall be stripped of all organic and deleterious materials in phases, so as to prevent and impede erosion and sedimentation.
- 3.2 *Compaction of Subgrade, Cut and Fill* –
- 3.2.1 Compaction requirements shall be as determined by the Modified Proctor Test (ASTM D 1557 or AASHTO T-180) or Standard Proctor Test (ASTM D 698) on existing soils, with a soil at or near optimum moisture content. In unpaved areas the top 8 inches of subgrade shall be compacted to a minimum soil density of 95 percent of the Standard Proctor Test with large traffic sized non-vibratory equipment. In paved areas the top 12 inches of subgrade shall be compacted to a minimum soil density of 96 percent of the Modified Proctor Test. All roots and other materials that would diminish the efficiency of the compaction operation shall be removed prior to compacting.
- 3.2.2 Remove and replace or scarify and air dry soil materials that are too wet to permit compaction to specified density. Only suitable materials free from excessive moisture shall be used for fill or backfill. Suitable soil materials that have been removed because they are too wet and compaction cannot occur, may be stockpiled or spread and allowed to dry. Assist in drying may be discing, Harrowing, or pulverizing until the moisture content is reduced to a satisfactory value.
- 3.3 *Stabilized Subgrade* – Subgrade stabilization shall be done in accordance with applicable portions of these specifications.
- 3.4 *Excavation* – Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.
- 3.5 *Stability of Excavations* –
- 3.5.1 All excavation work shall conform to OSHA Publication “Excavations 2226,” 1990 Revision, and OSHA Excavation; Final Rule 29, CFR, Part 1926, October 31, 1989. The Contractor will provide written assurance of compliance with the law and with the laws of Florida Chapter 90-96.
- 3.5.2 The Contractor’s method of providing protective support to prevent cave-ins shall be submitted with the Bid and conform to OSHA requirements. Slope excavations, shoring, and trench box usage in the field will be based on tabulated data and designed by the Contractor.

3.5.3 *Shoring and Bracing –*

- 3.5.3.1 Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.
- 3.5.3.2 Provide permanent steel sheet piling or pressure treated CCA timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2.5 feet below final grade and leave permanently in place.
- 3.5.4 The Contractor shall do all shoring required to perform and protect the excavation and as necessary for the safety of the employees.

3.6 *Dewatering –*

- 3.6.1 Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
- 3.6.2 The Contractor shall prevent the accumulation of water in the excavated areas, and shall remove by pumping or other means, any water which accumulates in the excavation. The Contractor shall prevent the accumulation of water in both structural and trench excavations and shall remove by well point system or by other means, water which accumulates in the excavation. The Contractor shall provide, install, operate and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations. The Contractor shall include the cost of this equipment and work in the price he bids for the work.
- 3.6.3 Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting of runoff areas. Do not use trench excavations as temporary drainage ditches.
- 3.6.4 The Contractor shall be responsible for and ensure all effluent water from the dewatering operations meets or exceeds F.D.E.P. and C.O.E. water quality standards prior to entering jurisdictional water bodies.

3.7 *Storage of Excavated Materials –*

- 3.7.1 Stockpile excavated materials acceptable for backfill and fill where directed. Place, grade, and shape stockpiles for proper drainage.
- 3.7.2 Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
- 3.7.3 Dispose of excess excavated materials not acceptable for use as backfill or fill offsite in a legal manner.

3.8 *Excavation for Structures –*

- 3.8.1 Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing

and removal of concrete formwork, installation of services, and other construction and for inspection.

3.8.2 Excavations for footings and foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.9 *Excavation for Pavements* – Cut surface under pavements to comply with cross-sections, elevations and grades as indicated.

3.10 *Trench Excavation for Storm Pipes, Conduit, and Irrigation Pipes* –

3.10.1 Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches of clearance on both sides of pipe or conduit.

3.10.2 Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

3.10.3 Where rock is encountered, carry excavation 6 inches below required elevation and backfill with a 6 inch layer of crushed stone or gravel prior to installation of pipe.

3.10.4 For pipes or conduit less than 6 inches in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand-excavate bottom, cut to accurate elevations, and support pipe or conduit on undisturbed soil.

3.10.5 For pipes and equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom $\frac{1}{4}$ of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads and ensure continuous bearing of pipe barrel on bearing surface.

3.11 *Other Excavations* –

3.11.1 Excavation for manholes, catch basins, junction boxes and other accessories shall be sufficient to leave at least 12 inches in the clear between their outer surfaces and the embankment of timber that may be used to protect them. Backfill of earth around manholes shall be filled with thoroughly compacted sand or gravel at the expense of the Contractor.

3.11.2 Excavations for footings and foundations shall be made to the dimensions and elevations indicated on the drawings, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection. Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottom to required lines and grades to leave a solid base to receive other work.

3.11.3 Excavations for Mechanical and Electrical structures shall be made to the dimensions and elevations indicated on the drawings and a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and inspection. Do not disturb bottom of excavations intended for bearing surface.

3.11.4 Excavation for all structures shall be made to the dimensions and elevation indicated on the drawings. Where the excavation is made below the indicated elevations, the

excavation shall be restored to the proper elevation with concrete fill, or the heights of walls and footings shall be furnished by the Contractor without extra compensations, except where additional excavation is ordered to obtain proper bearing in which case the Contract price will be adjusted to cover such additional work.

3.12 *Cold Weather Protection* – Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

3.13 *Backfill and Fill* –

3.13.1 *General* – Place soil material in layers to required subgrade elevations, for each area classification listed below.

3.13.1.1 Under grassed areas, use satisfactory non-structural fill, excavated or borrow materials.

3.13.1.2 Under walks and pavements, use satisfactory structural fill, excavated or borrow materials, or a combination.

3.13.1.3 Under piping, conduit, and equipment, use satisfactory structural fill, excavated or borrow materials where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder.

3.13.1.4 Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.

3.13.1.5 Concrete is specified in appropriate section.

3.13.1.6 Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Architect/Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

3.13.2 Backfill excavations as promptly as work permits, but not until completion of the following:

3.13.2.1 Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.

3.13.2.2 Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.

3.13.3 Removal of concrete formwork

3.13.3.1 Remove of shoring and bracing, and backfill voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in such a manner as to prevent settlement of the structure and/or utilities, or leave in place if required.

3.13.3.2 Remove trash and debris from excavation

3.14 *Backfilling* –

- 3.14.1 Trenches shall be backfilled with excavated materials, free from large clods and stones. Backfill shall be deposited in layers not to exceed 6 inches (6”) in thickness, moistened, and compacted to density equal to or greater than 95 percent of the Modified Proctor Density (ASTM D 1557), to a minimum depth of 12 inches over the pipe. The remainder of the backfill shall be placed in 8-inch layers compacted to 95 percent maximum density of the Modified Proctor Test unless the backfill is beneath paved or building areas in which case it shall be compacted to 98 percent of the Modified Proctor Test.
- 3.14.2 Selected materials shall be used for all backfill, trash shall not be allowed to accumulate in spaces to be backfilled, and this space shall be well cleared before backfill is placed.
- 3.14.3 No fill material shall be placed, spread or rolled while the ground or fill is frozen or thawing or during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until the moisture content and density of the fill are as previously specified.

3.15 *Grading (Only as Applicable per Plans)* –

- 3.15.1 *General* – Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.
 - 3.15.1.1 *Unpaved Areas* – Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
 - 3.15.1.2 *Concrete Swales* – Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.
 - 3.15.1.3 *Walks* – Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than ½-inch above or below required subgrade elevation.
 - 3.15.1.4 *Pavements* – Shape surface of areas under pavement to line, grade, and cross-section with finish surface not more than ½-inch above or below required subgrade elevation.
- 3.15.2 *Compaction* – After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.16 *Field Quality Control* –

- 3.16.1 *Quality Control Testing During Construction* – Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
- 3.16.2 *Compaction Test* – A minimum of one compaction test shall be performed on each different type of material encountered which will be subject to applicable field density tests.

- 3.16.2.1 *Density Test* – Perform field density tests in accordance with ASTM 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), as applicable.
 - 3.16.2.1.1 Field density tests may also be performed by the nuclear method in accordance with ASTM D 2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gauges in accordance with ASTM D 3017.
 - 3.16.2.1.2 If field tests are performed using nuclear methods, make calibration checks of both density and moisture gauges at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect/Engineer.
 - 3.16.2.2 *Footing Subgrade* – For each strata of soil on which footings will be placed, perform at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Architect/Engineer.
 - 3.16.2.3 *Paved Areas* – Perform at least one field density test of subgrade for every 300 square yards of paved area at 8 inches below subgrade in cut sections. In each compacted fill layer, perform one field density test for every 300 square yards of paved area. Location of tests shall be determined by the Architect/Engineer.
 - 3.16.2.4 *Unpaved Areas* – Perform at least one field density test of subgrade for every 1000 square yards of non-paved area at 8 inches below subgrade in cut sections. In each compacted fill layer, perform one field density test for every 1000 square yards of non-paved area. Location of tests shall be determined by the Architect/Engineer.
 - 3.16.2.5 *Trench Backfill* – Field tests shall be made at the minimum rate of one test per layer of backfill per 400 linear feet of trench or at least one test per layer of backfill per run of pipe.
 - 3.16.2.6 *Unsatisfactory Tests* – If in opinion of Architect/Engineer, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained at no additional cost.
- 3.17 *Erosion Control* – The Contractor shall be responsible for the prevention of erosion from the site, the control of turbidity generated on site and for maintaining graded surfaces, for the duration of the project.
- 3.18 *Maintenance* –
- 3.18.1 *Protection of Graded Areas* – Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
 - 3.18.2 *Repairs* – Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

- 3.18.3 *Reconditioning Compacted Areas* – Where completed compacted areas are disturbed by subsequent construction operations, or adverse weather, scarify surface, reshape and compact to required density prior to further construction.
- 3.18.4 *Settling* – Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- 3.19 *Existing Utility Lines* – Attention is called to the fact that the Contractor is responsible for contacting all utility companies to obtain locations of all existing utilities or obstructions which he may encounter during construction. After location of utilities by the appropriate utility company and Owner, it is the Contractor's liability to protect all such utility lines, including service lines and appurtenances, and to replace at his own expense any which may be damaged by the Contractor's equipment or forces during construction of the project.
- 3.20 *Barricades, Guards, and Safety Provisions* – To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained by the Contractor during the progress of the construction work. Rules and regulations of the local authorities with respect to safety provisions shall be observed.
- 3.21 *Traffic Controls* – Excavations for pipe laying operation shall be conducted in a manner to cause the least interruption to traffic. When traffic must cross open trenches, the Contractor shall provide suitable bridges.
- 3.22 *Flow Drain and Sewer Maintenance* – Adequate provision shall be made for the flow of sewers, drains, and water courses encountered during construction, and the structures which may have been disturbed shall be satisfactorily restored by the Contractor.
- 3.23 *Property Protection* – Trees, fences, poles, manholes, and all other property shall be protected unless their removal is authorized; and any property damaged shall be satisfactorily restored by the Contractor at the Contractor's expense.
- 3.24 *Clean-Up* – Before final inspection and acceptance the Contractor shall clean ditches, shape shoulders, and restore all disturbed areas, including street crossings, grass plots, re-grassing if necessary, to as good a condition as existed before work started. All trenches shall be leveled, and loose material removed from pavement, gutters, and sidewalks, employing hand labor if necessary.
- 3.25 *Disposal of Excess, and Waste Materials* – Remove waste materials, including trash, and debris, and dispose in a legal manner.