

SECTION 02200EARTHWORKPART 1 - GENERAL1.1 DESCRIPTION

- A. The Work described by this Section consists of all earthwork encountered and necessary for construction of the project as indicated in the Contract Documents, and includes but is not limited to the following:
1. Excavation
 2. Backfilling and Filling
 3. Compaction
 4. Embankment Construction
 5. Grading
 6. Providing soil material as necessary
 7. Disposal of excess suitable material and unsuitable materials
- B. Related Work Specified Elsewhere: (When Applicable)
1. Clearing and Grubbing, Temporary Erosion Control are specified in the appropriate sections of this Division.
 2. Section 01400 - Quality Control.
 3. Pipe, fittings and valves are specified in Division 15.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
1. All work shall be performed and completed in accordance with all local, state and federal regulations.
 2. The General Contractor shall secure all other necessary permits unless otherwise indicated from, and furnish proof of acceptance by, the municipal and state departments having jurisdiction and shall pay for all such permits, except as specifically stated elsewhere in the Contract Documents.
- B. Line and Grade:
1. The Contractor shall establish the lines and grades in conformity with the Drawings and maintain same to properly perform the work.
- C. Testing Methods:
1. Gradation Analysis: Where a gradation is specified the testing shall be in accordance with ASTM C-117-90 and ASTM C-136-93 (or latest revision).
 2. Compaction Control:
 - a) Unless otherwise indicated, wherever a percentage of compaction for backfill is indicated or specified, it shall be the in-place density divided by the maximum density and multiplied by 100. The maximum density shall be the density at optimum moisture as determined by ASTM Standard Methods of Test for Moisture-Density Relations of Soil Using 10-lb.

Hammer and 18-in. Drop, Designation D-1557-91 (Modified Proctor), or latest revision, unless otherwise indicated.

- b) The in-place density shall be determined in accordance with ASTM Standard Method of Test for Density of Soil in Place by the Sand Cone method, Designation D 1556-90, (or latest revision) or Nuclear method Designation D2922.
- c) Wherever specifically indicated, maximum density at optimum moisture may be determined by ASTM Standard Methods of Test for Moisture Density Relations of Soils, ASTM D-698-91 (Standard Proctor).
- d) An Independent Testing Laboratory will be retained by the Owner to conduct all laboratory and field soil sampling and testing, and to observe earth work and foundation construction activities. Laboratory testing will consist of sieve analyses, natural water content determinations, and compaction tests. Field testing will consist of in-place field density tests and determination of water contents.

1.3 SUBMITTALS

- A. Collection of samples and testing of all materials for submittals shall be performed by the Independent Testing Laboratory and paid for by the Contractor until the materials are approved by the Owner or Engineer.
- B. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.
- C. Submit test results (including gradation analysis) and source location for all borrow material to be used at least 10 working days prior to its use on the site. Contractor shall identify and provide access to borrow sites.
- D. Submit moisture density curve for each type of soil (on site or borrow material) to be used for embankment construction or fill beneath structures or pavement.

1.4 TESTS

The Independent Testing Laboratory shall conform to the following procedures and standards:

- A. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.
- B. All testing shall be performed by a qualified Independent Testing Laboratory acceptable to the Engineer and Contractor at the Contractor's expense unless otherwise indicated (see Section 01400 - Quality Control).
- C. Field density tests on embankment materials shall be as follows:
 - 1. Tests shall be taken on every 200 cubic yards of embankment material.
- D. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.
- E. Trenches: Field density test in trenches shall be taken at 75 linear foot intervals on every third lift.

- F. Foundation Wall Backfill: Take at least one (1) field density tests per lift per wall at locations and elevations as designated by the Engineer.
- G. In addition to the above tests the Independent Testing Laboratory will perform additional density tests at locations and times requested by the Engineer.
- H. Additional density testing will be required by the Engineer if the Engineer is not satisfied with the apparent results of the Contractor's compaction operation.
 - 1. If the test results fail to meet the requirements of these specifications, the Contractor shall undertake whatever action is necessary, at no additional cost to the Owner, to obtain the required compaction. The cost of retesting will be paid by Contractor.

1.5 JOB CONDITIONS

- A. Site Information:
 - 1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner and Engineer will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. Data are made available for the convenience of Contractor.
 - 2. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to Owner.
- B. Existing Utilities and Structures:
 - 1. The locations of utilities and structures shown on the Drawings are approximate as determined from physical evidence on or above the surface of the ground and from information supplied by the utilities and Owner. The Engineer in no way warranties that these locations are correct. It shall be the responsibility of the Contractor to determine the actual locations of any utilities or structures within the project area.

PART 2 - PRODUCTS

2.1 SOIL MATERIAL

- A. Aggregate Base: Shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. Type B Aggregate for base shall not contain particles of rock that will not pass the 4 inch square mesh sieve. The gradation of the part that passes a 3-inch sieve shall meet the following grading requirements:

<u>Sieve</u> <u>Designation</u>	<u>Percent by Weight</u> <u>Passing Square Mesh Sieves</u>
	<u>Type B</u> <u>Aggregate</u>
1/2 inch	35-75
1/4 inch	25-60
No. 40	0-25
No. 200	0-5

- B. Crushed Stone: Shall be a uniform material consisting of clean, hard, and durable particles or fragments, free from vegetable or other objectionable matter, containing angular pieces, as are those which come from a mechanical crusher. Gradation requirements shall be as follows:

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
No. 4	0-10

- C. Select Fill: Shall consist of well graded granular material free of organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material and having no rocks with a maximum dimension of over 4 inches and meeting the following gradation requirements, except where it is used for pipe bedding in which case the maximum size shall be 2 inches.

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
4 inch	100
3 inch	90-100
1/2 inch	25-90
No. 40	0-30
No. 200	0-5

- D. Sand: Shall be well graded durable material free of organic matter and conform to the following gradation requirements:

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
3/8 inch	100
No. 4	95-100
No. 16	50-85
No. 50	10-30
No.100	2-10
No.200	0-5

Sand conforming to the requirement for fine aggregate in ASTM Standard Specifications for Concrete Aggregate, Designation C-33, will meet the above requirement.

2.2 CONCRETE

- A. If concrete is required for excess excavation, provide 3,000 psi concrete complying with requirements of Section 03300.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the areas and conditions under which excavating, backfilling, filling, compaction and grading are to be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 EXCAVATION

A. General:

1. Excavation consists of removal and disposal of all material encountered when establishing line and grade elevations required for execution of the work.
2. The Contractor shall make excavations in such manner and to such widths as will give suitable room for building the structures or laying and jointing the piping; shall furnish and place all sheeting, bracing, and supports; shall do all cofferdamming, pumping, and draining; and shall render the bottom of the excavations firm, dry and acceptable in all respects.
3. All excavation shall be classified as either earth or ledge.
 - a) Earth Excavation shall consist of the removal, hauling and disposal of all earth materials encountered during excavation including but not limited to native soil or fill, pavement (bituminous or concrete), existing sewers and manholes, ashes, loam, clay, swamp muck, debris, soft or disintegrated rock or hard pan which can be removed with a backhoe, or a combination of such materials, and boulders measuring less than one cubic yard.
 - b) Ledge Excavation: Shall consist of the removal, hauling, and disposal of all ledge or rock encountered during excavation. "Ledge" and "rock" shall be defined as any natural compound, natural mixture that in the opinion of the Engineer can be removed from its existing position and state only by drilling and blasting, wedging, sledging, boring or breaking up with power operated tools. No boulder, ledge, slab, or other single piece of excavated material less than one cubic yard in total volume shall be considered to be rock unless, in the opinion of the Engineer it must be removed from its existing position by one of the methods mentioned above.
4. The Contractor shall not have any right of property in any materials taken from any excavation. Do not remove any such materials from the construction site without the approval of the Engineer. This provision shall in no way relieve the Contractor of his obligations to remove and dispose of any material determined by the Engineer to be unsuitable for backfilling. The Contractor

shall dispose of unsuitable and excess material in accordance with the applicable sections of the Contract Documents.

- B. Additional Excavation: When excavation has reached required subgrade elevations, notify the Engineer and Resident Project Representative who will observe the conditions.
1. If material unsuitable for the structure or paved area or pipeline (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the Drawings and/or Specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, screened stone, crushed stone, or concrete as directed by the Engineer.
 2. All excavated materials designated by the Engineer as unsuitable shall become the property of the Contractor and disposed of at locations in accordance with all State and local laws and the provisions of the Contract Documents.
- C. Unauthorized Excavation: Shall consist of removal of materials beyond indicated subgrade elevations or dimensions without specific authorization of Engineer. Unauthorized excavation, as well as remedial work required by the Engineer shall be at the Contractor's expense. Remedial work required is as follows:
1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation with select fill or screened stone compacted to 95%. Provide 12" minimum select fill or screened stone directly under footings. Concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.
 2. If the bottom of a trench is excavated beyond the limits indicated, backfill the resulting void with thoroughly compacted screened stone, unless otherwise indicated.
 3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.
- D. Structural Excavation:
1. Shall consist of the removal, hauling, disposal, of all material encountered in the excavation to permit proper installation of structures.
 2. Excavations for structures shall be carried to the lines and subgrades shown on the Drawings.
 3. Excavate areas large enough to provide suitable room for building and/or installing the structures.
 4. The extent of open excavation shall be controlled by prevailing conditions subject to any limits designated by the Engineer.
 5. Provide, install, and maintain sheeting and bracing as necessary to support the sides of the excavation and to prevent any movement of earth which could diminish the width of the excavation or otherwise injure the work, adjacent structures, or persons and property in accordance with all state and OSHA safety standards.
 6. Erect suitable fences around structure excavation and other dangerous locations created by the work, at no additional cost to the Owner.

7. Exposed subgrade surfaces shall remain undisturbed, protected, and maintained as uniform, plane areas and shape to receive the structure.
 - a. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', 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.
 - b. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade and trim bottoms to required lines and grades to leave solid base to receive the structure.
 - c. If a structure is to be constructed within the embankment, the fill shall first be brought to a minimum of 3 feet above the base of the footing. A suitable excavation shall then be made as though the fill were undisturbed earth.
- E. Trench Excavation: Shall consist of removal, hauling and disposal of all material encountered in the excavation to the widths and depths shown on the Drawings to permit proper installation of underground utilities.
 1. Excavate trenches to the uniform width shown on the Drawings sufficiently wide to provide sufficient space for installation, backfilling, and compaction. Every effort should be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
 2. Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation one foot above the top of the pipe.
 3. Grade bottoms of trenches as indicated for pipe and bedding to establish the indicated slopes and invert elevations, notching under pipe joints to provide solid bearing for the entire body of the pipe, where applicable.
 4. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least two feet above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material.
 5. Unless otherwise specifically directed or permitted by the Engineer, begin excavation at the low end of sewer and storm lines and proceed upgrade.
 6. Perform excavation in a logical sequence.
 7. The extent of open excavation shall be controlled by prevailing conditions subject to any limits prescribed by the Engineer.
 8. As the excavation progresses, install such shoring and bracing necessary to prevent caving and sliding and to meet the requirements of the state and OSHA safety standards, as outlined in the appropriate section of this Specification.
- F. Protection of Persons, Property and Utilities:
 1. Barricade open excavations occurring as part of this work and post with warning lights in compliance with local and State regulations.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations. Exercise extreme caution and

utilize sheeting, bracing, and whatever other precautionary measures that may be required.

3. Rules and regulations governing the respective utilities shall be observed in execution of all work. Active utilities and structures shall be adequately protected from damage, and removed or relocated only as indicated or specified. Inactive and abandoned utilities encountered in excavation and grading operations shall be removed, plugged or capped only with written authorization of the utility owner. Report in writing to the Engineer, the locations of such abandoned utilities. Extreme care shall be taken when performing work in the vicinity of existing utility lines, utilizing hand excavation in such areas, as far as practicable.
 4. Repair, or have repaired, all damage to existing utilities, structures, lawns, other public and private property which results from construction operations, at no additional expense to the Owner, to the complete satisfaction of the Engineer, the utility, the property owner, and the Owner.
- G. Use of Explosives:
1. Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.
 2. All blasting shall be performed in accordance with all pertinent provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
- H. Stability of Excavations:
1. Slope sides of excavations to comply with all codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
 2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- I. Shoring and Bracing:
1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
 2. Provide trench shoring and bracing to comply with local codes and authorities having jurisdiction.
 3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Install shoring and bracing as excavation progresses.
- J. Material Storage:
1. Stockpile excavated materials which are satisfactory for use on the work until required for backfill or fill. Place, grade and shape stockpiles for proper drainage and protect with temporary seeding or other acceptable methods as needed to control erosion.
 2. Locate and retain soil materials away from edge of excavations.
 3. Dispose of excess soil material and waste materials as specified herein.
- K. Dewatering:

1. To ensure proper conditions at all times during construction, the Contractor shall provide and maintain ample means and devices (including spare units kept ready for immediate use in case of breakdowns) with which to intercept and/or remove promptly and dispose properly of all water entering trenches and other excavations (including surface and subsurface waters).
 2. Excavations shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged.
- L. Cold Weather Protection:
1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
 2. No frozen material shall be used as backfill or fill and no backfill shall be placed on frozen material.
- M. Separation of Surface Material:
1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the work.
 2. Prior to excavation, existing pavement shall be cut where in the opinion of the Engineer it is necessary to prevent damage to the remaining road surface.
 3. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.
 4. From areas within which excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as directed; or, if the Contractor prefers not to separate surface materials, he shall furnish, as directed, loam and topsoil at least equal in quantity and quality to that excavated.
- N. Dust Control:
1. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. Refer to Specification Section 01562.
 2. If the Engineer decides that it is necessary to use calcium chloride for more effective dust control, the contractor shall furnish and spread the material, as directed.

3.3 BACKFILL AND FILL

- A. General:
1. Backfilling shall consist of replacing material removed to permit installation of structures or utilities, as indicated in the Contract Documents.
 2. Filling shall consist of placing material in areas to bring them up to grades indicated on the Drawings.
 3. The Contractor shall provide and place all necessary backfill and fill material, in layers to the required grade elevations.
 4. Backfill excavations as promptly as work permits, but not until completion of the following:

- a. Acceptance by Engineer of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 - b. Inspection, approval, and recording locations of underground utilities.
 - c. Removal of concrete formwork.
 - d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Temporary sheet piling driven below bottom of structures shall be removed in manner to prevent settlement of the structure or utilities, or cut off and left in place if required.
 - e. Removal of trash and debris.
 - f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
 - g. Density testing having results meeting requirements specified herein.
5. In general, and unless otherwise indicated, material used for backfill of trenches and excavations around structures shall be suitable excavated material which was removed in the course of making the construction excavation. Unless otherwise specified or allowed by the Engineer the backfill and fill shall be placed in layers not to exceed eight inches in thickness.
 6. All fill and backfill under structures and pavement, and adjacent to structures, shall be compacted crushed stone or select fill as specified or as indicated on the Drawings. The fill and backfill materials shall be placed in layers not exceeding eight inches in thickness.
 7. All structures (including manholes) shall be placed on a 6-inch mat of screened stone unless otherwise indicated.
 8. Suitable excavated material shall meet the following requirements:
 - a. Free from large clods, silt lumps or balls of clay.
 - b. Free from stones and rock fragments with larger than 12-inch maximum dimension.
 - c. Free from organics, peat, etc.
 - d. Free from frozen material.
 9. If sufficient suitable excavated material is not available from the excavations, the backfill material shall be select fill unless otherwise indicated, as required and as directed by the Engineer.
 10. Do not backfill with, or on, frozen materials.
 11. Remove, or otherwise treat as necessary, previously placed material that has frozen prior to placing backfill.
 12. Do not mechanically or hand compact material that is, in the opinion of the Engineer, too wet.
 13. Do not continue backfilling until the previously placed and new materials have dried sufficiently to permit proper compaction.
 14. The nature of the backfill materials will govern the methods best suited for their placement and compaction. Compaction methods and required percent compaction is covered in the Compaction section of this Specification.
 15. Before compaction, moisten or aerate each layer as necessary to provide a water content necessary to meet the required percentage of maximum dry density for each area classification specified.

16. Do not allow large masses of backfill material to be dropped into the excavation in such a manner that may damage pipes and structures.
 17. Place material in a manner that will prevent stones and lumps from becoming nested.
 18. Completely fill all voids between stones with fine material.
 19. Do not place backfill on or against new concrete until it has attained sufficient strength to support loads without distortion, cracking, and other damage.
 20. Deposit backfill and fill material evenly on all sides of structures to avoid unequal soil pressures.
 21. Keep stones or rock fragments with a dimension greater than two inches at least one foot away from the pipe or structure during backfilling.
 22. Leave sheeting in place when damage is likely to result from its withdrawal.
 23. Completely fill voids left by the removal of sheeting with screened stone which is compacted thoroughly.
- B. Pipe Bedding, Initial Backfill and Trench Backfill
1. Place bedding and backfill in layers of uniform thickness specified herein, and as shown on the Drawings.
 2. Thoroughly compact each layer by means of a suitable vibrator or mechanical tamper.
 3. Install pipe bedding and initial backfill in layers of uniform thickness not greater than eight inches.
 4. Deposit the remainder of the backfill in uniform layers not greater than eight inches.
 5. Provide underground sewer marking tape for the full length of sewer trenches as shown on the Drawings. Marking tape shall be SETON #210 SEW or equivalent.
 6. Where soft silt and clay soils are encountered the trench shall be excavated six inches below the normal bedding and backfilled with six inches of compacted sand.
 7. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footings.
 8. The following schedule gives the bedding requirements for various types of pipe. Distances refer to vertical thickness below the pipe.

BEDDING REQUIREMENTS

DI or Concrete Pipe 6 inches min. screened stone or select fill.

PVC or PE Pipe 6 inches min. screened stone.

9. The following schedule gives the initial backfill requirements for various types of pipes.

INITIAL BACKFILL REQUIREMENTS

DI or Concrete Pipe	Screened stone or select fill 6 inches minimum over top of pipe.
PVC or PE Pipe	6 inches min. screened stone over the top of pipe

10. Special bedding and backfill requirements shown on the Drawings supersede requirements of this section.

C. Improper Backfill:

1. When excavation and trenches have been improperly backfilled, and when settlement occurs, reopen the excavation to the depth required, as directed by the Engineer.
2. Refill and compact the excavation or trench with suitable material and restore the surface to the required grade and condition.
3. Excavation, backfilling, and compacting work performed to correct improper backfilling shall be performed at no additional cost to the Owner.

D. Ground Surface Preparation:

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, scarify or break-up sloped surface steeper than 1 vertical to 4 horizontal.
2. When existing ground surface has a density less than that specified under "compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

3.4 COMPACTION:

A. General:

1. Control soil compaction during construction to provide not less than the minimum percentage of density specified for each area classification.

B. Percentage of Maximum Density Requirements:

1. Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D1557 as indicated.
 - a. Structures: Compact each layer of backfill or fill material below or adjacent to structures to at least 95% of maximum dry density (ASTM D1557).
 - b. Off Traveled Way Areas: Compact each layer of backfill or fill material to at least 90% of maximum dry density (ASTM D1557).
 - c. Walkways: Compact each layer of backfill or fill material to at least 93% of maximum dry density (ASTM D1557).
 - d. Roadways, Drives and Paved Areas: Compact each layer of fill, subbase material, and base material to at least 95% of maximum dry density (ASTM D1557).

- e. Pipes: Compact bedding material and each layer of backfill to at least 90% maximum dry density (ASTM D1557). Where backfilling with excavated material, compact to native field density.
 - f. Embankments: Compact each layer of embankment material to at least 95% of maximum dry density (ASTM D1557).
- C. Moisture Control:
- 1. Where subgrade or a layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, in quantities controlled to prevent free water appearing on surface during or subsequent to compaction operations.
 - 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 - 3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory level.
- D. Compaction Methods: The Contractor may select any method of compaction that is suitable to compact the material to the required density.
- 1. General: Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. All voids left by the removal of sheeting shall be completely backfilled with suitable materials and thoroughly compacted.
 - 2. Tamping or Rolling: If the material is to be compacted by tamping or rolling, the material shall be deposited and spread in uniform, parallel layers not exceeding the uncompacted thicknesses specified. Before the next layer is placed, each layer shall be tamped as required so as to obtain a thoroughly compacted mass. Care shall be taken that the material close to the excavation side slopes, as well as in all other portions of the fill area, is thoroughly compacted. When the excavation width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe or structure, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar powered equipment instead of by tamping. For compaction by tamping or rolling, the rate at which backfilling material is deposited shall not exceed that permitted by the facilities for its spreading, leveling, and compacting as furnished by the Contractor.
- E. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.5 GRADING:

A. General:

- 1. Grading shall consist of that work necessary to bring all areas to the final grades.

2. Uniformly grade areas within limits of work requiring grading, including adjacent transition areas.
 3. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Grading Outside Building Lines:
1. Grade areas adjacent to building to drain away from structures and to prevent ponding.
 2. Grade surfaces to be free from irregular surface changes, and as follows:
 - a. Lawn or Unpaved Areas: Finish grade areas to receive topsoil to within not more than one-inch above or below the required subgrade elevations.
 - b. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than ½-inch above or below the required subgrade elevation.
 - c. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 3/8-inch above or below the required subgrade elevation.
- C. Compaction:
1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.
- D. Protection of Graded Areas:
1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
 2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

3.6 BITUMINOUS CONCRETE AND CEMENT CONCRETE BASE COURSE

- A. General:
1. Base course consists of placing the specified materials in layers to support a level, paved surface, as indicated in the Drawings.
- B. Grade Control:
1. During construction, maintain lines and grades as needed to ensure positive drainage.
- C. Placing:
1. Place base course on prepared subbase conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base materials.
- D. Shaping and Compacting:
1. All layers of aggregate base course shall be compacted to the required density immediately after placing. As soon as the compaction of any layer has been completed, the next layer shall be placed.
 2. The Contractor shall bear full responsibility for and make all necessary repairs to the base courses and the subgrade until the full depth of the base leveling courses is placed and compacted. Repairs shall be made at no additional cost to the Owner.

3. If the top of any layer of the base course becomes contaminated by degradation of the aggregate or addition of foreign materials, the contaminated material shall be removed and replaced with the specified material at the Contractor's expense.

END OF SECTION