

**TECHNICAL SPECIFICATIONS  
FOR:  
PARHAM PARK**

**DEVELOPED BY:**

**TOWN OF MAGGIE VALLEY  
MAGGIE VALLEY, NORTH CAROLINA**

**PREPARED BY:**



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# TABLE OF CONTENTS

## TECHNICAL SPECIFICATIONS

### DIVISION 2 - SITEWORK & STORM PIPING

|       |   |
|-------|---|
| 02210 | GRADING   |
| 02211 | CLEARING AND GRUBBING   |
| 02213 | WASTE MATERIAL DISPOSAL                                       |
| 02220 | EXCAVATING, BACKFILL, & COMPACTING FOR UTILITIES & STRUCTURES |
| 02223 | DITCH EXCAVATION  |
| 02230 | AGGREGATE BASE COURSE   |
| 02241 | SUBGRADE  |
| 02510 | ASPHALT PAVING  |
| 02580 | PAVEMENT MARKINGS   |
| 02720 | DRAINAGE MATERIALS  |
| 02722 | MINOR DRAINAGE STRUCTURES                                     |
| 02795 | POROUS PAVEMENT   |
| 02901 | SITE STABILIZATION  |
| 02905 | RESTORATION OF SURFACES                                       |

### DIVISION 3 - SITE CONCRETE

|       |                                   |
|-------|-----------------------------------|
| 03300 | CAST IN PLACE CONCRETE (SITEWORK) |
|-------|-----------------------------------|

1. **DESCRIPTION:** This portion of the project includes the excavation, undercut excavating, grading, earthwork and compaction required as shown on the plans and all other associated miscellaneous items of earthwork construction, as shown on the plans. The Contractor shall furnish all materials, labor, equipment and incidental items necessary to complete this portion of the work as detailed on the plans and as called for in these Specifications.

1.1 All classified excavation shall be in accordance with Section 225 of the "Standard Specifications for Roads and Structures" dated February 10, 2006, published by the North Carolina Department of Transportation, unless otherwise directed herein.

1.2 Site grading shall conform to the grades indicated by the finish contours on the plans. Where topsoil, pavement, gravel or crushed stone surfacing and other items are shown, rough grade shall be finished to such depth below finish grade as necessary to accommodate these items. All areas where structures are to be built on fill shall be stripped to such depth as necessary to remove turf, roots, organic matter and other objectionable materials.

2. **MATERIALS:**

2.1 Topsoil shall be considered to mean original surface soil, typical of the area, which is capable of supporting native plant growth, and shall be free of large stones, roots, brush, waste, construction debris and other undesirable material or contamination.

2.2 All fill used for site grading operations should consist of a clean (free of organics and debris) low plasticity soil (plasticity index less than 30).

3. **INSTALLATION:**

3.1 **General Requirements:**

3.1.1 Construction stakeout will be provided by the Contractor. Exact locations and grade points are to be staked or fixed by the Contractor before construction. The Contractor shall not disturb any bench marks, reference stakes or property line monuments. In the event it becomes necessary to remove any bench mark, reference stake or property line monument in the performance of the work, the Contractor shall reference such points in preparation for replacement. If any such points are disturbed or damaged, they shall be replaced by a North Carolina Registered Land Surveyor at the expense of the Contractor.

3.1.2 Existing utility lines (either overhead or underground), sidewalks, fencing, pavement or other structures shown on the drawings, shown to the Contractor or mentioned in the plans and specifications shall be kept free of damage by the Contractor's operations. It shall be the

responsibility of the Contractor to verify the existence and location of all underground utilities within the Project Site. The omission from or the inclusion of utility locations on the plans is not to be considered as the non-existence of or a definite location of existing underground utilities. Any existing construction damaged by the Contractor shall be restored to an equal condition as that existing at the time prior to damage, at the Contractor's expense. If any existing utility is inadvertently damaged during construction, the Contractor shall notify the utility, the Engineer and the Owner of said damaged utility at once so that emergency repairs may be made at the Contractor's expense and to the satisfaction of the party having jurisdiction of the utility.

### 3.2 Classified Excavation:

3.2.1 Excavation is classified and includes all excavation to the required elevations. Excavation shall be classified as earth excavation (includes borrow and waste materials as required), trench rock excavation, mass rock excavation, undercut excavation. There shall be no additional payment made for earth excavation. Trench rock excavation, mass rock excavation and undercut excavation shall be paid at the unit prices as provided in the bid form. The Engineer should be notified immediately if rock is encountered. All excavated materials which are not required or suitable for fills shall be considered as waste and shall be disposed of off the Owner's property at the Contractor's expense.

3.2.2 Earth excavation includes excavation of pavements and other obstructions visible on the surface, underground structures, utilities, and other items indicated to be demolished and removed in order to reach subgrade elevation; together with soils and other materials encountered that are not classified as trench rock excavation, mass rock excavation or undercut excavation.

3.2.3 Trench rock excavation includes boulders exceeding one-half cubic yard in volume or solid ledge rock, which in the opinion of the Engineer, requires for its removal drilling and blasting, or wedging or sledging and barring.

In addition, classification as trench rock is only applicable when encountered, as described above, during the installation of storm drainage lines, water lines or services, sewer lines or services and associated structures as represented on the design drawings. Where trench rock excavation is necessary, the Contractor shall excavate the same as near the neat lines of the trench as practicable and the Contractor shall take all due precautions in the pursuance of the work. The Contractor will be held strictly responsible for all injury to life and to public and private property.

Trench rock shall be removed from the applicable excavation to the following limits:

- a. Trenches - The diameter of the pipe plus 8 - inches on each side, extending 6 - inches below the pipe wall and bell.
- b. Structures - 12 - inches beyond the vertical plane of the structure on all sides and on the bottom only to the depth necessary for proper installation.

Trench rock excavation includes removal and off-site disposal of rock material and obstructions encountered in trench excavations that cannot be removed without systematic drillings, blasting, or ripping; and backfilling with the specified compaction of the trench with suitable material.

3.2.4 Mass rock excavation shall be considered any naturally occurring material, in the opinion of the Engineer, cannot be removed with a Caterpillar D-9 or equal, equipped with a properly fitted single tooth ripper, or removed by a Caterpillar 225 backhoe or equal, equipped with rock teeth. Mass rock in the bottom of roadway cuts shall be excavated to a depth of one foot below the roadbed and ditches. Mass rock in building pad areas shall be excavated to a depth of one foot below finished grade, or as directed by the Engineer. Where mass rock excavation is necessary, the Contractor shall excavate the same as near the neat limits of excavation as practicable and the Contractor shall take all due precautions in the pursuance of the work. The Contractor will be held strictly responsible for all injury to life and to public and private property.

Mass rock excavation includes removal and off-site disposal of rock material and obstructions encountered in excavations that cannot be removed without systematic drillings, blasting, or ripping; and backfilling with the specified compaction of the undercut rock with suitable material.

3.2.5 Undercut excavation shall be any natural soil materials, not including topsoil, situated at or below the proposed subgrade elevation that is deemed unsuitable or undesirable in their location or condition as determined by a qualified Geotechnical Engineer, employed by the Owner. The Geotechnical Engineer may require that the Contractor remove this undesirable material and backfill with approved material properly compacted. Moisture content shall not be an acceptable means for declaring a soil unsuitable. It is the responsibility of the contractor to properly condition the soil to an acceptable moisture content prior to use in grading operations.

Undercut excavation includes excavation and off-site disposal of undesirable material; any backfilling in the undercut area from an approved borrow source; and proper compaction of the borrow material. Topsoil, regardless of depth, shall not be classified as undercut excavation material and the replacement thereof shall be covered in the price for earth excavation as described above.

3.2.6 Borrow material shall be suitable material from an approved off-site area that is required to; backfill undercut areas; bring the site to the proposed grades in the absence of sufficient material on-site; backfill trenches and other excavations as required. The borrow material shall be checked for suitability for compaction and approved by a qualified Geotechnical Engineer prior to placement on-site at the Contractor's expense. Borrow excavation shall be performed in accordance with Section 230 of the NCDOT Standard Specifications for Roads and Structures except where modified herein. All borrow material required shall be permitted, acquired and placed at the Contractor's sole expense. Borrow material required to bring the site to proposed grades in the absence of sufficient material on site shall be considered part of earth excavation and, therefore, no additional payment shall be made.

3.2.7 The Contractor shall provide all sheeting, shoring, underpinning and bracing required to hold the sides of any excavation and for the protection of all adjacent structures. The Contractor shall be held responsible for any damage to any part of the work by failure of excavated sides or bottoms.

### 3.3 Blasting:

3.3.1 Any and all blasting operations shall be conducted in strict accordance with existing ordinances and regulations relative to storage and use of explosives. Blasting shall be done only by experienced and qualified personnel and extreme caution and care shall be exercised to prevent injury to persons or damage to any pipe, mains, wires, drains, buildings, railroad tracks or other property above or below the surface of the ground. The Contractor shall use safety nets or other equivalent measures as approved by the Engineer to reduce the possibility of flying rock as a result of blasting operations. The Contractor shall be held strictly responsible for any injury to persons or damage to public or private property.

3.3.2 The Contractor shall submit blasting plans to the Engineer for review and shall not proceed with blasting operations until approval has been granted. As directed by the Engineer, blasting operations shall be monitored to insure that vibration levels produced by blasting are within tolerable limits.

3.3.3 The Contractor shall obtain at his expense, all Federal, State and Local permits required to perform blasting operations.

### 3.4 Dewatering:

3.4.1 The Contractor shall control the grading in all areas so that the surface of the ground will be properly sloped, diked or ditched to prevent water from entering into excavated areas. The Contractor shall maintain sufficient personnel and equipment to promptly and continuously remove all water, from any source, entering or accumulating in the excavation or other parts of the work. All water pumped or drained from these areas shall be disposed of in a suitable manner without damaging adjacent property or other work under construction.

### 3.5 Embankments, Fills and Backfills:

3.5.1 Upon completion of the stripping operations, the exposed subgrade in areas to receive fill should be proofrolled with a loaded dumptruck or similar pneumatic-tired vehicle with a minimum loaded weight of 20 tons, under the supervision of the geotechnical engineer. The proofrolling procedure should consist of four complete passes of the exposed areas with two of the passes being in a direction perpendicular to the preceding ones. Any areas which deflect, rut or pump excessively during the proofrolling or fail to "tighten up" after successive passes should be undercut to suitable soils and replaced with compacted fill.

3.5.2 Embankments and fills shall be constructed at the locations and to the lines and grades indicated on the drawings. Material shall be placed in horizontal layers not to exceed 8 inches in loose depth and thoroughly compacted prior to placing each following layer. All fill material shall be free from roots or other organic material, trash, and from all stones having any one dimension greater than 6 inches. Stones larger than 4 inches, maximum dimension, shall not be permitted in the upper 6 inches of fill or embankment. Fill areas shall be kept level with graders or other approved devices. Fill shall not be placed on surfaces that are muddy, frozen, or contain frost or ice.

3.5.3 Embankment and fill compaction shall be accomplished by thoroughly compacting each layer with sheep foot rollers, pneumatic rollers, and mechanical tampers in places inaccessible to rollers, or other equipment. When material has too much moisture, grading operations shall be limited to drying soil by spreading and turning for drying by the sun and aeration. When material is dry, moisture shall be added by sprinkling by approved means.

3.5.4 Where natural slopes exceed 4:1, horizontal benches shall be cut to receive fill material. Slopes of less than 4:1 and other areas shall be scarified prior to placing fill material.

3.5.5 All embankments and fills shall be compacted to the following percentages of the maximum dry density as determined by the Standard Proctor Density Test, ASTM D-698, Method C.

3.5.6 The following table shall be used throughout the project unless otherwise directed by the Geotechnical Report that may be provided by the Owner.

TABLE OF COMPACTION

| <u>Type Fill or Embankment</u> | <u>Zone</u> | <u>Minimum Density %</u> |
|--------------------------------|-------------|--------------------------|
| Structures                     | All Depths  | 98                       |
| Paved Areas                    | All Depths  | 98                       |
| Yard or Field Areas            | All Depths  | 95                       |

Embankment types are defined as follows:

Structure - beneath concrete slabs of buildings, floors, foundations, etc.

Paved Areas - beneath all roads, tracks, runways, pads, streets, truck operations, and automobile parking lots.

3.5.7 Where backfilling is required after the completion of drainage structures, all forms, trash, and construction debris shall be removed from excavation before backfilling begins. Backfill shall be placed in horizontal layers of 6 inches in loose depth. Compaction shall conform to requirements in the above table. Heavy rollers, crawler equipment, trucks or other heavy equipment shall not be used for compacting backfill within 5 feet of structure walls or other facilities which may be damaged by their weight or operation. No backfilling shall begin until concrete and masonry walls are properly cured.

3.5.8 The Contractor shall carry the top of embankments, fills, or backfills to the surrounding grade so that upon compaction and subsequent settlement, the grade will be at proper elevation. Should settlement occur during the guarantee period of the contract, the Contractor shall provide sufficient fill to bring area up to finished grade and shall reseed as required.

### 3.6 PROOFROLLING:

3.6.1 Proofrolling under the observation of the Soils Engineer will be performed using a loaded dumptruck or similar pneumatic-tired vehicle with a minimum loaded weight of 20 tons as specified herein and as follows: The proofrolling procedure should consist of four complete passes of the exposed areas with two of the passes being in a direction perpendicular to the preceding ones. Any areas which deflect, rut or pump excessively during the proofrolling or fail to "tighten up" after successive passes should be undercut to suitable soils and replaced with compacted fill.

3.6.2 Immediately following stripping, all areas to receive fill shall be proofrolled as specified herein.

3.6.3 Immediately following the completion of excavation to proposed grades in cut areas, proofrolling shall be performed as specified herein.

3.6.4 Immediately prior to stone base course placement in pavement areas and following final floor slab preparation, all subgrade areas will be proofrolled. Any local areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material as specified herein. Undercut will not be paid for in fill areas where proofroll does not pass.

### 3.7 AIR POLLUTION

3.7.1 Comply with all pollution control rules, regulations, ordinances, and statutes which apply to any work performed under the Contract, including any air pollution control rules, regulations, ordinances and statutes, or any municipal regulations pertaining to air pollution.

3.7.2 During the progress of the work, maintain the area of activity, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use calcium chloride or more effective dust control, furnish and spread the material, as directed, and without additional compensation.

### 3.8 SOIL INSPECTION AND TESTS:

3.8.1 All excavated and fill material shall be removed, selected, placed and compacted under supervision of a representative of a commercial soils testing laboratory which will be selected by the Owner. A commercial soils testing laboratory shall be any firm properly equipped to perform such compaction tests and who has in their employment a Professional Engineer experienced in testing and soil mechanics. The laboratory representative shall have the authority to approve or disapprove the condition of the subgrade on which fill is to be placed, filled material, placement methods, compaction methods, and shall make compaction density tests as necessary to determine that the specified density is obtained. The Contractor shall notify the laboratory at least three (3) days prior to starting fill operations in order that suitability of material for compaction may be checked and no material shall be used that has not been previously checked and approved by the laboratory. The laboratory shall be notified before any cut is made or fill is placed in order that the laboratory representative may be present during all grading operations. The Contractor shall remove, replace, recompact and retest all fills failing to meet the density requirements at no additional expense to the Owner.

3.8.2 A soils testing laboratory shall be retained by the Owner to supervise fill placement and compaction at no expense to the Contractor. However, extra time and trips caused by excessive delay, failure of the Contractor to properly coordinate with the laboratory, or failure of the Contractor to properly compact fill material shall be backcharged to the Contractor.

3.8.3 Field density tests shall be performed by the Owner's testing agency for each one foot of fill material placed at the following frequency:

3.8.4 A minimum of one field density test shall be made for each 2,000 square feet/vertical foot of fill placement in building areas.

3.8.5 A minimum of one field density test shall be made for each 5,000 square feet/vertical foot of fill placement in all other areas where pavement is to be placed.

3.8.6 Prior to final acceptance, the Soils Engineer and Surveyor shall submit certification specifying that the project compaction criteria and subgrade elevations have been satisfactorily obtained. The Contractor is responsible for the certification statement from the Surveyor. This certification should be in the form of a letter accompanied by a stamped as-built drawing showing spot elevations.

### 3.9 Borrow and Waste Materials:

3.9.1 Borrow: In the event borrow material is required, the borrow material shall be checked for suitability for compaction and approved by the soils testing laboratory. The Contractor shall notify the laboratory at least three (3) days in advance of beginning borrow operations. Borrow excavation shall be performed in accordance with Section 230 of the NCDOT Standard Specifications for Roads and Structures except where modified herein. The Contractor shall be

responsible for any erosion control, seeding and stabilization of any borrow area regardless of whether such area is located on or off the Owners property.

3.9.2 Waste: Excavated materials not suited for backfill and excavated material in excess of that needed to complete the work shall be hauled off the Owner's property at the Contractor's expense. The Contractor shall be responsible for any erosion control, seeding and stabilization at any waste site at no additional cost to the Owner. See section 02213 Waste Material Disposal.

### 3.10 Residual Soil Areas:

3.10.1 If proofrolling indicates that on-site virgin soils supporting any roadway, parking, building or other structural areas are not adequate as determined by the Soils Engineer, then these unsuitable areas shall be classified as undercut and be repaired by the Contractor. The necessary repair procedure shall be determined by the Soils Engineer and may include scarifying, drying and recompaction procedures or undercutting and replacement procedures.

### 3.11 Final Grading:

3.11.1 On completion of all grading, all graded areas (except building pads and pavement areas and all cut slopes steeper than 4:1 slope) shall be provided with 4 inches of topsoil and brought to the finished grades shown on the drawings. Areas disturbed by operations of the Contractor shall be properly returned to their original condition with a topsoil covering of 4 inches.

3.11.2 After the entire graded area has been brought to the finished grades shown on drawings, all areas shall be left smooth and free from erosion, ridges, ditches and evidence of ponding. Final grades shall be free from all roots, debris, rock and soil lumps and left in readiness for seeding.

3.11.3 Prior to acceptance of the entire project, the Contractor shall correct all embankments and graded areas of all damages due to washes, settlement, erosion, equipment ruts or any other cause at his expense.

3.11.4 Prior to final acceptance, the Contractor shall provide certification as specified in paragraph 3.7.6 that all grades are  $\pm .1$  foot of the finished grades shown on project drawings.

3.11.5 The Contractor shall stabilize all disturbed areas, unless otherwise directed, by seeding and mulching per section 02901 of these specifications or other means of stabilization called for by the contract drawings.

### 3.12 Clean-Up:

3.12.1 Upon completion or termination of the work, and before final payment is made, the Contractor shall remove from site all equipment, waste materials and rubbish resulting from his operations. In the event of his failure to do so, the same may be done by the Owner at the expense of the Contractor.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

- A. Clearing and grubbing shall consist of the removal and satisfactory disposal of all trees, brush, stumps, logs, grass, weeds, roots, decayed vegetable matter, posts, fences, stubs, rubbish and all other objectionable matter resting on or protruding through the original ground surface and occurring within the construction limits or right-of-way of any excavation, borrow area, or embankment.

**PART 2: NOT USED****PART 3: EXECUTION****3.01 GENERAL**

- A. Clearing and grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of the debris from the clearing and grubbing operations from interfering with the excavation or embankment operations. All work under this section shall be performed in a manner which will cause minimum soil erosion. The Contractor shall perform such erosion control work, temporary or permanent, as may be directed by the Engineer in order to satisfactorily minimize erosion resulting from clearing and grubbing operations.

- 1. Clearing

- a. The work of clearing shall be performed within the limits established by the plans, specifications, or the Engineer.
- b. Clearing shall consist of the felling and cutting up, or the trimming of trees, and the satisfactory disposal of the trees and other vegetation together with the down timber, snags, brush and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation, as may be indicated on the plans to be left standing, and all stumps, roots and brush in the areas to be cleared shall be cut off six inches above the original ground surface.
- c. Individual trees and groups of trees designated to be left standing within cleared areas shall be trimmed of all branches to such heights and in such manner as may be necessary to prevent

interference with construction operations. All limbs and branches required to be trimmed shall be neatly cut close to the whole of the tree or to main branches, and the cuts thus made shall be painted with an approved tree wound paint. Individual trees, groups of trees, and other vegetation, to be left standing shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances require.

- d. The Engineer will designate all areas of growth or individual trees which are to be preserved due to their desirability for landscape or erosion control purposes. When the trees to be preserved are located within the construction limits, they will be shown on the plans or designated by the Engineer.
- e. Clearing operations shall be conducted so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others. When such damages occur, all damaged areas shall be repaired, removed or otherwise resolved utilizing generally accepted practices at the Contractor's expense.

2. Grubbing

- a. Grubbing shall consist of the removal and disposal of all stumps, roots and matted roots from all cleared areas, except as herein specified.
- b. In embankment areas, when the depth of embankment exceeds 3'-6" in height sound stumps shall be cut off not more than 6" above the existing ground level and not grubbed. Unsound or decayed stumps shall be removed to a depth of approximately two feet below the natural ground surface.
- c. All depressions excavated below the natural ground surface for or by the removal of stumps and roots shall be refilled with suitable material and compacted to make the surface conform to the surrounding ground surface.

3. Disposal of Cleared and Grubbed Material

Saw logs, pulp wood, cord wood or other merchantable timber removed incidental to clearing and grubbing shall remain the property of the Owner. All combustible matter shall be deposited at locations approved by the Engineer. Combustible matter may be burned or may be disposed of as stated above. Debris shall not be burned unless written permission or

permit is issued by the Fire Marshall having jurisdiction in the area if applicable. The Contractor shall adhere to all limitations and conditions set forth in the permit. Burning shall be done at such time and such manner as to prevent fire from spreading and to prevent any damage to adjacent cover and shall further be subject to all requirements of State or Federal Governments pertaining to the burning. Disposal by burning shall be kept under constant attendance until all fires have burned out or have been extinguished.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

- A. The work covered by this section consists of the disposal of waste and debris in accordance with the requirements of these specifications. Waste will be considered to be all excavated, grubbed or removed materials, which are not utilized in the construction of the project.

**PART 2: NOT USED****PART 3: EXECUTION****3.01 GENERAL REQUIREMENTS**

- A. Waste shall be disposed of in areas that are outside of the project area and provided by the Contractor, unless otherwise required by the plans or special provisions or unless disposal within the project area is permitted by the Engineer.
- B. The Contractor shall maintain the earth surfaces of all waste areas, both during the work and until the completion of all seeding and mulching or other erosion control measures specified, in a manner which will effectively control erosion and siltation.
- C. The following requirements shall also be applicable to all waste or disposal areas other than active public waste or disposal areas:
1. Rock waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practical, and shall be covered with a minimum 6" thick layer of earth material either from the project waste or from borrow.
  2. Earth waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practicable, but in no case will slopes steeper than 2:1 be permitted.
  3. Construction debris, grubbed debris and all broken pavement and masonry shall be covered with a minimum 6" thick layer of earth waste material from the project or borrow. The completed waste area shall be shaped as required above for disposal of earth waste.
  4. Seeding and mulching shall be performed over all earth or earth covered waste areas. The work of seeding and mulching shall be performed in accordance with Section 02901.

5. Where the Engineer has granted permission to dispose of waste and debris within the project, the Engineer will have the authority to establish whatever additional requirements may be necessary to insure the satisfactory appearance of the completed project.

Disposal of waste or debris in active public waste or disposal areas will not be permitted without prior approval by the Engineer. Such disposal will not be permitted when, in the opinion of the Engineer, it will result in excessive siltation or pollution.

**END OF SECTION**

**SECTION 02220 EXCAVATING, BACKFILL, & COMPACTING FOR UTILITIES & STRUCTURES**

**PART 1 - DESCRIPTION**

- A. The Contractor shall furnish all labor, material, equipment, and supplies, and shall perform all earthwork for installation of utilities including excavation and backfill, pavement removal, sheathing, bracing, shoring, pumping or bailing, dewatering, restoration and cleanup; all as indicated, specified and/or necessary to complete the work.
- B. Any reference to NCDOT standard specifications was obtained from "Standard Specifications for Roads and Surfaces" published by the North Carolina Department of Transportation dated February 10, 2006. Unless otherwise noted, the most current date published applies.
- C. Related Work: Reference the following specifications for related work:

|       |                         |
|-------|-------------------------|
| 02210 | Grading                 |
| 02901 | Site Stabilization      |
| 02905 | Restoration of Surfaces |

**PART 2 - MATERIALS**

- A. Fill Material: Shall be classified as ML-low plasticity silt or better by the Unified Soil Classification System and tabulated below:

|           | <u>Unified Class</u> | <u>Description</u>   |
|-----------|----------------------|--|
| Class I   | GW                   | 1/4" - 1-1/2" well graded stone including coral, slag, cinders, crushed stone and crushed shells |
| Class II  | GP<br>SW<br>SP       | Coarse gravel poorly graded<br>Coarse sands well graded<br>Coarse sands poorly graded            |
| Class III | GM<br>GC<br>SM<br>SC | Silty-sandy gravel<br>Clayey-sandy gravel<br>Silty-sands<br>Clayey-sands                         |

Class IV

ML

Inorganic silts and fine sands

Backfill material shall exhibit a plasticity index of less than 20, and Standard Proctor maximum density at optimum moisture greater than 90 pounds per cubic foot.

B. The following materials are unacceptable:

|          | <u>Unified Class</u> | <u>Description</u>                |
|----------|----------------------|-----------------------------------|
| Class IV | CL                   | Inorganic clays - low plasticity  |
|          | MH                   | Inorganic elastic silts           |
|          | CH                   | Inorganic clays - high plasticity |
| Class V  | OL                   | Organic silts                     |
|          | OH                   | Organic clays                     |
|          | PT                   | Highly organic soil               |

C. Washed Stone: Stone material where indicated shall be crushed stone or gravel of strong, durable nature and shall conform to standard size No. 57 per NCDOT Section 1000.

D. Concrete: Minimum 28-day compressive strength of 3000 psi.

### PART 3 - EXECUTION

#### 3.1 EXISTING FACILITIES

A. Existing Utilities Shown on the Drawings: It shall be the Contractor's responsibility to conduct the work in such a manner as to avoid damage to or interference with any utilities services shown on the drawings. If such damage, interference, or interruption of service shall occur as a result of his work, then it shall be the Contractor's responsibility to promptly notify the Engineer of the occurrence and to repair or correct it immediately, at his own expense, and to the satisfaction of the Engineer and the Owner of the Utility.

B. Existing Utilities Not Shown on the Drawings: It shall be the Contractor's responsibility to exercise all reasonable precaution in the performance of the work to avoid damage to or interference with any utilities services, even though not shown on the drawings. If such damage, interference, or interruption of service shall occur as the result of this work, then the Contractor's responsibility will be the same as stipulated in Paragraph 3.1.1 above.

### 3.2 EXISTING STREAMS

Exercise reasonable precaution to prevent the silting of streams. Provide at Contractor's expense temporary erosion and sediment control measures to prevent the silting of streams and existing drainage facilities. The Contractor shall size structures and conform fully with the North Carolina Sedimentation Pollution Control Act.

### 3.3 EXCAVATION AND BACKFILL – GENERAL REQUIREMENTS

- A. Pavement, gutters, sidewalks, aprons and curbs which will be disturbed by excavation shall be removed and disposed of as a part of ordinary excavation. That which is to be removed shall be cut or sawn along clean straight lines from that which is to remain. Remove enough such that a minimum of twelve inches of undisturbed earth remain between the excavation and that which is to remain.
- B. Where required, and as approved by the Engineer, sheeting and bracing shall be used to prevent injury to persons, caving of trench walls and to conform with all governing laws and ordinances. Sheeting and bracing shall be left in place until the trench is refilled to a safe limit. The top portion may then be removed, but the lower portion shall remain undisturbed.
- C. It is the responsibility of the Contractor to provide an adequate dewatering system where required. The system shall be capable of removing any water that accumulates in the excavation and maintaining the excavation in a dry condition while construction is in progress. The surface of the ground shall be sloped away from the excavation or piping provided to prevent surface water from entering the excavation. Disposal of water resulting from the dewatering operation shall be done in a manner that does not interfere with normal drainage, and does not cause damage to any portion of the work or adjacent property. All drains, culverts, storm sewers and inlets subject to the dewatering operation shall be kept clean and open for normal surface drainage. The dewatering system shall be maintained until backfilling is completed or as otherwise directed by the Engineer. All damage resulting from the dewatering operation shall be repaired by the Contractor to the satisfaction of the Engineer and at no cost to the Owner.
- D. The Contractor shall erect, maintain, and safeguard temporary bridges, walkways, or crossings where it is necessary to maintain traffic. Where trenches are open in the vicinity of pedestrian or vehicular travel lanes, suitable carriers will be constructed and maintained and the work will be further protected from sunset to sunrise with a sufficient number of lights or flares to fully protect the public from accidents on account of construction.
- E. If the specified depth for foundations proves insufficient to reach firm ground, the Engineer shall be notified and will furnish instructions for proceeding with the work.

- F. Rock, wherever used as a name for excavation material, shall mean boulders exceeding one-half cubic yard in volume or solid ledge rock, which in the opinion of the Engineer, requires for its removal drilling and blasting, or wedging or sledging and barring. Where rock excavation is necessary, the Contractor shall excavate the same as near the neat lines of the trench as practicable and he shall take all due precautions in the pursuance of the work. He will be held strictly responsible for all injury to life and to public and private property.
1. Rock shall be removed from the excavation to the following limits:
    - a. Trenches - The diameter of the pipe plus 8-inches on each side, extending six inches below the pipe wall and bell.
    - b. Structures - 12-inches beyond the vertical plane of the structure on all sides and on the bottom only to the depth necessary for proper installation.
- G. Blasting: Prior to commencing any blasting operations the Contractor shall notify the Engineer and either the Local Fire Department - Fire Prevention Section or the County Fire Administrator (as applicable) and obtain blasting permits as required. The Contractor must furnish proof (certification) of insurance specifically covering any and all obligations assumed pursuant to the use of explosives.

All blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, laws as may be imposed by any regulatory body and/or agency having jurisdiction over the work relative to handling, transporting, use and storage of explosives. Blasting shall be done only by competent, and experienced men whose activities shall be conducted in a workmanlike manner. Satisfactory information must be provided to the Engineer, that the blaster meets or exceeds the qualifications enumerated in OSHA Regulations Part 1926, Subpart U, Section 1926.901 - Blaster Qualifications.

The Contractor shall protect all structures from the effects of the blast and repair any resulting damage. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the Engineer may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

1. Overburden: Undisturbed overburden may be deemed adequate in lieu of matting but only after the actual depth of the undisturbed overburden has been determined and adjudged sufficient by the Engineer. Under no circumstances will loose or fill overburden be adequate without the use of weighted mats.
2. Permission to Blast: The Contractor shall not be allowed to blast before 9 a.m. or after 3 p.m. without approval of the Engineer and Owner. Blasting will not occur within any rights-of-way maintained by any agency (D.O.T., R.R., Gas, Owner, etc.) without specific approval of the controlling agency and only in accordance with their respective requirements (as exceeded herein). The Contractor shall be

held responsible for any and all injury to persons or damage to public or private property.

3. The Contractor shall not use excavated rock as backfill material. Dispose of rock which is surplus or not suitable for use as rip rap.
4. **Monitoring:** The Contractor shall notify the Engineer prior to any blasting. Additionally, the Contractor shall notify the Engineer before any charge is set. Following review by the Engineer regarding the proximity of permanent structures to the blasting site, the Engineer may direct the Contractor to employ an independent, qualified specialty sub-contractor, approved by the Engineer, to monitor the blasting by use of seismograph, identify the areas where light charges must be used, conduct pre-blast and post-blast inspections of structures, including photographs or videos, and maintain a detailed written log.

## PART 4 – TRENCH EXCAVATION AND BACKFILL

### A. Trench Excavation

1. General Perform all excavation of every description and of whatever substance encountered so that the pipe can be laid to the alignment and depth shown on the Drawings.
2. Brace and shore all trenches, where required, in accordance with the rules and regulations, promulgated by the Department of Labor, Occupation Safety and Health Administration, "Safety and Health Regulations for Construction".
3. Make all excavations by open cut unless otherwise specified or indicated on the Drawings.
4. Width of Trenches: Excavate trenches sufficiently wide to allow proper installation of pipe, fittings and other materials and not more than 18" clear of pipe on either side at any point. Do not widen trenches by scraping or loosening materials from the sides.
5. Trench Excavation in Earth: Earth excavation includes all excavation of whatever substance encountered. In locations where pipe is to be bedded in earth excavated trenches, fine grade the bottoms of such trenches to allow firm bearing for the bottom of the pipe on undisturbed earth. Where any part of the trench has been excavated below the grade of the pipe, fill the part excavated below such grade with pipe bedding material and compact at the Contractor's expense.
6. Trench Excavation in Fill: If pipe is to be laid in embankments or other recently filled material, first place the fill material to the finish grade or to a height of at least one foot above the top of the pipe, whichever is the lesser. Take particular care to ensure maximum consolidation of material under the pipe location. Excavate the pipe trench as though in undisturbed material.

7. Trench Bottom in Poor Soil: Excavate and remove unstable or unsuitable soil to a width and depth, as directed by the Engineer, and refill with a thoroughly compacted gravel bedding.
8. Bell Holes: Provide bell holes at each joint to permit the joint to be made properly and to provide a continuous bearing and support for the pipe.

#### B. Trench Backfill

1. General: Unless otherwise specified or indicated on the Drawings, use suitable material for backfill which was removed in the course of making the construction excavations. Do not use frozen material for the backfill and do not place backfill on frozen material. Remove previously frozen material before new backfill is placed. Start backfilling as soon as practicable after the pipes have been laid, or the structures have been built and are structurally adequate to support the loads, including construction loads to which they will be subjected, and proceed until its completion.
2. With the exception mentioned below in this paragraph, do not backfill trenches at pipe joints until after that section of the pipeline has successfully passed any specified tests required. Should the Contractor wish to minimize the maintenance of lights, and barricades, and the obstruction of traffic, he may, at his own risk, backfill the entire trench as soon as practicable after installation of pipe, and the related structures have acquired a suitable degree of strength. He shall, however, be responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints or pipe.
3. Material: The nature of the materials will govern both their acceptability for backfill and the methods best suited for their placement and compaction in the backfill. Both are subject to the approval of the Engineer. Do not place stone or rock fragments larger than 4" in greatest dimension in the backfill. Do not drop large masses of backfill material into the trench in such a manner as to endanger the pipeline. Use a timber grillage to break the fall of material dropped from a height of more than 5 feet. Exclude pieces of bituminous pavement from the backfill unless their use is expressly permitted.
4. Zone Around Pipe: Place bedding material to the level shown on the Drawings and work material carefully around the pipe to insure that all voids are filled, particularly in bell holes. For backfill up to a level of 2 feet over the top of the pipe, use only selected materials containing no rock, clods or organic materials. Place the backfill and compact thoroughly under the pipe haunches and up to the mid-line of the pipe in layers not exceeding 6" in depth. Place each layer and tamp carefully and uniformly so as to eliminate the possibility of lateral displacement. Place and compact the remainder of the zone around the pipe and

to a height of one foot above the pipe in layers not exceeding 6" and compact to a maximum density of at least 100 % as determined by ASTM D0698.

5. Tamping: Deposit and spread backfill materials in uniform, parallel layers not exceeding 12" thick before compaction. Tamp each layer before the next layer is placed to obtain a thoroughly compacted mass. Furnish and use, if necessary, an adequate number of power driven tampers, each weighing at least 20 pounds for this purpose. Take care that the material close to the bank, as well as in all other portions of the trench, is thoroughly compacted. When the trench 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, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similarly powered equipment instead of by tamping. For compaction by tamping (or rolling), the rate at which backfilling material is deposited in the trench shall not exceed that permitted by the facilities for its spreading, leveling and compacting as furnished by the Contractor.
6. Wet the material by sprinkling, if necessary, to insure proper compaction by tamping (or rolling). Perform no compaction by tamping (or rolling) when the material is too wet either from rain or applied water to be compacted properly.
7. Trench Compaction: Compact backfill in pipe trenches that is under pavement to the maximum density of soil material compacted at optimum moisture content to 98% and with the last 2' being 100%. Compact backfill in pipe trenches that is not under pavement to the maximum density of soil material compacted at optimum moisture content to 95%.

## PART 5 - STRUCTURE EXCAVATION AND BACKFILL

### 5.1 STRUCTURE EXCAVATION

- A. Structure Excavation shall be made at the locations shown on the plans and to the exact subgrade required. Bottom of excavations shall be level and in firm, solid material, with soft material or voids treated as specified. Excavated areas shall be kept free of water during the construction period. Where earth will stand, footing trenches may be cut to the exact size of the footings; otherwise, forms shall be used. Where necessary, sides of excavations shall be shored and sheathed, or cofferdams built, as required for protection of the work and personnel.
- B. Wherever excavation for a foundation extends below the water table or where specifically indicated on the plans, washed stone shall be placed to a minimum thickness of 12 inches, unless otherwise shown or as directed by the Engineer, prior to placing the foundation. The washed stone shall be compacted to 90% of maximum as determined by the Standard Proctor test (ASTM D698).
- C. If the specified depth for foundations proves insufficient to reach firm ground, the Engineer shall be notified for furnishing instructions and proceeding with the work.

## 5.2 STRUCTURE BACKFILL

- A. Structure Backfill shall be done with material free from large clods, frozen earth, organic material or any foreign matter, and shall evenly and carefully be placed and tamped in horizontal layers. Compaction equipment specifically designed for these purposes must be present and operational at the job site and shall be utilized throughout to obtain uniform compaction. The degree of compaction and the density shall be determined by the Standard Proctor Test (ASTM D698), with compaction requirements as follows:

| <u>Percent of Maximum Density<br/>at Optimum Moisture</u> | <u>Location</u>   |
|---|---|
| 98  | Top 24" of fill beneath pavement and structures.  |
| 95  | 24" or deeper beneath all roads and driveways, full depth under sidewalks and undercut backfill for structure excavation. |

- B. No backfill shall be placed against a structural wall until all connecting structural members are in place. It shall be the Contractor's responsibility to provide compaction to such a degree that subsidence after placing shall not be detrimental to the stability or appearance of the structure, adjacent ground, or paved areas. The Contractor shall provide adequate protection to all structures during backfilling and shall use every precaution to avoid damaging or defacing them in any way. Contractor shall be responsible for the protection of all structures from damage or flotation prior to backfill being placed.
- C. Unless otherwise approved by the Engineer, liquid-retaining structures shall not be backfilled until tested for leakage.

## PART 6 - UNSTABLE SUBGRADE

### 6.1 UNSTABLE SUBGRADE

- A. Should unstable soil, organic soil, or soil types classified as fine-grained soils (silts and clays) by ASTM D-2487 be encountered in the bottom of pipe trenches or structure excavations, such soils shall be removed to a depth and width determined by the Engineer, properly disposed of and shall be backfilled with crushed stone conforming to the Department of Transportation Specifications, Size 57. Placement shall not exceed 12-inches loose and compacted to 90% of the dry density determined by the Standard Proctor test ASTM D698 (Concrete may be substituted in place of #57 stone at the Contractor's option. A 24-hour cure must be given before proceeding with the work).

## PART 7 – COMPACTION

## 7.1 COMPACTION

- A. Compaction: Unless otherwise noted, each layer of fill and backfill and the top 12 inches of existing subgrade material in cuts shall be compacted by approved equipment as specified below. Maximum lift thickness shall be 8" of loose material prior to compaction efforts. The degree of compaction and the density shall be determined by the Standard Proctor Test (ASTM D698).

|  | Percent of<br>Max. Dry Density at<br><u>Optimum Moisture Content</u> |
|--|--|
| Top 24 inches of fill under pavement or structures | 98%  |
| 24" and deeper under roads and structures          | 95%  |
| Fill and backfill in other areas                   | 95%  |

Material too dry for proper compaction shall be moistened by suitable watering devices, turned and harrowed to distribute moisture, and then properly compacted. When material is too wet for proper compaction, operations shall cease until such material has sufficiently dried.

## PART 8 - COMPACTION TESTING

### 8.1 COMPACTION TESTING

- A. The Owner, or its authorized representatives, reserve the right to perform compaction tests on any or all portion(s) of backfill placed at no cost to the Contractor. However, in the event the compaction of this backfill is not in compliance with the specification, then the Contractor shall take corrective measures at no cost to the Owner to bring the backfill within the limits of the specifications. The Contractor shall then be responsible for reimbursing the Owner all costs associated with the performance of compaction test(s) in those sections of the backfill that failed the initial compaction test(s). Minimum testing shall be:

1. Every 300 lf/lift in paved areas for linear utilities in paved areas.
2. Every 500 lf/lift in non-paved areas.
3. Other areas, such as adjacent to structures, 1 test/40 cubic yards of material.

In the event that the soil compaction is not in compliance with these specifications, then the Contractor shall take corrective action, at no cost to the Owner, to compact the soils within the limits of the specifications. The Engineer shall be notified within 24 hours of any failing compaction tests. Any retesting of failed areas shall be performed only after corrective measures have been made by the Contractor to bring

the compacted soils into compliance. All retesting shall be performed with the Engineer present.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

The work covered by this section consists of the excavation and satisfactory disposal of all material excavated in the construction of ditches.

**1.02 QUALITY ASSURANCE**

- A. The excavation shall be done to the lines, grades, typical sections and details shown on the plans or established by the Engineer. All work covered by this section shall be coordinated with the grading, and shall be maintained in a satisfactory condition so that adequate drainage is provided at all times. Ditches shall be landscaped in accordance with Section 02901.
- B. The ditches shall be maintained by the Contractor until the final acceptance of the project.

**PART 2: NOT USED****PART 3: EXECUTION****3.01 PREPARATION****A. SILT DETENTION**

When directed by the Engineer or shown on the drawings, the Contractor shall excavate silt detention basins and silt ditches to the dimensions and at the locations established by the Engineer for the purpose of siltation control. Silt detention basins shall be cleaned out, when so directed by the Engineer, if necessary to maintain their effectiveness. Silt detention basins and silt ditches shall be backfilled and shaped for seeding and mulching prior to the completion of the project unless otherwise directed by the Engineer.

- B. All roots, stumps, and other foreign matter in the sides and bottom of ditches shall be cut one foot below finish grade. Care shall be taken not to over-excavate ditches below the grades indicated. Any excessive ditch excavation due to removal of roots, stumps, etc., or due to over-excavation shall be backfilled to grade either with suitable material, thoroughly compacted, or with suitable stone or cobble to form an adequate invert, as directed. The Contractor shall maintain

all ditches excavated under this specification free from detrimental quantities of leaves, sticks, and other debris until final acceptance of the work.

### **3.02 DISPOSAL OF MATERIALS**

All excavated materials shall be utilized in the construction of embankments except where otherwise directed by the Engineer. Materials which are excess to the needs of the project may be deposited alongside the ditch, and spread to form a low, flat, inconspicuous spoil bank of sufficiently regular contour to permit seeding and mowing to be performed.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

- A. The work covered by this section consists of the construction of a base composed of an approved aggregate material hauled to the site, placed on the site, compacted, and shaped to conform to the lines, grades, depths, and typical sections shown on the plans or established by the Engineer.

**PART 2: PRODUCTS****2.01 MATERIALS**

- A. Aggregate base course materials shall consist of crushed stone or uncrushed gravel, or other similar material having hard, strong, durable particles free of adherent coatings.
- C. The Contractor shall furnish aggregate base course material produced in accordance with the requirements indicated herein for Type A, aggregate unless otherwise specified in the special provisions.
- D. All aggregates shall be from approved sources. Sources will not be approved unless the material has satisfactory soundness and satisfactory resistance to abrasion. Satisfactory soundness will be considered to be a weighted average loss of not greater than 15% when subjected to five (5) alternations of the sodium sulfate soundness test in accordance with AASHTO T104. Satisfactory resistance to abrasion will be considered to be a percentage of wear of not greater than 55% when tested in accordance with AASHTO T96.
- E. Aggregates shall be handled in such a manner as to minimize segregation.
- F. Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the ground surface shall be firm, smooth, and well drained. A cover of at least 3" of aggregate shall be maintained over the ground surface in order to avoid the inclusion of soil or foreign material. Stockpiles shall be built in such a manner as to minimize segregation. When it is necessary to operate trucks or other equipment on a stockpile in the process of building the stockpile, it shall be done in a manner approved by the Engineer.
- G. Stockpiles of different types or sizes of aggregates shall be spaced far enough apart, or else separated by suitable walls or partitions, to prevent the mixing of the aggregates.
- H. Any method of stockpiling aggregates which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the

aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has been operated, and failure of such samples to meet all grading requirements for the aggregate will be considered cause for discontinuance of such stockpiling procedure.

I. GRADATION

All standard sizes of aggregates shall meet the gradation requirements when tested in accordance with AASHTO T27.

**PART 3: EXECUTION**

**3.01 CONSTRUCTION OF STONE BASE**

- A. The aggregate material shall be spread on the subgrade to a uniform loose depth and without segregation.
- B. Where the required compacted thickness of base is 8" or less the base material may be spread and compacted in one layer. Where the required compacted thickness of base is more than 8", the base material shall be spread and compacted in 2 or more approximately equal layers. The minimum compacted thickness of any one layer shall be approximately 4".
- C. Each layer of material shall have been sampled, tested, compacted, and approved prior to placing succeeding layers of base material or pavement.
- D. No base material shall be placed on frozen subgrade or base. Hauling equipment shall not be operated on subgrade or a previously completed layer of base material soft enough to rut or weave beneath the equipment.
- E. The maximum speed of trucks hauling or traveling over any part of the subgrade or base shall be 5 miles per hour.
- F. The Contractor shall utilize methods of handling, hauling, and placing which will minimize segregation and contamination. If segregation occurs, the Engineer may require that changes be made in the Contractor's methods to minimize segregation, and may also require mixing on the road which may be necessary to correct any segregated material. No additional compensation will be allowed for the work of road mixing as may be required under this provision. Aggregate which is contaminated with foreign materials to the extent the base course will not adequately serve its intended use shall be removed and replaced by the Contractor at no additional cost to the Owner. The above requirements will be

applicable regardless of the type of aggregate placed and regardless of prior acceptance.

- G. The Engineer or the owner's representative will have the right to require that any portion of the work done in his presence and if the work is covered up after such instruction, is shall be exposed by the contractor for observation at no additional cost to the owner.

### **3.02 QUALITY CONTROL**

#### **A. TOLERANCES**

1. After final shaping and compacting the base, the Engineer will check the surface of the base for conformance to grade and typical section and will determine the base thickness.
2. The thickness of the base shall be within a tolerance of  $\pm 1/2$ " of the base thickness required by the plans.

#### **B. MAINTENANCE**

Where the base material is placed in a trench section, the Contractor shall provide adequate drainage through the shoulders to protect the subgrade and base until such time as shoulders are completed. The Contractor shall maintain the surface of the base by watering, machining, and rolling or dragging when necessary to prevent damage to the base by weather or traffic.

#### **C. Testing**

1. There will be at least one base density test performed per 5,000 square feet. Compaction will be 100% of the maximum laboratory dry density as determined by ASTM D 1557 or AASHTO T 180. This test procedure will be the Owners responsibility to have done and at the owners cost.
2. Depth measurements for compacted thickness shall be made by test holes through the base course. Where the base course is deficient, correct such areas by scarifying, adding base material and recompacting as directed by the Engineer. At staggered intervals not to exceed 250 feet for two lane streets and roads.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

The work covered by this section consists of the preparation, shaping, and compaction of that portion of the roadbed upon which base or pavement, including base and paving for shoulders, is to be placed.

**PART 2: NOT USED****PART 3: EXECUTION****3.01 CONSTRUCTION**

- A. The subgrade shall be shaped to the lines, grades, and typical sections shown on the plans. All unsuitable material, boulders, and all vegetative matter shall be removed and replaced with suitable material. Suitable material, when not available from the subgrade work, shall be taken from roadway excavation or borrow pits.
- B. Material excavated in preparing the subgrade shall be stored or stockpiled in such a manner as to not interfere with proper drainage or any of the subsequent operations of placing base or pavement.
- C. The top 24" of subgrade in paved areas shall be compacted at a moisture content required to produce 98% of maximum density. All other areas subgrade will be compacted to 95% of maximum density at the optimum moisture content. The Contractor shall dry or add moisture to the subgrade when required to provide a uniformly compacted and acceptable subgrade.

**3.02 QUALITY CONTROL**

- A. Refer to Section 02220-3.07 and 3.08 for testing all subgrade under curbing and paving.
- B. A tolerance of plus or minus 1/2" from the established grade will be permitted after the subgrade has been graded to a uniform surface.
- C. Ditches and drains shall be provided and maintained when required to satisfactorily drain the subgrade. Where previously approved subgrade is damaged by natural causes, by hauling equipment, or by other traffic, the Contractor shall restore the subgrade to the required lines, grades, and typical sections and to the required density at no cost to the Owner.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

The work covered by this section shall consist of the production, delivery, and placement of asphalt plant mix base, intermediate, and surface courses properly laid on a prepared aggregate base course, in accordance with these specifications and in conformity with the lines, grades, thickness, and typical sections shown on the plans.

**1.02 SUBMITTALS**

- A. Prior to paving operations, the contractor should supply the engineer with the appropriate job mix formulas (JMF) for review and approval.
- B. The quantity of asphalt materials, measured as provided in Section 02510, will be paid for at the contract prices as specified in the bidding documents. In all cases, the Contractor shall furnish copies of certified weight tickets for all asphalt materials placed on the project.

**1.03 QUALITY ASSURANCE**

- A. The Owner's Representative or Engineer will have the right to require that any portion of the work be performed in his presence and if the work is covered up after such instruction, it shall be exposed by the Contractor for observation at no additional cost to the Owner. However, if the Owner's Representative or Engineer fails to appear within 48 hours, the Contractor may proceed without him.
- B. All work done and materials furnished shall be subject to review by the Owner, Engineer or Project Representative. Improper work shall be reconstructed, and all materials which do not conform to the requirements of the specifications, shall be removed from the work upon notice being received from the Engineer for the rejection of such materials. The Engineer shall have the right to mark rejected materials so as to distinguish them as such.

The Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

- C. When required by the Engineer, the automatic weighing and recording system shall be checked by weighing a truck load of mix with an approved set of platform scales. Other means of checking the automatic weighing and recording system will be designated by the Engineer if such checking becomes necessary.

- D. The Contractor will not be permitted to use an asphalt mixture delivered to the road which is not accompanied by a load ticket signed by the weighman or an automatic printout ticket in accordance with the above requirements.
- E. The original of all tickets, including any voided tickets or tickets for rejected mixture, shall become the property of the Engineer.
- F. Asphalt materials will be accepted at the source of shipment subject to the following conditions:
  - 1. All asphalt transport tankers shall have a sampling valve in accordance with the requirements outlined by the Asphalt Institute and ASTM D140, or a comparable device acceptable to the Engineer.
  - 2. Each transport tanker delivering asphalt materials to the project shall keep a running log showing the date, destination, type and grade of material hauled on each trip. The tanker number shall be printed, stamped, or written in ink on each logbook. The logbook shall be available for examination upon request of the Engineer at any time.
  - 3. The Contractor shall furnish with each shipment two (2) copies of the delivery ticket. One copy shall accompany the shipment and be delivered to the Engineer or his representative at the destination. The delivery ticket shall contain the following information: Delivery ticket number, date shipped, state project or purchase order number, destination, name of consignee, trailer number, storage tank or batch number, quantity loaded (tons or gallons), loading temperature, specific gravity or pounds per gallon at 60°F, and net gallons at 60°F.
  - 4. The Engineer reserves the right to sample and test any shipment regardless of whether or not the above conditions have been met and to reject any material not meeting the requirements of the specifications.

#### **1.04 STORAGE AND DELIVERY**

##### **A. ASPHALT MIXTURE STORAGE SYSTEM**

- 1. The asphalt mixture storage system shall be capable of conveying the mix from the plant to the storage bin while minimizing production interruptions and ensuring the mixture discharged from the storage bin meets the job mix formula requirements.
- 2. The mixture shall be stored without a loss in temperature, segregation, or oxidation of the mix. Storage time should be limited to the ability of the storage system to maintain the mixture within the specification requirements.

## B. TRANSPORTATION OF ASPHALT MIXTURE

1. The mixture shall be transported from the mixing plant to the point of use in vehicles which have tight, clean, smooth metal beds that have been lightly coated with a release agent to prevent the mixture from adhering to the bed. The release agent should be a material that is approved by the North Carolina Department of Transportation (NCDOT) Materials and Test Unit. Each vehicle shall be equipped with a canvas or other suitable material that will cover the bed of the vehicle. All covers shall be constructed and secured as to prevent the entrance of moisture and the rapid loss of temperature. A 3/8" diameter hole shall be provided on each side of the vehicle body near the center of the body and 6" above the bed of the vehicle for the purpose of inserting a thermometer.
2. The temperature of the mixture immediately prior to discharge from the hauling vehicle shall be within a tolerance of plus 15°F to minus 25°F of the specified job mix temperature. The asphalt mixture temperature should not exceed 350°F. Asphaltic concrete shall not be placed once the temperature of the mix falls below 250° F.

## PART 2: PRODUCTS

### 2.01 MATERIALS

#### A. COMPOSITION OF MIXTURES

1. Asphalt mixtures noted herein refers to mix types for base (B 25.0X), intermediate (I 19.0X), and surface (S 12.5X, S and SF 9.5X) courses.
2. The asphalt plant mix shall be composed of a mixture of course and fine aggregate, asphalt binder, and mineral filler. The aggregate components shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading and physical requirements of the NCDOT specifications for the specified mix type. Materials which will not produce an asphalt mixture within the full allowable tolerances required by these specifications will be rejected.
3. If a recycled mixture is used, reclaimed asphalt pavement (RAP) may constitute up to 50 percent of the total material used.
4. Asphalt mixtures should be designed and produced in accordance with the gradation and design criteria for the specified mix type outlined in Table

610-1 and Table 610-2 of the most current NCDOT Standard Specifications for Roads and Structures.

5. The job mix formula shall be established with the allowable tolerances within the design limits specified for the particular type of asphalt mixture. At a minimum, each job mix formula should include the following information:
  - Asphalt mixture type
  - Asphalt mixture identification number (JMF#)
  - Source and percentage of each aggregate and recycled asphalt pavement (RAP) component to be used.
  - JMF combined gradation including target value for percent passing each standard sieve.
  - Percentage of asphalt binder in RAP.
  - Supplier and percentage of anti-strip additive.
  - Supplier, grade, and percentage of asphalt binder.
  - Target value (percentage) of asphalt binder content by weight of total mix and required design properties at that percentage.
  - Mix temperature.
  - Volumetric properties of compacted mixture.
  - Required Field Density.
6. The job mix formula for each mixture shall be in effect until modified in writing by the Engineer.
7. All mixtures furnished for the work shall conform to the job mix formula within the tolerance ranges specified for the particular mix.
8. Should a change in sources of aggregate, RAP, or asphalt binder materials be made, a new job mix formula will be required before the new mixture is produced.
9. When unsatisfactory results or other conditions make it necessary, the Engineer may establish a new job mix formula.
10. The asphalt binder for the mixtures shall be a performance graded binder meeting the requirements of AASHTO M320. The binder grade used in standard asphalt mixtures in North Carolina is Performance Grade 64-22 (PG 64-22). Depending on traffic conditions and other factors, other grades of asphalt binder may be used.

## B. ASPHALT MATERIALS

1. Asphalt Tack Coat

- a. Materials used as a tack coat shall meet the requirements for the grades indicated below unless otherwise indicated in the contract. Any of the grades of tack coat material noted in this specification may be used:
  - Asphalt Binder, Grade PG 64-22
  - Emulsified Asphalt, Grade RS-1H, CRS-1H, CRS-1, HFMS-1, CRS-2
- b. Do not dilute or mix the tack coat with water, solvents, or other materials prior to application.
- c. When tack coat is required beneath an open-graded asphalt friction course, the asphalt grade and rate of application to be used will be specified on the job mix formula.

### **PART 3: EXECUTION**

#### **3.01 CONSTRUCTION REQUIREMENTS**

- A. BASE COURSE (B 25.0X); INTERMEDIATE COURSE (I 19.0X); SURFACE COURSES (S 12.5X, S AND SF 9.5X)
  1. Weather and Temperature Limitations
    - a. Asphalt mixtures shall not be produced or placed during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond. Asphalt material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the temperatures noted in the table on the following page.
    - b. Where the surface course is to be placed on the intermediate course, the surface course shall be placed as soon as possible after the intermediate course has been placed, and in all cases during the same paving season.

## Minimum Paving Temperatures

| Asphalt Mixture                     | Minimum Air Temperature (°F) | Minimum Road Surface Temperature (°F) |
|-------------------------------------|------------------------------|---------------------------------------|
| B 25.0B<br>B 25.0C                  | 35                           | 35                                    |
| I 19.0B<br>I 19.0C                  | 35                           | 35                                    |
| S 9.5C, S 9.5D,<br>S 12.5C, S 12.5D | 50                           | 50                                    |
| SF 9.5A<br>S 9.5B                   | 40                           | 50                                    |

### 2. Spreading and Finishing

- a. Coat surface of manhole frames and inlet frames with oil to prevent bonding with asphalt pavement. Do not tack or prime coat these surfaces.
- b. Tack coat shall be applied to the existing pavement, when necessary, in accordance with the provisions of these specifications.
- c. The asphalt mixture shall be spread and struck off to the required grades, cross sections, and thicknesses by self contained, power propelled pavers. The pavers shall be equipped with an activated screed plate assembly which is designed to be preheated. The screed unit shall be equipped with a sliding shoe attachment that will form a slope on the edge of the mixture to help prevent edge raveling when the mixture is compacted. The paver shall be equipped with a receiving hopper and an automatically controlled distribution system capable of maintaining a uniform load of material in front of the full length of the screed.
- d. A string line shall be placed by the Contractor for the first lane of each layer of mixture placed to provide alignment control for the paver, except when the first layer is placed adjacent to a curb section.
- e. Pavers shall be operated at forward speeds consistent with plant production, mixture delivery and satisfactory laying of the mixture in order to provide a uniform and continuous laydown operation. Paving and loading operations should be coordinated such that an adequate amount of asphalt mixture is maintained in the paver hopper between trucks. Do not allow the hopper to become empty between loads. Should unevenness of texture, tearing, segregation,

or shoving occur during the paving operation due to unsatisfactory methods or equipment, the Contractor shall immediately take such action as may be necessary to correct such unsatisfactory work. Excessively throwing back material will not be permitted.

- f. Pavers shall be equipped with an electronic screed which will automatically control the longitudinal profile and cross slope of the pavement by the use of either a mobile grade reference(s), or string line(s), joint matching shoes, or other approved methods. When a fixed string line is required, the Engineer will furnish grade stakes for the finished pavement grade and the Contractor shall furnish and erect the necessary guide line for the equipment.
- g. A mobile grade reference system or non-contacting laser or sonar type ski shall be used during placement of the initial lanes and all adjacent lanes of all layers to control the longitudinal profile. A joint matching device may only be used where approved by the Engineer.
- h. An automatic slope control system shall be utilized, unless otherwise approved. The Engineer may waive the requirement for automatic slope controls in areas where the use of such equipment is impractical due to irregular cross section or shape. Mobile grade references may be required when the use of automatic slope controls is waived. Manual screed operation will be permitted based on approval from the Engineer for construction of irregularly shaped and minor areas.
- i. In the case of malfunction of the automatic control equipment, the Contractor may manually operate the paver for the remainder of the workday only provided acceptable results are obtained.
- j. The Engineer will waive the requirement for use of pavers for spreading and finishing where irregularities or obstacles make their use impractical and the Contractor shall spread, rake, and lute the mixture by hand methods.
- k. Roadway paving shall be as continuous as possible. Intersections, auxiliary lanes, and irregular areas shall be paved after the adjacent roadway has been paved.

3. Compaction

- a. Immediately after the asphalt mixture has been spread, struck off, shaped to the required width, depth, cross-section, and surface and edge irregularities adjusted, it shall be thoroughly and uniformly compacted. Compaction must be obtained in a manner that

provides uniform density over the pavement and meets the required degree of compaction for the type of mixture being placed. Compaction rolling shall be complete before material temperature drops below 185°F.

- b. Compaction rolling should be performed at the maximum temperature at which the mix will support the rollers without moving horizontally. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Adjustments to the compaction equipment may be required where uniform density is not being obtained throughout the depth of the layer being tested.
- c. All final wearing surfaces, except open-graded asphalt friction course, shall be compacted using a minimum of 2 steel wheel tandem rollers. Pneumatic-tired rollers with smooth tread tires may be used after the breakdown roller and prior to finish rolling. Vibratory rollers must not be operated in vibratory mode during finish rolling on any mix type or pavement layer.
- d. Rollers used to compact the mixture shall be in good condition and capable of reversing without backlash. The rollers shall be operated with the drive wheels nearest the paver and at uniform speeds slow enough to avoid displacement of the mixture. Steel wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels. Fuel oil shall not be used to moisten roller wheels.
- e. All asphalt mixtures, except open-graded asphalt friction course and type SF 9.5A, shall be compacted to at least 92 percent of the mixtures maximum specific gravity. An SF 9.5A mixture shall be compacted to at least 90 percent of the mixtures maximum specific gravity.
- f. Rolling for open-graded asphalt friction course shall consist of one coverage with a tandem steel wheel roller weighing a maximum of 10 tons, with additional rolling limited to one coverage with the roller where necessary to improve riding surface.
- g. The use of rolling equipment that results in excessive crushing of the aggregate or excessive displacement of the mixture will not be permitted.
- h. In areas inaccessible to standard rolling equipment, the mixture shall be thoroughly compacted by the use of hand tampers, hand operated mechanical tampers, or other approved equipment.

- i. The tolerance of the final compacted pavement shall be within 1/4” of the typical cross-sections shown on the plans.

4. Joints

a. Transverse Joints

- i. Transverse joints shall be constructed when the laying of the mixture is to be suspended long enough to permit the mixture to become cooled. At the end of each day's paving operation, the Contractor shall construct a sloped wedge ahead of the end of the full depth pavement to provide for proper compaction and protection of the full depth pavement. The Contractor shall place a paper parting strip beneath this wedge to facilitate joint construction, unless otherwise waived by the Engineers.
- ii. Before paving operations are resumed, the Contractor shall remove the sloped wedge and cut back into the previously constructed pavement to the point of full pavement depth. The exposed edge of the previously constructed pavement shall then be lightly coated with tack coat.
- iii. When laying of the mixture is resumed at the joint, the construction of the joint shall be completed while the mixture is still in a workable condition.

b. Longitudinal Joints

- i. The exposed edge of all longitudinal joints should be lightly coated with tack coat prior to placing the adjoining pavement.
- ii. Longitudinal joints shall be formed by allowing the paver to deposit the mixture adjacent to the joint to such depth that maximum compaction can be obtained along the joint. The joint shall be pinched by rolling immediately behind the paver.
- iii. When multi-lane multi-layer construction is required, the longitudinal joint in each layer shall offset that in the layer immediately below by approximately 6 inches. The joint in the top layer shall be constructed, where possible, between design travel lanes.

- c. Placement of surface course material as the final layer of pavement should not be placed between November 15 and April 1 of the next

year unless otherwise approved by the Engineer. In addition, open-graded asphalt friction course shall not be placed between October 31 and April 1, unless otherwise approved.

- d. As an exception to the above, when in any day's operations the placement of a layer of asphalt base course material or intermediate course material 2 inches or greater in thickness has started, it may continue until the temperature drops to 32° F.

## B. ASPHALT TACK COAT

### 1. Surface Preparation

- a. The surface to which the tack coat is to be applied shall be cleaned of dust, dirt, clay, and any other deleterious matter prior to placing the tack coat.
- b. The Contractor shall remove grass, dirt and other materials from the edge of the existing pavement prior to the placement of tack coat.

### 2. Weather Limitations

- a. Tack shall be applied only when the surface to be treated is sufficiently dry and the atmospheric temperature in the shade away from artificial heat is 35° F or above.
- b. Tack coat shall not be applied when the weather is foggy or rainy.

### 3. Application Rates and Temperatures

- a. Tack coat shall be uniformly applied at a rate from 0.04 to 0.08 gallons per square yard. The exact rate of application will be established by the Engineer and will be based on the volume of material at the actual application temperature. When tack coat is required beneath an open-graded asphalt friction course, an asphalt binder Grade PG 64-22 material shall be used. The exact rate of application will be specified on the job mix formula and will be within the range of 0.06 to 0.08 gallons per square yard.
- b. The temperature of the material at the time of application shall be within the ranges shown in the table below:

### **Application Temperatures for Tack Coat**

| Asphalt Material                               | Temperature Range |
|--|-------------------|
| Asphalt Binder, Grade PG 64-22                 | 375 - 425°F       |
| Emulsified Asphalt, Grade RS-1H, CRS-1, CRS-1H | 90 - 150°F        |
| Emulsified Asphalt, Grade HFMS-1               | 90 - 160°F        |
| Emulsified Asphalt, Grade CRS-2                | 125 - 185°F       |

4. Application

- a. No more tack coat material shall be applied than can be covered with base, intermediate, or surface course during the following day's paving operations.
- b. Tack coat material shall be uniformly applied to the entire surface utilizing an adjustable spray bar. Areas of tack coat application should be uniformly and completely covered.
- c. Tack coat shall be applied only in the presence of and as directed by the Engineer. No base or surface mixture shall be deposited onto tacked the tacked pavement until the tack coat has sufficiently cured.
- d. Contact surfaces of headers, curbs, gutters, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course shall be painted or sprayed with tack coat before new asphalt mixture is placed adjacent to such surfaces.
- e. Bridge floors, curbs and handrails of structures, and all other appurtenances shall be covered to prevent tack coat from being tracked or splattered on the structures or appurtenances.

5. Protection

- a. Protect the tack coat after application until it has cured for a sufficient length of time to prevent it from being picked up by traffic.
- b. Contractor shall take the necessary precautions to minimize tracking and/or accumulation of tack coat material on existing or newly constructed pavements. Corrective measures may be required in areas where an excessive accumulation of tack has occurred.

### **3.02 QUALITY CONTROL AND TESTING**

#### **A. SAMPLES AND TESTING**

1. It will be the responsibility of the Owner to hire and pay for an independent testing agency to perform quality control testing during paving operations.
2. Density testing to verify compaction may be performed by either Nuclear density procedures or Core Sampling procedures, and will be designated by the Engineer.
3. Nuclear density testing shall be performed the same day the mix being tested is placed and compacted. Nuclear density tests must be performed at a frequency of no less than 1 test every 400 linear feet for each mix type and layer, with a minimum of 5 nuclear density readings on a given day's paving.
4. Core samples shall be 6 inches in diameter and obtained no later than the beginning of the next production day, not to exceed 3 calendar days. Core samples shall be tested and test results submitted to the Engineer within one working day from the time the cores are taken. Cores must be obtained at a minimum frequency of 1 core every 1000 linear feet for each mix type and layer, with a minimum of 3 cores obtained on a given day's paving.
5. Cores shall be obtained from the full layer depth of compacted pavement at random locations. Artificial methods may be utilized to cool the pavement layers to allow cutting the core samples as quickly as possible.
6. Where cores have been taken, clean the inside surfaces of the core hole, dry, apply tack coat, place and compact the same type asphalt mixture to conform with the surrounding area.
7. It will be the responsibility of the Contractor to perform sufficient testing at the plant to verify mix production is in accordance with the specified job mix formulas being used.
8. During mix production, samples of the asphalt mixture should be obtained at a minimum frequency of 1 sample every 750 tons produced, with a minimum of 1 sample for each day's production for each asphalt mixture produced. Each sample should be tested to determine binder content, gradation, and maximum specific gravity. As requested by the Engineer, additional tests may be performed to verify the volumetric properties of the asphalt mixture being produced. The Engineer may also request that

the independent testing agency oversee the testing, or perform testing on additional samples.

## B. SURFACE REQUIREMENTS

1. The surface of the plant mix base or pavement after compaction shall be smooth and true to the required cross section and grade. Any defective areas shall be corrected with satisfactory material which shall be immediately compacted to conform with the surrounding area. Any area showing an excess of asphalt cement shall be removed and replaced.
2. The surface will be tested by the Engineer at all joints and at other selected locations using a 10'-0" straightedge. The variation of the surface from the testing edge of the straightedge, when applied parallel to the centerline of the surface, shall not exceed 1/8" between any two contact points. Areas found to exceed this tolerance shall be corrected by the Contractor by removal of the defective work and replacement with new material unless other corrective measures are permitted by the Engineer. The work and materials required in the correction of defective work shall be provided by the Contractor at no cost.
3. The Contractor shall repaint and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.
4. All existing manhole, inlet, and valve covers shall be raised by the Contractor as necessary prior to paving so that the tops of the covers are flush with the final surface. Any pavement left on covers shall be removed as necessary by the contractor. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK****A. PAINT**

The work under this section shall consist of furnishing all labor, equipment, materials and services for the proper placement and installation of all pavement markings in accordance with the requirements shown on the plans and the provisions of these specifications.

**B. THERMOPLASTIC PAVING MARKING**

This specification covers a reflectorized pavement striping material of the type that is applied to a road surface in a molten state with premixed glass beads by spray or extrusion means, with a supplemental surface application of glass spheres. When applied properly and at the designated thickness and width the stripe shall, upon cooling, be reflectorized and be able to resist deformation by traffic. The applied material shall be impervious to degradation by motor oil, diesel fuel, grease deposits and ice-preventative chemicals.

**1.02 DELIVERY, STORAGE, AND HANDLING**

- A. Contractor shall deliver paint to site in sealed and labeled containers. Upon Engineer's request, the Contractor shall make containers available for inspection to verify acceptance of product. Paint shall be stored at a minimum ambient temperature of 45°F and a maximum of 90°F, in well ventilated areas, unless required otherwise by manufacturer's instructions.

**1.03 RELATED DOCUMENTS**

- A. All pavement markings shall be in accordance with the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration and the North Carolina Supplement to the MUTCD.

**PART 2: PRODUCTS****2.01 MATERIALS****A. STANDARDS**

The following are minimum requirements and shall govern except all local, state and/or federal highway or transportation department standard specifications shall govern when their requirements are in excess thereof.

B. PAINT

Paint shall be chlorinated rubber-alkyd type meeting the requirements of AASHTO M 248 (FS TT-P-115), Type III factory mixed, quick drying and non-bleeding.

C. THERMOPLASTIC MATERIALS

The thermoplastic pavement marking materials used in this contract shall meet the following specifications. This specification covers reflectorized oil and grease impervious thermoplastic road marking materials which are (1) hot extrusion applied with a surface application of glass spheres and (2) heat fused applied. The properly applied markings shall be reflectorized and able to durably resist degradation and deformation by traffic.

The thermoplastic materials shall be homogeneously composed of pigment, filler, resins, and glass reflectorizing sphere and shall be available in both yellow and white.

Composition: The pigment, beads and filler shall be uniformly dispersed in the resin. The materials shall be free from all skins, dirt, and foreign objects and shall comply with requirements according to Table 1. Only new materials shall be acceptable for use on this project.

| <b>COMPONENT</b>                     | <b>WHITE</b> | <b>YELLOW</b> |
|--------------------------------------|--------------|---------------|
| Binder (see note A)                  | 18.0% min    | 18.0% min     |
| Glass Beads<br>(AAASHTO M247 Type D) | 30.0 – 40.0% | 30.0 – 40.0%  |
| Titanium Dioxide                     | 10.0% min    | ----          |
| Yellow Pigments                      | ----         | 2.0% min      |
| Calcium Carbonate                    | 42.0% max    | 50.0% max     |

**Note A:** The alkyd binder shall consist of a mixture of synthetic resins (at least one of which is solid at room temperature) and a high boiling point plasticizer. At least one third of binder composition shall be solid maleic modified glycerol ester resin and shall be no less than 8% by weight of the entire material formulation. The alkyd binder shall not contain petroleum based hydrocarbon resins.

**Note B:** The percentage of yellow pigment can be reduced if lead pigments are eliminated from the formulation.

Temperature – The molten material temperature shall be between 400 and 440 F unless otherwise recommended by the manufacturer and approved by the Engineer.

Primer – A primer shall be used if thermoplastic is applied to Portland cement concrete. Any primer used shall be compatible with the thermoplastic material.

Thickness – The pavement markings shall yield a solid thickness range of 80 to 95 mils above the roadway surface across the middle two-thirds of the line width when tested as specified in MSMT 729.

Glass Beads – Glass beads shall be uniformly applied to the surface of the molten thermoplastic at the minimum rate of 7 to 9 lb./100ft<sup>2</sup> as specified in MSMT 729

Color – The color of the dry markings shall match Federal Standard 595 (13538-yellow or 17886-white). The Contractor shall supply the specified color chips for the Engineer’s use to visually determine that the thermoplastic material matches the specified color.

Retro reflectance – The millicandel/lux/square meter values taken anytime within the first 30 days shall conform to the following:

**RETROREFLECTANCE**

| <b>COLOR</b> | <b>RETROREFLECTIVITY</b>     | <b>CORRECTIVE ACTION</b>  |
|--------------|------------------------------|---|
| White        | equal to or greater than 250 |   |
| Yellow       | equal to or greater than 150 | None  |
| White        | less than 250                | Necessary corrective actions including grinding if necessary and re-tracing |
| Yellow       | less than 150                |   |

The “Drop-On” glass beads shall conform to AASHTO specifications M-247-81 except as follows: The glass beads shall have the following gradation:

| <b>US SIEVE NUMBER</b> | <b>PERCENT PASSING</b> |
|------------------------|------------------------|
| 20                     | 100                    |
| 30                     | 75-95                  |
| 50                     | 15-35                  |
| 80                     | 0-5                    |
| 100                    | 0                      |

The “Drop-On” glass beads shall be smooth, clear and free from air inclusions. The beads shall have a minimum refractive index of 1.50 and shall be a minimum of 80% true spheres overall and minimum 70% true spheres on each sieve. The beads shall be moisture proof coated and shall meet the requirements of AASHTO M-247-81 Section 4.4.2 to insure optimum embedment of 60-65 percent (60-65%) in various thermoplastic traffic marking systems. The material shall set to bear traffic in not more than 2 minutes when the air temperature is 50 degrees F and not more than 10 minutes when the air temperature is 90 degrees F.

Bond Strength – After heating the thermoplastic material for four hours at 425 degrees F the bond strength to Portland Cement Concrete shall exceed 180 psi (1.24 Mpa Method ASTM D4796-88)

Cracking Resistance – For at least 90 days after application the materials shall show no cracks other than with substrate cracking.

Smear and Softening Resistance-During the life of the materials, the applied markings shall not smear or soften apart from substrate movement.

D. **TRAFFIC AND LINE MARKINGS**

1. Unless otherwise noted, paint for traffic and line markings shall be white in color.
2. Dimensions and spacing of markings shall be in accordance with MUTCD and as indicated in the pavement markings detail included in the contract drawings.

**PART 3: EXECUTION**

**3.01 SURFACE PREPARATION**

- A. Contractor must insure that pavement surface to be painted shall be clean and dry before application. All surface contamination such as oil, grease, dirt, foreign matter, or other deleterious materials will be removed by the Contractor prior to application of paint.

**3.02 INSTALLATION**

A. **PAINT**

1. No paint shall be applied when the atmospheric, surface, or material temperature is less than 40°F or when the relative humidity is greater than 85%.
2. No paint shall be applied until the layout and placement has been verified by the Engineer.
3. Paint shall be applied with mechanical equipment to produce uniform straight edges in strict compliance with the manufacturer's instructions. Paint shall be applied in two (2) coats at the manufacturer's recommended rates.

B. **THERMOPLASTIC PAVING MARKINGS**

1. The molten applied thermoplastic material shall readily screed/extrude at temperatures between 400 degrees F and 440 degrees F from the approved equipment to produce a line which shall be continuous and uniform in shape having sharp dimensions. The application of additional glass beads by drop-on methods shall be at a minimum rate of 8 lbs. per 100 sq ft of marking. Ambient and surface temperatures shall be at least 50 degrees F and rising at the time of application.

2. Method of Application

The Contractor shall furnish and install machine-applied extruded and/or sprayed hot thermoplastic with glass spheres (pre mixed and drop-on) in the proper ratio to immediately produce a highly reflective marking as described elsewhere in these specifications, in accordance with the details in this contract and the following provisions.

3. Primer-Sealer:

It shall be the responsibility of the contractor to recommend to the Engineer and obtain the Engineer's concurrence as to whether primer-sealer is required on a given pavement in order to meet the material manufacturer's warranty conditions. Generally, on all Portland Cement concrete pavement surfaces and aged asphalt-concrete pavements having less than eighty percent (80%) bituminous concrete, primer-sealer shall be applied to the area where the thermoplastic pavement markings are to be placed. Also, the Owner reserves the right to direct the Contractor to apply primer/sealer for any given markings. The primer/sealer shall be that recommended by the manufacturer of the thermoplastic material, and approved by the Engineer. The material shall form a continuous film which shall dry rapidly and adhere to the pavement. The material shall not discolor nor cause any noticeable change in the appearance of the pavement outside of the finished pavement markings. All solvents shall have evaporated from the primer/sealer prior to the application of the molten thermoplastic materials. A sample of the primer/sealer and the recommended method of application must be submitted to the Engineer, and shall have been approved by the Engineer and the manufacturer of the material before application. The Engineer has the authority to require the Contractor to apply the primer/sealer using a separate vehicle which may require additional traffic control. Payment for application of primer/sealer and any additional traffic control will be incidental to the marking item.

4. Removal of Existing Plastic or Pavement Markings

When called for in the contract or otherwise as directed by the Engineer, removal of existing painted or plastic pavement markings shall be accomplished by the Contractor using equipment and methods specifically approved by the Engineer. Marking removal shall not be by

the “painting out” with black paint method nor shall it result in excessive scarring of the pavement. No more than 1/8 inch depth of scarred pavement will be allowed. At least 90 percent of all markings shall be removed.

As directed by the Engineer, the Contractor shall be responsible for sweeping or otherwise adequately cleaning up debris after completion of markings required to be removed by the Engineer because they are improperly located or otherwise incorrect or improper. Unless permitted otherwise by the Engineer, where old markings are removed, the new markings must be applied the same day as the old markings are removed. Whenever grinding, scraping, sandblasting, or other operations are performed, the work shall be conducted in such manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect motorists. When these operations are completed, the pavement markings shall be cleaned to remove residue and debris resulting from the cleaning work.

Where cleaning and/or removal of pavement paint striping or objectionable material is being performed within ten (10) feet of a lane occupied by traffic, the residue removal shall be by method(s) approved by the Engineer.

Any damage to the pavement or pavement joint materials caused by pavement marking removal shall be repaired by the Contractor at no cost to the Owner by methods acceptable to the Engineer.

5. Pre-marking of Lines

When a line is required to be placed in the same location as an existing painted line, and existing painted markings not required to be removed are visible, they shall be retraced (i.e. new markings installed in exactly the same locations, patterns, and dimensions as the old markings). However, if the existing markings are to be removed or are not visible, or if new roadway surface has been placed before markings installation occurs, or if the contract requires a line to be installed where none currently exists, the Contractor will be required to pre-mark as directed by the Engineer and subsequently shall install the required markings in accordance with the requirement of other sections of the specifications. The actual placement of the pavement markings at any such site shall not be performed until the pre-marking has been inspected and approved by the Engineer. Pre-marking is incidental to the pavement marking installation work and there will be no separate payment for pre-marking.

6. Traffic Maintenance

All work shall be performed in accordance with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) and section 104 of the MSHA Standard Specifications for Construction and Materials. The Contractor shall furnish and place all warning devices, flag persons, and other traffic control devices required to direct, control and protect the traveling public while marking operations are in progress. Maintenance of traffic for this work will be paid under the Maintenance of Traffic item if an item is included in the bid proposal, otherwise it will be considered incidental to the work.

### **3.02 WARRANTIES**

#### **A. THERMOPLASTIC PAVING MARKINGS**

The Thermoplastic pavement marking materials and glass beads furnished under this contract shall assume the manufacturer's warranty for these materials and shall be guaranteed by the supplier against failure due to traffic oil degradation.

The contractor shall assume all costs arising from the use of patented materials, equipment, devices or processes used on or incorporated in the work, and agrees to indemnify and hold harmless the Owner and its duly authorized representatives from all suits at law or action of every nature for, or on account of, the use of any patented materials equipment, devices or processes. Further, the material shall meet the requirements of this specification for a period of one year.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

This section covers providing and installing the storm drainage and underdrainage collection systems, including pipe culverts, French drains and appurtenant structures. Storm drainage systems shall be constructed as shown on the Contract drawings and as specified herein.

**1.02 DELIVERY, STORAGE AND HANDLING****A. UNLOADING AND HANDLING**

All pipe and storm drainage material shall be unloaded and handled with reasonable care. Pipe shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe is damaged during unloading or handling, the undamaged portions of the joint or section may be used where partial lengths are needed, or if damaged sufficiently, the Engineer will reject the joint or section as being unfit for installation and the Contractor shall remove such rejected pipe from the project.

**1.03 SUBMITTALS**

A. The Contractor shall submit for approval of the Engineer shop drawings, which describe in detail the materials to be utilized before ordering. Six (6) copies of shop drawings shall be submitted. Prior to submittal all shop drawings are to be reviewed by the Contractor, and shall be stamped and signed as to compliance with the referenced specification. Any variance to the specification shall be noted.

The following shop drawings shall be submitted:

1. Drainage Pipe
2. Underdrain Pipe
3. Underdrain or Pipe Bedding
4. Drainage Structure Castings
5. Precast Drainage Structures

**1.04 WARRANTY**

All pipe and materials shall be warranted for a period of one (1) year following installation and acceptance by the Owner.

**PART 2: PRODUCTS**

**2.01 REINFORCED CONCRETE PIPE**

- A. Reinforced concrete pipe shall conform to ASTM C-76, latest revision. Pipe shall be Table III or Table IV with Wall B, unless otherwise noted. All pipe shall have interior surfaces free from roughness, projection, indentations, offset or irregularities of any kind.
- B. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant. Joint material for reinforced concrete pipe shall comply with ASTM C 443 and shall be either "O" ring type joints utilizing a rubber "O" ring, or bell and spigot type utilizing a mastic joint material equal to Ram-Neck.

**2.02 CORRUGATED METAL PIPE**

- A. All corrugated metal pipe shall be aluminized type 2 corrugated steel conforming to AASHTO M-274 latest revision unless otherwise called out on the design drawings. If called out as bituminous coated, pipe will conform to AASHTO M190, latest revision. Pipe shall be fully bituminous coated with an asphalt paved invert. Bituminous coating, shall consist of asphalt cement having a minimum thickness of 0.04" measured at the crest of the corrugations. Paved inverts in corrugated metal pipe, shall consist of asphalt cement applied on the inside of the pipe for one quarter of its circumference (bottom of pipe when installed). The pavement shall have a minimum thickness of 0.50" tapering to 0.1" at the sides. If pipe is called out as plain, non-coated, it shall conform to AASHTO M-36 latest revision.
- B. Corrugated metal pipe shall have 2-2/3" x 1/2" corrugations and shall be of the following minimum gauges:

|                             |          |
|-----------------------------|----------|
| 18" and smaller pipes ..... | 16 gauge |
| 21" - 30" pipes .....       | 14 gauge |
| 36" - 48" pipes .....       | 12 gauge |
| 56" and larger pipes .....  | 10 gauge |

Corrugated Metal Pipe shall have rerolled ends to accommodate corrugated coupling bands. Coupling bands shall conform to NCDOT 932-3(A) installed with a minimum of two corrugations per pipe. Dimple bands shall not be used.

**2.03 HIGH DENSITY POLYETHYLENE PIPE**

All HDPE shall be water tight type "s" Hancor Blue Seal or approved equivalent and installed according to manufacturers specifications. Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252, M294, and MP7. Pipe and fittings shall be made from virgin PE compounds which conform with the applicable current

edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM F667. Pipe shall have smooth wall interior unless otherwise specified.

The fittings shall not reduce or impair the overall integrity of function of the pipeline. Fittings may be either molded or fabricated. Common corrugated fittings include in-line joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes and end caps. These fittings may be installed by various methods such as snap-on, bell and spigot, bell – bell and wrap around couplers. Couplers shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation of the joints. Only fittings supplied or recommended by the manufacturer shall be used. Where designated on the plans or project specifications, an elastomeric gasket meeting the requirements of ASTM F477 shall be supplied.

Installation of the pipe specified above shall be in accordance with either AASHTO 30 or ASTM D2321 and as recommended by the manufacturer, with the exception that minimum cover in traffic load areas shall be 12” for pipe diameters between 4” and 48” and 18” for pipe diameters 60” and greater.

## **2.04 CASTINGS**

Castings shall be sound and free from warp, holes and other defects that impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp, well defined lines and arises. Machined joints, where required, shall be milled to a close fit. Provide all necessary lugs and brackets so that work can be assembled in a neat, substantial manner.

## **2.05 AGGREGATE FOR UNDERDRAINS**

Aggregate for underdrains shall be washed stone, standard size number 67 per North Carolina Department of Transportation specifications, Section 905.

## **PART 3: EXECUTION**

### **3.01 PREPARATION OF PIPE FOUNDATION**

#### **A. LINES AND GRADES**

The pipe foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustments will require the approval of the Engineer. When an Inspector is present on the site and is so requested by the Contractor, he shall check the position of grades and lines; but the Contractor shall be responsible for the finished drain line being laid to exact and proper line and grade.

#### **B. PIPE FOUNDATION**

1. Whenever the nature of the ground will permit, the excavation at the bottom of the trench shall have the shape and dimensions of the outside lower third of the circumference of the pipe, care being taken to secure a firm bearing support uniformly throughout the length of the pipe. A space shall be excavated under and around each bell to sufficient depth to relieve it of any load and to allow ample space for filling and finishing the joint. The pipe, when thus bedded firmly, shall be on the exact grade. In case the bed shaped in the bottom of the trench is too low, the pipe shall be completely removed from position, and earth of suitable quality shall be placed and thoroughly tamped to prepare a new foundation for the pipe.
2. In no case shall the pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe. Where rock or boulders are encountered in the bottom of the trench, the same shall be removed to such depth that no part of the pipe, when laid to grade, will be closer to the rock or boulders than 6". A suitably tamped and shaped foundation of suitable earth shall be placed to bring the bottom of the trench to proper subgrade over rock or boulders.
3. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer, within the limits established on the plans, and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by the Engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the Engineer.

#### C. WATER IN TRENCHES

The Contractor shall remove all water which may be encountered or which may accumulate in the trenches by pumping or bailing; and no pipes shall be laid until the water has been removed from the trench. The Contractor will not be permitted to drain water through the storm drain within a period of twenty-four (24) hours after the pipe has been laid, and the open end of the pipe in the trench shall be kept closed with a tight fitting plug to prevent washing of dirt or debris into the line. Water so removed from the trench must be disposed of in such manner as not to cause injury to work completed or in progress.

#### D. SPECIAL FOUNDATIONS

Whenever the bottom of the trench shall be of such nature as to provide unsatisfactory foundation for the pipe, the Engineer will require the pipe to be laid on timber or concrete cradle foundations. Such foundations whether of single plank, plank cradle, plank cradle supported on piles, or poured concrete cradle, shall be placed by the Contractor; and compensation will be allowed the Contractor for the materials so used.

### **3.02 LAYING PIPE**

#### **A. GENERAL**

All piping is to be installed in strict accordance with the manufacturer's recommendations. Installation manuals from various material suppliers shall be furnished to the Engineer for his review and approval prior to installation of any material. The Engineer may augment any manufacturer's installation recommendations, if in his opinion it will best serve the interest of the Owner.

#### **B. LAYING PIPE**

1. No pipe shall be laid except in the presence of the Engineer or his inspector, or without special permission from the Engineer. Proper tools, implements, and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe, fittings, valves, and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be carefully given a final inspection to see that it is clean, sound and free of defects. It shall be laid on the prepared foundation to produce a straight line on a uniform grade, each pipe being laid as to form a close abutted joint with a preceding pipe, so as to form a smooth and straight inside flow line. Each pipe will be tested for its exact position after it is in its final position. The pipes shall be fitted together in order to insure sufficient space for joint gaskets, and other jointing material. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.
2. When cutting short lengths of pipe, a pipe cutter as approved by the Engineer will be used, and care will be taken to make the cut at right angles to the center line of the pipe, or on the exact skew as shown on the plans. In the case of push-on pipe, the cut ends shall be tapered with a portable grinder, of course file to match the manufactured taper.
3. When coupling bands for annular or helical corrugated metal pipe are used, the pipe sections shall be joined and fully bolted so that the circumferencial and longitudinal strength will be sufficient to preserve the

alignment, prevent separation of the sections, and to prevent infiltration of backfill material.

### **3.03 BACKFILLING**

- A. The backfill around the pipe shall be placed in layers not to exceed 6" loose and compacted to 98% Standard Proctor test for all areas directly beneath paved areas and subgrade. From the bottom of the trench to the centerline of the pipe the backfill material shall be compacted by approved hand tamps. From the centerline of the pipe to the top of the trench other mechanical tamps as approved by the Engineer may be used. The Engineer shall approve all backfill material. Select backfill material shall be used when called for on the plans.
- B. Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stones, frozen lumps, roots and limbs, chunks of highly plastic clay, or other objectionable materials.
- C. All pipe backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.
- D. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover as required by the plans. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe, which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner.

### **3.04 TESTING**

- A. Upon completion, installed lines shall show a full circle of light when "Lamped" between catch basins. This test shall be performed by the Engineer.
- B. Other tests may be required by the Engineer, such as exfiltration and compaction of backfill over pipes. In this event the results shall meet the minimum standards that the manufacturer states are obtainable.
- C. One compaction test performed directly above storm pipe placed in areas under pavement shall be conducted every 300 LF of storm pipe placed and shall meet testing requirements noted in section 2220 of the specifications. This will be the Owners responsibility to have done and at the Owners cost.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

The work covered by this section consists of the construction of reinforced concrete or brick masonry inlets, catch basins, junction boxes, and other minor drainage structures, excluding headwalls, together with all necessary metal grates, covers, frames, and other hardware, in accordance with the requirements shown on the plans and the provisions of these specifications.

**1.02 QUALITY ASSURANCE**

All precast concrete structures and other fabricated materials shall be manufactured by suppliers with at least five (5) years of experience in the manufacture of similar materials.

**1.03 SUBMITTALS****SHOP DRAWINGS**

The Contractor shall submit at least six (6) copies of shop drawings to the Engineer, including dimensional drawings, materials of construction; catalogue cut sheets, and other pertinent information.

**1.04 DELIVERY, STORAGE AND HANDLING**

All materials shall be delivered, stored and handled in strict accordance with the manufacturer's recommendations, and in a manner, which preserves the structural integrity of the materials.

**1.05 WARRANTY**

All materials and equipment shall be warranted to be free from defects in workmanship and materials for one (1) year after final acceptance.

**PART 2: PRODUCTS****2.01 MATERIALS****A. CONCRETE AND MASONRY**

1. Concrete and masonry shall meet the requirements of the appropriate section of NCDOT Standard Specifications for Roads and Structures (latest Edition). All concrete shall be Class A or B 4000 psi minimum unless otherwise indicated on the plans, meeting the requirements of

Section 900 and constructed in accordance with Section 825. Masonry shall meet the requirements of Section 940 and construction in accordance with Section 830 and/or 834.

2. Where necessary to fit field conditions, the dimensions of the structure and footings shall be varied as directed by the Engineer.

#### B. FITTINGS AND CONNECTIONS

1. Where fittings enter the masonry, they shall be placed as the work is built up, thoroughly bonded, and accurately spaced and aligned.
2. Pipe connections shall be cut off flush with the inside wall of the drainage structure and grouted as necessary to make smooth and uniform surfaces on the inside of the structure and to withstand any infiltration of ground water.
3. Metal frames for grates and covers shall be set in full mortar beds or secured by methods approved by the Engineer.

#### C. BACKFILL

After the structure has been completed, and all forms, falsework, sheeting, and bracing have been removed, the excavation shall be backfilled with approved material compacted to a density of 95% standard proctor for areas unpaved and 98% for areas under pavement, and 100% for the last 9" under paving. Backfilling shall not be done until the concrete or brick masonry has cured for at least seven (7) curing days, unless otherwise permitted by the Engineer.

#### D. PIPE COLLARS AND PIPE PLUGS

Pipe collars and pipe plugs shall be constructed in accordance with the details shown on the plans or as directed by the Engineer.

#### E. PRE-CAST CONCRETE CATCH BASINS

Pre-cast concrete catch basins shall conform to the requirements of NCDOT Standard Specifications for Roads and Structures (Latest Edition) Articles 840-1 through 840-3. Curb inlet catch basins shall conform to NCDOT Standard Detail 840.02. Drop inlets shall conform to Standard Detail 840.14. Junction boxes shall conform to standard detail 840.31.

#### F. FRAME, GRATE, AND HOOD/MANHOLE COVER AND FRAME

Frame, grate and hood shall be Neenah R-3233 Type D, Products by Dewey Bros. U.S. Foundry or approved equivalent. Drop inlet frame and grate shall be Neenah R-3433 or approved equivalent. Curb inlet frame, grate, and hood shall conform

to NCDOT Standard Detail 840.03E with the opening facing upstream. Drop inlet frame and grate shall conform to NCDOT Standard Detail 840.16. Junction box frame and manhole cover shall conform to NCDOT Standard Detail 840.54.

### **PART 3: EXECUTION**

#### **3.01 INSTALLATION**

- A. Drainage structures shall be built to the lines, grades and dimensions as shown on the plans. The Contractor shall adjust the final grades in the field as necessary to provide positive drainage to the structures or to match final pavement or grade elevation.
- B. Excavations for drainage structures shall be made with care so as not to disturb the surrounding areas more than necessary. All excavations shall be maintained water free until completion of the drainage structure, including backfilling. The Contractor shall provide adequate pumping capacity as required.
- C. Place 6" of #57 washed stone under structures. Where the foundation material is found to be of poor supporting value, the existing foundation material shall be removed by undercutting to the depth directed by the Engineer and backfilled with suitable material secured from locations along the project or from a borrow pit. The backfill placed in the undercut area shall be compacted to a degree satisfactory to the Engineer.
- D. For cast-in-place structures the Contractor shall use care in placing rebar and concrete. All rebar is to be approved by the Engineer prior to pouring concrete. Unless otherwise approved, the bottom slabs shall be poured separate from the walls. A minimum of seven (7) days cure time shall be provided between completion of pouring the bottom and the walls. Cast-in-place catch basins shall conform to the requirements of NCDOT Standard Specifications for Roads and Structures (Latest Edition) Articles 840-1 through 840-3. Curb inlet catch basins shall conform to NCDOT Standard Detail 840.02. Drop inlets shall conform to Standard Detail 840.14. Junction boxes shall conform to standard detail 840.31. If the Contractor chooses to use cast-in-place structures, the Engineer must be notified in advance to inspect the rebar placement and formwork prior to pouring. If the Engineer is not allowed to inspect rebar, the Contractor may be subject to rejection of the catch basin and subsequent re-installation of the catch basin at no additional cost to the Owner.
- E. When drainage structures are constructed with concrete brick, only new, sound brick shall be used. Mortar mix shall be mixed on site using an approved mortar mix consisting of Portland Cement (Type S), and clean sand. Following construction of the drainage boxes, both the interior and exterior shall be plastered with a minimum 1/2" thick coat of Portland Cement and sand mixture.

#### **3.02 QUALITY CONTROL AND FIELD TESTING**

The Contractor shall demonstrate to the Owner and Engineer that all drainage structures operate as intended and designed. All drainage structures shall be field tested by the Contractor in the presence of the Engineer prior to final acceptance. All drainage structures will be cleaned of debris and sediment before being turned over to the Owner.

**END OF SECTION**

**PART 1 - GENERAL****1.01 General Provisions**

- A. The Conditions of the Contract and all Sections of Division 1 are hereby made a part of this Section.

**1.02 Description of Work**

- A. Work Included:
  - 1. Provide and install sandy gravel road base as per Geotechnical Engineer's recommendations and/or as shown on drawings, to provide adequate support for project designs loads. See 2.02 Materials.
  - 2. Provide Gravelpave2 Paving products including Gravelpave2 units, anchors and installation per the manufacturer's instructions furnished under this section.
  - 3. Provide and install fine decorative gravel to fill the Gravelpave2 units.
- B. Related Work:
  - 1. Subgrade preparation under Section 31 20 00 Earth Moving (02200 – Earthwork).
  - 2. Utilities and subsurface drainage - Section 33 40 00 Storm Drainage Utilities (02700 – Subsurface Drainage and Structures), as needed.

**1.03 Quality Assurance**

- A. Follow Section 01 33 23 Shop Drawings, Product Data, and Samples (01340 Shop Drawings, Product Data, and Samples) requirements.
- B. Installation: Performed only by skilled work people with satisfactory record of performance on landscaping or paving projects of comparable size and quality.

**1.04 Submittals**

- A. Submit manufacturer's product data and installation instructions.
- B. Submit a 10" x 10" section of Gravelpave2 product for review. Reviewed and accepted samples will be returned to the Contractor.
- C. Submit material certificates for base course and sand fill materials.

**1.05 Delivery, Storage, and Handling**

- A. Protect Gravelpave2 material units from damage during delivery and store under tarp when time from delivery to installation exceeds one week.

**1.06 Project Conditions**

- A. Review installation procedures and coordinate Gravelpave2 work with other work affected.
- B. All hard surface paving adjacent to Gravelpave2 areas, including concrete walks and asphalt paving, must be completed prior to installation of Gravelpave2.
- C. Cold weather:
  - 1. Do not use frozen materials or materials mixed or coated with ice or frost.

- 2. Do not build on frozen work or wet, saturated or muddy subgrade.
- D. Protect partially completed paving against damage from other construction traffic when work is in progress.
- E. Protect adjacent work from damage during Gravelpave2 installation.

**PART 2 – PRODUCTS**

**2.01 Availability**

- A. Manufacturer: (Gravelpave2) Invisible Structures, Inc., 1600 Jackson Street, Suite 310, Golden, CO 80401. Call from USA and Canada 800-233-1510 toll free, (International 303-233-8383), Fax 800-233-1522 (International 303-233-8282).
- B. Local Sales Representative: (Contact Manufacturer)

**2.02 Materials**

- A. Base Course: Sandy Gravel material from local sources commonly used for road base construction, passing the following sieve analysis.

| Sieve | % Passing |
|-------|-----------|
| 1"    | 100       |
| 3/4"  | 90-100    |
| 3/8"  | 70-80     |
| #4    | 55-70     |
| #10   | 45-55     |
| #40   | 25-35     |
| #200  | 3-8       |

- 1. Sources of the material can include either "pit run" or "crusher run". Crusher run material will generally require coarse, well-draining sand (AASHTO M6 or ASTM C-33) to be added to mixture (25 to 35% by volume) to ensure long-term porosity.
- 2. Alternative materials such as crushed shell, limerock, and/or crushed lava may be considered for base course use, provided they are mixed with coarse, well draining sand (25 - 35%) to ensure long-term porosity, and are brought to proper compaction.

(Crushed shell and limerock alone can set up like concrete unless sand is added.)

- B. Gravelpave2 Paving Units:

- 1. Lightweight injection-molded plastic units 0.5x0.5x0.025m (20"x20"x1" high, 2.7 ft2 each) with hollow rings rising from a strong open grid and a geotextile fabric heat fused to the bottom of the grid.
- 2. Unit weight = 535 g (19 oz.), volume = 8% solid.
- 3. The plastic shall be 100% post-industrial recycled HDPE plastic resins, with minimum 3% carbon black concentrate added for UV protection.
- 4. Loading capability is equal to 402 kg/cm2 (5721 psi, 823,824 psf, 7.4 million psy, 39,273 kPA, 3707 tons/sq.yd.) when filled with gravel, over an appropriate depth of base.
- 5. Units are shipped in pre-assembled rolls that vary from 10 square meters (108 sf) to 50 square meters (538 sf).

6. Male/Female Fastener Tensile Strength, determined using a Pull Test, is equal to 80,208 N/m (450 lbf/in.)
  7. Colors are black, gray, terra cotta, and tan with custom colors available.  
*Any products failing to meet these standards will be rejected.*
- C. Gravel Fill: Obtain clean, washed, fine decorative gravel, must be sharp and angular (not rounded) stone, granite hardness, to fill the 25 mm (1") high rings and spaces between the rings, not to be overfilled more than 1/4" (6 mm). Maximum Size of stone should be: 3/16" to 3/8" (5 mm to 10 mm) and uniform in size - not graded.
  - D. Anchors: Typical anchors shall be 8" long nails with "fender" type washers 7 x 30 mm od (5/16" id x 1.25") od, all galvanized metal or similar corrosion resistant coating. Supplied anchors may vary in size and type based on source and availability.

## **PART 3 – EXECUTION**

### **3.01 Inspection**

- A. Examine subgrade and base course installed conditions. Do not start Gravelpave2 installation until unsatisfactory conditions are corrected. Check for poor drainage, improperly compacted trenches, debris, and improper gradients.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact Project Manager for resolution.

### **3.02 Preparation**

*(Ensure that subbase materials are structurally adequate to receive designed base course, wearing course, and designed loads. Ensure that grading and soil porosity of the subbase will provide adequate subsurface drainage.)*

- A. Place base course material over prepared subbase to grades shown on plans, in lifts not to exceed 150 mm (6"), compacting each lift separately to 95% Modified Proctor. Leave 25 mm (1.0") for Gravelpave2 unit and gravel fill to Final Grade.

### **3.03 Installation of Gravelpave2 Units**

- A. Install the Gravelpave2 units by placing units with rings facing up, and using small male/female connectors provided along each edge to maintain proper spacing and interlock the units. Cutting can be performed with pruning shears and knife, or portable power saw. Units shall be anchored to the base course, using anchors described above, as required to secure units in place from movement by traffic, at an average rate of 6 pins per square meter (high speed, heavy vehicles, fast turning movement will require additional anchors). Tops of rings shall be flush with the surface of adjacent hard surfaced pavements.
- B. Install gravel into rings after the units are anchored by "backdumping" directly from a dump truck, or from buckets mounted on tractors, with a minimum depth of 6", then exit the site by driving forward over rings already filled. Sharp turning of vehicles on bare rings must be avoided. The gravel is then spread laterally from the pile using power brooms, blades, flat bottomed shovels and/or wide "asphalt rakes" to fill the

- rings. A stiff bristled broom should be used for final "finishing". The gravel should be "compacted", if necessary, by using a vibrating plate or small roller, with the finish grade no less than the top of rings and no more than 6 mm (0.25") above top of rings.
- C. If a binder for fill stone is desired (due to traffic speed, concentrated water flow, or other reason); use Portland cement, mixed dry at 10% by weight with fill stone. Place into rings after thoroughly wetting the base, then lightly mist the surface after fill and compaction. Then, cover with a water resistant tarp, or plastic sheeting material for a minimum period of 3 days, or until the mixture has bonded.

### **3.06 Cleaning**

- A. Remove and replace segments of Gravelpave2 units where three or more adjacent rings are broken or damaged, reinstalling as specified, with no evidence of replacement.
- B. Perform cleaning during the installation of work and upon completion of the work. Remove all excess materials, debris, and equipment from site. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

**END OF SECTION**

**PART 1: GENERAL****1.01 SCOPE OF WORK**

- A. This section covers the furnishing of all labor, equipment and materials necessary for the establishment of vegetation of all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses and legumes.

**PART 2: PRODUCTS****2.01 MATERIALS****A. FERTILIZER**

1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.
2. Fertilizer shall be 10-10-10 grade. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.
3. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

**B. LIME**

1. The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the North Carolina Board of Agriculture.
2. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original conditions before being used.
3. Lime shall be agriculture grade ground dolomitic limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and

shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

C. SEED

1. The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture. Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the Engineer before being sown, and no seed will be accepted with a date of test more than 9 months prior to the date of sowing. Such testing however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.
2. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents or other causes.
3. Seed shall be entirely free from bulblets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic, and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockle, Field Bindweed, Quackgrass, Didders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound. No tolerance on weed seed will be allowed.

D. MULCH

Straw Mulch shall be threshed straw of oats, rye or wheat free from matured seed of obnoxious weeds or other species which would grow and be detrimental to the specified grass.

E. TACKIFIER

Emulsified asphalt or organic tackifier such as Reclamare R2400 shall be sprayed uniformly on mulch as it is ejected from blower or immediately thereafter. Tackifier shall be applied evenly over area creating uniform appearance. Rates of

application will vary with conditions. Asphalt shall not be used in freezing weather.

### **PART 3: EXECUTION**

#### **3.01 PREPARATION**

##### **A. PROTECTION OF EXISTING TREES AND VEGETATION**

1. Protect existing trees and other vegetation indicated to remain in place against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide wood or metal stakes set on 8 to 10 foot centers and connected at a 4'-0" height by 2" minimum brightly colored flagging tape to protect trees and vegetation to remain. Set perimeter of protection at the drip line of trees to remain unless approved otherwise by the Engineer.
2. Provide protection for roots over 1-1/2" diameter cut during construction operations. Cleanly cut off end of damaged root and coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.
3. The Contractor shall not remove or damage trees and shrubs which are outside the Clearing Limits established by the Owner or those within the Clearing Limits designated to remain.
4. Repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the Engineer. Repair damaged trees promptly to prevent progressive deterioration caused by damage.
5. Replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the Engineer with trees of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor's expense.

##### **B. GRADING**

1. Rough grading shall be done as soon as all excavation required in the area has been backfilled. The necessary earthwork shall be accomplished to bring the existing ground to the desired finish elevations as shown on the Contract Drawings or otherwise directed.

2. Fine grading shall consist of shaping the final contours for drainage and removing all large rock, clumps of earth, roots and waste construction material. It shall also include thorough loosening of the soil to a depth of 6" by plowing, discing, harrowing or other approved methods until the area is acceptable as suitable for subsequent landscaping operations. The work of establishing vegetation shall be performed on a section by section basis immediately upon completion of earthwork or pipeline installation.
3. Upon failure or neglect on the part of the Contractor to coordinate his grading with seeding and mulching operations and diligently pursue the control of erosion and siltation, the Engineer may suspend the Contractor's grading operations until such time as the work is coordinated in a manner acceptable to the Engineer.

### C. SEEDBED PREPARATION

1. The Contractor shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as directed by the Engineer to provide for more effective seeding and for ease of subsequent mowing operations.
2. The soil shall then be scarified or otherwise loosened to a depth of not less than 6" except as otherwise provided below or otherwise directed by the Engineer. Clods shall be broken and the top 2" to 3" of soil shall be worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the Engineer.
3. On 2:1 slopes a seedbed preparation will be required that is the same depth as that required on flatter areas, although the degree of smoothness may be reduced from that required on the flatter areas if so permitted by the Engineer.
4. On cut slopes that are steeper than 2:1, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the Engineer, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.
5. On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.

6. The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the Engineer determines that it is in an otherwise unfavorable working condition.

### **3.02 APPLICATION**

- A. Seed shall be applied by means of a hydro-seeder or other approved methods. The rates of application of seed, fertilizer and limestone shall be as stated in Table I.
- B. Equipment to be used for the application, covering or compaction of limestone, fertilizer, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.
- C. Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.
- D. Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at the specified rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed. Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.
- E. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.
- F. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.
- G. Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved by the Engineer.

- H. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.

Such modifications may include but not be limited to the following:

1. The incorporation of limestone into the seedbed may be omitted on (a) cut slopes steeper than 2:1; (b) on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or (c) on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.
2. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.
3. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

I. MULCHING

1. All seeded areas shall be mulched unless otherwise indicated in the special provisions or directed by the Engineer.
2. It shall be spread uniformly at a rate of two tons per acre in a continuous blanket over the areas specified.
3. Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, the Contractor shall remove and dispose of all exposed stones in excess of 3" in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil. Mulch shall be applied within 24 hours after the completion of seeding unless otherwise permitted by the Engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operation.
4. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.
5. Mulch shall be held in place by applying a sufficient amount of asphalt or other approved binding material to assure that the mulch is properly held in place. The rate and method of application of binding material shall meet the approval of the Engineer. Where the binding material is not

applied directly with the mulch it shall be applied immediately following the mulch application.

6. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities which may occur.

### **3.03 MAINTENANCE**

- A. The Contractor shall keep all seeded areas in good condition, reseeding if and when necessary, until an acceptable stand of grass is established over the entire area seeded and shall maintain these areas in an approved condition until final acceptance of the Contract. Any of these additional efforts will be at no additional cost to the Owner.
- B. Grassed areas will be accepted when a 95% cover by permanent grasses is obtained and weeds are not dominant. On slopes, the Contractor shall provide against washouts by an approved method. Any washouts which occur shall be regraded and reseeded until a good sod is established.
- C. Areas of damage or failure due to any cause shall be corrected by being repaired or by being completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the specifications, shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

#### **TABLE I - APPLICATION RATES**

##### **A. LIME AND FERTILIZER**

In the absence of a soil test, the following rates of application of limestone and fertilizer shall be:

1. 4,000 pounds limestone per acre
2. 1000 pounds 10-10-10 (N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) fertilizer per acre and the remaining quantity applied when vegetation is three inches in height or 45 days after seeding, whichever comes first.

##### **B. MULCH**

Mulch shall be applied at the following rates per acre:

1. 3,000-4,000 pounds straw mulch, or

2. 1,500-2,000 pounds wood cellulose fiber.
3. 35-40 cubic yards of shredded or hammermilled hardwood bark
4. 1,200-1,400 pounds of fiberglass roving

C. TEMPORARY SEED

The kinds of seed and the rates of application shall be as contained in this table. All rates are in pounds per acre. See Notes 1 and 2.

1. Fall and Winter (Normally August 1 to June 1)  
80 pounds of Ky-31 tall fescue and 15 pounds of rye grain
2. Summer (Normally May 1 to September 1)  
100 pounds of Ky-31 tall fescue

NOTES

1. On cut and fill slopes having 2:1 or steeper slopes, add 40 pounds of sericea lespedeza per acre to the planned seeding (hulled in spring and summer unhulled in fall and winter) plus 15 pounds of sudangrass in summer seeding or 25 pounds of rye cereal per acre in fall and winter seeding, if seeded September to February.
2. These seeding rates are prescribed for all sites with less than 50% ground cover and for sites with more than 50% ground cover where complete seeding is necessary to establish effective erosion control vegetative cover. On sites having 50% to 80% ground cover where complete seeding is not necessary to establish vegetative cover, reduce the seeding rate at least one-half the normal rate.

END OF SECTION

**PART 1: GENERAL****1.01 SCOPE OF WORK**

- A. This section covers the furnishing of all labor, equipment and materials necessary for the proper restoration of existing surfaces disturbed or damaged as a result of construction operations which are not specifically scheduled or specified for topsoil and seeding, paving, landscaping or other surfacing.
- B. In general, the types of replacement included in this section are seeding along pipelines, concrete sidewalks, driveways, roadways, ditches, lawns and landscaped areas, curb and gutter.
- C. Any damage to existing structures shall be repaired using materials and workmanship equal to those of original construction.

**PART 2: NOT USED****PART 3: EXECUTION****3.01 RESTORATION OF SURFACES**

- A. SEEDING ALONG PIPELINES
  - 1. All ground surfaces along pipelines, which are not classified as lawns, landscaped areas, or pavement areas, but would be classified as open fields, shall be raked smooth and seeded in accordance with section 02901 entitled Site Stabilization. Large rocks, clumps of earth and excessive spoil material shall be removed from the area prior to seeding.
  - 2. Shoulders of all roads shall be restored as specific for lawns and landscaped areas.
  - 3. Wooded areas, not classified as lawns shall be restored to as near their original condition as possible.
- B. CONCRETE SIDEWALKS
  - 1. Concrete walks removed in connection with, or damaged as a result of, construction operations under the Contract shall be replaced with new construction. Such walks shall be constructed of Class B concrete on a thoroughly compacted subgrade, shall have a vertical thickness of not less than 4" or the thickness of the replaced walk where greater than 4".

2. Walks shall be float finished, edged with an edging tool, and grooved at intermediate intervals not in excess of the width of the walk, uniform throughout the length of the walk in any one direction.

#### C. DRIVEWAYS

1. Unpaved driveways shall be surfaced with not less than 3" of Crusher-run gravel, topped with 3" of stone, gravel, or other materials equal to that found in the original driveway. Driveways shall be left in a condition better than their original condition.
2. Concrete drives shall be replaced with Class B concrete and shall have equal thickness and reinforcing steel to that of the original drive. Prior to placing the concrete a 6" aggregate base course shall be placed in the drive area.
3. Bituminous or Asphaltic concrete drives shall be restored with a 6" aggregate base course and a 2" surface course, as defined in the section entitled Bituminous Pavement Repairs.

#### D. ROADWAY REPLACEMENT

1. Bituminous or Asphaltic pavements shall include all areas paved with blacktop; built-up pavements or oil and stone, tar and stone and similar pavements constructed with a bituminous or asphalt and stone materials.
2. Immediately upon completion of installation of underground piping and structures, the trench shall be backfilled and the roadway shall be repaired. In the excavated area, the repair shall consist of an 8" aggregate base course, 4" HB Binder Course and a 2" surface course as defined in the section entitled Bituminous Pavement Repairs. If, in the opinion of the Engineer, the area adjacent to the excavation has not been damaged to the extent that the base course need to be replaced, restoration may consist of a surface course of sufficient thickness to meet the existing pavement.
3. Portland cement concrete roadways shall be replaced with Class B Concrete and shall have equal thickness and reinforcing steel as the original roadway. An aggregate of 6" shall be placed prior to the placing of concrete.
4. Differential settlement of restored pavements shall be corrected immediately.
5. The Contractor shall repair and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications.

6. All existing manhole and valve covers shall be raised as required by the Contractor prior to paving. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

E. DITCHES

Ditches shall be regraded to the original grade and line. The surface of all ditches shall be returned to the same condition as found before commencing work.

F. LAWNS AND LANDSCAPED AREAS

1. Lawns and landscaped areas shall be regraded and replaced as follows:
  - a. Grading shall be to the grade existing before construction of the work under this Contract.
  - b. Lawn replacement shall be in accordance with the section entitled Landscaping. Topsoiled areas shall be replaced with topsoil of equal quality and quantity.
2. Landscaped areas shall be replaced with shrubs, hedges, ornamental trees, flowers, or other items to original condition.

G. CURB AND GUTTER

Curb and gutter removed with, or damaged as a result of construction operations, injured or disturbed by the Contractor, his agents, or employees, shall be replaced with new construction to a condition similar and equal to that existing before damage was incurred. Class B Concrete shall be used in curb and gutter replacement.

H. DAMAGE TO STRUCTURES

Any damage to existing structures shall be repaired of materials and workmanship equal to those of original construction. Extensively damaged structures, where the structural stability has been affected or which cannot be repaired in a suitable fashion shall be replaced entirely. Replacement shall not commence until approval of the plan of replacement has been given by the Engineer. Replacement costs shall be responsibility of the Contractor.

**END OF SECTION**

1. **DESCRIPTION:** This section includes cast-in-place concrete as shown on Drawings, and as specified herein. In general, this work includes providing cast-in-place concrete consisting of Portland Cement, fine and coarse aggregate, selected admixtures, mixing, transporting, placing, finishing, and curing as herein specified. This section further includes related items of quality control, testing, and evaluation of concrete strength.

1.1 **References:** Some products and execution are specified in this section by reference to published specifications or standards of the following with respect abbreviations used.

1. American Concrete Institute .....ACI
2. The American Society for Testing and Materials.....ASTM

1.2 **Standard References:** The current edition of the following standard references shall apply to the work of this Section as indicated. Suffixes indicating issue date are omitted from reference numerals elsewhere in the text. Concrete work shall comply with the following standards and codes except as indicated otherwise on the Drawings or herein.

1. ACI 301 "Specifications for Structural Concrete"
2. ACI 304 "Recommended Practice for Measuring, Mixing Transporting, and Placing Concrete"
3. ACI 305 "Recommended Practice for Hot Weather Concreting"
4. ACI 306 "Recommended Practice for Cold Weather Concreting"
5. ACI 308 "Recommended Practice for Curing Concrete"
6. ACI 309 "Recommended Practice for Consolidation of Concrete"
7. ACI 311 "Recommended Practice for Concrete Inspection"
8. ACI 214 "Recommended Practice for Evaluation of Compressive Test Results of Field Concrete"
9. ACI 211.1 "Recommended Practice for Selecting Proportions 70 for Normal Weight Concrete"
10. ACI 211.2 "Recommended Practice for Selecting Proportions for Structural light-weight Concrete"
11. ACI 212 "Guide for Use of Admixtures in Concrete"

12. ACI 214 "Recommended Practice for Evaluation of Compression Test Results of Field Concrete"

1.3 Quality Assurance:

1.3.1 If the average strength of the laboratory control cylinders shows the concrete to be below the specified design strength, the aggregate proportions and water content may be changed by the Engineer, who, in addition to such changes, may require core tests. Tests confirming concrete strengths on hardened concrete, which was poured without testing, shall be paid for by the Contractor.

1.3.2 Prepare design mixes for each class of concrete used in accordance with ACI 311.1. The Contractor shall pay for all design mix costs. Submit written reports to the Engineer for each proposed mix for each class of concrete prior to start of work. Do not begin concrete production until mixes have been reviewed by the Engineer.

1.3.3 Strength data for establishing standard deviation and required overstrength factor will be considered suitable if the concrete production facility has certified records consisting of at least 30 consecutive tests in one group or the statistical average for two groups totaling 30 or more tests representing similar materials and project conditions. Records of these tests shall be submitted with the proposed design mix.

1.3.4 If standard deviation exceeds 800 psi or if no suitable records are available, selected proportions to produce an average strength of at least 1200 psi greater than the required compressive strength of concrete. If standard deviations are less than 600 psi, the minimum overstrength factor required in the design mix shall be in accordance with ACI 318, Section 4.3.1.

1.3.5 Design mixes shall be proportioned using the maximum specified slump and temperature. Laboratory test date for revised mix designs and strength results must be submitted to and accepted by the Engineer before using in the work. Admixtures shall be used in strict accordance with the manufacturer's written instructions. Design mix shall be proportioned using the proposed admixtures at optimum recommended dosages. The manufacturer of the mixture shall prepare and submit test date used to determine the optimum dosage.

1.4 Submittals:

1.4.1 The Contractor shall submit four copies of the proposed design mix for each class of concrete specified herein in accordance with the requirements herein. Design mixes shall be submitted two weeks prior to placement of concrete. The cost of the design mix shall be paid for by the contractor. Submit records of all concrete pours showing exact location of pour, date of pour, quantity of pour, and class of concrete poured to the Engineer each month. Temperature at time of pour should also be recorded. Submit to the Engineer chemical and physical analysis of all cement and fly ash delivered to the batch plant seven (7) days prior to use of the cement or fly ash.

2. MATERIALS:

2.1 PORTLAND CEMENT shall be fresh stock of an approved standard brand meeting the requirements of ASTM C-150, of Type II and shall be 4000 PSI unless otherwise specified. Only one brand of cement shall be used except when otherwise approved by the Engineer, and the Contractor shall inform the Engineer of the brand name of the cement proposed for use. The Contractor shall submit a copy of mill test reports on all cement delivered to the job 7 days prior to use of the cement. Cube strength from mill tests shall have a tolerance of  $\pm 600$  psi. The fineness of cement used shall not have more than 10% retained on a #325 mesh screen when tested in accordance with ASTM C-430.

2.2 FLY ASH shall have a high fineness and low carbon content and shall exceed the requirements of ASTM C-618. Specifications for Fly Ash and Raw or Calcined Natural for use in Portland Cement Concretes for Class 7, except that the loss of ignition shall be less than 3%, and all fly ash shall be a classified processed material. Fly ash shall be obtained from one source for the concrete delivered to the project. Complete chemical and physical analysis of each carload of fly ash shall be submitted to the Engineer ten (10) days prior to use of each carload delivered. Concrete mixes proportioned with fly ash shall contain not less than 10% nor more than 20% by weight of cement of fly ash.

2.3 CONCRETE AGGREGATE for stone concrete shall consist of clean crushed stone or gravel having hard, strong, uncoated particles free from injurious amounts of soft, thin, elongated or laminated pieces, alkali, organic or other deleterious matter. Maximum aggregate size shall be 3/4" of slabs, columns, etc. The maximum permissible percentage of elongated particles shall not exceed 5% by weight. Elongated particles are those defined as having a length equal to or greater than 5 times the width. Samples of coarse aggregate shall be submitted to the testing laboratory for testing and approval prior to use. The fineness modulus of the coarse aggregate shall not vary for more than  $\pm 0.3\%$ .

2.4 FINE AGGREGATE shall consist of sand, stone screening, or other inert materials with similar characteristics having clean, strong, durable, uncoated grains and free from lumps, soft or flaky particles, clay, shale, alkali, organic matter or other deleterious substances. Fine aggregate shall be submitted for testing and approval to the testing laboratory. The laboratory shall verify that fine aggregate conforms to ASTM standards by making standard colorimetric, sediment, and comparative tensile tests, and by sieve analysis. The fineness modulus of the sand shall not vary by more than  $\pm 0.2\%$ . Color shall be standard as determined from colorimetric tests.

2.5 CONCRETE ADMIXTURES, when required or permitted shall conform to the appropriate specification listed. Do not use admixtures, which have not been incorporated and tested in the accepted mixes unless otherwise authorized in writing by the Engineer. Air-entraining admixtures shall exceed the requirements of ASTM C-260, "Specifications for Air-Entraining Admixtures for Concrete". Water reducing admixtures shall be hydroxylated polymer type exceeding the requirements of ASTM C-494, Type A.

2.6 PREMOLDED EXPANSION JOINT FILLERS shall conform to ASTM D1751.

2.7 LIQUID CURING MATERIAL for concrete shall exceed the requirements of ASTM C-309, Type I. Products acceptable shall provide water retention not exceeding a loss of 0.020

grams per sq. cm. when tested at a coverage of 200 sq. ft. per gallon and tested in accordance with ASTM C-156. Submit test data verifying these requirements for approval.

2.8 BURLAP shall be free of sizing or any substance that is injurious to cement or can cause discoloration. Burlap shall be rinsed in water prior to use. Burlap shall be sufficient thickness to retain water without requiring wetting.

2.9 STEEL FOR EMBEDDED ANGLES AND PLATE CAST IN CONCRETE shall conform to ASTM A-36. Plates and angles shall receive a commercial sand blast and be painted with an inorganic zinc base paint equal to Carbomastic #11, or an approved equal.

2.10 CRUSHED STONE FILL, 4" in depth, shall be placed under all concrete floors in contact with the ground. Stone shall be uniform 3/4" stone, no fines, compacted as thoroughly as possible by tamping and rolling. Stone fill shall conform to ASTM C-33.

2.11 VAPOR BARRIER shall be a minimum of a 6 mil polyethylene.

2.12 WATERSTOPS shall be Sealtight PVC waterstrips as manufactured by the W.R. Meadows Co., or an approved equal. All waterstops shall be Type 6316. Water bars shall be located in all expansive joints in the concrete and in all construction joints in concrete walls.

2.13 JOINT SEALING COMPOUND shall be a two-part mineral filled epoxy polyurethane, and shall be used for all exposed joints in exterior paving slabs, sidewalks, where concrete slabs abut concrete walls, and in exposed joints in slabs on grade.

2.14 SURFACE COATING for all exposed concrete except where otherwise shown shall be "Thoroseal" as manufactured by the Standard Dry Wall Co., or an approved equal.

2.15 AIR ENTRAINMENT: Air-entraining admixtures shall be used for all concrete exposed to freezing and thawing or subjected to hydraulic pressure. Entrained air shall conform to the air control limits of Table 3.4.1 of ACI 301. The water-cement ratio for all air-entrained concrete exposed to freezing and thawing shall not exceed 0.53.

2.16 SLUMPS: All concrete shall be proportioned and produced to have a maximum slump of 4" and a minimum slump of 2" as per ASTM C143. A tolerance of up to but not exceeding 1" above the indicated maximum shall be allowed for individual batches in any one day's pour provided the average of the most recent ten batches within the same pour does not exceed the maximum limits. No tolerance will be permitted for individual batches when less than ten (10) batches are delivered for one day's pour.

2.17 CONCRETE MIXING:

2.17.1 Concrete shall be mixed at batch plants or it may be transit mixed as specified herein. Concrete batch plants must comply with the requirements of ASTM C-94 for ready-mixed concrete, ASTM C33 for aggregates and ACI-304 with sufficient capacity of producing concrete of the quantity and quality as specified herein. All plant facilities are subject to inspection by the Engineer. Ready-mix concrete shall comply with requirements of ASTM C-94, and as specified

herein, unless otherwise noted. During hot weather or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C-94 will be required as follows:

1. When air temperatures are between 80°F. and 90°F., reduce the mixing and delivery time from 1-1/2 hours to 1 hour
2. When outside air temperatures are above 90°F, reduce the mixing and delivery time from 1-1/2 hours to 45 minutes.

2.17.2 Addition of water at the site for concrete mix with insufficient slumps, slumps less than the maximum specified herein, will not be permitted. Concrete delivered to the project with slump less than the minimum or greater than the maximum specified shall be rejected and discarded off site.

2.17.3 Batch tickets for each load of concrete shall be submitted to the Engineer. The following information shall be provided on each batch ticket:

1. Design mix designation
2. Exact time cement, water and aggregate were discharged into the mix
3. Compressive strength of mix
4. Amount of water added to the mix

2.17.4 Maintain equipment in proper operating condition, with drums cleaned before charging of each batch. Schedule delivery of trucks in order to prevent delay of placing after mixing.

2.17.5 \*CONCRETE TYPE AND STRENGTHS

| Location        | Maximum Size Aggregate | *28 Day Compressive Strength |
|-----------------|------------------------|------------------------------|
| Slabs on Grade  | 3/4"                   | 4000 psi                     |
| Walls           | 3/4"                   | 4000 psi                     |
| Walks and Steps | 3/4"                   | 4000 psi                     |

\*Twenty-eight day strength shall be as determined from concrete sampled in accordance with ASTM C-172 and standard 6" x 12" molded cylinders tested in accordance with ASTM C-31 and C-39.

\*\*See notes on plans for required concrete strengths.

3. EXECUTION:

3.1 PREPARATION: Before placing concrete, all equipment for mixing and transporting and placing concrete shall be cleaned, all debris and ice removed from spaces to be occupied by the concrete, forms thoroughly cleaned of soil, ice, or other coatings which will prevent proper bond, reinforcement shall be securely tied in place and expansion joint material, anchors, and other embedded items shall be securely positioned. Hardened concrete and foreign materials shall be removed from the conveying equipment.

3.2 CONCRETE PLACEMENT:

3.2.1 Place concrete in compliance with the practices and recommendations of ACI 304 or as herein specified. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practical by methods, which will prevent separation or loss of ingredients and in a manner, which will assure that the required quality concrete, is obtained. Conveying equipment shall be of size and design to insure a continuous flow of concrete at the delivery end.

3.2.2 Concrete shall be deposited continuous, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or as approved. Placing shall be carried on at such a rate that the concrete, which is being integrated, with fresh concrete is still plastic. Deposit concrete as nearly as possible to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure, which will cause segregation.

3.2.3 Concrete shall not be allowed to "freefall" a distance greater than 3'-0". All concrete placed in columns and walls shall be placed through a tremie with the bottom or outlet of the tremie being held at maximum of 3'-0" above the surface where concrete is being placed.

3.2.4 Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

3.2.5 Do not use concrete which has become non-plastic and unworkable or does not meet the required quality control limits, or which has become contaminated by foreign material. Remove rejected concrete from the project site and dispose of in an acceptable location. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, and tamping. Vibration of forms and reinforcing steel will not be permitted.

3.2.6 Do not use vibrators to transport concrete inside forms. Insert and withdraw vertically at uniformly spaced locations not further than the visible effectiveness of the vibrator. Do not insert vibrators into lower levels of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcing and other embedded items without causing segregation of the mix.

3.2.7 Deposit and consolidate concrete in slabs in a continuous operation, within the limits of construction joints until the placing of the entire section is complete.

3.2.8 Bring surface of slabs to the correct elevations with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of lumps and hollows. Do not

sprinkle water on the plastic surface. Do not disturb the surface prior to beginning the finish operation.

3.2.9 Concrete placed by plumbing shall conform to the recommendations of ACI Publication, "Placing Concrete by Pumping Methods."

3.3 CONSTRUCTION JOINTS: Joints not shown on the drawings shall be made at locations that will least impair the strength of the structure and shall be approved by the Engineer. In general, they shall be located near the middle of the span of members. Joints in walls and columns shall be located at the underside of floors or slabs, and the tops of foundation walls. Roughen surfaces of hardened concrete at all vertical construction joints. Clean surface of laitance, coatings, loose particles, and foreign matter to expose aggregate. Prepare for bonding of fresh concrete to new concrete that has hardened; at joints between foundation systems and walls dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete. In lieu of neat cement grout, bonding grout may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instruction of this bonding material manufacturer. Provide keyways at least 1-1/2" deep in all construction joints in walls, slabs, and between walls, and foundation systems. Provide PVC Waterstops in all construction joints in concrete walls and in concrete beams and slabs. PVC waterstops shall also be provided between concrete beams and slabs at all expansion joints.

3.4 COLD WEATHER PLACING AND CURING REQUIREMENTS:

3.4.1 No concrete is to be placed when the air temperature is 40° F or below and the predicted low temperature for the succeeding 24 hour period is less than 32° F.

3.4.2 All Concrete when placed in the forms shall have a temperature of between 50° and 90° F and shall be maintained at a temperature of not less than 50° F for at least 72 hours for normal concrete and 24 hours for high early strength concrete, or for as much time as is necessary to secure proper rate of curing and designed compressive strength.

3.5 HOT WEATHER PLACING: An approved admixture designed to retard the rate of set shall be used for all concrete placed when temperatures exceed 75°F. Set retarding admixtures shall conform to ASTM C-494, Type D, water reducing and retarding. Wet forms thoroughly before placing. Cool reinforcing by wetting sufficiently so that steel temperatures will be nearly equal to the ambient air temperature. Provide windbreaks around the perimeter of the area where concrete is being placed. Fresh concrete with temperatures of 90°F. or above shall be discarded off site. The amount of cement used in the job is computed for the temperature indicated on the approved design mix. For higher concrete mix temperature, the weight of the cement shall be increased at the rate of 12 lbs. per cubic yard for each 10°F. above the concrete mix temperature.

3.6 CURING AND PROTECTION:

3.6.1 Protect freshly placed concrete from premature drying and excessive cold or hot temperatures, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

3.6.2 Curing for all horizontal slab surfaces, except those to receive a bonded finish material, during periods when the outside air temperature does not exceed 60°F. shall be provided by applying a membrane-forming curing compound to concrete surfaces as soon as the final troweling or floating operation has been completed. Apply uniformly with a roller brush at a rate not to exceed 200 sq. ft. per gallon. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. Curing for surfaces to receive a bonded finish material shall be as noted below. Curing for all horizontal surfaces during period when the outside air temperature will exceed 60°F. shall be provided by covering the entire surface with burlap. The burlap shall be lapped 1/2 width in order to provide a double thickness of burlap. Immediately following the placement of the burlap, the entire surface shall be maintained continuously wet for a period of 7 days. Do not permit surfaces to dry at any period during the required curing period.

3.6.3 Cure formed surfaces by moist curing with the forms in place for the full curing period, or until forms are removed. If forms are removed before the curing period is complete, apply a membrane-forming curing compound to damp surfaces as soon as the water film has disappeared. Apply uniformly in continuous operation by roller brushes in accordance with the manufacturer's directions.

3.6.4 Do not use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to the concrete or with any other cover or finish material which shall be bonded to the concrete. These surfaces must be watercured with a full coverage of burlap kept continuously moist for a period of 7 days.

3.6.5 During the curing period, protect concrete from damaging mechanical disturbances, including load stresses, shocks, excessive vibration and from change caused by subsequent construction operations.

### 3.7 SURFACE REPAIRS:

3.7.1 Repair and patch defective areas immediately after removal of forms as directed by the Engineer. Cut out honeycombs, rock pockets, voids over 1/2" in diameter and holes left by tie rods and bolts down to solid concrete, but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surfaces. Exposed reinforcing steel with at least 3/4" clearance all around. Dampen all concrete surfaces in contact with patching concrete, and brush with a neat cement grout coating or concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type or class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

3.7.2 Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face to insure complete filling. Remove stains and other discolorations that cannot be removed by cleaning for all exposed surfaces. Repair isolated random cracks and single holes not over 1" in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a #16 mesh sieve

using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match the existing surface.

3.7.3 Fill in holes and openings left in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete work.

3.7.4 Correct high areas in unformed surfaces by grinding, after the concrete has cured at least 14 days. Correct low areas in unformed surfaces during, or immediately after, completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.

### 3.8 SLABS ON GRADE:

3.8.1 PREPARATION OF SUBGRADE: The subgrade shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required in the specifications. The bottom of an undrained granular base course shall not be lower than the adjacent finished grade. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing, it shall be raised and maintained above 50°F. long enough to remove all frost from the subgrade. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

3.8.2 JOINTS: Joints in slabs on grade shall be located as to divide the slab in areas not in excess of 800 sq. ft. The maximum distance between joints in slabs on grade at all points of contact between slabs on grade and vertical surfaces such as foundation walls and elsewhere as indicated. At exposed joints, recess the premolded fill on a minimum of 1/2", and fill the remaining section with a joint seal and as specified herein. All exposed construction joints in the slabs on grade shall have the edges tooled and the crack and groove formed by the edging tool filled with a polyurethane joint sealant. No kold-key or metal form joints will be permitted.

### 3.9 SIDEWALKS:

3.9.1 Brooming of the concrete surface shall be done transverse to the direction of traffic. Joint spacing shall not be less than 5'-0". Where existing sidewalks are being widened, transverse joints shall be located so as to line up with existing joints in the adjacent sidewalk. Joints shall not be sealed.

3.9.2 All sidewalks shall contain 6"x6" / 1.4x1.4 WWF. Chairs shall be installed or WWF lifted during placement to allow WWF to be within middle 1/3 of sidewalk cross section.

3.9.3 4" of #57 stone shall be placed beneath all sidewalks.

3.9.4 Backfill shall be compacted to a degree comparable to the adjacent undisturbed material.

### 3.10 FINISHES:

3.10.1 STANDARD ROUGH FORM FINISH: Provide a standard rough form finish to all concrete formed surfaces that are to be concealed in the finish work or other construction. (**NOTE:** Interior faces of walls of water retaining structures are not considered to be concealed.) Standard rough form finish shall consist of all defective areas repaired as specified and all holes or voids larger than 3/8" filled with cement grout.

3.10.2 STANDARD FINISH FOR EXPOSED SURFACES: Provide an applied surface finish of "Thoroseal" or an approved equal to all exposed interior and exterior concrete finishes unless otherwise noted. Interior faces of walls of water retaining structures, including areas which are normally submerged, are considered to be exposed surfaces and shall receive the specified standard finish for exposed surfaces. The surface finish shall consist of chopping and/or grinding down all high spots removing grinding of all burrs and/or other projections, filling all voids 3/8" and larger, and cutting out all unsound concrete and patching as specified herein. Before applying the finish, wet and clean the surface of all grease, oils, efflorescence, and other foreign material. Dampen surface immediately ahead of application. Apply the finish coat with a tampico fiber brush by laying the finish coat on the wall in a thick coat of a minimum of 2 lbs. per sq. yard, and brush to a uniform level surface. Do not apply in temperatures 40°F or below, or when temperatures are likely to fall below 40°F within 24 hours after application. The finish coat shall be mixed in strict accordance with the manufacturer's written instructions. After the finish coat has cured, apply a finish coat of "Quick Seal" at a minimum of 12 lb. per sq. yd. Trained technicians shall apply the Thoroseal.

3.10.3 SMOOTH FORM FINISH: Provide a smooth form finish for all exposed interior concrete walls inside buildings, in pipe gallery areas, or as noted on the Drawings. Standard form finish shall produce a smooth, hard, uniform texture on the concrete. The arrangement of the forms and the number of seams and joints shall be kept to a minimum. Immediately after forms are removed, cut out all unsound concrete and patch as specified herein, and fill all pinholes and other voids larger than 1/4" with a cement grout. Compress mortar into voids with a firm rubber trowel or float. After mortar dries, wipe off surface with burlap.

### 3.10.4 SLAB FINISHES:

#### 1. Scratched Finish

After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance, the surface shall be roughened with stiff brushes or rakes before a final set. A scratched finish shall be applied to all surfaces which are to receive a bonded surface finish.

#### 2. Floated Finish

After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared and when the surface

has stiffened sufficiently to permit the operation. During or after the first floating, planeness of surface shall be checked with a 10'-0" straight edge applied at not less than two different angles. All high spots shall be cut down and all low spots filled during this procedure to produce a surface with Class B tolerance throughout. This slab shall then be floated immediately to a uniform sandy texture. A float finish shall be applied to all slab surfaces, which are to receive a waterproofing membrane.

3. Troweled Finish

The surface shall first be float-finished as specified. It shall next be power troweled, and finally hand troweled. The first troweling after power floating shall produce a smooth surface, which may still show some trowel marks. Additional troweling shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations.

The finished surface shall be essentially free of trowel marks, uniform in texture, and appearance, and shall be planed to a Class tolerance. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor covering shall be removed by grinding. A trowel finish shall be applied to all surfaces, which are exposed to view or are to receive a floor covering of carpet, vinyl, asbestos, tiles, etc.

4. Broom Finish

Immediately after the concrete has received a float finish as specified in Section B, it shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface. A broom finish shall be applied to all parking surfaces, exterior concrete walks, and concrete paving slabs.

3.11 FINISHING TOLERANCES: Finishes with a Class C tolerance shall be true planes within 1/4" in 2'-0" as determined by a 2'-0" straight edge placed elsewhere on the slab in any direction. Variation from level for Class A. tolerance shall not exceed 1/4" in 10'-0" or 1/2" maximum in any one bay between columns. Variation from level for a Class B and Class C finish shall not exceed 1/4" in 10'-0" or 3/4" in any one bay between columns.

3.12 RELATED UNFORMED SURFACES: As tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surface unless otherwise shown.

3.13 MISCELLANEOUS CONCRETE ITEMS:

3.13.1 Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

3.13.2 Provide machine and equipment bases and foundations, as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations prior to placement of the concrete, complying with certified diagrams or templates of the manufacturer finishing machines and equipment.

3.14 INSPECTION: Before placing concrete, the formwork installation, reinforcing steel, and items to be embedded or cast-in must be complete. Notify other crafts involved in ample time to permit the installation of their work; co-operate with other trades in setting such work, as required. Notify Engineer upon completion of installation of all reinforcing and other items in ample time to permit inspection of the work before concrete is poured. Soil bottoms at foundation systems are subject to testing laboratory as directed by the Engineer. Place concrete immediately after approval of foundation excavations.

3.15 TESTING AND QUALITY CONTROL:

3.15.1 The Owner shall employ a concrete testing laboratory to provide all laboratory testing services on the project and a concrete technician to perform all quality control tests on concrete and materials used to batch concrete. The testing agency employed shall meet the requirement of "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction", (ASTM E-329).

3.15.2 The Contractor shall provide and maintain adequate facilities on the project for the testing laboratory to locate the required testing equipment and for safe storage area for test cylinders. The general contractor shall provide at his own expense all casual labor needed to assist the concrete technician in obtaining samples of concrete and concrete materials and moving and transporting cylinders and materials which are being tested.

3.15.3 The following services shall be performed by the designated testing agency:

1. Review and/or check-test the Contractor's proposed materials for compliance with the specifications.
2. Review and/or check-test the Contractor's proposed mix design as required by the Engineer.
3. Secure production samples of materials at plants or stock-piles during the course of the work and test for compliance with the specifications as required by the Engineer.
4. Conduct strength tests of the concrete during construction in accordance with the following procedures:

- a. Secure composite samples in accordance with "Method of Sampling Fresh Concrete" (ASTM C-172). Each sample shall be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.
  - b. Mold and cure three specimens from each sample in accordance with "Method of Making and Curing Concrete Compression and Flexural Specimens in the Field" (ASTM C-31). Any deviations from the requirements of this Standard shall be recorded in the test report.
  - c. Test specimens in accordance with "Method of Test for Compression Strength of Molded Concrete Cylinders" (ASTM C-39). Two specimens shall be tested at 28 days for acceptance and one shall be the average of the strengths of the two specimens tested at 28 days. If one specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result. Should both specimens in the test show any of the above defects, the entire test shall be discarded. When high early strength concrete is used, the specimens shall be tested at the ages indicated in the Contract Documents.
  - d. Make at least one strength test for each 50 cu. yd., or fraction thereof, of each mix design of concrete placed in any 1 day. When the total quantity of concrete with a given mix design is less than 50 cu. yd., the strength test may be waived by the Engineer if, in his judgment, adequate evidence of satisfactory strength is provided, such as strength test results for the same kind of concrete supplied on the same day and under comparable conditions to other work or other projects.
5. Determine slump of the concrete sample for each strength test and whenever consistency of concrete appears to vary, using "Method of Test for Slump of Portland Cement Concrete" (ASTM C-143). Slump is to be 4" with a +/- 1" tolerance. Anything not in this range is to be approved by the engineer prior to placement.
  6. Determine air content of normal weight concrete sample for each strength test in accordance with either "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C-231), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C-173), or "Method of Test for Weight per Cubic Foot, Yield and Air Content (Gravimetric) of Concrete", (ASTM C-138). Concrete shall be air entrained with 5-7% air.
  7. Determine unit weight of concrete sample for each strength test.

8. Determine temperature of concrete sample for each strength test. If temperature is 90° or above, concrete is not to be used.
9. Determine in-place strength of concrete by curing cylinders under the same field conditions that the concrete representing these field cylinders is cured and additionally by determining the degree/hours of curing required for the concrete to develop the required strength for form removal.
10. Inspect concrete batching, mixing and delivery operations to the extent deemed necessary by the Engineer.

### 3.16 EVALUATION AND ACCEPTANCE OF CONCRETE STRUCTURES:

3.16.1 The concrete quality control testing as specified will be evaluated by the following criteria:

1. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength test results equal or exceed the 28-day design compressive strength of the type of class of concrete; and, no individual strength test falls below the required compressive strength by more than 500 psi. If compressive strength tests fail to meet these requirements, the concrete represented by these tests will be considered deficient and subject to additional testing and/or removal.
2. Concrete work, which does not conform to the specified requirements, including strength, tolerance and finishes, shall be corrected as directed at the Contractors expense, without extension of time therefor. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from correction to the concrete work. Core tests, if required, shall be evaluated in accordance with the requirements of ACI 318-77.

**END OF SECTION**