

TECHNICAL SPECIFICATIONS

SECTION 1 - GENERAL

1.1 EXISTING CONDITIONS

Improvements to be constructed on City of Sumter property, or other property, are depicted on the project drawings. Construction easements have been obtained by the City where in the City's opinion they are necessary. These easements are available for viewing at the City Engineer's office and copies are supplied to the Contractor, as necessary. Should the Contractor desire or require more working area, it shall be his responsibility to arrange for such additional area, though the City will assist where possible. The Contractor is solely responsible for examining the work areas and will include the cost of all work required to complete the project in the Bid Items of the Bid Proposal. The Contractor shall be responsible for determining the amount of excavation, fill and all other materials, labor and services required in determining his bid. The Contractor shall maintain liability insurance against personal and property damage that could occur during construction. The Contractor is bound to obey all Federal, State and local laws, rules and regulations pertaining to the execution of the work.

1.2 WORK IN ROADWAYS

Work to be done in roadways requires approval by the SCDOT. Traffic on these roadways shall be maintained or detoured as depicted in the SCDOT encroachment permit. Workers and work shall be adequately protected from traffic as shall traffic be protected from the construction. A copy of the encroachment permit is on file at the City's offices for viewing and a copy will be supplied to the contractor.

1.3 PROTECTION AND/OR RELOCATION OF CONFLICTING UTILITIES

The Contractor is responsible for the protection from damage all utilities within the designated work areas. The Contractor shall schedule the work so that utility customers are not without services in excess of four hours in any one day. City personnel will assist the Contractor in locating City owned utilities while the Contractor shall secure location services to locate other utilities. The Contractor shall notify the City of his progress and request location of any City owned utility not shown on the drawing. Cost of utilities relocated solely for the convenience of the Contractor shall be born by the Contractor. Any utility conflicts shall be brought to the attention of the City Engineer.

1.4 LINES AND LEVELS

A. Lines

Center lines of rights-of-way and other necessary baselines shall be established and marked. The Contractor shall engage such competent services as needed to mark the edges of the rights-of-way and all other areas or easements to be used unless otherwise located by the City Engineer.

B. Levels

Bench marks shall be established at conspicuous locations for the Contractor's benefit. The benchmark location and elevation will be provided on the construction drawings.

C. Utility layout

The Contractor shall use the services of a qualified persons. The person need not be a licensed surveyor but shall demonstrate his qualifications to the Engineer's satisfaction.

1.5 SEQUENCE OF CONSTRUCTION

A. Clearing and grubbing of rights-of-way.

B. Scarifying pavement to be removed.

C. Construction of drainage, sanitary sewers, water lines and services.

D. Construction of roadway to include grading; curbs and gutters, sidewalks, base course and finish surfacing.

1.6 STANDARDS

A. The South Carolina State Highway Department Standard Specifications for Highway Construction, Edition of 1973, by reference is made a part of these specifications. These referenced specifications shall govern unless specifically noted otherwise.

B. Other standards are referred to throughout these specifications and are made a part of these specifications by reference.

SECTION 1A

MATERIALS AND EQUIPMENT APPROVAL

1A.1 GENERAL

All materials and equipment to be furnished for installation under this contract must be approved by the Engineer prior to its installation. The Contractor shall submit to the Engineer three copies of shop drawings, certificates and/or samples from his suppliers. Submittals shall have a Contractor's letter of transmittal bearing the Contractor's certification that he has reviewed, checked and approved the submittal data and that they are in conformance with the requirements of the contract documents.

1A.2 REQUIRED SUBMITTALS

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|-----------------------------------|-----------------------------------|
| A. Asphaltic concrete | B. Portland cement concrete |
| C. Reinforcement steel | D. Sand-clay base course |
| E. Storm Drain pipe | F. Masonry units |
| G. Sanitary sewer pipe & fittings | H. Sanitary sewer services |
| I. Sanitary sewer manholes | J. Frames and covers |
| K. Steps | L. Water pipe fittings and valves |
| M. Hydrants | N. Water services |
| O. Expansion joint material | P. Specialized devices |

SECTION 2A - EARTH WORK

2A.1 GENERAL.

This section consists of furnishing all labor, materials and equipment and performing all operations in connection with clearing and grubbing, removal of structures, roadway and drainage excavation, structure excavation, embankment construction, subgrade and shoulders and slopes. Section 200 of the South Carolina State Highway Department Standard Specifications for Highway Construction is referred to.

2A.2 EXCEPTIONS OR CHANGES TO THE REFERENCED SECTION 200

A. Clearing and Grubbing

- 1) The Contractor shall establish rights-of-way lines from horizontal control points provided by the Engineer.
- 2) Structures or materials removed from the rights-of-way may be offered to the adjoining property owner for his further use.

B. Removal of Structures and Obstructions

- 1) This section is limited to removal of drainage structures and curbs. All other items within the right-of-way are included under clearing and grubbing.
- 2) Catch basins to be removed shall be paid for on a unit basis. Pipe to be removed shall be paid for on a unit basis. Compensation for backfill shall be included in the unit bid prices.
- 3) Castings and salvageable pipe are to be stored at a location designated by the Engineer. Such items are the property of the City. Disposal of material of no value to the City is the responsibility of the Contractor.
- 4) Compensation for removal and disposal of existing pavement shall be included in station grading. Compensation for removal and disposal of curb and gutter will be by a unit basis.

C. Roadway and Drainage Excavation

- 1) Grading work is to be done on a Station Grading basis and bid on that basis. Net yardage of cut is the Engineer's estimate and is intended only as an aid to bidders. The bidder (Contractor) is responsible for determining net cut and/or fill and providing any fill or disposing of any excess. Borrow or dirt, disposal of dirt (waste) and its overhaul are not directly reimbursable items. Cost for these items are to be included in the bid items listed in the proposal for Station Grading. Construction of shoulders and slopes is included in this bid item.
- 2) Muck excavation is not anticipated to be required, however, a bid item may provided to establish a unit cost if mucking is required by the Engineer. Cost of this bid item shall include excavation and disposal of the waste and the backfill hauled and compacted in place. The Contractor may use the City lots for temporary storage of fill material to be used for this purpose. Fill material may be that from roadway excavation and disposal of excess dirt and backfill in place around and over the structure is to be included in the bid item for the structure.

D. Structure Excavation

Cost of such excavation and disposal of excess dirt and backfill in place around and over the structure is to be included in the bid item for the structure.

E. Compaction of Subgrade

Compaction of subgrade below roadways and sidewalks is to be 95% of maximum density or more. Compaction of subgrade below gutters and adjacent to street drainage inlet boxes is to be no less than 100% of maximum density.

SECTION 2B - BASE COURSE

2B.1 GENERAL.

This section consists of furnishing all labor, material and equipment and performing all operations in connection with placing an earth type base course composed of approved selected local soil materials. Section 300 of the South Carolina State Highway Department Standard Specifications for Highway Construction is referred to.

2B.2 EXCEPTIONS OR CHANGES TO THE REFERENCED SECTION 300

A. Base Course

The base course shall consist of a naturally proportioned sand-clay from a location approved by the Engineer. Material shall meet the requirements of paragraph 303.04 of the referenced specifications.

B. Contractor Requirements

The Contractor shall furnish the base materials on a unit basis. No payment for haul will be made.

C. Tolerance in Base Thickness

Areas of base material deficient by more than one-half inch (1/2") or in excess by more than one-half inch (1/2") in elevation shall be corrected.

D. Tolerance in Base thickness

Areas of base deficient by more than one half inch (1/2") or in excess by more than one half (1/2") in elevation shall be corrected.

E. Measurement and Payment

The quantity of work done under this section shall be measured and paid for in units of cubic yards of earth type base course in its finished, compacted in place, accepted state. No extra payment shall be made for the mixing, remixing, shaping or reshaping required to obtain that state. The length to be used in the calculation of volume shall be the actual length measured along the surface of the base course actually constructed within the neat lines shown on the plans or ordered by the Engineer.

SECTION 2C - BITUMINOUS PAVEMENT

2C.1 GENERAL

This section consists of furnishing all labor, materials and equipment and performing all operations in connection with constructing a bituminous surface course. Section 400 of the South Carolina State Highway Department Standard Specifications for Highway Construction is referred to.

2C.2 EXCEPTIONS OR CHANGES TO SECTION 400

A. Composition of Mixture

Submission of materials and job mix formula shall be made to the Engineer. No work shall be started prior to receipt of written approval by the Engineer of materials and mix.

B. Prime Coat

A prime coat is required to be placed on the base course. Coat is to meet requirements of Section 406 of the referenced Specifications.

C. Surface Course

Surface course shall consist of a hot laid asphaltic concrete surface course composed of mineral aggregate and asphalt cement mixed in an approved plant and constructed on a prepared base in accordance with these Specifications and in conformity with the lines, grades a typical cross section on the plans or as otherwise specified. Composition of mixture shall be Type I as defined in Section 403.03 of the referenced Specifications.

D. Measurement and Payment

Bituminous plant mix surface course shall be measured by the ton. Payment will be at the contract unit price per ton for the bituminous plant mix course. Prices and payments shall be full compensation for furnishing, mixing, hauling, placing and compacting all materials, including furnishing and applications of prime coat and for all labor, equipment, tools and incidentals necessary to complete the work.

**SECTION 3A - SANITARY SEWER LINES
AND APPURTENANCES**

General Note: For the purpose of these specifications, all standards are referenced in their latest revisions.

3A.1 MATERIALS

Furnish all materials as shown on the drawings and herein specified.

A. **GRAVITY SEWER**, pipe sizes 8 through 18 inches, shall comply with the following requirements

1. **DUCTILE IRON PIPE**

Ductile iron pipe shall be in accordance with ANSI/AWWA A21.51/C151. Push on joints and mechanical joints shall comply with ANSI/AWWA A21.11/C111. Restrained joints shall comply with ANSI/AWWA A21.51.C151. Pipe shall be furnished with cement mortar lining and seal coating in accordance with ANSI/AWWA A21.4/C104; unless otherwise shown on the drawings pipe thickness shall be based on Class 50.

2. **SMOOTH WALLED PVC PIPE**

Smooth walled PVC pipe shall conform to the requirements of ASTM D1784 for "Rigid Poly (Vinyl Chloride) and Chlorinated Poly (Vinyl Chloride) Pipe shall be manufactured from PVC Resins having a minimum cell classification of 12454B or 12454C as defined by ASTM D1784. Pipe joints shall be Bell and Spigot with integrally molded bell. Pipe thickness shall be determined according to the Standard Dimension Ratio (SDR) 35. Joint length shall be 13 feet. Pipe shall be first class product with smooth interior and exterior surfaces. Pipe minimum stiffness at 5% for all sizes when tested in accordance with ASTM D2412. Pipe shall also resist cracking, splitting or breaking up until the inside diameter is reduced by 60% of original dimensions as specified by ASTM D794. Impact shall be tested according to ASTM D2444 using a 20 pound weight. Extrusion quality shall be tested in accordance with ASTM D2162. Each joint or pipe shall be marked with the following information: Manufacturer's name, nominal size, cell classification, ASTM assignments, pipe thickness class and date code. PVC gravity mains shall be installed in accordance with ASTM D2321.

B. PVC SEWER FORCE MAINS

1. PVC sewer force mains shall conform to ASTM D2241. PVC pressure pipe shall be Pressure Class 160 or higher.
2. PVC sewer force mains shall also be installed in accordance with ASTM D2221.

C. DUCTILE IRON FORCE MAIN

1. Ductile Iron shall conform to ASTM A377.
2. Installation of ductile iron pressure pipe shall be in accordance with AWWA C600.

3A.2 TESTING OF GRAVITY SEWER MAINS

Test for infiltration will be as specified for clay pipe. Maximum allowable leakage will be as specified for clay pipe.

3A.3 VITRIFIED CLAY PIPE (VCP)

Pipe and fittings shall be bell and spigot, extra strength, clay pipe conforming to ASTM Standard C700. Tests shall be made in accordance with ASTM Standard C301 by an independent laboratory, to include the acid resistance test outlined in paragraph 4.4.2. Laying length for full joints shall be no less than five feet. Each pipe and fitting shall be marked with the initials or name of the manufacturer, the words "Extra Strength" or "ES" and the identifying mark of the independent testing laboratory. Compression joints for VCP shall be used only where approved by the Engineer. Joints shall be manufactured and tested in accordance with ASTM Standard C425. Joints shall be encased in Class B (2500 psi) concrete as shown in the Detail Drawings. VCP shall be installed in accordance with these specifications, the drawings and ASTM Standard C12.

3A.4 INSTALLATION OF PIPE

All pipe shall be laid upgrade with the spigot pointing downgrade. The pipe shall be laid in the trench so that after the line is completed, the interior bottom surface shall conform to the grades and alignments fixed or given by the Engineer.

A. JOINTS

Prior to joining, all surfaces of the pipe joint will be thoroughly cleaned so that all traces of earth and/or dirt are removed. The interior of the pipe will be carefully freed of all dirt and superfluous material as the work proceeds. Installation of joint material will be in accordance with the manufacturer's recommendation. If any pipe is found to be defective before or after being laid it shall be discarded and replaced without charge to the Owner. No blocking of pipe will be permitted unless in preparation for a concrete cradle.

B. PIPE BEDDING

Unless otherwise directed by the plans, specifications or the Engineer, PVC shall have a Class C bedding (with granular foundation) on depths of 0 to 10 feet and a Class B bedding (with granular foundation) on depths in excess of 10 feet, DIP shall have a Type 2 Bedding, each as depicted on the detailed drawings and the referenced standards. No pipe shall be laid in wet soil or water. When wet conditions are encountered, the Contractor shall de-water the trench to the Engineer's satisfaction. If the wet condition is minor, the contractor shall use a Class C (with granular foundation) for PVC and Type 4 for DIP. Control of water and/or use of rock bedding because of water shall be at the Contractor's expense and no extra payment will be made therefor. Inadvertent over-excavation in depth shall be backfilled to proper ditch elevation with No. 67 crushed rock. Excavation by toothed machinery shall be limited to that depth at which the earth will not be disturbed at the proper level by the machinery teeth. Final excavation shall be done by hand and special care will be taken to insure bell holes are made and the entire length of the pipe barrel rests on undisturbed earth or consolidated crushed rock.

3A.5 MANHOLES

A. Manholes

Unless otherwise directed in these specifications or drawings, shall be of precast concrete with monolithic or cast-in-place bottom at the Contractor's option. Manholes shall conform to ASTM Standard C478. Cones shall be eccentric to facilitate steps. Base riser shall have integral floor or separate base slab as directed or as desired if applicable. Tests required by ASTM Standards C478 and C497 shall be performed by the manufacturer or independent laboratory. Compression test specimen shall be in the amount of 8% of the total order, but not exceed two cylinders for each day's production. Each manhole section shall be marked with the manhole number, the specifications designation, date of manufacturer and name or trademark of the

manufacturer. Lifting holes may be cast in sections at the Contractor's option provided they are properly filled and sealed after installation. The exterior surfaces of all manholes shall be given two coats of bituminous waterproofing material. Waterproofing material shall be of a product intended for such purpose and shall be applied in accordance with the manufacturer's instructions. Joint sealant shall be natural or synthetic rubber gaskets conforming to ASTM Standard C361, paragraph 8, or a flexible plastic joint sealant in extruded form of material that is resistant to sewage and industrial wastes. Inverts shall conform to the size of the pipe. They shall have minimum depth of $\frac{1}{2}$ diameter of pipe and shall have largest horizontal radius possible. Manhole inlets and outlets shall have resilient connections between reinforced manhole structures and pipes that conform to ASTM Standard C923.

B. MANHOLE FRAMES AND COVERS

Frames shall be set in mortar in accordance with the detail drawings. The top of the frame shall be set to the grade of the pavement or finished ground surface or as indicated on the drawings. Water-tight manhole covers shall be installed where finished elevations are below the fifty-year flood plain or in area subject to street flooding. These shall be installed where designated on the drawings or as specified by the Engineer. Covers shall have a ground fit with the frames so that no rocking and/or noise is noticeable under traffic.

C. MANHOLE STEPS

Manhole steps shall be cast into the manhole sections during casting of the manhole section. Steps shall be cast so that they form a continuous vertical ladder with equal spacings not to exceed 16 inches on center. Steps shall be made of gray iron castings conforming to ASTM Standard A48, Class 30 or of aluminum alloy 6061-TS conforming to Federal specifications 00-4-200/B. Steps shall have non-skid top surfaces and designed so that the foot cannot slip off the end. Steps shall have a minimum cross section of one square inch and a minimum length of 10 inches. Steps shall be coated with bituminous paint before being cast into concrete.

3A.6 SEWER SERVICES

- A. Sewer Services (laterals) shall be constructed in accordance with the drawings and shall be of heavy cast iron soil pipe or type PSM poly (vinyl chloride) (PVC) sewer pipe.
- B. Where heavy case iron soil pipe and fittings shall conform to ASTM Standard A74. Pipe and fittings shall be tested by an independent laboratory in accordance with ASTM Standard A74. Each length of pipe and each fitting shall be marked with the manufacturer's initials or registered trademark, the letters "XH" designating extra heavy and the identifying mark of the inspecting laboratory. Joints may be caulked and leaded or gasketed in accordance with ASTM Standard C564. Joints and end plug shall be water tight and be subjected to exfiltration tests.

3A.7 FIELD PERFORMANCE AND ACCEPTANCE TESTING

- A. Alignment of mains: Alignment shall be checked by video camera inspection. All pipe shall show a true line between manholes without defects in conditions, grade or alignment.
- B. Manholes shall not show signs of leakage.
- C. Line leakage

Lines shall be tested from manhole to manhole as construction progresses. All equipment, material and labor shall be provided by the Contractor.

1. Lines installed below the ground water table shall be tested by infiltration of ground water. The high end of the line shall be plugged. A flow through plug, dam or trough shall be installed at the low end of the line so that a container can be placed so as to catch the flow over a period of time determined by the Engineer. The quantity and time interval shall be carefully measured and converted to gallons per mile per day per inch of diameter. Leakage shall not exceed 200 gallon per day per inch of diameter per mile of pipe.
2. Lines installed above the ground water table shall be tested by exfiltration or air in accordance with ASTM Standard C828. Exfiltration shall not exceed 200 gallons per day per inch of diameter per mile of pipe

3A.8 PIPE AND MANHOLE CLEANING

Prior to acceptance all pipe and manholes will be cleaned of dirt in a manner that will not direct the dirt to the existing sewer system. Burrs and rough edges are to be removed from inverts within manholes. Any apparent leaks are to be made watertight.

3A.9 PAYMENT AND MEASUREMENT

- A. Pipe will be paid for at the unit prices per linear foot as stated in the Bid Proposal and shall include the cost of excavation and backfill. Pipe length will be measured from center of manhole to center of manhole.
- B. Manholes will be paid for at the price for each in the Bid Proposal. This payment shall include cost of all appurtenances.
- C. Services (laterals) shall be paid for at the linear foot as stated in the Bid Proposal for length of service line and at the price for each in the proposal for service connections.

3A.10 SEPARATION OF WATER MAINS AND SEWERS

A. Parallel Installation

Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, lesser separation may be allowed by the Engineer, in coordination with the Health Agency. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

B. Crossings

Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the invert of the water main and the top of the sewer. Where a water line crosses under a sewer line, both the water and sewer line must be cast iron or ductile iron. At crossing, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required, as directed by the Engineer.

C. Exception

The Engineer must specifically approve any variance from the requirements of A. and B. when it is impossible to obtain the specified separation distances.

D. Force Mains

There shall be at least a 10-foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18-inch vertical separation at crossing as required in Part A. and B. above.

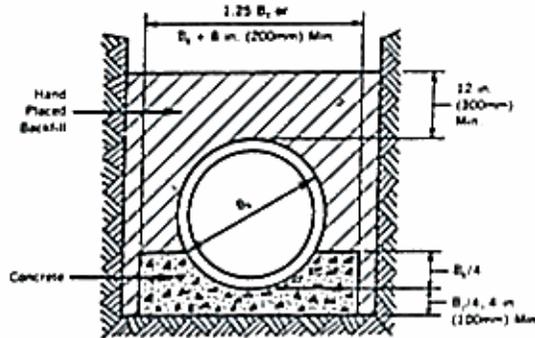
E. Sewer Manholes

No water pipe shall pass through or come in contact with any part of a sewer manhole.

F. All installations shall comply with the latest revision of the Ten State Standards.

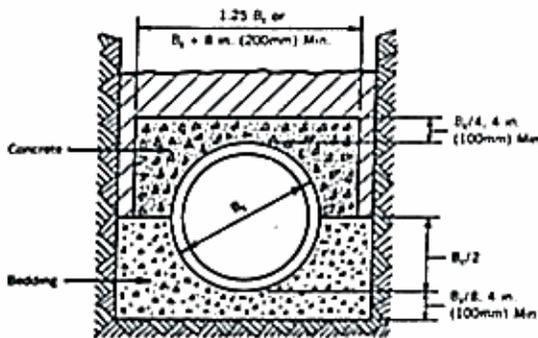
G. Contractor is cautioned to also see Section 4A, Page 30 of these specifications for further requirements for water and sewer separation.

LOAD FACTORS – Class A



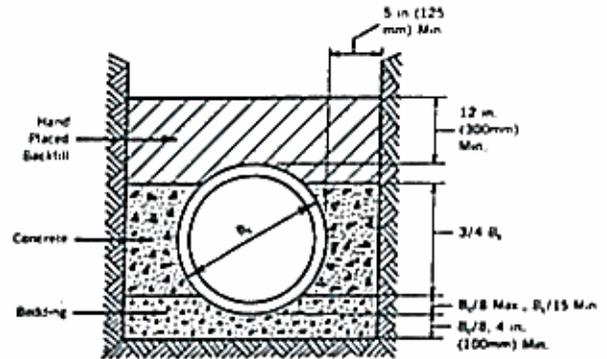
Load Factors: 2.2 Native backfill material lightly tamped
 2.8 ASTM D448 #67 crushed stone
 3.4 Reinforced concrete, $\rho = 0.4\%$

Fig. 1 Class A-I



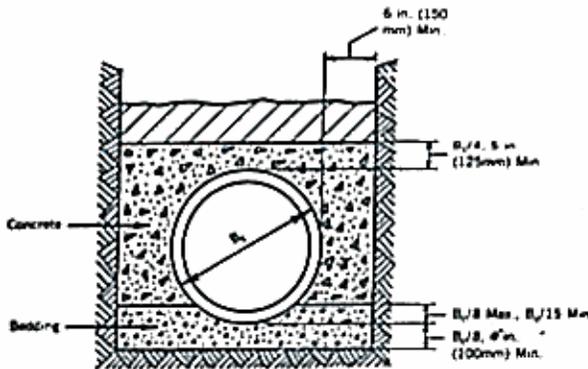
Load Factors: 2.8 Plain concrete
 3.4 Reinf. conc., $\rho = 0.4\%$

Fig. 2 Class A-II



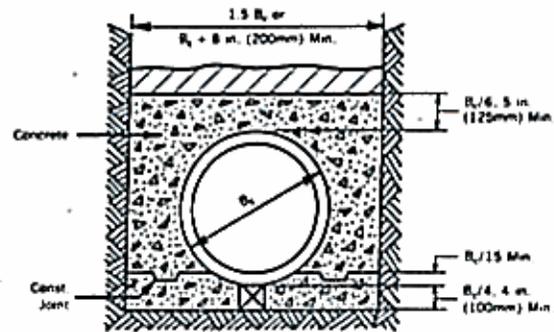
Load Factor 2.7

Fig. 3 Class A-III



Load Factor 3.2

Fig. 4 Class A-IV



Load Factor 4.5

Fig. 5 Class A-V

LOAD FACTORS – Class B, C and D

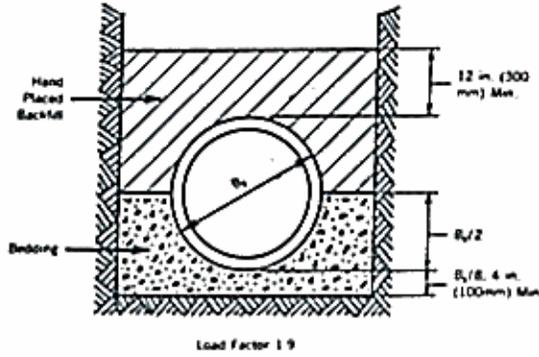


Fig. 6 Class B

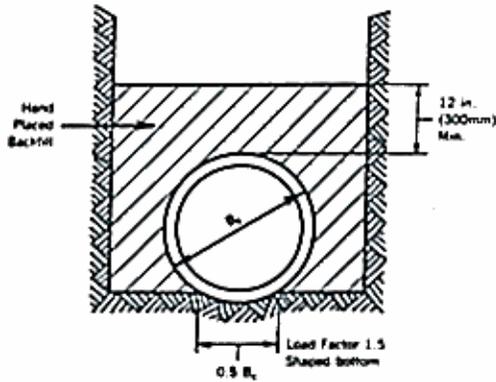


Fig. 7 Class C

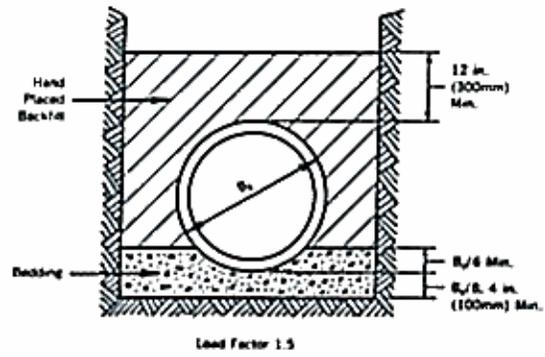


Fig. 8 Class C

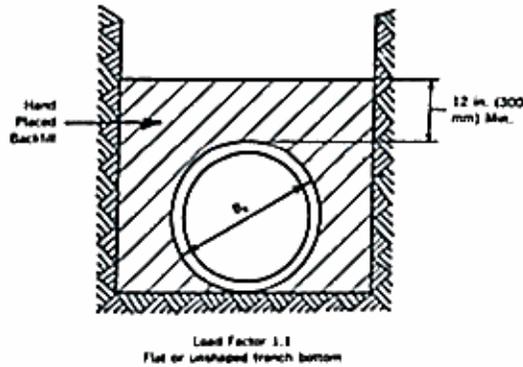


Fig. 9 Class D

SECTION 3B**EXCAVATION & BACKFILLING FOR SANITARY SEWERS****3B.1 SCOPE**

This section includes the furnishing of all labor, materials and equipment and performing all operations in connection with the excavation, trenching and backfilling for sanitary sewers complete. Removal and replacement of pavement is also included in this section.

3B.2 EXCAVATION

The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required suitable for backfill shall be removed and disposed of by the Contractor. Such grading shall be done as necessary to prevent surface water from flowing into trenches or other excavations and any water accumulating therein shall be removed by pumping or by other approved method. Such sheeting and shoring shall be done as may be necessary for the protection of the work and for the safety of personnel. Where in the opinion of the Engineer, damage is liable to result from withdrawing of the sheeting, it shall be left in place and the Contractor will be so notified in writing. All excavation shall be by open cut unless otherwise indicated.

A. Trench Excavation

Trenches shall be of necessary width for the proper laying of the pipe and the banks shall be as nearly vertical as practicable. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length, except for the portions of the pipe sections where it is necessary for the proper sealing of pipe joints. Depressions for joints shall be dug after the trench bottom has been graded, and in order that the pipe rests upon the prepared bottom for as nearly its full length as practicable. It shall be only of such length and width as required for properly making the particular type of joint. Except where rock is encountered, care shall be taken not to excavate below the depths indicated. Where rock or other hard material is encountered, it shall be removed to provide a clearance of not less than six (6) inches in any horizontal direction from all parts of pipe, fitting, etc. Where rock is encountered at grade in trenches, the trench shall be excavated not less than four (4) inches below the bottom of the pipe bell and refilled with crushed stone. Unauthorized overdepths shall be backfilled with crusher run

or graded stone. Whenever wet or other unstable soil that is incapable of properly supporting the pipe as determined by the Engineer is encountered in the bottom of the trench, the trench should be backfilled to the proper grade with crusher run or graded stone. The Contractor shall be reimbursed for any ordered stone backfill by the cubic yard as bid in the Bid Proposal.

B. Excavation for Appurtenances

Excavation for manholes and similar structures shall be sufficient to leave at least one foot in the clear between outer surfaces and the embankment or sheathing and bracing line. Care shall be taken not to excavate below the depth specified or indicated. Any excavation below the proper level shall be filled with Class C concrete, at the expense of the Contractor.

C. Sanitary Sewer Excavations

Trench excavation shall not advance more than 50 feet ahead of pipe laying unless permitted by the Engineer. The top portion of sewer pipe trenches may be excavated with sloping or vertical side to any width which will not cause damage to adjoining structures, roadways, pavements, utilities or private property. For untimbered trenches or trenches held by stay-bracing only, the width of the lower portion of the trench to a height of two feet above the top of the pipe shall not exceed eight inches on either side of the pipe. The width of trenches where skeleton or solid sheeting is used may be increased to dimensions approved by the Engineer, but not greater than necessary to clear the walers when lowering pipes into the trench. If trenches are excavated to widths in excess of the above limitations or collapse because of insufficient bracing and sheeting, the Contractor will be required to use special methods of constructing pipe foundations and backfilling as directed, at his own expense. The bottom of all trenches, except as otherwise specified shall be rounded to conform to the bottom of the pipe so as to afford full bearing on the pipe barrel. The depth and width required for such shaping shall be as directed by the Engineer.

D. Bracing and Sheeting

The sides of all trenches and excavation for sewers and structures shall be securely held by stay-bracing or by skeleton or solid sheeting and bracing as required by the soil conditions encountered. Bracing and sheeting may be removed in units when the level of the backfilling has reached the elevation necessary to protect the pipe work and adjacent property. When, in the opinion of the Engineer, sheeting or shoring can not be safely removed, it

shall be left in place. The Contractor shall be reimbursed for any sheeting ordered to be left in place by the square foot as bid in the Bid Proposal.

3B.3 BACKFILLING

All trenches and excavations shall be backfilled immediately after the pipes are laid therein unless other protection of the pipe line is directed. Backfill materials shall be selected and deposited with special reference to the future safety of the pipes. Fine, loose earth, free from large clods or stones, shall be carefully deposited on both sides of the pipe and thoroughly rammed and tamped until enough fill has been placed to provide a cover of not less than one foot above the top of the pipe. The remainder of the backfill material shall be deposited in six-inch layers and thoroughly tamped to not less than 95% of maximum density. Whenever trenches have not been properly filled or settlement occurs, they shall be refilled, smoothed of and finally made to conform to surface of the ground. Surplus material shall be disposed of by the Contractor. The original surface shall be restored to the full satisfaction of the Engineer.

3B.4 CUTTING, REMOVING & REPLACING EXISTING PAVEMENTS

Existing pavements and base courses cut for the installation of sewer drain lines and appurtenances shall be removed to neat lines and disposed of by the Contractor. Replacement shall be made with like materials as follows: The base course shall consist of a stabilized aggregate with prime conforming to applicable portions of South Carolina State Highway Department Specifications, Section 403.

3B.5 MEASUREMENT AND PAYMENT

A. Excavation and Backfilling

No measurement or direct payment will be made for this work and cost of same shall be included in the price bid for the item to which it pertains.

B. Removal and Replacement of Pavement

Measurement will be made along the utility center line over which the pavement has been replaced. No measurement of width will be made. Payment will be made at the unit prices stated in the Bid Proposal.

Section 3C

GATE, CHECK & PLUG VALVES FOR SEWER SERVICE

3C.1 SCOPE

Valves and appurtenances for piped utilities shall be provided as shown on the plans and as specified herein.

3C.2 SUBMITTALS

Shop drawings and related data on all valves and other items as specified shall be submitted to the Engineer for review. Service manuals shall be furnished for each item specified in this section, as applicable.

3C.3 MATERIAL

Valves and appurtenances shall be the type, size and class shown on the plans. Unless otherwise noted, underground valves shall have standard mechanical joint ends and exposed valves shall have flanged ends. Flanges shall be Class 125 except where Class 250 is specifically noted. Valves shall be furnished with operating devices as specified or as shown. Direction of opening for all valves shall be identical to that of existing valves in the system; otherwise all valves shall open left (counterclockwise). Valves shall be at least the same class as the pipe on which they are used. All exposed valves shall be shop primed. Valves shall be marked with the name of the manufacturer, year of manufacture, maximum working pressure, direction of flow, and size as applicable. Insofar as possible, all valves of the same type shall be by the same manufacturer.

A. GATE VALVES

Gate valves larger than two (2) inches unless otherwise noted on the drawings or further specified below, shall be the double disc, parallel seat, cast iron body, bronze mounted, bottom wedge type conforming to AWWA C500. Unless otherwise noted, valves shall be the non-rising stem type with suitable stem seals. Valves shall be rated at 200 psi working pressure for through 12 inch sizes and 150 psi working pressure for larger sizes. Unless otherwise noted, underground valves shall have an operating nut and exposed valves shall have a handwheel operator.

1. Gate valves, 2 inches and smaller, shall be the solid wedge, all bronze, non-rising stem type, with suitable operator and rated at 200 psi working pressure.

2. Valves 16-inches and larger for working pressures greater than 50 psi, shall be provided with a spur or bevel gear operator and a bypass. Bypass valves shall be the same design as the parent valve. Gear ratios and bypasses shall conform to AWWA C500.
3. Valves 16-inch and larger installed in horizontal pipelines with stems horizontal, shall be provided with roller, tracks and scrapers conforming to AWWA C500.
4. Gate valves of sizes 4, 6, 8, 10 & 12 inches shall be resilient seated type with a working pressure of 200 psi; and meet or exceed all the requirements of AWWA C509. Valve shall have a protective coating of fusion bonded epoxy inside and outside. Resilient seal shall be made of SBR rubber.

B. CHECK VALVES

Check valves 2-inches and larger shall be the cast iron, bronze mounted, full opening swing type, except where other types are specifically noted. Valves shall be rated at 175 psi working pressure for 2 through 12-inch sizes and 150 psi working pressure for larger sizes. Check valves shall conform to AWWA C508. For vertical installations and elsewhere as required, check valves shall be the outside lever-and-spring or outside lever-and-weight type.

1. Check valves, smaller than 2-inch, shall be the all-bronze swing type, with suitable end connections.

C. PLUG VALVE

Plug valves shall be the non-lubricated eccentric type with cast iron body, resilient faced plugs, welded overlay seats of not less than 90% pure nickel, sleeve-type metal bearings and easily adjustable and repackable multiple V-ring type shaft seals. Valves with resilient seats attached to the body or with sprayed or plated seats or screwed-in seats will not be acceptable. Plugs shall be one piece cast iron construction. Port area shall be at least 80% of the full pipe area. Valves shall be rated at 175 psi working pressure and shall seal leak-tight against full rated pressure in both directions. Unless otherwise noted, valves for buried service shall be provided with an extension stem and nut operator and exposed valves shall be provided with a lever operator or gear actuator.

1. Valves 8-inches and larger shall be equipped with gear actuators. Gearing shall be enclosed in a suitable housing with shaft seals. Actuators shall provide clear indication of valve position. An adjustable stop shall be provided to set closing torque.
2. Actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. Exposed nuts, bolts, springs and washers used in buried or submerged service shall be stainless steel.

D. SEWAGE SURGE RELIEF VALVES

Surge relief valves larger than 2-inch shall be the angle body design with external springs. Valve shall be normally closed and shall open when system pressure protection against surge exceeding the spring settings and shall close at slow speed to prevent hammer and shock. Closing speed shall be regulated by means of a self-contained oil cushion chamber. In the closed position with line pressure below the spring setting, the valve shall provide drop-tight closure. Valve body shall be cast iron. Spring shall be enclosed in protective casings and shall be in compression.

1. Valve shall be GA Industries Fig. 625-D or equal.

E. SEWAGE AIR AND VACUUM VALVES

Sewage air and vacuum valves in sewer force mains shall be the type that automatically vents large quantities of air during filling of the line and allows air to re-enter during draining or when a vacuum occurs. Valves shall be the long body design with cast iron body and cover, stainless steel or bronze trim, stainless steel float and rubber seat. Valves shall be supplied with backflushing attachments consisting of an inlet shutoff valve, clear water inlet valve, rubber hose and quick-disconnect couplings. Unless otherwise noted, valves shall be designed for a max. working pressure of 150 psi.

1. Valves shall be manufactured by APCO, Crispin, Val-Matic or equal.

F. VALVE BOXES

Valve boxes shall be the cast iron, three-piece screw type, complete with cover and base. Each box shall be of suitable size and length with extension

sections provided as required. The cover shall have the proper word designating the valve service cast into the top. The base shall be a type which completely covers the operating nut, gland, stuffing box and upper bonnet of the valve.

G. VALVE MARKERS

Markers shall be as detailed on the plans, and shall be of 3000 psi concrete, reinforced as shown. Valve markers shall be marked with recessed letters identifying the valve function, either MV, AV or BO as applicable.

3C.4 MATERIAL TESTING

Valves shall be tested to double the design working pressure and the test results furnished to the Engineer upon request.

3C.5 INSTALLATION

Valves and appurtenance shall be installed in accordance with the best practice, the manufacturer's instructions and at the Engineer's direction. Utility manholes, precast utility boxes or vaults and underground service enclosures for valves shall be as specified.

A. VALVES

Valves shall be installed at the locations shown on the plans. Before installation, valves shall be checked for proper operation and maintained in a clean condition. No dirt, rock or other obstacles that may interfere with operation shall be left in the valve. All defective valves and appurtenances will be rejected.

1. Each underground valve shall be provided with a valve box, unless otherwise noted. The box shall be carefully set and installed to provide easy access to the operating nut. The base shall be set so that the weight of the box and superimposed loads are supported by the base and not by the valve or adjacent pipe. The top shall be set at or slightly above grade, as directed. Extension stems shall be furnished where the operating nut is more than 4 feet beneath finished grade.
2. Each underground valve shall be provided with a valve marker, unless otherwise noted. The marker shall be set plumb with the letters facing the valve.

- 3 Unless otherwise noted, a concrete pad of the size and thickness shown shall be provided at each valve box. The top of the pad shall be flush with finish grade.

B. AIR VALVES

Air valves shall be installed where shown on the plans or where directed by the Engineer. Each air valve shall be complete with auxiliary piping and valves as shown. If the test pressure is greater than the valve design pressure, the air valve shall be removed from the line and air blown off manually during tests.

SECTION 4A
WATER LINES, VALVES AND HYDRANTS

4A.1 SCOPE

The Contractor shall provide all labor, materials and equipment required to construct water mains and appurtenances as shown on the Drawings and as herein specified. All materials and installation methods are to be in accordance with the standards of AWWA and as outlined in subsequent paragraphs of this Section. For the purpose of these specifications, all standards are referenced in their latest revisions. .

4A.2 MATERIAL

Buried piping material may be:

- A. Polyvinyl chloride (PVC)
- B. Cast Iron (CIP)
- C. Ductile Iron (DIP)

Any other material intended for such use must have prior approval by the regulating Health Authority and the Engineer.

4A.3 POLYVINYL CHLORIDE (PVC) PIPE (4-inch and larger)

Rigid PVC pipe shall be designed to carry potable water. Material used to produce the pipe, couplings and fittings shall conform to AWWA Standard C900 and C905. By reference AWWA Standards C900 and C905 are made a part of these specifications.

- A. Pipe shall be as specified in project submittals, but not less than Pressure Class 150, Dimension Ratio (DR) 18.
- B. Bells shall be an integral part of the pipe. Solvent cement will NOT be used for joining purposes.
- C. Maximum length of pipe shall be 20 feet.
- D. Pipe, pipe couplings and other materials and appurtenance associated with the construction of potable water mains shall conform to AWWA Standard C. Fittings shall be mechanical joint with retainer glands.

4A.4 POLYVINYL CHLORIDE (PVC) PIPE (3-inch and smaller)

Rigid PVC pipe shall be designed to carry potable water. Material used to produce the pipe, couplings and fittings shall conform to ASTM D2241. By reference ASTM Standard D2241 is made a part of these specifications.

- A. Pipe shall be as specified in project submittals, but not less than Pressure Class 160 Dimension Ratio (DR) 26.
- B. Bells shall be an integral part of the pipe. Solvent cement will NOT be used for joining purposes.
- C. Maximum length of pipe shall be 20 feet.
- D. Pipe and couplings shall be marked in accordance with Section 9 of ASTM Standard D2241.
- E. Thrust blocking of bends, tees and caps shall be supplied as shown on the detail sheet where mechanical joint and retainer glands are not available in a particular size.

All PVC pipe shall bear the stamp of the National Sanitation Foundation indicating compatibility with potable water transmission. All gasket materials must be AWWA approved.

4A.5 CAST IRON (CIP) PIPE

- A. All cast iron pipe shall be designed in accordance with AWWA/ANSI C101/A21.1 and manufactured in accordance with C106/A21.6 or C108/A21.8. Pipe shall be 18/40 iron, strength Class 22 unless otherwise indicated on the drawings or herein. Cast iron pipe with threaded flanges shall be of strength Class 23.
- B. Fittings shall conform to AWWA/ANSI C110/A21.10 and C111/A21.11 and shall be of a pressure classification at least equal to that of the pipe with which they are used: 150 psi working pressure unless otherwise specified.
- C. Buried fittings shall be push-on or mechanical joint with retainer glands unless otherwise specified.
- D. The inside of cast iron pipe shall be given a cement lining and bituminous seal coat in accordance with AWWA/ANSI C104/A21.4.

4A.6 DUCTILE IRON (DIP) PIPE

- A. All ductile iron pipe shall be designed in accordance with AWWA/ANSI C150/A21.50 and manufactured in accordance with AWWA/ANSI C151/A21.51. Pipe shall be a thickness Class 52 unless otherwise indicated on the drawings. Ductile iron pipe with threaded flanges shall be of Class 52.
- B. Fittings shall conform to AWWA/ANSI C110/21.10 and C111/21.11 and shall be of a pressure classification at least equal to that pipe with which they are used: 125 psi working pressure unless otherwise specified.
- C. Buried fittings will be mechanical joint with retainer glands unless otherwise specified.
- D. The inside of ductile iron pipe shall be given a cement lining and bituminous seal coat in accordance with AWWA/ANSI C104/A21.4.
- E. All water transmission mains shall be traced by installing a length of no. 12 insulated wire along its length and attached at ends to metallic appurtenances, i.e., valve boxes or fire hydrants.

4A.7 GATE VALVES

- A. Gate valves three inches and larger are to be manufactured in accordance with AWWA C509. They shall have an iron body, bronze mounted and double bronze discs. Buried valves shall be nonrising stem with a standard two-inch square operating nut. Valves installed above ground shall be as specified on the drawings. Valves are to be 125 psi water service and shall open counter-clockwise. Valves are to have mechanical joint connections and resilient seats. Valves must be AWWA approved.
- B. Gate valves smaller than three inches may have bronze bodies and have ends to fit the pipe used. Other features shall be similar to valves in paragraph above.

4A.8 VALVE BOXES

Valve boxes shall consist of two or three cast-iron sections and a cast iron cover marked "Water." The box shall have a base that rests on compacted backfill and a top section that is threaded to the bottom section(s) for height adjustment.

4A.9 OTHER MISCELLANEOUS VALVES

- A. Check valves shall be manufactured in accordance with AWWA Standard C508 bronze mounted and have a full opening.
- B. Butterfly valves shall ascribe to AWWA C504.
- C. Ball valves shall meet standard AWWA C507.

4A.10 HYDRANTS

- A. Standard hydrants shall have two 2-1/2 inch ports and one 4-1/2 inch port and comply with the requirements of AWWA C502 for dry barrel fire hydrants. The hydrant leg shall be 6-inch diameter ductile iron with retained mechanical joints, buried a minimum 30 inches. Hydrant shall be furnished with breakable barrel that will break cleanly on impact. Hydrant shall open counter-clockwise with a standard pentagon operating nut. Mueller Centurion or equal.
- B. All hydrants will be installed with auxiliary leg valves and appurtenances as shown on detail sheet.
- C. Post hydrants shall not be installed. Appropriately sized blowoffs shall be installed for flushing purposes.

4A.11 BLOWOFFS

Blowoffs shall be of size indicated on the detail sheet and shall be dependent on the size of main. Construction of piping shall be as shown on the detail sheet and shall be housed in a cast iron meter box. The portable portion shall be turned over to the Owner on completion of the project.

4A.12 TAPPING SLEEVES AND VALVES AND ADAPTER FITTINGS

- A. Fabricated tapping sleeve with mechanical joint resilient seat tapping valve and retainer glands with shoulder bolts. Smith Blair 622 Sleeve and 687 resilient Mueller Tapping valve or equal. Taps shall have mechanical joints unless otherwise specified. Tapping valve outlet shall accommodate the pipe used.

- B. Adapter fittings used on small diameter mains shall be of extra-rugged construction for heavy-duty service. Fittings shall be Style 90 Dresser or approved equal.
- C. All valves and fittings will be installed with retainer gland unless otherwise specified. Natural rubber gaskets and seats shall not be incorporated into these or any other devices serving potable water.

4A.13 INSTALLATION

- A. Lines and Levels. The Engineer shall establish sufficient alignment and elevation control points on the ground for proper guidance of the Contractor in constructing the various items of work. The Contractor shall lay out the work from that control and shall be responsible for his own measurements.
- B. Trenches shall be prepared to provide support throughout the length of the pipe with sharps and stones removed to prevent damage to pipe material. Sharps and stones shall be removed from an area at least 6 inches around the pipe barrel and replaced with suitable bedding material. Where directed by the Engineer, improved bedding shall be used. Bedding materials shall be fine crushed stone or compacted sand where improved bedding is required.
- C. Pipe shall be shipped, unloaded and otherwise handled so as not to be damaged. Pipe shall be installed in accordance with the manufacturer's recommendations and these specifications. Depth of cover shall be 30 inches for buried pipeline. No joint lubricants which would support microbial growth all be applied. Only lubricants manufactured to this purpose and recommended by the manufacturer shall be accepted. O rings of natural rubber will not be accepted for pipe joints.
- D. Backfill material shall be placed in six-inch layers and buried pipeline. Backfill material shall be placed in six-inch layers and thoroughly tamped to not less than 95% of maximum density. Whenever trenches have not been properly backfilled or settlement occurs, they shall be refilled properly, smoothed off and finally made to conform to the surface of the ground.
- E. Where 30 inch cover cannot be maintained, ductile iron pipe will be supplied to the point adequate cover is resumed.

4A.14 HYDROSTATIC TEST

The Contractor shall provide all necessary equipment and perform all work for this test. During the hydrostatic testing of the water lines, the pressure must be at least 1.5 times the maximum working pressure, or 100 percent of the pipe pressure rating, for at least (2) hours. Formulae to be used to calculate the allowable leakage per hour are given below. Test pressure shall deviate no more than 5 psi in 2 hours. Any visible leaks must be repaired regardless of leakage test results.

FOR DUCTILE IRON PIPE

(Sections to be tested shall be approved by Engineer. Testing to be in accordance with AWWA C600, latest revision)

$$L = S * D * P^{1.5} / 133200$$

L = allowable leakage (gals./hr.)

S = length of the pipeline tested (ft.)

D = diameter of pipe (inches)

P = average test pressure (psig)

FOR PVC PIPE

$$L = N * D * P^{1.5} / 7400$$

L = allowable leakage (gals./hr.)

N = number of joints in new pipeline

D = pipeline diameter in inches

P = average test pressure (psig)

4A.15 DISINFECTION

All new lines and appurtenances shall be disinfected in accordance with AWWA C651. The Contractor shall provide all necessary equipment and perform all work. The Engineer shall be notified before disinfection begins. Disinfectant solution shall be uniformly distributed throughout the new mains with a minimum initial free chlorine residual of 25 milligrams per liter and retained in the new mains no less than 24 hours. The lines shall be flushed by the Contractor after disinfection is completed. The Contractor shall provide a sample tap at the end of each dead end main and additional taps as directed by the Engineer to provide a representative sampling of the newly constructed water system. The Contractor shall engage the services of a SCDHEC certified commercial laboratory to analyze samples on two consecutive days, no less than 24 hours apart. All appropriate sampling protocols shall be observed in the collection of the samples, including recording of free chlorine residuals at the time of sampling. These two samples must confirm that no coliform bacteria are present in the new mains. If the membrane filter method is used, non-coliform density shall be reported and

suspicious colonies confirmed. Results will be made available to SCDHEC as part of the Engineer's final submittal package.

4A.16 CUTTING, REMOVING & REPLACING EXISTING PAVEMENTS

Existing pavements and base courses cut for the installation of water lines and appurtenances shall be removed to neat lines and disposed of by the Contractor. Replacement shall be made with like materials as follows: The base course shall consist of a stabilized aggregate with prime coat conforming to applicable portions of SCDOT specifications, Section 306. The surface course shall consist of 1 ½ inch of hot laid asphaltic concrete, Type 1 or Type 2, conforming to applicable portions of SCDOT specifications, Section 403.

4A.17 MEASUREMENT & PAYMENT

- A. Excavation and backfilling
No measurement or direct payment will be made for this work and the cost of same shall be included in the unit prices stated in the Bid Proposal.
- B. Removal and Replacement of Pavement
Measurement will be made for this work and the cost of same shall be included in the unit prices stated in the Bid Proposal.
- C. Pipe will be paid for as bid for in the Proposal. NO allowance will be made for fittings. The Contractor will include the cost of such fittings in the unit price of pipe.
- D. Valves, blowoffs, taps, service lines, services and appurtenances other than fittings (couplings, elbows, tees, crosses, reducers) will be paid for at the unit price in the Proposal.

4A.18 LEAD AND ASBESTOS REQUIREMENTS

- A. All pipe material, solder and flux shall be lead free (less than 0.2 percent lead in solder and flux and less than 8.0 percent lead in pipes and fittings).
- B. Asbestos cement water main will not be accepted in the execution of any project subject to these specifications.

4A.19 SEPARATION OF WATER MAINS & SEWERS

(a) **Parallel Installations**

Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, installation of the water main may be closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

(b) **Connections to Water Mains**

No connections shall be allowed between potable water mains and sources of inferior quality water such that inferior quality water can be introduced by vacuum or pressurization to the potable main.

(c) **Crossings**

Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the invert of the water main and the top of the sewer. Where a water line crosses under a sewer line, both the water and sewer line must be cast iron or ductile iron. At crossing, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required as directed by the Engineer.

(d) **Force Mains**

There shall be at least a 10-foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18-inch vertical separation at crossing as required in Paragraphs (a) and (b) above.

(e) **Sewer Manholes, Tile Fields and Contaminated Excavation Areas**

No water pipe shall pass through or come in contact with any part of a sewer manhole. Water mains will not be installed within 25 feet of a septic tank tile field or wastewater spray field. Fire hydrants shall not be installed within 10 feet of a sanitary sewer. In a case where the Contractor discovers contamination in the path of the water main construction, he shall immediately cease work and notify the Engineer regarding measures necessary to proceed. If the contaminated area cannot be avoided, compatible pipeline material shall be verified and used to cross the area.

(f) No water supply pipe or other appurtenances shall be directly or indirectly connected to storm drains or sanitary sewers in such fashion as to promote contamination of the water supply. Where separation cannot be achieved, ductile iron shall be used as the water main material and have its joints separated to be the maximum distance from the storm drain or sanitary sewer. All effort shall be taken to avoid contact with sanitary sewers. Where separations cannot be achieved, materials in water and sewer mains shall be meet water supply material and construction standards.

(g) Where surface water crossings are made above water, sufficient anchorage and support will be provided to ensure the security of the installation. Special materials or devices will be supplied to prevent freezing damage. See standard detail sheet

(h) Where adequate separations cannot be achieved between water and sewer mains, they shall be arranged to separate pipe joints as far as possible from each other. Where water mains pass under sewer mains, ductile iron shall be used for water main construction or concrete encasement will be used to separate the water main from soil piping or other pollution sources.

(i) Sufficient separation shall be maintained in all cases to provide for maintenance or repair.

Water and sewer crossings must meet these and other provisions of the Ten State Standards, latest revision.

4A.20 MATERIALS IN CONTACT WITH POTABLE WATER

- A. All materials and products used in contact with potable water must meet the specifications of ANSI/NSF Standard 61.
- B. Chemical additives to potable water must meet the specifications of ANSI/NSF Standard 60.

SECTION 4B

WATER METERS & SERVICE CONNECTIONS

4B.1 SCOPE

The Contractor shall provide all labor, materials and equipment required to make service connections and installation of meters as shown on the drawings and herein described.

4B.2 LOCAL CONDITIONS AND REQUIREMENTS

- A. Existing meter services shall be changed to comply with backflow prevention Regulations. This will involve replacing the meter setter and adding a stretch setter to accept the existing meter and a dual check valve assembly. Additionally, the meter, setter, check valve and new box will be positioned horizontally and vertically to be set in either the proposed sidewalk or utility strip.
- B. On those streets where a water main is being replaced, the exiting taps and service line shall be abandoned. The Contractor shall make new taps on the proposed line and install new service line to the new location of the meter installation. After the main has been tested, sterilized, approved and accepted, the houses will be switched from the old service to the new service.

4B.3 SERVICES

Services shall consist of the tap, corporation stop, service line, setter, meter, dual check valve and box.

A. Taps

Service clamps shall be used on all taps, regardless of type main being tapped. Clamp shall have cc outlet and be designed for use of the pipe being tapped. Clamps shall be Mueller or approved equal.

B. Corporation Stops

Stops shall be of the same size as the service. Normal house taps shall be 3/4 inch. Stops shall be CC x CTS (Compression) with an insert if recommended by the manufacturer and shall be Ford, Mueller, Hays or approved equal.

C. Service Pipe

Pipe shall be SDR9 (160 psi) polyethylene, CTS. Pipe shall be marked with the following information: nominal size, manufacturer's name, operating pressure, water service, CTS, NSF, ASTM D 2737, material classification and date code. Pipe shall be as manufactured by Yardley or approved equal.

D. Setters

Setters shall be Ford V-172-7W with 11 1/2" laying length 3/4 CTS x IP outlet comp joint inlet or approved equal.

E. Meters

Unless otherwise directed by the Engineer, meters shall be 5/6" x 3/4" size. Meters shall conform to AWWA Standard C700, Standard Specifications for Cold Water Meters, modified as follows:

- 1) Only displacement meters of flat nutating disc type will be accepted.
- 2) The size, capacity and meter lengths shall be as specified in AWWA Standard C700.
- 3) Main cases shall be the removable bottom cap type with the bottom cap secured by four (4) bolts on 5/6" and 3/4" sizes and six (6) bolts on the 1" size. Bottom caps shall be interchangeable, size for size, between frost-protected synthetic polymer and non frost-protected (bronze) models.
- 4) Meters shall be frost protected and shall have a synthetic polymer bottom. The bottom shall break clean across its diameter when subjected to freezing pressure of approximately 500 psi.
- 5) All main case bolts shall be of stainless steel.
- 6) Meter end connections shall be male spuds of the same size as meter specified.
- 7) The register shall be of the straight reading sealed magnetic drive type; shall be field repairable; shall contain calibrating change gears which are visible and identifiable when viewed through the top lens; and shall contain six (6) numeral wheels which can be reset in the meter shop. The dial shall be of the center sweep pointer type and shall contain 100 equally

divided graduations at its periphery. The register assembly shall be encased in a copper shell and a double rubber gasketed glass lens to provide a nonpermeable envelope. The envelope shall be secured into a plastic hood with a removable camming type, non-ferrous clamp ring, and shall contain desiccating capsule to prevent moisture accumulation on the lens. The register shall be attached to the meter case by a bayonet attachment integral with the register clamp ring, and shall be secured with a single seal screw. Register assembly shall mount in any of four positions and be removable without disassembling the meter.

- 8) The measuring chamber shall be of the snap-joint type equipped with a flat disc piston. The chamber shall be made of non-hydrolyzing synthetic polymer, shall be smoothly and accurately machined, and shall contain a molded diaphragm of the same material as that of the chamber. The diaphragm shall be permanently attached to the lower chamber half and shall contain an integral curved buttress and bearing track for the disc piston thrust roller. The control block shall be the same material as the measuring chamber and be mounted on the chamber top to provide sand ring protection. The control block assemble shall be removable.
- 9) The flat disc piston shall be one piece construction molded of a non-hydrolyzing synthetic polymer and contain a thrust roller located within the disc slot. The roller head shall roll on the buttressed track provided by the diaphragm in the measuring chamber.
- 10) All meters shall contain removable polypropylene plastic strainer screens or a suitable substitute.
- 11) Registration accuracy shall comply with minimum requirements outlined in AWWA applicable standards.

F. Dual Check Valve

A backflow preventer of the dual check valve type shall be installed ahead every domestic water meter. Valve shall be approved by the South Carolina Department of Health and Environmental Control and shall be Watts #7 Backflow Preventer. All other types and sizes of water taps shall also be fitted with the appropriate model backflow preventer from the approved SCDHEC list.

G. Meter Box

Boxes shall be selected according to locations and/or external loading anticipated.

- 1) Cast iron boxes shall be used if box is to be placed in a sidewalk or if it will be subjected to traffic loads (i.e., driveways). Box shall be Sumter Machinery MB with a MBC 10 cover or approved equal.
- 2) Plastic boxes shall be used in dirt areas not subject to traffic loads. Box shall be Intercontinental Plastics Mfg. Co. heavy duty high density polyethylene 18" x 21" x 16" with a cast iron flanged reader lid, brooks meter box #419 or equal. Heavy duty C.I. solid lid 15 lbs. #290.

4B.4 MEASUREMENT & PAYMENT

Items specified in this section shall be measured and paid for as delineated in the Bid Schedule.

SECTION 4C - BORING AND JACKING

4C.1 SCOPE

This section includes the furnishing of all labor, materials, equipment and performing all operations in connection with boring and jacking casing(s) at location(s) shown on the drawings.

4C.2 MATERIALS

Casing pipe shall be of steel and of leakproof construction, capable of withstanding highway loading. The inside diameter of the casing pipe shall be a minimum of 12 inches and such as to allow the carrier pipe to be removed subsequently without disturbing the casing pipe. Minimum wall thickness shall be 0.250 inches. The steel pipe shall have minimum yield strength of 35,000 psi.

4C.3 INSTALLATION

Bored or jacked casing shall have a bored hole diameter essentially the same as the outside diameter of the casing pipe. If voids should develop or if the bored hole diameter is greater than the outside casing diameter by one inch, remedial measures as approved by the Engineer shall be taken. The location of the pit for boring equipment shall be approved by the Engineer. Ends of casing shall be sealed around the carrier pipe by means approved by the Engineer.

4C.4 CARRIER PIPE

The carrier pipe shall be mechanical jointed Class 52 ductile iron pipe. Outside of bells shall rest on inside surface of casing pipe. PVC carrier pipe may be used where designated by the Engineer. PVC carrier pipe shall be installed according to manufacturer's recommendations.

4C.5 MEASUREMENT & PAYMENT

Measurement of casing length will be made in the field to insure minimum specified length. Payment shall be made for the minimum specified length only in accordance with the bid schedule.

**STORM DRAINAGE
SECTION 4D**

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SECTION 4D - STORM DRAINAGE**4D1.0 SCOPE**

This section covers the storm drainage system, including pipe, culverts, and appurtenances, trenching and bedding complete.

4D2.0 PIPE CULVERTS

Pipe culverts shall be reinforced concrete pipe (RCP) and shall meet the requirements of Section 714 of the South Carolina State Highway Department Standard Specifications.

4D2.1 REINFORCED CONCRETE PIPE

RCP shall be Class III pipe meeting the requirements of AASHTO M-170.

4D3.0 TRENCHING & BEDDING FOR PIPE CULVERTS & STORM DRAINS

The Contractor shall perform all excavation of every description and whatever substances encountered, to the depths indicated on the drawings or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner at a sufficient distance from the banks of the trench to avoid overloading, which may cause slides or cave-in. All excavated materials not required or suitable for backfill shall be recovered and wasted as indicated on the drawings or as directed. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations.

Any water accumulating therein by surface flow, seepage or otherwise shall be removed by pumping, piping or by other approved methods. Such sheeting, bracing and shoring shall be done as may be necessary for the protection of the work and for the safety of the personnel. Unless otherwise indicated, excavation shall be open cut. Excavation shall include all excavations regardless of the type material encountered.

4D3.1 TRENCHING

The width of trenches at any point below the top of the pipe shall not be greater than the outside diameter of the pipe plus 2' - 0" for pipes measuring up to 30" and 2'-6" for pipe measuring greater than 30" to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Care shall be taken not to over-excavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor

4D3.2 REMOVAL OF UNSTABLE MATERIAL

Whenever wet or otherwise unstable soil is encountered in the bottom of the trench is incapable of adequately supporting the pipe as determined by the Engineer, such material shall be removed to the depth required and replaced to the proper grade with selected material. Removal of unstable material and filling with suitable material down to a depth of 12 inches below the proposed pipe invert shall be included in the Contractor's unit bid price for the pipe installation. If additional unstable material must be removed or where the bottom of the trench at 12 inches below grade is found to consist of material suitable to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of stabilized earth, crushed aggregate, concrete, pilings, timber or other suitable materials as approved or directed by the Engineer. Payment for special foundations, if not called for on the drawings or in the Bid Documents shall be paid for in accordance with approved change orders. The Contractor shall determine the quantities of special foundation work and acquire the daily approval of these quantities from the Engineer.

4D3.3 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. (See pipe bedding detail)

4D4.0 INSTALLATION OF PIPE

Each pipe section shall be carefully examined before being laid and defective or damaged pipe shall not be used. Pipe shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water and no pipes shall be laid when trench conditions or weather are unsuitable for such work.

4D5.0 PIPE LAYING

These types of pipe shall be laid with the separate sections jointed firmly together, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Any unprotected metal in joints shall be coated with a suitable bituminous paint. During installation, the pipe shall be handled with care as not to damage the bituminous coating or paving. Prior to placing the backfill, damaged areas of the coupling bands and pipe shall be given a coating of bituminous cement. Pipe on which the bituminous coating has been damaged to such extent that satisfactory field repairs cannot be made, shall be removed and replaced by the Contractor at his expense. Vertical elongation, where indicated, shall be gained by sidefill compaction

4D6.0 JOINING PIPE

In making joints, care shall be taken to be sure that proper jointing is achieved in accordance with the Highway Department Specifications except that for RCP approved mastic joint materials shall be used. RCP shall have tongue and groove joints. Joint sealing material shall conform to the requirements of AASHTO M-198. Mastic material shall completely fill all joints. Mastic strips shall be 1/2 inch thick and 1.0 inch wide for 12" through 18" pipe, 1-1/2" wide for 24" through 42" and 1-3/4 inches wide for 48" through 66".

4D7.0 BACKFILLING FOR PIPE

See trench bedding detail previously shown.

4D7.1 BACKFILL TRENCHES

After the bedding has been prepared and pipe installed, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both side of the pipe in layers not exceeding 6-inches in compacted depth. The backfill shall be brought up evenly on both sides of the pipe for its full length. Care shall be taken to insure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers and rammers to achieve a minimum density of 95% of the maximum density as determined by ASSHTO method T-99 within road curb limits and 90% elsewhere. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8-inches to achieve the above specified density. The Engineer will determine the number and locations of density tests to be performed. These tests will be paid for the Owner.

4D7.2 BACKFILLING PIPE IN FILL SECTIONS

For pipe placed in fill sections, the backfill material and the placement and compaction procedures shall be as specified above. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth and shall be compacted by rolling parallel with the pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12" whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches.

4D7.3 CONSTRUCTION MACHINERY

In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of the construction shall be at the Contractor's risk. Any pipe damaged thereby shall be repaired or replaced at the option of the Engineer and at the expense of the Contractor.

4D8.0 PIPE UNDERDRAINS

When requested by the Owner's representative, underdrain piping shall be installed as shown on the drawings. Underdrain pipe shall be perforated PVC, HDPE, or an approved equal pipe. The PVC pipe shall be standard dimension ration (SDR) 35 or thicker with manufacturer formed perforations of suitable size and in two rows approximately 90 degrees apart. Pipe underdrains will be paid for at a the unit price bid per linear foot of pipe actually requested and installed. This price shall cover all work necessary to complete the installation as shown on the drawings and directed by the Engineer.

4D9.0 MEASUREMENT AND PAYMENT

For concrete pipe, the linear feet of pipe to be measured for payment of each class and size specified shall be the net length of pipe installed complete and accepted. The length shall be obtained by multiplying the nominal length of the sections by the number of sections used. Any extra length not necessary in the total length of the pipe caused by using joints other than 4 feet in length will not be measured. The footage of new pipe, measured will be paid for at the contract unit prices per linear foot for each of the types, classes, sizes and dimensions called for in the Bid Schedule, complete in place and accepted, which price and payment shall be full compensation for furnishing, hauling and placing all pipe and materials, excavation and backfilling new or existing trench, removal of existing pipe to be replaced, constructing connections, removal of old endwalls, cleaning out pipe, disposal of surplus materials, and for all labor, equipment, tools and incidentals necessary to complete the work.

STORM DRAINAGE STRUCTURES

4E1.0 SCOPE

This section includes the furnishing of all labor, materials and equipment and performing all operations in connection with the construction of concrete and masonry unit structures and applies to sidewalks, concrete driveways, concrete ramps, catch basins, junction boxes and manholes. Section 700 of the South Carolina Highway Department Standard Specifications for Highway Construction is referred to.

4E2.0 EXCEPTIONS, CHANGES OR ADDITIONS TO THE REFERENCED SECTION 700

- A. Class B concrete shall be used and shall conform to that consistency as defined in Section 701.17 of the referenced specifications.
- B. Type I or Type II Portland cement may be used.
- C. No admixtures or additives not on the approved submitted mix will be used without written approval by the Engineer.

4E3.0 MEASUREMENT AND PAYMENT

Measurement for payment will be made according to the quantities in the bid Document and comparison with field installation.

4E3.1 SIDEWALK, DRIVEWAYS AND RAMPS

Concrete sidewalk, concrete driveway and concrete ramps will be measured by the square yard of finished surface complete in place and accepted. Deduction for drainage structures such as catch basins, drop inlet, etc., shall be in accordance with the plans.

4E3.2 CATCH BASINS, DRY INLETS, MANHOLES AND JUNCTION BOXES

Catch basins, drop inlets, manholes and junction boxes, both new and adjusted as applicable, complete in place and accepted, will be measured by the unit and shall include all frames, covers, gratings and fittings necessary to complete the unit.

CURB AND GUTTER

SECTION 4F

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CURB AND GUTTER

SECTION 4F

4F1.0 SCOPE

Included shall be all necessary labor and materials and all incidentals for complete finished curb and gutter. Included shall be all necessary excavation, backfills and compacting of subgrade.

4F2.0 MATERIAL

Concrete shall be Class B in accordance with SCDOT Specifications, Section 700. Cross section of curb shall be as shown on drawings. Extruded curb shall be accepted provided construction method is approved by the Engineer 10 days prior to signing of the construction contract.

4F3.0 SUBGRADE

The subgrade shall be thoroughly compacted and finished to a smooth firm surface and shall be moist at the time the concrete is placed. Any concrete that settles after placement shall be removed and replaced without additional cost to the Owner as directed by the Owner's representative.

4F4.0 CONSTRUCTION

The curb and the combined curb and gutter shall be constructed in sections having a uniform length of 10 feet, except for closures. In no case shall any section be constructed having a length less than 6 feet. The curb and the combined curb gutter sections shall be separated by approved separator plates 1/8 to 1/4 inch thick. The separator plates shall be carefully set and allowed to remain in place until the concrete has set sufficiently, after which they shall be carefully removed. Expansion joints in the curb or the combined curb and gutter shall be placed at 10 foot intervals at the ends and midpoint of return and at the point where the new curb and the combined curb and gutter abuts other concrete structures. Expansion joint material shall be 1/2 inch thick performed bituminous material and shall be cut to fit the full depth of the section unless otherwise noted on the drawings.

4F4.1 EXTRUDED CURB AND GUTTER

Extruded curb and gutter may be place by an extrusion machine approved by the Engineer. When, in the opinion of the Owner's representative, satisfactory results are not

being obtained, the Contractor shall use the form type of construction with no adjustment in compensation. When slip-form or extruded type construction is used, the aggregate sizes, amount of cement a proportion of all materials for the concrete may vary from the requirements set forth in this Specification as necessary to produce a workable and otherwise satisfactory mix. Concrete supplier shall furnish certified copy of concrete mix to Owner's representative. Expansion joints shall be constructed at the same locations as required when form construction is being used. Weakened joints, spaced at ten-foot intervals, shall be made by cutting the concrete with a trowel or by other acceptable means.

4F5.0 FINISHING

The finishing of the concrete shall be conducted in a manner so as to force all coarse aggregate from the surface and thoroughly work the concrete against the forms to produce a smooth finish, free from water, air pockets, sand streaks and honeycomb. The forms on the face of the curb shall be removed as soon as possible. All exposed surfaces of the curb and gutter shall be finished with a wood float to produce a uniform gritty texture. After the forms are removed, any surface that contains honeycombs shall be repaired immediately by patching in an approved manner, using a cement mortar composed of one part cement and two parts of fine aggregate. It is expected that forms, concrete and workmanship shall be such that the quantity of trimming and repair work is kept to a minimum.

4F6.0 CURING

All concrete shall be fully covered and protected from moisture evaporation, rapid temperature changes, rain, flowing water and mechanical injury during a period of at least 72 hours immediately following the furnishing and edging of the pavement. The protective covering (curing method) or combination of methods shall be applicable to local conditions and shall be approved by the Engineer. The use of a covering material which contains or becomes contaminated with sugar in any form, tannic acid or other substance considered detrimental to Portland cement, will not be permitted. The initial curing medium shall be effective and applied so as to prevent checking, cracking or the appearance of dry spots in the surface of the concrete. The sides of the concrete exposed after removal of forms shall be protected immediately to provide continuance of curing and prevent injury of the pavement edges and underlying subgrade.

4F7.0 MEASUREMENT AND PAYMENT

Concrete curb, concrete gutter and concrete curb and gutter will be measured by the linear foot complete in place and accepted. Curb and gutter will be measured along the roadway face of the curb at the finished grade elevation.

GRASSING

SECTION 4G

PART 1 GENERAL

4G1.1 DESCRIPTION

A. Work included: Provide grassing of the areas specified herein, or as indicated, for a complete and proper installation.

1. Water lines, storm drains, sanitary sewer easements, including highway and street shoulders: All areas disturbed by the construction operation.

4G1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods for proper performance of the work for this Section.

B. Seed: Conform to all State laws and to ail requirements and the methods needed for proper performance of the work for this Section.

C. Fertilizer: Conform to State Fertilizer Law.

4G1.3 SUBMITTAL

A. Project data: After the Contractor has received the Owner's Notice to Proceed, submit:

1. Complete materials list of items proposed to be provided under this section.

4G1.4 PRODUCT HANDLING

A. At time of delivery, furnish the Engineer invoices of all material received in order that application rates may be determined.

B. Immediately remove from the site materials which do not comply with the specified requirements and promptly replace with materials meeting the specified requirements.

PART II PRODUCTS

4G2.1 FERTILIZER

- A. Provide commercial balanced 16-4-12 or 12-4-8 fertilizer 15G-2 delivered to the site in bags labeled with the manufacturer's guaranteed analysis.

4G2.2 GRASS SEED

- A. Provide grass seed which is:
 1. Free from noxious weed seeds, and re-cleaned;
 2. Grade A recent crop seed;
 3. Treated with appropriate fungicide at time of mixing;
 4. Delivered to the site in sealed containers with dealer's guaranteed analysis.

4G2.3 LIME

- A. Provide agricultural grade, standard ground limestone conforming to current "Rules, Regulations and Standards of the Fertilizer Board of Control" issued at Clemson University.
- B. Bag tags or delivers slip for bulk loads shall indicate brand or other trade name, calcium carbonate equivalent and other pertinent data to identify the lime.

4G2.4 EMULSIFIED ASPHALT (ANTIONIC)

- A. Provide Grade EA-P meeting the requirements of SCDOT Specifications, Subsection 406.5, Edition of 1986.
- B. If necessary for satisfactory spraying, material shall be diluted at the manufacturing plant with water.

4G2.5 WOOD CELLULOSE FIBER

- A. Provide wood chip particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer.
- B. Material to be heat processed so as to contain no germination or growth inhibiting factors.
- C. It shall be dyed (non-toxic) an appropriate color to facilitate metering.

4G2.6 STRAW MULCH

- A. Provide straw or hay material.
 - 1. Straw to be stalks of wheat, rye, barley or oats.
 - 2. Hay to be timothy, peavine, alfalfa or coastal 15G-3 Bermuda.
- B. Material to be reasonably dry and reasonably free from mature seed bearing stalks, roots or bulblets or Johnson Grass, Nutgrass, Wild Onion and other noxious weeds.

4G2.7 EXCELSIOR FIBER MULCH

- A. To consist of 4 to 6 inches, average length, wood fibers cut from sound, green timber.
- B. Make cut in such a manner as to provide maximum strength of fiber, but at a slight angle to natural grain of the wood.

PART III EXECUTION

4G3.1 GENERAL

- A. Seed these areas immediately upon completion of grading or construction and clean-up operations.
 - 1. Slopes greater than four horizontal to one vertical.
 - 2. Utility right-of-ways adjacent to stream banks.
- B. Areas ready for planting between August 16 and February 28 shall be planted with a temporary cover of Schedule No. 2. At the acceptable seasons for planting Schedule No. 1, the turf shall be destroyed by reworking the soil and Schedule No. 1 seeding established as specified herein.
- C. Use Rate A pounds per 1000 sq. ft. on slopes over five feet horizontal to one foot vertical in height and use Rate B pounds per 1000 sq. ft. on slopes less than five feet horizontal to one foot vertical.

4G3.2 SEEDING SCHEDULES

A. Mixtures of different types of seed for the various schedules shall be weighed and mixed in proper proportions in the presence of the Engineer.

B. Schedule No. 1 - Planting dates March 1 to August 15:

<u>COMMON NAME OF SEED</u>	<u>RATE A</u>	<u>RATE B</u>
Annual Rye Grass	4	4
Hulled Bermuda	0	1
Pensacola Bahia	1	1
Sericea Lespedeza	1	0

C. Schedule No. 2 - Planting dates August 16-February 28:

<u>COMMON NAME OF SEED</u>	<u>RATE A</u>	<u>RATE B</u>
Annual Rye Grass	0	5
Brown Top Millet	5	0

4G3.3 GROUND PREPARATION

A. Bring all area to proper line, grade and cross section indicated on the plans.

B. Repair erosion damage prior to commencing seeding operations.

C. Loosen seed bed to minimum depth of 3 inches.

D. Remove all roots, clods, stones larger than 2 inches in any dimension, and other debris.

E. Conduct soil test to determine pH factor.

1. If pH is not in the range of 6.0 to 6.5, adjust.

4G3.4 APPLICATION OF FERTILIZER

A. Spread uniformly over area to be seeded at:

1. Rate of 6 lbs per 1,000 sq. ft. when using 16-4-12.
2. Rate of 8 lbs per 1,000 sq. ft. when using 12-4-8.
3. Use approved mechanical spreaders.

B. Mix with soil to depth of approximately 3 inches.

4G3.5 SOWING METHODS

A. General:

1. Perform seeding during the periods and at the rates specified in the seeding schedules.
2. Do not conduct seeding work when ground is frozen or excessively wet.
3. Produce satisfactory stand of grass regardless of period of the year the work is performed.

B. Seeding, slopes less than four horizontal to one vertical:

1. Shall conform to Methods EA, WF or WCF as specified hereinafter.
2. Method EA (Emulsified Asphalt):
 - a. Sow seed not more than 24 hrs. after application of fertilizer
 - b. Use mechanical seed drills on accessible area, rotary hand seeders, power sprayers, etc. may be used on steep slopes or area not accessible to seed drills.
 - c. Cover seed and lightly compact with cultipacker if seed drill does not.
 - d. Within 24 hrs. following compaction of seeded areas, uniformly apply 0.2 gallons per square yard of emulsified asphalt over the seeded area.

3. Method WF:

- a. Sow seed as specified for Method EA.
- b. Within 24 hrs. following covering of seeds, uniformly apply excelsion fiber at the rate of 100 pounds per 1,000 square feet.
- c. Material may be applied hydraulically or dry. If applied dry, it shall be thoroughly wetted immediately following placing.
- d. Seeded area to be lightly rolled to form a tight mat of the excelsion fibers

4. Method WCF:

- a. Apply seed, fertilizer and wood fiber mulch using hydraulic equipment.
- b. Equipment to have built-in agitation system with capacity to agitate, suspend and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed and water.
- c. Minimum capacity of slurry tank: 1000 gallons.
- d. Apply fiber mulch at rate of 345 pounds per 1,000 sq. ft.
- e. Regulate slurry mixture so that amounts and rates of all application will result in uniform application of all materials at not less than the specified amounts.
- f. Apply slurry in a sweeping motion, in an arched stream so as to fall like rain, allowing the wood fibers to build upon each other.
- g. Use color of wood pulp as guide, spraying the prepared seed bed until a uniform visible coat is obtained.

C. Seeding, slopes greater than four horizontal to one vertical:

1. Sow seed as specified for Method EA, unmulched.
2. Apply straw or hay mulch at the rate of 100 pounds per 1,000 square feet uniformly to the seeded area. Mulch may be applied by hand, by mechanical spreaders or by blowers.

3. Hold mulch in place with a tack coat of emulsified asphalt, applied at the rate of 0.2 gallons per square yard.

4G3.6 SECOND APPLICATION OF FERTILIZER

- A. When plants are established and showing satisfactory growth, apply nitrogen at the rate of 1.0 pound per 1,000 square feet.
- B. Apply in dry form unless otherwise directed by the Engineer.
- C. Do not apply to stands of temporary grasses.

4G3.7 MAINTENANCE

- A. Maintain all seeded areas in satisfactory condition until final acceptance of the work.
- B. Areas not showing satisfactory evidence of germination within six weeks of the seeding date shall be immediately reseeded, fertilized and/or mulched.
- C. Repair any eroded areas.
- D. Mow as necessary to maintain healthy growth rate until final acceptance of the Work.

4G3.8 ACCEPTANCE

- A. Permanently seeded areas (Schedule No. 1) will be accepted when the grass attains a height of two inches.
- B. No acceptance will be made of temporary seeded areas (Schedule No. 2); Rework and seed with Schedule No. 1.

4G3.9 MEASUREMENT AND PAYMENT

- A. No measurement and payment will be made for the work under this Section and all costs for same shall be included in the unit price bid for sewer lines, water lines, storm drains for the project.

**CONCRETE MASONRY
SECTION 4H
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4H.1 GENERAL

The contractor shall furnish all necessary materials and build all concrete masonry required under this contract and not otherwise provided for, as indicated on the drawings and as herein specified.

All concrete shall be site-mixed or ready-mixed as produced by a plant acceptable to the Engineer.

4H.2 CLASSES OF CONCRETE

Class C concrete shall be used for all reinforced and plain concrete not otherwise specified or noted on the drawings.

Class B concrete may be used wherever low strength concrete is approved, including concrete fill under foundations and elsewhere as specified or indicated on the drawings.

Class A or Class D concrete shall be used where specified or indicated on the drawings.

4H.3 PORTLAND CEMENT

All cement used on the work shall be American -made Portland cement, free from water-soluble salts or alkalis which will cause efflorescence on exposed surfaces. The cement manufacturer shall have a well-established reputation for producing a uniform, high-quality product. Unless otherwise approved, cement from only one mill shall be used throughout the work. All cement used in exposed work shall be uniform in color. Air-entraining cement shall not be used.

Normal Portland cement shall be Type II conforming to the ASTM Standard Specification for Portland Cement, Designation C1500-73a. High early strength cement may be used only with the written permission of the Engineer, but no additional payment will be made to the Contractor for the use thereof. If used, it shall be Type III conforming to the above-mentioned ASTM Specification.

In addition to the requirements of the above-mentioned specifications, cements to be used in exposed concrete shall exhibit no efflorescence when tested in accordance with the ASTM Standard Methods of Sampling and Testing Brick, Designation C67-66. However, 2-in. x 7-in. x ½ in. mortar slabs comprising a 1:3 mixture by weight of the cement in question and Ottawa sand, mixed with local tap water to a flow of 100 percent and aged 1 week before test shall be employed in the test.

All cement to be used in the work shall be subject to testing to determine whether it conforms to the requirements of the specifications. The methods of testing shall conform to the appropriate specification, but the place, time, frequency and method of sampling will be determined by the Engineer in accordance with the particular project conditions.

When used in the work, cement shall be free from lumps and partially or wholly set cement.

4H.4 ADMIXTURES

Concrete exposed to the elements shall be air-entrained concrete obtained by the use of approved admixtures such as MBVR made by the Master Builders Company; Darex AEA made by the Dewey & Almy Chemical Division of the W.R. Grace & Company; Sika AER made by Sika Chemical Corporation; or approved equal products.

The specific admixture shall be subject to approval by the Engineer.

The compressive strengths of the concrete mixes made with the admixture shall conform to the applicable water-cement ratios in Table 3A-C.

The average resulting air content in field mixtures shall be 5 percent when measured by means of an ACME air meter, or approved equal, in conformity with the ASTM Tentative Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method, Designation C231-72-T. No concrete shall be used for which the individual air content is less than 4 or greater than 6 percent.

If the admixture is applied in solution form, the quantity of the solution shall be included in the computations of the water-cement ratio. Combinations of types of cement and types of admixtures which produce undesirable or erratic air contents with the available aggregates shall be avoided.

Admixtures causing accelerated setting of cement in concrete shall not be used in any class of concrete.

The use of an admixture in concrete other than concrete exposed to the elements will not be permitted except by written consent of the Engineer.

4H.5 WATER

The water for concrete shall be clean, fresh and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.

4H.6 FINE AGGREGATE

Fine aggregate shall consist of inert natural sand conforming to the ASTM Standard Specifications for Concrete Aggregate, Designation C33-71a and also conforming to the detailed requirements given in Table 4A-A.

TABLE 4A-A

GRADING

<u>SIEVE</u>	<u>PERCENT PASSING</u>
3/8	100
No. 4	95 - 100
8	80 - 100
16	50 - 85
30	25 - 60
50	10 - 30
100	2 - 10
Fineness modules	2.50 - 3.15
Organic impurities	The color shall have an intensity not darker than two-thirds the intensity of the standard color solution. (Not darker than Plate 2 as determined by the ASTM Standard Method of Test for Organic Impurities in Sands for Concrete, Designation C40-73.
Silt	Not more than 2 percent.
Mortar strength	Compression ratio not less than 95 percent.
Soundness	Weighted average loss when subjected 5 cycles of the soundness test using magnesium sulfate, not more than 10 percent.

4H.7 COARSE AGGREGATE

Coarse aggregate shall consist of well graded gravel or crushed stone conforming to the ASTM Standard Specifications for Concrete Aggregates, Designation C33-71a, and also conforming to the detailed requirements given in Table 4A-B.

Aggregate used in concrete shall not exceed the following maximum designated sizes:

- a. 2 - inches for mass concrete
- b. 1 ½ inches for piles, caps, footings, foundation mats & walls 8 inches or more thick.
- c. ¾ inches for slabs, beams and girders.
- d. ½ inches for fireproofing on steel columns and beams.
- e. 1 - inch for all other concrete.

TABLE 4A-B
DESIGNATED AGGREGATE SIZE
PERCENT PASSING

SIEVE SIZE	2 in.	1-1/2 in.	1-in.	¾ in.	½ in.
2 "	95-100	100	100		
1-1/2"		95-100	100		
1"	50-70		95-100	100	
¾"		50-70		90-100	100
½"	15-30		26-60		90-100
⅜"		10-30		20-55	40-70
No.4	0-5	0-5	0-10	0-10	0-15
No. 8			0 - 5	0 - 5	0 - 5
F.M.(+0.20)	7.45	7.20	6.95	6.70	6.10

Organic impurities	The color shall have an intensity not darker than one-third the intensity of the standard color solution. (Not darker than Plate 1 as determined by the ASTM Standard Method of Test for Organic Impurities in Sands for Concrete, Designation (40-73).
Silt	Not more than 1.0 percent
Soundness	Weighted average loss when subjected to 5 cycles of the soundness test using magnesium sulfate, not more than 14 percent.

4H.8 SAMPLES OF AGGREGATES

If required, the contractor shall submit samples of fine and coarse aggregates to the **Engineer** in ample time for determination of the mix design work. At least 2 cubic feet of each size of aggregate shall be submitted in suitable containers. All samples shall be **plainly** and neatly labeled indicating the source, where proposed to be used, date and name of collector.

Materials shall not be delivered to the site or used until the samples have been **approved**, and as used, they shall in all respects be equal to the approved samples.

4H.9 CONCRETE QUALITY

It is the intent of this specification to secure for every part of the work, concrete of **homogeneous** structure, which when hardened, will have the required strength, **watertightness** and durability. To this end, it is essential that careful attention be given to the **selection** of materials, mixtures, placing, spading or vibrating and curing of the **concrete**.

Concrete shall meet the limiting requirements given in Table 4A-C below.

TABLE 4A-C

Class	Minimum Compressive Strength at 28 days psi	Maximum Net Water Content per sack of Cement Gallon	Cement Factor: Sacks per Cubic Yard of Concrete		
			Average Gravel Concrete	Probable Crushed Rock Concrete	Permissible
A	3,000	6.50**	5.7***	6.2***	5.50
B	1,500	8.50**	4.4***	4.7***	4.25
C	4,000	5.75**	6.8***	7.3***	6.50
D	5,000	5.50**	7.5***	8.0***	-----

* Total water in mix at time of mixing, including free water in the aggregates.

** Maximum; decrease is possible.

*** For estimating only; not for construction.

Minimum; increase as necessary to meet other requirements.

When high-early-strength Portland cement is used in lieu of normal Portland cement, the above requirements shall apply except that the required minimum allowable compressive strength shall be attained at 7 days instead of 28 days.

4H. 10 CONSISTENCY

Concrete shall be of such consistency that it can be worked readily into all parts of the forms and around embedded work without permitting the materials to segregate, or free water to collect on the surface. Consistency shall be measured by the ASTM Standard Method of Test for Slump of Portland Cement Concrete, Designation C143-71. The consistency of concrete shall be as given in Table 4A-D below.

TABLE 4A-D

<u>Portion of Structure</u>	<u>Normal</u>	<u>Slump Inches Special *</u>
Pavements & slabs on ground	2	1 - 3
Plain footings, caissons & heavy walls	2 - 3	1 - 4
Massive reinforced sections	2	2 - 4
Reinforced foundation walls & footings	3 - 4	2 - 5
Slabs, beams & reinforced walls & columns	4	3 - 5

* If approved for particular placements when conditions permit or necessitate.

When concrete is compacted by high-frequency mechanical vibration, the above "normal" consistencies shall not be exceeded, and the limiting consistencies may be modified by the Engineer. Slump tests shall be made in the field by the Contractor as directed.

4H.11 TESTING AGGREGATES & DETERMINING PORTIONS

No concrete shall be used in the work until the materials and mix have been approved by the Engineer.

The conformity of aggregates to the specifications hereinbefore given, and the actual proportions of cement, aggregates, admixtures where used and water necessary to produce concrete conforming to the requirements set forth in Tables 3A-C and 3A-D shall be demonstrated and determined by tests made with representative samples of the materials to be used on the work. All such tests shall be made by a laboratory employed by the Owner. The Owner shall pay for one set of tests of samples of cement and aggregates and for the cost of determining the correct proportions. Should the materials prove to be unacceptable, or should the Contractor desire to use an aggregate not included in the first set of samples, additional samples shall be tested at the expense of the Contractor by the laboratory employed by the Owner.

Aggregates shall be tested in accordance with the methods referred to in the specifications therefore. Unless required by the Engineer, the magnesium sulfate soundness test need only be made if such test is considered necessary by the test lab.

The water-cement ratio of the concrete to be used in the work shall be based on a curve showing the relation between water-cement ratio and 28-day compressive strength of concrete made using the proposed materials. The curve shall be determined by four or more points, each representing an average value of at least four test specimens, and shall have a range of values sufficient to yield the desired data without extrapolation. All procedures and tests shall conform strictly to the ASTM Standard Method of Making and Curing Concrete Compression and Designation C192-68 and the ASTM Standard Method of test for Compressive Strength of Cylindrical Concrete Specimens, Designation C39-72.

The water-cement ratio of concrete to be used in the work shall correspond to a laboratory test strength at 28 days of 3,450 psi for Class A concrete, 1,800 psi for Class B concrete, 4,600 psi for Class C concrete and 5,750 psi for Class D concrete.

In no case however; shall the resulting mix conflict with the limiting values for maximum water-cement ratio and minimum cement content as specified in Table 3A-C.

Reports on the tests of aggregates, the above-mentioned water-cement ratio strength curve and a statement of the proportions proposed for the concrete mixture shall be submitted in triplicate to the Engineer for approval as soon as possible, but not less than 5 days prior to the proposed beginning of the concrete work. If the contractor furnishes in writing, similar, reliable detailed information from an acceptable source and of date not more than 4 months prior to the time when concrete will be used on this project, the above requirements for laboratory tests may be modified by the Engineer. Such data shall derive from mixtures containing constituents, including the admixtures where used of the same types and from the same sources as will be used on this project.

Test cylinders will be made by the Contractor in accordance with ASTM C-31 latest revision. Four cylinders shall be made for each pour of 25 cubic yards or less and one cylinder for each additional 25 cubic yards in that pour. Contractor will be responsible for obtaining the molds making the cylinders and delivery to the testing lab. The testing lab will submit the report and bill to the Engineer who will certify the correctness of the bill to the Owner. The Owner will pay the laboratory bill.

These requirements may be waived by the Engineer when no concrete is used except for blocking pipe.

If concrete of the required characteristics is not being produced as the work progresses, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure concrete of the specified quality. The Contractor shall make such changes at his own expense and no extra compensation will be allowed because of such changes.

If as the work progresses the characteristics of the materials originally approved undergo a change, or if the Contractor wishes to use other materials, he shall submit for approval, evidence that the new combination of materials will produce concrete meeting the stated requirements and will not result in objectionable changes in the color or appearance of the work.

4H.12 MEASURING MATERIALS

All materials for concrete including water, shall be measured with equipment and facilities suitable for their accurate measurement and capable of being readily adjusted to changing conditions as required.

Cement in whole standard sacks need not be measured.

Water shall be measured by volume or weight ; the error of measurement shall not exceed one-half of 1-percent.

Where volumetric measurements of aggregates are authorized, the weight proportions shall be converted to equivalent volumetric proportions and suitable allowance shall be made for variations in the moisture condition of the aggregates including the bulking of fine aggregates, due to moisture and the method of compaction.

4H.13 SITE-MIXED CONCRETE.

Concrete to be produced at the site shall be mixed in an approved batch mixer with a capacity of not less than ½ cubic yard, except for small quantities which by permission may be handmixed. The volume of the mixed batch shall not exceed the manufacturer's rated capacity of the mixer. The site-mixed concrete plant and all operations pertaining to the production of the concrete shall be subject to the inspection and specific approval of the Engineer.

The minimum mixing time for each batch (from the time when all solid materials and water are in the drum) shall be 1- ½ minutes for mixers of 1-cubic yard capacity or less; for mixers of larger capacity, the mixing time shall be increased 30 seconds for each additional ½ cubic yard or fraction thereof. The mixer shall revolve at uniform peripheral speed of about 200 fpm. The entire batch shall be discharged before the mixer is recharged.

Hand mixing shall be subject to the approval of the Engineer. If the concrete is mixed by hand, it shall be done on a suitable surface. The cement and aggregates shall be mixed dry until an even and uniform color has been attained throughout. Then the proper quantity of water shall be added and the whole mass turned with square-edged shovels until it has become thoroughly mixed.

4H.14 READY-MIXED CONCRETE

Ready mixed concrete will be permitted provided that all requirements therefore herein set forth are fully complied with. The ready-mixed concrete plant and operations pertaining to the production of the concrete shall be subject to the inspection and specific approval of the Engineer. Methods of batching mix constituents shall conform to the requirements set forth above Section 15H.12, Measuring Materials. All constituents shall be batched at the central plant.

All central-plant and rolling-stock, equipment and methods shall conform to the Truck Mixer and Agitator Standards of the truck and mixer manufacturer's Bureau of the National Ready-Mixed Concrete Association, dated 1949, as well as the ACI Standards for Measuring, Mixing, and Placing Concrete (ACI 614-59) and with Sections 6 to 14, inclusive of the ASTM Standard Specifications for Ready-Mixed Concrete, Designation C94-73a, insofar as applicable.

Ready-mixed concrete shall be transported to the site in watertight agitator or mixer trucks. The quantity of concrete to be mixed or delivered in any one batch shall not exceed the rated capacity of the mixer or agitator for the respective conditions as stated on the nameplates.

Central-mixed concrete shall be plant-mixed a minimum of 1 - ½ minutes per batch and then shall be truck-mixed or agitated a minimum of 8 minutes. Agitation shall begin immediately after the premixed concrete is placed in the truck and shall continue without interruption until discharge. For transit-mixed concrete the major portion of the mixing water shall be added and mixing started immediately after the truck is charged. The amount of water initially added shall be recorded on the delivery slip for the Engineer's information; no additional water shall be added, either in transit or at the site, except as directed. Mixing (at mixing speed) shall be continued for at least 10 minutes followed by agitation without interruption until discharge. Concrete shall be discharged at the site within 1 - ½ hours after water was first added to the mix, and shall be mixed at least 5 minutes after all water has been added.

Attention is directed to the importance of dispatching trucks from the batching plant so that they shall arrive at the site of the work just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.

Delivery slips shall contain the following information:

- a. Ticket Number
- b. Load Number
- c. Truck Number
- d. Class of concrete
- e. Cement brand, type and weight in pounds
- f. Fine aggregate source and weight in pounds
- g. Coarse aggregate source and weight in pounds
- h. Water in gallons
- i. Time mix left plant

Concrete delivered without a complete delivery slip will be rejected.

4H.15 REMIXING CONCRETE

Concrete which has become compacted or segregated during transportation to or on the site of work shall be satisfactorily remixed just prior to being placed in the forms.

Partially hardened concrete shall not be deposited in the forms. The retempering of concrete which has partially hardened (that is, the remixing of concrete with or without additional cement, aggregate or water) will not be permitted.

4H.16 PLACING AND COMPACTING CONCRETE

At least 20 hours before the Contractor proposes to make any placement of concrete, he shall notify the Engineer of his intention and planned procedure. Unless otherwise permitted, the work shall be so executed that a section begun on any day shall be completed during the daylight of the same day.

No concrete shall be placed on frozen subgrade or in water or until the subgrade, forms and preliminary work have been approved. No concrete shall be placed until all materials to be built into the concrete have been set and have been approved by the various trades and by the Engineer. All such materials shall be thoroughly clean and free from rust, scale, oil or any other foreign matter.

Forms and excavations shall be free from water and all dirt, debris and foreign matter when concrete is placed. Except as otherwise directed, wood forms and embedded wood called for or allowed shall be thoroughly wetted just prior to placement of concrete.

Concrete placed at air temperature below 40 degrees F shall have a minimum temperature of 50 degrees F and a minimum of 70 degrees F when placed.

Concrete shall be transported from the mixer to the place of final deposit as rapidly as practicable and by methods which will prevent separation of ingredients and avoid rehandling. Chutes for conveying concrete shall be metal or metal-lined and of such size, design and slope as to ensure a continuous flow of concrete without segregation. The slope of chutes shall not be flatter than 1 on 2 and all parts of a chute shall have approximately the same slope. The discharge end of the chute shall be provided with a baffle or if required, a spout; and the end of the chute or spout shall be kept as close as practicable to, but in no event more than 5 feet above the surface of the fresh concrete. When the operation is intermittent, the chute shall discharge into a hopper.

In thin sections of considerable height (such as walls and columns), concrete shall be placed in such manner as will prevent segregation and accumulations of hardened concrete being placed. To achieve this end, suitable hoppers, spouts with restricted outlets, etc., shall be used as required or approved unless the forms are provided with suitable openings.

Chutes, hoppers, spouts, etc., shall be thoroughly cleaned before and after each run and the water and debris shall not be discharged inside the form.

For any one placement, concrete shall be deposited continuously in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and lanes of weakness within the section and so as to maintain, until the completion of the unit, an approximately horizontal, plastic surface. No wooden spreaders shall be left in the concrete.

During and immediately after being deposited, concrete shall be thoroughly compacted by means of suitable tools and methods, such as internal type mechanical vibrators operating at not less than 5,000 RPM, or other tool spading, to produce the required density and quality of finish. Vibration shall be done only by experienced operators under close supervision and shall be carried on in such manner and only long enough to produce homogeneity and optimum consolidation without permitting segregation of the solid constituents, "pumping" of air or other objectionable results. All vibrators shall be supplemented by proper spade puddling approximately 2 to 3 inches away from forms to remove included bubbles and honeycomb. Excessive spading against the forms, causing the deposition of weak mortar at the surface, shall be avoided.

The concrete shall be thoroughly rodded and tamped about embedded materials so as to secure perfect adhesion and prevent leakage. Care shall be taken to prevent the displacement of such materials during concreting.

Construction joints shall be made as specified under CONSTRUCTION AND EXPANSION JOINTS.

4H.17 BONDING CONCRETE AT CONSTRUCTION JOINTS

In order to secure full bond at construction joints, the surface of the concrete previously placed (including vertical, inclined and substantially horizontal areas) shall be thoroughly cleaned of foreign materials and laitance, if any and then roughened so that the aggregate will be slightly exposed over 90 percent of each 2-inch square area. Such cleaning and roughening shall be done by the use suitable tools and methods, such as picks, wire brushed, wet sandblasting, etc., and shall be followed by reclining by means of stream of clean water or compressed air.

The previously placed concrete at the joint shall be saturated with clean water and kept thoroughly wet overnight, after which all pools shall be removed by an air jet. After free or glistening water disappears, the concrete shall be given a thorough coating of neat cement mixed to a suitable consistency. The coating shall be 1/8 inches thick on vertical surfaces and 1/4 inches thick on horizontal surfaces and shall be well scrubbed in by means of stiff bristle brushes wherever possible. New concrete shall be deposited before the neat cement dries.

4H.18 BONDING FILL TO BASE CONCRETE

Where concrete fill is to be placed to structural or other concrete, the previously placed base concrete shall be prepared as hereinafter specified under Section 4G.21, Surface Finish.

4H.19 CURING AND PROTECTION

All concrete work shall be protected against damage from the elements and defacement of any nature during construction operations.

Water shall not be permitted to rise on concrete within 24 hours after it is placed, not shall running water be allowed to flow over completed concrete within four days after it has been placed. All concrete, particularly slabs and including finished surfaces, shall be treated immediately after concreting or cement finishing is completed, to provide continuous moist curing for at least 7 days, regardless of the adjacent air temperature. Walls and vertical surfaces may be covered with continuously saturated burlap, or kept moist by other approved means. Horizontal surfaces, slabs, etc. shall be ponded to a depth of 1/2 inch wherever practicable, or kept wet by the use of lawn sprinklers, a complete covering of saturated burlap, or other approved means. For at least 7 days after having been placed, all concrete shall be so protected that the temperature at the surface will not fall below 50 degrees F. During adverse weather and

against the possibility thereof, the Contractor shall take all necessary precautions so that the work may be properly done and satisfactory in all respects. When required, protection shall be provided by use of tarpaulins, wood and building-paper shelters, or other approved means and shall be subject to approval.

No manure, salt or other chemicals shall be used for protection.

The above-mentioned 7-day periods may be reduced to 3 days in each case if high-early-strength cement is used in the concrete. Wherever practicable, finished slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

4H.20 TRIMMING & REPAIRS

It is the intent of this specification to require forms, mixture of concrete and workmanship so that concrete surfaces, when exposed, will require no patching.

As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed, recesses left by the removal of form ties shall be filled and surface defects which do not impair structural strength shall be repaired.

Defective concrete shall be cut normal to the surface until sound concrete is reached, but not less than 1-inch deep. The remaining concrete shall be thoroughly roughened and cleaned. Concrete around the cavity or the form-tie recess shall be thoroughly wetted and promptly painted with a 1/16 inch brush coat of neat cement mixed to the consistency of lead paint. The hole shall then be filled with mortar.

Mortar shall be a 1:1-1/2 cement and sand mix with sufficient white cement or fine limestone screenings in lieu of sand to produce a surface matching the adjoining work. Cement and sand shall be from the same sources as in the parent concrete.

For filling form-tie recesses, the mortar shall be mixed slightly damp to the touch (just short of "balling"), hammered into the recess until it is dense and an excess of paste appears on the surface, and then troweled smooth. Mortar in patches shall be applied so that after partial set it can be compressed and rubbed to produce a finish flush and uniform in texture with the adjoining work. All patches shall be warm-moist cured as above specified.

The Contractor shall be responsible for the adherence of mortar used in repairing concrete. He shall prepare the cavity and apply repair material in such manner that this end may be attained. Unless otherwise specifically required, mortar shall not be applied as a coating or plastering over the surfaces, but each void shall be individually filled.

The use of mortar patching as above-specified shall be confined to the repair of small defects in relatively green concrete. If substantial repairs are required, the defective portions shall be cut out to sound concrete and the masonry replaced by means of a cement gun or the masonry shall be taken down and rebuilt or as the Engineer may decide or direct.

4H.21 SURFACE FINISH

Fins and irregularities on formed surfaces to receive no other finish shall be smoothed. The top on concrete on which other concrete or unit masonry will later be placed shall be struck off true at the surface indicated on the drawings or approved as the concrete is being placed. As soon thereafter as the condition of the concrete permits and before it has hardened appreciably (normally within 2-hours after being deposited), all water, scum, laitance and loose aggregate shall be removed from the surface by means of wire or bristle brooms in such manner as to leave the coarse aggregate slightly exposed and the surface clean. Raking or other methods which cause weak serrations shall not be employed. The formation of depressions and general unevenness shall be avoided. Thereafter, the Contractor shall take all necessary precautions to ensure that the surface thus prepared shall be kept free from storage piles, drippings, staining or accumulation of substances which would adversely affect the concrete or the bond between layers of concrete and cannot be adequately removed by the cleaning specified in Section 15H.17, Bonding Concrete at Construction Joints.

Where the top surface of structural concrete or concrete fill is to be left in a finished condition, the concrete shall be brought monolithically to the finished grade therefor, as indicated on the drawings or required; subsequent addition of a layer of mortar (topping) or concrete to bring the finished surface to the correct grade will not be permitted.

Wood-float finish shall be given to all top, substantially horizontal, exposed surfaces not otherwise specified or indicated on the drawings. Burlap-rubbed finish shall be given to all interior and exterior surfaces placed against forms which will be exposed to view on completion of the work.

All surfaces shaped without forms and over which liquids will flow shall be given a steel-trowel finish.

Concrete surfaces to which roof insulation or roofing are to be applied shall be finished sufficiently smooth to receive the roofing material as obtained by steel trowel or very smooth wood-float finish.

The finishes to be given to certain other concrete surfaces are indicated on the drawings.

4H.22 BROOMED FINISH

Surfaces to be given broomed finish shall first be given a steel-trowel finish. Immediately after troweling, the surface shall be lightly brushed in one direction with a hair broom to produce a non-slip surface of uniformly good appearance.

4H.23 WOOD-FLOAT FINISH

Surfaces to be given a wood-float finish shall be finished by tamping with special tools to force aggregate away from the surface and screening with straight edges to bring the surface to the required line.

As soon after screening as the condition of the concrete permits and before it has hardened appreciably, all water, film and foreign material which may work to the surface shall be removed by means of lutes. Rough finishing shall be done with straight edges and darbies. Machine floating, if used, shall not be started until the surface will support the float adequately without digging in and/or bringing excess fines to the surface. At such time, a minimum of machine and/or hand floating with a wood-float shall be employed to bring the finish to a true and uniform surface with no coarse aggregate visible.

Under no circumstances will sprinkling with water or dusting with cement be permitted during finishing of the slab.

4H.24 STEEL-TROWEL FINISH

Surfaces to be given a steel-trowel finish shall first be given a wood-float finish. This shall be followed by hand troweling with steel trowels to bring the surface to a uniform, smooth, hard, impervious surface free from marks and blemishes. Troweling shall not be started until all water has disappeared from the surface. Over-troweling shall be avoided. Dusting with dry cement or other mixtures or sprinkling with water will not be permitted in finishing.

4H.25 BURLAP-RUBBED FINISH

Immediately after the forms have been striped and before the concrete has changed in color, all fins and other projections shall be carefully removed by use of a hammer or other suitable means and imperfections shall be repaired as hereinbefore specified under Section 15H.20, Trimmings and Repairs. While the surface is still damp, a thin coat of cement slurry of medium consistency shall be applied by means of bristle brushes to provide a bonding coat within pits and minor blemishes in the parent concrete; the coating of large areas of the surface with this slurry shall be avoided.

Before the slurry has dried or changed color, a dry (almost crumbly) grout composed of 1 volume of cement to 1-1/2 volumes of masonry sand shall be applied. The sand shall have a fineness modulus of approximately 2.25 and comply with the gradation requirements of the ASTM Standard Specifications for Aggregate for Masonry Mortar, Designation C144-70.

The grout shall be uniformly applied by means of damp (neither dripping wet or dry) pads of burlap of convenient size (approximately 6 inches square) and shall be well-scrubbed into the pits, etc., to provide a dense mortar in such imperfections. The mortar shall be allowed to harden for 1 to 2 hours, depending on the weather. In hot, dry weather, the surface shall be kept damp by means of a fine fog spray during the hardening period.

When the grout has hardened sufficiently therefore, but before it becomes so hard as to be difficult to remove, the excess grout shall be scraped from the surface of the parent concrete by the edge of a steel trowel, without removing the grout from the imperfections. Thereafter, the surface shall be allowed to dry thoroughly and then be rubbed vigorously with burlap to remove all dried grout so that no visible film remains on the surface after the rubbing. The entire cleaning operation for any area shall be completed the day it is started, and therefore the work shall be so planned that sufficient time is allowed for the grout to dry and be rubbed after it has been cut with the trowel.

On the day following the routing and burlap rubbing, the concrete surface shall again be rubbed clean with a dry burlap to remove inadvertent dust. If any build-up film remains on the parent surface, it shall be removed by being rubbed with a fine abrasive stone without breaking through the surface film of the original concrete. Such rubbing shall be light and sufficient only to remove excess material without working up a lather of mortar or changing the texture of the concrete. Following the final rubbing with burlap or abrasive stone, the surface shall be thoroughly washed with stiff bristle brushes (worked only along parallel lines) to remove extraneous materials from the surface. The surface shall then be sprayed with a fine fog spray to maintain a continually damp condition for at least 3 days after application of the grout.

When the burlap-rubbed finish has been completed, the concrete surface shall be smooth, free from discolorations and stains and of uniformly good appearance.

4H.26 METALWORK IN CONCRETE

All castings, inserts, conduits and other metalwork shall be accurately built into or encased in the masonry by the Contractor as directed and all necessary precautions shall be taken to prevent the metalwork from being displaced or deformed. Anchor bolts shall be set by means of substantial templates.

The Contractor shall build into new concrete against which facing brick or tile is to be laid, suitable, approved, non-corrodible metal, dove-tailed grooves for ties for securing the brickwork to the concrete.

4H.27 FORMS

Forms shall be used for all concrete masonry including footings, except as otherwise permitted. Forms shall be so constructed and placed that the resulting concrete will be of the shape, lines, dimensions and to the elevations indicated on the drawings or specified and exposed concrete will be substantially free from board or grain marks, poorly matched joints and other irregularities or defects.

For surfaces to be given burlap-rubbed finish, the form surface in contact with the concrete shall be made of heavy gauge metal, new plywood (used plywood which, in the opinion of the Engineer is substantially equal to new plywood, may be used), tempered wood fiberboards with smooth surface, or similar materials. Metal forms or form linings shall have square edges so that the concrete will not have fins or fluting. Joints between form panels shall be well fitted so as to be tight and result in substantially flush concrete surface on opposite sides of the joints. Forms shall not be pieced out by use of materials different from those in the adjacent form or in such manner as will detract from the uniformity of the finished surfaces.

For surfaces other than those to be given burlap-rubbed finish, forms shall be made of wood, metal or other approved material. Wooden forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots. Plywood shall be reasonably good, as approved. Metal forms shall be of an approved type for the work involved. Edges of forms in contact with concrete shall be flush within 1/16 inches. All forms shall be suitable material, design and construction so as to be rigid, tight enough to prevent the passage of mortar and plane surfaces shall be plane within 1/16 inch in 4 feet. Particular care shall be taken to ensure that forms are true to line where deviations in the concrete would be obvious or objectionable, as where building superstructures are to be built thereon, or where the tops of walls are exposed. All such deviations which may occur shall be corrected by and at the expense of the Contractor as directed, even to the extent of tearing down and rebuilding the concrete.

Forms for walls, columns or piers shall have removable panels at the bottom for cleaning, inspection and scrubbing-in of bonding grout. Forms for thin sections (such as walls or columns) of considerable height shall be arranged with suitable openings so that the concrete can be placed in a manner that will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the fresh concrete and so construction joints can be properly keyed and treated.

Forms shall be sufficiently rigid to prevent displacement or sagging between supports and so constructed that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for their adequacy.

All forms shall be oiled with an approved nonstaining oil or liquid form coating before reinforcement is placed.

Before form material is reused, all surfaces that are in contact with the concrete shall be thoroughly cleaned, all damaged places repaired and all projecting nails withdrawn.

Form ties to be encased in concrete shall not be made of throughbolts or common wire, but shall be of a well-established type, so made and installed as to embody the following features:

- a. After removal of the protruding part of the tie, there shall be no metal nearer than 1-inch to the face of the concrete.
- b. That part of the tie which is to be removed shall be at least ½ inch in diameter, or if smaller, it shall be provided with a wood or metal cone 1-inch long, placed against the inside of the forms. Cones shall be carefully removed from the concrete after the forms have been stripped.
- c. Ties which pass through walls subject to hydrostatic pressure shall be provided with approved water stops, such as washers, securely fastened to the ties.

4II.28 REMOVING FORMS

Except as otherwise specifically authorized by the Engineer, forms shall not be removed until the concrete has aged for the following number of day-degrees*

- a. Beams and slabs - 500 day-degrees.
- b. Walls and vertical surfaces - 100 day-degrees.

* Day-degree: Total number of days times average daily air temperature at surface of concrete. for example, 5-days at a daily average temperature of 60 degrees F equals 300 day-degrees

Shores under beams and slabs shall not be removed until the concrete has attained at least 60 percent of the specified cylinder strength and also sufficient strength to support safely its own weight and the construction live loads upon it.

CONCRETE REINFORCEMENT**SECTION 41**

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CONCRETE REINFORCEMENT

SECTION 41

41.1 GENERAL

The contractor shall furnish and place all concrete reinforcement as indicated on the drawings and as herein specified. Concrete reinforcement in sizes No. 3 (3/8 inch) and larger shall be deformed steel bars of the shapes and sizes indicated on the drawings.

41.2 QUALITY

The steel shall be newly rolled stock substantially free from mill scale, rust, dirt, grease or other foreign matter. Bars shall be of billet or axle steel and unless otherwise indicated, shall be Grade 60 bars.

- a. Billet Steel Bars: Billet steel bars shall conform to ASTM Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement, Designation A617.72.
- b. Axle Steel Bars: Axle Steel Bars shall conform to ASTM Standard Specifications for Axle Deformed and Plain Bars for Concrete Reinforcement, Designation A617.72.

All bars shall be rolled by an approved mill. The Contractor shall submit at his own expense, certified copies of tests of the bars furnished. The tests shall be as specified in the appropriate ASTM Specification referred to above and shall be made by an approved laboratory.

41.3 DEFORMATIONS

Deformations on bars for concrete reinforcement shall conform to the requirements of the above-mentioned ASTM Specifications.

41.4 SOFFIT CLIPS

Soffit Clips shall be made of galvanized steel wire not lighter than No. 12 STL, W.G. They shall be shaped so that the greater portion of the wire is held about 1-inch from the flange of the steel beam and shall be spaced not less than 9-inches on centers, the spacing being maintained by suitable longitudinal wires.

41.5 WELDED STEEL WIRE FABRIC

Welded steel wire fabric shall conform to the ASTM Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement, Designation A1815-70. The gauge and spacing of wires shall be as indicated on the drawings.

41.6 DRAWINGS AND SCHEDULES

As required by the Engineer, the Contractor shall submit for review, cutting and bending drawings for reinforcement, to be furnished by him.

41.7 FABRICATING REINFORCEMENT

Reinforcement shall be accurately formed to the dimensions indicated on the drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than two times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than six times the minimum thickness except for bars larger than 1-inch, in which case the bends shall be made around a pin or 8 bar diameters. All bars shall be bent cold.

Bars shall be shipped to the work with bars of the same size and shape fastened in bundles with securely wired-on metal identification tags giving size and mark.

41.8 PLACING REINFORCEMENT

Before being placed in position, reinforcement shall be thoroughly cleaned of loose mill and rust scale, dirt and other coatings, including ices that tend to interfere with development of proper bond. Where there is delay in depositing concrete after reinforcement is in place, bars shall be reinspected and cleaned when necessary.

Reinforcement shall be accurately positioned as indicated on the drawings and secured against displacement by using annealed iron wire ties or suitable clips at intersections. Concrete blocks having minimum bearing area of 2 in. x 2 in. and equal in quality to that specified for the slab, shall be used for supporting reinforcing bars for slabs on grade. Where the underside of slabs will be exposed to view in the finished work, stainless steel supports, spacers or hangers may be used. Wood blocks, stones, brick chips, etc. shall not be used to support reinforcement.

Reinforcement which is to be exposed for a considerable length of time after having been placed shall be painted with a heavy coat of cement grout, if required.

SECTION 5A

TRAFFIC CONTROL

5A.1 GENERAL

This section consists of furnishing all labor, materials, equipment and performing all operations in connections with performing traffic control plans in accordance with the SCDOT Encroachment Permit. The Permit is attached as the general conditions of the contract documents.

5A.2 WORK ZONE TRAFFIC CONTROL DEVICES

All signs, sign holders, traffic cones, barricades or other work zone traffic control devices shall be in accordance with the National Cooperative Highway Research Program Report 350 Standards and approve by the SCDOT supplemental specifications released May 14, 2008. All traffic control signs shall be fabric, no rigid signs will be accepted. The City of Sumter reserves the right to reject any traffic control devices that are not SCDOT approved and to halt all construction until proper traffic control devices are installed. A list of all approved traffic control devices can be obtained from the City of Sumter's Engineering Department.

5A.3 PRECONSTRUCTION CONFERENCE

The contractor shall attend a preconstruction meeting on the project site with a representative of the SCDOT Sumter Maintenance Engineer's Office and a representative of the City Engineers Office prior to any construction beginning on SCDOT Right of Way. The contractor shall have in place all traffic control devices in accordance with the approved SCDOT Encroachment Permit prior to this meeting. The contractor shall request the preconstruction meeting a minimum of 24 hours in advance by contacting the City of Sumter's Engineering Department representative.

