ARTICLE 11

SUPPLEMENTAL STANDARDS AND SPECIFICATIONS

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ARTICLE 11

MISCELLANEOUS STANDARDS AND SPECIFICATIONS

SECTION 11-100 CLEARING AND GRUBBING

11-110 GENERAL CRITERIA

11-110.1 DESCRIPTION OF WORK

Provide all labor, material, and equipment to perform all clearing and grubbing as called for on the approved plans and as specified herein.

11-110.2 RELATED WORK SPECIFIED ELSEWHERE

- Article 4 - Erosion Control

11-110.3 APPLICABLE REFERENCES

- Virginia Soil and Water Conservation Commission Erosion and Sediment Control Handbook.
- Erosion and Sediment Control Ordinance (Chapter 58 of the City of Manassas Code).

11-110.4 PROTECTION

A. Protect property pipes, stones, and monuments from damage. Be responsible for replacing disturbed markers by a registered surveyor at no expense to the City.

B. Protect existing trees, shrubs, and bushes outside the limits of clearing and grubbing by fencing, barricading or wrapping as required. Protect existing trees designated to be saved inside the limits of clearing and grubbing by appropriate methods.

C. Trees damaged by construction operations shall be trimmed and treated by an approved nurseryman.

D. Replace trees damaged beyond repair by the construction process with acceptable stock at no cost to the City.

E. Existing facilities required to be restored or removed due to damage by clearing and grubbing operations shall be restored or replaced to match the original position and condition. Restore or replace damaged facilities at no expense to the City.

F. Protect streets, roads, historical objects, adjacent property, vegetation, and other works to remain throughout the contract.

11-120 MATERIALS

Materials shall be at the Contractor's option with the approval of the City.

11-130 EXECUTION

11-130.1 CLEARING

The area of clearing shall be maintained within the limits shown on the plans. Leave individual trees, groups of trees and other vegetation, which are to remain within the areas to be cleared, standing and uninjured.

11-130.2 GRUBBING

The area of grubbing shall be maintained within the clearing limits shown on the plans. Remove stumps and matted roots to a depth of 24 inches below existing ground surface. Refill excavations made by removal of stumps or roots with materials specified for structural backfill in Section 10-760 of this Manual.

11-130.3 TRIMMING OF TREES

A. Trees may be trimmed to remove branches or roots, which interfere with construction when so approved by the City Arborist. Cut branches cleanly and leave as small an exposed section as possible. All trimming and pruning shall conform to the specifications and standards of practice of the International Society of Arboriculture or other acceptable arboriculture standards.

B. Do not unnecessarily cut tree roots extending into grading limits. Backfill around tree roots immediately after completion of construction in vicinity of the trees.

11-130.4 SALVAGE

A. Unless otherwise indicated on the plans, remove only those trees, which directly interfere with the construction of the project. Trees designated by the City Arborist to be salvaged shall be removed with a sufficient earthball at the roots to maintain the tree.

B. Material, which is to be salvaged, as a result of clearing operations, shall include live plants suitable for replanting. Remove shrubs to be salvaged, being sure to retain a sufficient earthball at the roots to maintain the shrub. If required, temporarily replant the shrub and at the completion of construction replace the plant in a condition equaling the original.

C. Place any desirable topsoil in well-drained stockpiles and protect in a manner stipulated in Article 4 of this Manual.

D. Remove and dispose of any salvageable material not desired by the City.

11-130.5 DISPOSAL

A. Dispose of trees and shrubs out of the Contract area, as directed by the City Engineer.

B. Do not burn materials on the site. The City Fire Marshal may consider granting a waiver from open burning restrictions in cases where the State Air Pollution Control Board has granted a waiver to the Contractor or permit holder. The responsibility for obtaining all waivers shall be the Contractor's or permit holder's.

C. Remove material from the site as it accumulates. Do not allow waste material to accumulate for more than 48 hours.

D. Prior to depositing surplus material at any offsite location, obtain a written agreement with the owner of the property on which the disposal is proposed unless the surplus material is deposited at a commercial drop facility or landfill. The agreement shall state that the owner of the property gives

permission for the Contractor to enter and deposit the material at no expense to the City. Furnish a copy of the agreement to the City Engineer.

SECTION 11-200 DEMOLITION

11-210 GENERAL CRITERIA

11-210.1 DESCRIPTION OF WORK

Provide all labor, material, and equipment to perform the required demolition of existing pavement no longer needed for access or parking, abandoned utilities, and structures, which interfere with the proposed construction.

11-210.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-100 - Clearing and Grubbing
- Section 11-400 - Rock Excavation

11-210.3 APPLICABLE SPECIFICATIONS

- Virginia Department of Transportation (VDOT), Road and Bridge Specifications

11-210.4 EXPLOSIVES

The use of explosives for demolition work shall be subject to the approval of the City Engineer and the Fire Marshal. The Contractor shall be responsible for obtaining necessary permits from the Fire Marshal. The Contractor shall be subject to the specifications, permits and regulations specified in Sections 10-740 and 11-400, of this Manual.

11-210.5 SUBMITTALS

A plan shall be submitted to show traffic control devices as required by MUTCD Standards.

11-220 MATERIALS

Materials and equipment shall be at the option of the Contractor with the approval of the City. Materials resulting from demolition activities shall be subject to retainage by the City and delivered to the location selected by the City, at no additional expense to the City.

11-230 EXECUTION

11-230.1 DEMOLITION OF PAVEMENT

Bituminous and Portland cement concrete pavement designated for demolition shall be broken into pieces and disposed of at a location selected by the Contractor and approved by the City Engineer.

11-230.2 RESTORATION OF OLD PAVEMENT OR PARKING AREA

Areas outside the limits of the pavement consisting of bituminous or cement concrete pavement shall be demolished as specified in Section 11-230.1 and the area shall be restored as specified in Section 9-5100 and Section 10-700 of this Manual.

11-230.3 DEMOLITION OF BUILDINGS

Buildings to be demolished shall be demolished as specified in Section 516.01 of the VDOT Road and Bridge Specifications and in conformance with the Virginia Uniform Statewide Building Code. The applicant must apply for a demolition permit and post the required bonds. The disturbed area will be required to be stabilized if erosion control devices are not being installed in conjunction with a development plan.

11-230.4 DISCONNECTION AND ABANDONMENT OF UTILITIES

The Contractor shall be solely responsible for making the arrangements for the disconnection and abandonment of gas, water, sewer, electricity, cable television, telephone and other service utilities. These utilities shall be disconnected at the tap at no expense to the City.

SECTION 11-300 SEEDING AND SODDING

11-310 GENERAL CRITERIA

11-310.1 DESCRIPTION OF WORK

Provide all labor, materials, tools, and equipment as required to have topsoil, fertilizer, lime, mulch, seed and/or sod applied on all areas disturbed by construction and all areas called for on the approved plans.

11-310.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-100 - Clearing and Grubbing
- Article 4 - Erosion Control

11-310.3 APPLICABLE SPECIFICATIONS

- Virginia Field Seed Law
- Virginia Soil and Water Conservation Commission Erosion and Sediment Control Handbook.
- Erosion and Sediment Control Ordinance (Chapter 58 of the City of Manassas Code).

11-310.5 SUBMITTALS

Submit proposed names of fertilizers, sod and seed mixtures together with their composition and any certificates requested to the City Engineer for approval.

11-310.6 QUALITY ASSURANCE

When requested by the City Engineer, supply the results of testing two samples from each source of topsoil to ensure that proper types and quantities of soil conditioners, fertilizers, and seed mixtures will be used resulting in a dense, vigorous growth of perennial lawn-quality grass.

11-310.7 TESTING

Test seed within six (6) months of seeding to meet the requirements of the Virginia Field Seed Law for percentage of germination as follows:

- Kentucky 31: 80%
- German Foxtail Millet: 78%

- Abruzzi Rye: 78%
- Red Top: 77%

11-320 MATERIALS

11-320.1 TOP SOIL

Top soil shall be a natural, fertile, friable soil, typical of productive soil in the vicinity, obtained from naturally well-drained areas, neither excessively acid nor alkaline, and containing no substances harmful to grass growth.

11-320.2 FERTILIZER

A. For seeding areas disturbed by clearing operations only; where vegetation remains:

Per acre: 500 pounds of 10-10-10 fertilizer

B. All other areas:

Per acre: 1,000 pounds of 10-10-10 fertilizer

400 pounds of 38-0-0 ureaform

1,000 pounds of triple superphosphate (45% phosphate)

11-320.3 SEED

A. For seeding areas disturbed by clearing operations only; where vegetation remains:

Per acre: March to July: Tall fescue, Kentucky 31 variety: 50 pounds

German Foxtail Millet: 30 pounds

August to February: Tall fescue, Kentucky 31 variety: 60 pounds

Abruzzi Rye: 20 pounds

B. For all other areas:

Per acre: Tall fescue, Kentucky 31 variety: 70 pounds

Red Top: 3 pounds

Under all conditions, seed shall be of the latest seed crop available.

11-320.4 LIME

Per acre: Two (2) tons/ground limestone of such fineness that 50% will pass through a U.S. Standard No. 100 mesh screen and 100% will pass through a U.S. Standard No. 10 mesh screen.

11-320.5 MULCH

Per acre: Two (2) tons of small grain mulch of high quality showing no rotting or caking and reasonably free of weeds.

11-320.6 SOD

Sod shall be vigorous, well-rooted, healthy turf, free from disease, insect pests, weeds, other grass, stones and of similar mix as used in seeding lawns. It shall be suitable character for the purpose intended and for the soil in which it is to be planted. Sod shall be at least eight (8) inches wide, not less than twelve (12) inches long, and shall have at least one and one half (1-1/2) inches in thickness, of dirt on its roots. Do not use broken or damaged sod.

11-320.7 JUTE OR FABRIC

A. Jute matting shall be of a uniform open plain weave of undyed and unbleached single jute yarn of a width of 4 feet. All material shall be new. Staples shall be made from No. 8 gauge or heavier steel wire and bent to form a "U." The staple shall be1 to 1-1/2 inches wide with 6-inch feet.

B. Fabric shall be a combination of paper and yarn manufactured into plastic netting interwoven with paper strips as manufactured by Hold/Gro, Gulf States Paper Corporation. Staples shall be 6 inches high carbon iron.

11-330 EXECUTION

11-330.1 FINAL GRADING

A. After grading of areas has been completed per approved plan or contours and before applying the approved sod, seed mixture, or mulch cover. The areas to be sodded, seeded, or mulched must have the approval of the City inspector and shall be raked or otherwise cleared free of sticks, stumps, stones m and other debris or other materials larger than one and one half inches (1.5”) in diameter within the City right-of-way and easements that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. Where residential or commercial yards exist, the areas shall be raked or otherwise cleared free of large clods, hard lumps, sticks, stones, and other debris or materials and shall not exceed three quarters of an inch (0.75”) in diameter that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas.

B. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of approved sod, seed mixture, or mulch cover, the contractor shall repair such damage. This may include filling gullies, smoothing irregularities, restoring contours, and repairing other incidental damage to the City inspector’s approval.

C. With the approval of the City Engineer, an area to be seeded shall be considered a satisfactory seedbed with additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than five inches (5”) as a result of grading operations and, if immediately prior to seeding, the top three inches (3”) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter and if shaped to the required grade.

D. When the area to be seeded is sparsely sodded, weedy, barren, and unworked, or packed and hard, any grass and weeds shall first be curt or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than five inches (5”). Clods shall be broken and the top three inches (3”) of soil shall be worked into a satisfactory seedbed by discing or by use of cultipackers, rollers, drags, harrows, other appropriate means.

E. Soil for repairs. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be free from sticks, stumps, stones, and other debris or other materials larger than one and one half inches (1.5”) in diameter that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the City Engineer before being placed. Where residential or commercial yards exist the size of large clods, hard lumps, sticks, stone, and other debris shall not exceed ¾ of an inch in diameter.

11-330.2 TOP SOIL

A. After approval of rough grading, place top soil on all areas indicated on the drawings and on other grassed areas damaged by construction. Place top soil at least three (3) inches deep.

B. Remove stripped top soil not used at the job site and dispose in a location approved by the City Engineer.

11-330.3 FERTILIZING AND ROLLING

Spread soil conditioners and fertilizers and thoroughly work into top soil. Rake top soil until the surface is finely pulverized and smooth. Compact with rollers, weighing not over one hundred (100) pounds per linear foot of tread, to an even surface conforming to the prescribed lines and grades. Minimum depth shall be three (3) inches after completion.

11-330.4 SEEDING

A. Use seed only when weather conditions are suitable between April 1 and May 30, or August 15 to October 1, unless approved by the City Engineer.

B. If there is a delay in seeding, during which weeds grow or soil is washed out, remove the weeds or replace the soil before sowing the seed. Immediately before seeding is begun, lightly rake the soil.

C. Uniformly apply lime, ureaform and triple superphosphate with broadcast spreaders prior to seedbed preparation.

D. Sow seed with mechanical spreaders at the specified rate on a calm day. Sow one-half (1/2) the seed in one (1) direction and the other half at right angles. Seed shall be raked lightly into the soil to a depth of one-quarter (1/4) inch and rolled with a roller weighing not more than one hundred (100) pounds per linear foot of tread.

E. If seeding by hydroseeder, add five hundred (500) pounds of wood cellulose fiber per acre and mix with the seed and the 10-10-10 fertilizer at the specified rate. Apply all seed mix within forty-five (45) minutes after mixing in hydroseeder to prevent fertilizer damage to seed and inoculants.

F. Keep the surface moist by a fine spray until the grass shows uniform germination over the entire area. Wherever poor germination occurs in areas larger than three (3) square feet, reseed, roll, and water as necessary to obtain proper germination.

11-330.5 MULCHING

A. Apply mulch immediately after seeding. Loosen baled straw and thoroughly break up before placing. Begin placement of mulch on the windward side and from the toe to slopes. Do not grind, cut, or crush mulch into pieces so small as to form a mat. Cutting mulch to aid in distribution may be accomplished, provided that 10 to 25% of the seeded area will be exposed. All types of seeding operations require the placement of mulch.

B. On slopes two to one (2 to 1) and greater, provide jute matting of Hold/Gro stapled eighteen (18) inches to three (3) feet apart, using closer spacing around curves and areas of concentrated storm water runoff.

C. Install jute strips beginning twelve (12) inches behind the top of slope. Bury the top ends in a slit trench, six (6) inches deep, and staple to trench bottom. Reinforce slit trench with a new row of staples one (1) foot below trench and space at intervals of six to ten (6 to 10) inches. Staple all overlaps and the center of the material at intervals of eighteen (18) inches to (3) three feet down the slope. After the jute matting is in place, overseed.

D. Install Hold/Gro with the fabric running vertically from the top of the slope in the direction of anticipated water flow. Do not stretch the material. Staple Hold/Gro in the same manner as specified for the jute.

11-330.6 SODDING

A. The Contractor may sod all grades exceeding a 2 to 1 slope in lieu of juting or using Hold/Gro.

B. On sloping areas where erosion may be a problem, sod shall be laid parallel to the contours of the slope with staggered joints and secured by camping, pegging or other approved method

C. Plant sod only when the soil is moist and favorable for growth. Shape the area to be sodded and finish to the lines and grades indicated on the drawings. Loosen the surface prior to placing sod. Keep the grade moist by sprinkling, if necessary, sod on the prepared surface with the edges in close contact. Each piece of sod laid shall be fitted and tamped into place with hand tampers not less than one hundred (100) square inches in area. Apply a sufficient quantity of water to all sod after laying, and to prevent the sod from drying out, for a period of at least two weeks to insure growth.

11-330.7 INSPECTION

Inspections shall be conducted on stabilized areas with overlot grading finals and prior to bond release of project. Also, at the beginning of the next planting season after that in which the permanent grass crop was sown. Promptly reseed any section not showing dense, vigorous growth. Water, weed, cut, and otherwise maintain the lawn until the end of that planting season.

SECTION 11-400 ROCK EXCAVATION

11-410 GENERAL CRITERIA

11-410.1 DESCRIPTION OF WORK

Provide all labor, materials, tools and equipment as required to excavate and dispose of rock as specified herein.

11-410.2 RELATED WORK SPECIFIED ELSEWHERE

- Article 10 - Geotechnical Guidelines

11-410.3 APPLICABLE SPECIFICATIONS

- Virginia Department of Transportation (VDOT), Road and Bridge Specifications

11-410.4 SUBMITTALS

Submit the blasting plan to the City Engineer for review and acceptance. Keep and submit to the City Engineer an accurate record of each blast. The record shall show the general location of the blast, the depth and number of drillholes, the kind and quantity of explosive used, seismograph reading, and other data required for a complete record.

11-410.5 DEFINITION

Rock shall be defined as:

- Boulders or concrete material, excluding curb and gutter and sidewalk, exceeding one half (1/2) cubic yard in volume.
- Solid ledge rock conglomerate deposits and unstratified masses so firmly cemented as to require drilling and blasting; wedging; and/or barring for its removal.

11-410.6 PERMITS AND REGULATIONS

A. Obtain all permits required for the transportation, handling, storage and use of explosives and drilling equipment. Blasting permits shall be obtained from the City Fire Marshal.

B. Observe state and federal laws and ordinances relating to explosives. Blasters shall have licenses available for examination at all times on the work site.

11-420 MATERIALS

Explosives shall be commercial grade. Explosives, equipment, and appurtenant items are the Contractor's option.

11-430 EXECUTION

11-430.1 GENERAL

Excavate rock to the lines and grades indicated on the construction standards. Excavate to six (6) inches below pipe or precast structure bottom and to the bottom of poured-in-place concrete structures.

11-430.2 EXPLOSIVES

When the use of explosives is necessary, exercise the utmost care not to endanger life or property. The owner shall be responsible for damage resulting from the use of explosives. The City Engineer shall not be responsible for the blasting plan.

11-430.3 BLASTING

A. Notify the City Engineer and the Fire Marshal at least 48 hours in advance of blasting operations.

B. Conduct all operations involving explosives using experienced personnel only.

C. Blast only with such quantities and strengths of explosives and in such manner as will break the rock approximately to the intended lines and grades.

D. Avoid excessive cracking of the rock upon or against which any structure will be built. Take appropriate steps to prevent damage to existing pipes or other structures and property above or below ground.

E. Cover areas to be blasted with mats, logs or other material to stop flying matter during explosions. Give sufficient warning to all persons in the vicinity of the work before a charge is exploded. Employ flagmen to stop or direct traffic as required.

F. Refer to Section 10-740 for additional standards.

11-430.4 EXCESS ROCK EXCAVATION

If rock is excavated beyond the limits of excavation indicated in the standards and is not authorized in writing by the City Engineer, the excess excavation, whether resulting from overbreakage or other causes shall be backfilled, by the Contractor, as specified below:

A. In pipe trenches, excess excavation below the elevation of the bottom of the pipe bedding, cradle, or encasement shall be filled with material of the same type, placed and compacted in the same manner, as specified for the bedding, cradle, or encasement.

B. In excavations for structures, excess rock excavation beneath foundations shall be filled with Class A3 concrete. Other excess rock excavation shall be filled with structural fill as specified in Section 10-760 of this Manual.

11-430.5 SHATTERED ROCK

If rock below normal depth is shattered due to drilling or blasting operations and such shattered rock is unfit for foundations, the shattered rock shall be removed and the excavation shall be backfilled as described above in excess rock excavation.

SECTION 11-500 TUNNELLING

11-510 GENERAL CRITERIA

11-510.1 DESCRIPTION OF THE WORK

Provide all plant, labor, materials, and equipment to install water mains, storm drains, or sewer pipes by tunnelling under railroad or highway crossings as called for on the approved plans and as specified herein.

11-510.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-200: Demolition
- Section 11-400: Rock Excavation
- Section 7-300: Sanitary Sewer Systems & Appurtenances
- Section 5-300: Water Mains & Appurtenances
- Section 11-700: Cast-In-Place Concrete
- Section 11-900: Masonry
- Drawing Number MS-1.0

11-510.3 APPLICABLE SPECIFICATIONS

- American Association of State Highway and Transportation Officials (AASHTO).
- American Society of Testing and Materials. (ASTM).
- United States Bureau of Mines.

11-510.4 APPLICABLE REFERENCES

- Virginia Soil and Water Conservation Commission Erosion and Sediment Control Handbook.
- Erosion and Sediment Control Ordinance (Chapter 58 of the City of Manassas Code).

11-510.5 PERMITS AND REGULATIONS

The City will obtain all permits required except those permits required for blasting as specified in Section 11-200 of this manual. The Contractor shall conform to the regulations set forth by the authorities having jurisdiction over the work performed in the areas of tunnel crossings.

11-510.6 SUBMITTALS

Submit detailed shop drawings, which shall include the location of the tunnel pits, soils data, method of excavation and support, method of dewatering, tunnel drawings showing thickness, size, shape and method of attachment, and grouting details. Include details on the method of installing the carrier pipe. Also submit a plan showing traffic control devices as required by MUTCD Standards.

11-520 MATERIALS

11-520.1 TUNNEL LINER PLATES

A. The tunnel liner plates shall be fabricated from structural quality, hot-rolled, carbon steel sheets, or plates, conforming to ASTM A-570, Grade B for sheets, or ASTM A-283, Grade B for plates. Liner plates shall be galvanized to meet the requirements of AASHTO M-167 and shall provide a minimum diameter of four (4) inches. Where specified, the tunnel liner plates shall be bituminous coated to meet the requirements of AASHTO M-190.

B. All tunnel liner plates shall be flanged and punched for bolting on both longitudinal and circumferential joints and shall be fabricated so as to permit erection from the inside.

11-520.2 BOLTS AND NUTS

Bolts and nuts shall be quick acting, coarse thread not less than one half (1/2) inch diameter for specified plate thicknesses up to and including 0.179 inches and 5/8-inch in diameter for liner plates of greater thicknesses. Bolts and nuts shall conform to ASTM A307 Grade A and shall be galvanized as per ASTM A153.

11-520.3 CARRIER PIPE

Water mains and sanitary sewers shall be as specified in Section 5-300 and Section 7-300 of this Manual respectively.

11-520.4 CONCRETE

Concrete used in tunneling construction shall be as specified in Section 11-700 of this Manual.

11-520.5 BRICKWORK

Brick and masonry work performed at the ends of the tunnel shall be as specified in Section 11-900 of this Manual.

11-520.6 FORCED GROUT

Grout that is force-injected between tunnel line plates and tunnel wall shall be one (1) part Portland cement (ASTM C150, Type II) and six (6) parts sand (ASTM C33).

11-520.7 EQUIPMENT

A. Tunneling equipment shall be as approved by U.S. Bureau of Mines.

B. The grout pump and injection system shall deliver the grout in a smooth and even flow without surge while developing a uniform pressure of 50 psi at the grout hole connection.

11-530 EXECUTION

11-530.1 GENERAL

A. Maintain free and full use of the surface on private property, streets, roadways and railways, under which tunneling construction takes place. Maintain close observation of surface facilities to detect settlement or displacement. Notify the City Engineer immediately if settlement is detected. Take appropriate action to maintain safe conditions and prevent damage. Test pits shall be excavated at all utility crossings (i.e., water, sewer, gas, electric or telephone).

B. Should the Contractor elect to sink shafts at any point on the tunnel alignment for more efficient construction, he shall obtain permission from the holders of private property or the agencies having jurisdiction over the property, easement, or right-of-way. Remove excavation from such shaft or shafts, as well as all mucking, from the premises to storage dumps acquired by the Contractor at his own expense.

C. Backfill shafts with materials approved for backfilling by the Engineer.

D. Line shafts with steel liner plate of structural adequacy to withstand all earth pressures. Plates shall form a concentric circle and be bolted in place as the shaft is sunk. Extend the liner plates above the surface three and one half (3-1/2) feet for protection of the public. No shaft shall be less than twelve (12) feet in diameter.

E. Where shafts are at portals, timber sheeting, and bracing of structural adequacy may be used as an alternate to steel liner plates if permission is granted by the City Engineer in writing.

11-530.2 VENTILATION SYSTEM

Furnish, install, operate, and maintain a temporary ventilation system for the removal of dust in the tunnel shaft according to local and Federal regulations.

11-530.3 ELECTRIC LIGHTS

Provide temporary electric lights to properly and safely illuminate all parts of the tunnel construction area with special illumination provided at the working face. Lighting circuits shall be thoroughly insulated and separated from power circuits, and shall be enclosed in plastic cages. Secure all necessary electrical permits for successful completion of this aspect of the work.

11-530.4 EXCAVATION FOR TUNNEL LINER PLATES

A. On initial set-up, support the tunneling equipment on a concrete cradle poured to permit the proper installation of the tunneling. During forward movement of tunneling operations, provide sufficient support at the tunnel face to ensure that only material physically displaced by the tunneling equipment is removed.

B. Excavation for liner plates shall proceed in increments sufficient for the erection of one ring of liners; install liner plates immediately after each increment of excavation. Keep voids behind liner plates to a minimum.

11-530.5 INSTALLATION OF TUNNEL LINER PLATES

A. Handle liner plates in such a manner as to prevent bruising, scaling, or any other damage to the linings and coatings.

B. Ensure that the plate edges are clean and free from material that could interfere with proper bearing during installation.

C. Assemble liner plates to the lines and grades shown on the Contractor's Drawings in accordance with the manufacturer's recommendations. Re-tension or replace any bolt that does not meet the requirements.

D. On eight (8) feet centers and in the liner plate at the top of each ring, there shall be a two (2) standard half pipe coupling welded into a hole in the liner plate and cast iron closure plugs screwed therein. On the completion of each day's work the cast iron plugs shall be removed and the voids between the outside of the liner plate and the earth or rock shall be completely filled by pressure grouting with one part Portland cement and six (6) parts mortar sand. The pressure shall be adequate to fill all the voids, but not great enough to bulge the liner plates.

11-530.6 INSTALLATION OF CARRIER PIPE IN TUNNEL

The carrier pipe shall be laid to the true line, grade, and elevations called for in the approved plans. Mount pipe on blocks, saddles, or other approved methods to obtain the exact lines and grades. Secure carrier pipe against flotation or vertical movement in accordance with standard details, or as otherwise approved by the City Engineer.

Protect the ends of the tunnel against entry of foreign matter and water with brick and masonry bulkhead, a minimum of six (6) inches thick. Construction of six (6) inch minimum grout. Provide one (1) inch weephole at each end of the tunnel. Grout or provide sand as shown on the Standard Detail MS - 1.0. of this Article.

11-530.7 ROCK EXCAVATION

Rock excavation shall be carried out as specified in Section 11-400.

SECTION 11-600 BORING AND JACKING

11-610 GENERAL CRITERIA

11-610.1 DESCRIPTION OF WORK

Provide all plant, labor, materials and equipment to install water mains or sewer pipes by boring and jacking under highway crossings as called for on the approved plans and as specified herein.

11-610.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-400: Rock Excavation
- Section 7-300: Sanitary Sewer Systems and Appurtenances
- Section 5-300: Water Mains and Appurtenances
- Section 11-700: Concrete Formwork, Reinforcement\ Materials
- Section 11-900: Masonry
- Drawing Number MS - 2.0

11-610.3 APPLICABLE SPECIFICATIONS

- American Water Works Association (AWWA)

11-610.4 APPLICABLE REFERENCES

- Virginia Soil and Water Conservation Commission Erosion and Sediment Control Handbook.
- Erosion and Sediment Control Ordinance (Chapter 58 of the City of Manassas Code).

11-610.5 PERMITS AND REGULATIONS

The Contractor will obtain all permits and post the appropriate bonds. The Contractor shall conform to the regulations set forth by the authorities having jurisdiction over the work performed in the areas of bore and jack construction.

11-610.6 SUBMITTALS

Submit detailed drawings, which shall include the location and size of pit, the method of boring and jacking, the size, capacity and arrangement of equipment, the method of dewatering, the method of controlling line and grade, and a traffic control plan that conforms to MUTCD Standards.

11-620 MATERIALS

11-620.1 CASING PIPE

The casing pipe used shall be black seamless steel pipe with a minimum thickness of 3/8" of the sizes shown on the Standard Detail MS - 2.0. Pipe shall have a minimum yield strength of 35,000 psi and shall conform to AWWA C-200.

11-620.2 CARRIER PIPE

Water mains shall be as specified in Section 5-300 and sanitary sewer pipes as specified in Section 7-300.

11-620.3 CONCRETE

Concrete shall be as specified in Section 11-700.

11-620.4 BRICKWORK

Brick and masonry work as performed at the ends of the casing pipe shall be as specified in Section 11-900.

11-620.5 EQUIPMENT

Boring and jacking equipment shall be at the Contractor's option.

11-630 EXECUTION

11-630.1 GENERAL

A. If an obstruction is encountered during installation, which stops the forward action of the pipe and makes it impossible to advance the pipe, notify the City Engineer immediately. If necessary, operations will cease and the pipe shall be abandoned in place and either plugged or filled completely with grout.

B. Maintain close observation of surface facilities to detect settlement or displacement. Notify the City Engineer immediately if settlement or displacement is detected. Take action to maintain safe conditions and prevent damage. Test pits shall be excavated at all utility crossings (i.e., water, sewer, gas, electric or telephone).

11-630.2 CONSTRUCTION OF BORING PIT

A. Excavate boring pit in accordance with detailed drawings specified in Section 11-610.6. The pit shall be of adequate length to provide room for the jacking frame, the jacking head, the reaction blocks, the jacks and two (2) sections of casing pipe. The pit shall be wide enough to allow ample working space on either side of the jacking frame. The depth of the pit shall be such that the invert of the pipe when placed on the guide frame will be at the desired elevation for the finished line. The pit shall be tightly sheeted and kept dry at all times.

B. Design and install the reaction blocks to carry the thrust of the jacks to the soil without excessive soil deflection and in such a manner as to avoid any disturbance of adjacent structures or utilities. Provide adequate protective railings and/or fences at the top of the pit at all times.

11-630.3 BORING AND JACKING OPERATION

A. Provide removable auger and cutting head arrangement. Arrange the face of the cutting head to provide reasonable obstruction to the free flow of soft material. Push the pipe with boring auger rotating within the pipe to remove the spoil. Overcut by the cutting head shall not exceed the outside diameter of the casing pipe by more than one half (1/2) inch.

B. Use hydraulic jacks in the jacking operation and take extreme care to hold the pipe to the exact lines and grades shown on the Contract Drawings. Excavation at the heading shall not exceed one (1) foot ahead of the lead pipe. As one section of casing pipe is installed, the next section shall be aligned on guide timbers and welded to preceding section, and the boring and jacking process continued.

11-630.4 INSTALLATION OF CARRIER PIPE

A. Lay the carrier pipe to the true line, grade and elevations called for on the Contract Drawings. Use rollers, timber skids or other supports, approved by the City Engineer, strapped to the carrier pipe inside the casing pipe to avoid the pipe resting on any bells and to keep the completed installation at the required line and grade.

B. Protect the ends of the casing pipe against entry of foreign matter and water with brick and masonry construction of six (6) inch minimum grout. Provide two (2) weephole at each end of casing pipe.

11-630.5 ROCK EXCAVATION

Rock excavation shall be as specified in Section 11-400 of this manual.

SECTION 11-700 CAST-IN-PLACE CONCRETE

11-710 GENERAL CRITERIA

11-710.1 SUMMARY

This section includes concrete curbs, combination curb and gutters, ramps, sidewalks, driveways, flumes, valley gutters, median strips, islands, retaining walls, steps, and headwalls on municipal roadways and its appurtenances.

11-710.2 DEFINITIONS

A. **General**:

For the purposes of this specification, the following definitions refer to the streets and roadway system that comes under the authority of the City of Manassas, Virginia as specified within this section and other sections of this manual.

a. **Aggregate Base Course**: A layer of graded aggregate materials of a specified thickness placed between the subgrade and the concrete structure or appurtenance.

b. **Public Road System**: Roadway, streets, and their appurtenances required for the conveyance of the motoring public that are maintained by the City of Manassas.

c. **Subgrade**: The top surface of a sidewalk, curb and gutter or driveway shaped to conform to the typical section on which the concrete structure or appurtenance is constructed.

d. **Suitable Subgrade**: A subgrade that consists of a material type and density that is approved by the City Engineer or his/her designee for placement of a subsequent concrete structure or appurtenance

B. The following are industry abbreviations for various materials and items:

a. **C&G**: Concrete Curb and Gutter

b. **D/W:** Driveway

c. **S/W:** Sidewalk

11-710.3 SUBMITTALS

A. Shop drawings shall include bar tabulations, placement drawings, details and product data for the following:

- Air Entrainment
- Concrete cylinder break tests.
- Concrete admixtures
- Joint Sealants and expansion joint material
- Job mix formula
- Other embedded items

These drawings shall be certified for its intended use by a professional engineer and Submitted to the City Engineer or his/her designee.

B. The Concrete Plant shall provide the concrete mix design and certified test reports on the aggregate, admixture, cement, and curing materials to be incorporated in the concrete for the project.

C. The steel fabricator shall provide certified mill test reports for the reinforcing steel and accessories to be incorporated in the work.

D. The Contractor shall provide delivery tickets for concrete and shall include the date, time, truck identification, concrete plant, plant inspector, ticket and load number, concrete class and design mix, moisture content of aggregates, quantity and location of placement.

11-710.4 EXCAVATION/UTILITY/RESTORATION ACTIVITIES IN THE CITY RIGHT-OF-WAY

Construction Materials are prohibited to be dumped or placed in the City ROW, street or alleyway without written approval form the City Public Works Director or designee. Removal of Excavated Material and Debris must be loaded directly onto a truck or trailer and removed from the City ROW, street or alleyway. Each Permittee must keep the area surrounding the excavation clean and free of loose dirt or other debris in a manner deemed satisfactory to the City Inspector or designee. In addition, the Permittee shall remove all excavated material, debris, and tools and equipment from the site of the excavation no later than the end of each workday. The spreading of mud and debris upon the roadway is prohibited.

The Permittee shall clean and sweep the roadway or otherwise directed by the City of all dirt and debris at the end of each work day.

11-710.5 QUALITY ASSURANCE

Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

The following codes and standards are hereby made a part of this specification and concrete work performed shall conform with the applicable references except as specified otherwise in this section:

- ACI Standard 318-71 - Building Code Requirements
- Reinforced Concrete (Working Stress Design)
- ACI Standard 306 – Standard Specification for Curing in Cold Weather
- ACI Standard 308.1-11 – Standard Specification for Curing Concrete
- ACI Standard 318 - Building Code Requirements for Reinforced Concrete
- ACI Standard 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures
- ACI Committee Report - Concrete Sanitary Engineering Structures, ACI Committee 350
- ACI Standard 301 - Specifications for Structural Concrete for Buildings
- Wire Reinforcement Institute, Inc., WRI - Manual of Standard Practice
- Virginia Department of Highways and Transportation (VDOT), Road and Bridge Specifications

STANDARD ABBREVIATIONS

AASHTO	American Association of State Highway Transportation Officials
ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
VDOT	Virginia Department of Transportation
WRI	Wire Reinforcement Institute

Note: Designations such as ASTM, AASHTO, VDOT, etc. Referenced throughout this specification imply the latest revision.

11-720 MATERIALS

11-720.1 GENERAL

Concrete materials, methods of mixing, conveying, curing, placing, reinforcement, and the making and removal of forms shall conform to the most recent requirements of the American Concrete Institute Standards or VDOT Road *and Bridge Specifications*.

11-720.2 CLASS OF CONCRETE / PORTLAND CEMENT CONCRETE MIX

Portland Cement Concrete VDOT Class A3 shall be the approved concrete mix for all concrete applications in the City. ALL other concrete mix design must be submitted for approval to the City Engineer or his/her designee and must be approved prior to placement in the City unless otherwise approved in the Design Engineer specifications or drawings. For the purpose of this Manual the term Hydraulic Cement and Portland Cement will have the same meaning.

All Cast-in-place concrete shall be Portland Concrete Class A3 General Use (3,000 psi) with air entrainment unless stated otherwise on the approved plans. All entrances shall be Class A3 H.E.S. Concrete.

11-720.3 EARTH FORMS

Except for the bearing surface of thrust blocks, concrete cradle, concrete encasement, and the second pours of drop manholes, do not place concrete directly against vertical surfaces of the soil.

11-720.4 PLYWOOD

Except where noted otherwise on the approved plans, use plywood forms for all concrete, which will be exposed in the finished work, and for all exterior walls below grade, which are to receive membrane waterproofing. Plywood shall conform to U.S. Product Standard PS I-66 and shall be a minimum of 5/8-inch thick. Each panel shall carry the grade trademark of the American Plywood Association along with the DFPA Quality stamp.

11-720.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

11-720.5.1 CONCRETE HANDLING/TRANSPORTATION

A. Hydraulic Portland cement concrete plant operations shall comply with the latest revision of VDOT *Road and Bridge Specifications*.

B. Time limitations and intervals between deliveries shall be in accordance with the latest revision of the VDOT *Road and Bridge Specifications*,

C. Forms required to be accompanied with delivery shall be in accordance with the latest revision of the VDOT *Road and Bridge Specifications*.

D. See Part 9-730 - EXECUTION of these specifications for handling of materials during placement of hydraulic cement concrete.

11-720.5.2 STEEL HANDLING/EXAMINATION

A. Steel Reinforcing Inspection:

   a. Plain Steel Reinforcing: Inspect materials thoroughly upon arrival. Examine materials for damage or excessive rust. Remove damaged or rejected materials from site. A light coat of rust is permitted to develop on steel bars and fabric; however, rust scaling and flaking is not permitted

   b. Coated Steel Reinforcing: Handling and storage of coated bars shall conform to the requirements of AASHTO A775. Visible damage to the coating shall be patched or repaired with materials compatible to the existing coating in accordance with AASHTO A775.

B. Pre-Installation Inspection:

   a. Prior to being installed, inspect each bar of steel reinforcing for the presence of dirt, paint, oil, rust scaling, flaking or other foreign matter. Remove such matter with appropriate methods and to the satisfaction of the City Engineer or his/her designee.

   b. Observe manufacturer's directions for delivery and storage of materials and accessories.

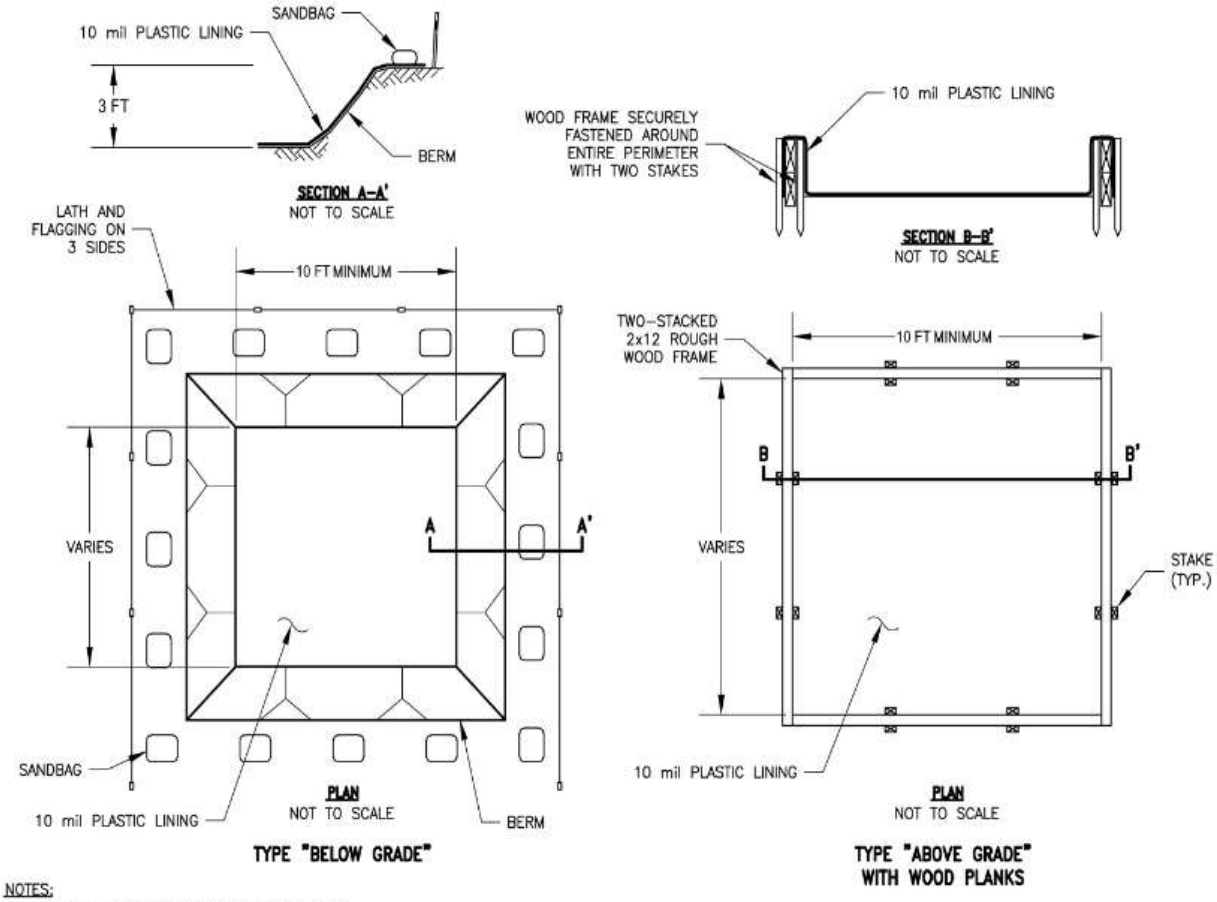
   c. Reinforcing steel shall be stored on platforms, skids, or other supports that will keep the steel above ground, well drained, and protected against deformation. Upon deliver to site, epoxy coated steel shall be covered with an opaque covering. Coverings shall be placed to provide air circulation and prevent condensation.

11-720.6 PROJECT CONDITIONS

11-720.6.1 PROTECTION OF STREAMS AND PUBLIC/PRIVATE PROPERTY

At No Time Shall concrete or excess concrete be discharged into a drainage pipe, catch basin, ditch, stream, river, pond, lake, or onto public/private property. See Figure 11-7-1 for Concrete Wash-out from the most recent *VDOT Pollution Prevention Field Guide for Construction Activities*.

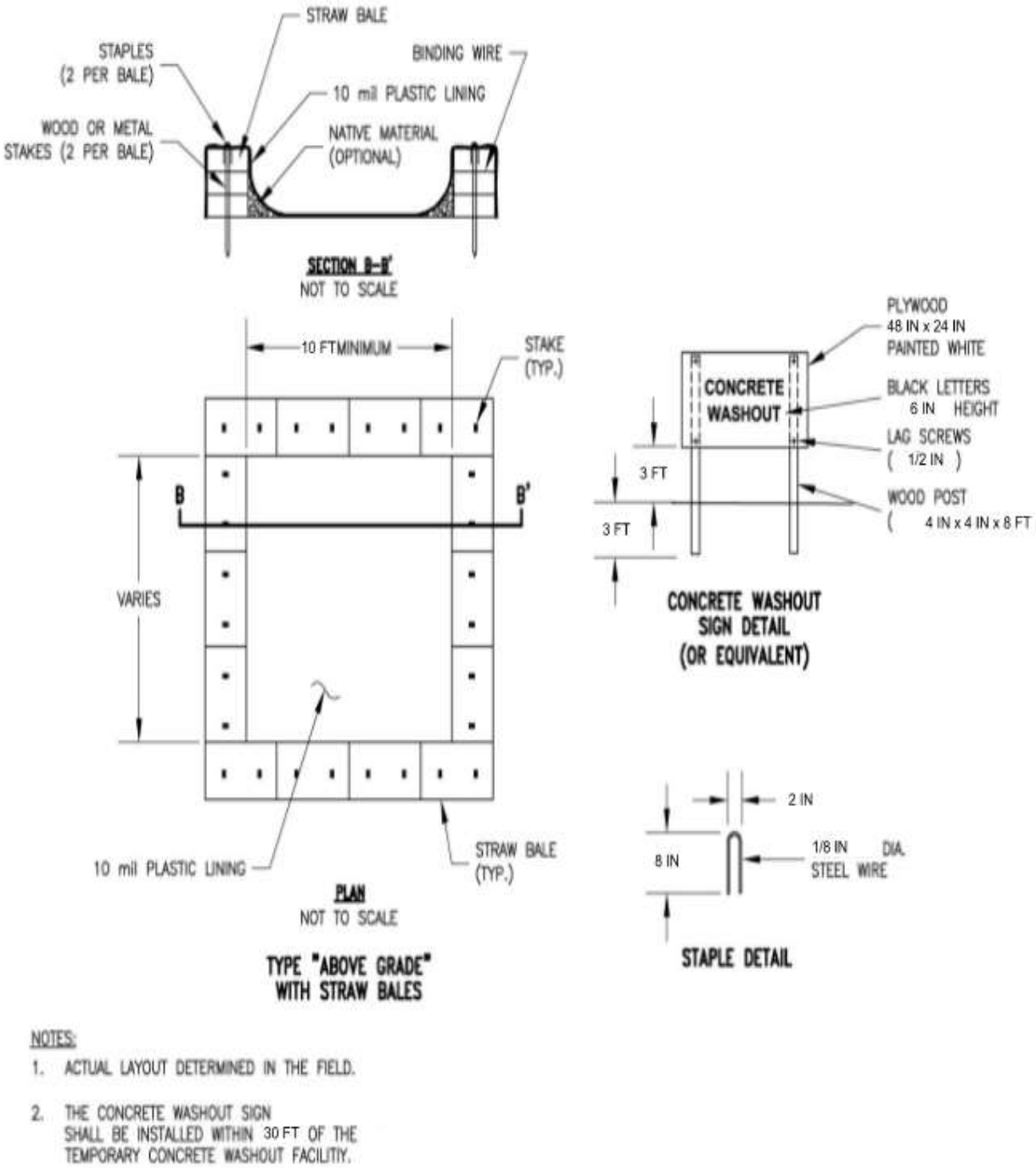
Figure 11-1. Typical Wooden Concrete Washout



NOTES:

1. ACTUAL LAYOUT DETERMINED IN THE FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

Figure 11-2. Typical Straw Bale Concrete Washout



NOTES:

1. ACTUAL LAYOUT DETERMINED IN THE FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT OF THE TEMPORARY CONCRETE WASHOUT FACILITIY.

11-720.6.2 PROTECTION OF ROADWAYS

Do not discharge or allow concrete to spill onto any roadway or appurtenances either during placement or while in transit. Remove spills immediately or otherwise repair street as directed by the City Engineer or his/her designee.

11-720.7 PROTECTION FROM DAMAGE AND GRAFFITI

11-720.7.1 GENERAL

Newly poured concrete roads, streets, curbs, sidewalks slabs or foundations shall be protected from weather related events AND guarded from damage and/or graffiti from passersby until the concrete has sufficiently cured to resist such damage. Failure to prevent any damage or graffiti, or other such vandalism, shall result in the new concrete having to be removed and replaced. This requirement shall mandate that the Contractor to take the necessary steps in preventing such incidents including, but not limited, to guarding the project after normal working hours.

11-720.7.2 PROTECTION OF CONCRETE

A. Protect all freshly placed concrete from mechanical injury or action of natural elements until such time as the concrete is thoroughly set.

B. Protect projecting inserts, anchor bolts and other embedded items from disturbances until the concrete has sufficiently set to hold such items.

   a. Sidewalks: Protect new concrete sidewalks and appurtenances from pedestrian traffic for a minimum of 24 hours and driveway surfaces and curb and gutter from vehicular traffic for minimum of 7 days, unless otherwise approved by the City Engineer or his/her designee. Erect and maintain warning signs, lights, and watchmen to protect pedestrian and to direct traffic as needed.

   b. Driveways and Curb and Gutter: Protect new concrete driveway surfaces and curb and gutter from vehicular traffic for minimum of 7 days or until the minimum design compressive strength is attained, whichever is the lesser time, unless otherwise approved by the City Engineer or his/her designee. Erect and maintain warning signs, lights, and watchmen to protect pedestrian and to direct traffic as needed.

   c. Protect concrete against public traffic, construction equipment and traffic caused by employees and agents. Repair or replace parts of concrete damaged from such prior to final acceptance.

   d. No equipment shall be driven or moved across newly concreted surfaces unless such equipment is rubber-tired and only if paved surface is designed for and capable of sustaining loads to be imposed by the equipment.

11-720.7.3 COORDINATION

Coordinate placement of sidewalk and driveway connections to municipal streets and roadways with the City Engineer or his/her designee.

11-720.8 PORTLAND / HYDRAULIC CEMENT CONCRETE

Ready mixed Portland concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete. Portland* cement concrete shall meet the requirements of the latest revision of the VDOT *Road and Bridge Specifications*. Concrete strength shall be as specified on standard details and drawings. Unless otherwise specified, all concrete shall be Class A3, minimum unless otherwise stated on the approved plans and specifications.

All exposed concrete shall be air entrained with an air content conforming to the requirements of Table II-17, Section 217 of the VDOT *Road and Bridge Specifications.* Air entrained admixtures for use

in Portland cement concrete shall meet the requirements of AASHTO M154. Only those admixtures shall be used which have been approved by the City Engineer or his/her designee.

Calcium chloride may be used as an admixture if approved by the City Engineer or his/her designee. Calcium chloride shall conform to AASHTO M144, type 2. *Do not use calcium chloride in reinforced concrete construction*.

Concrete admixtures, when specified, shall conform to Section 215 of VDOT *Road and Bridge Specifications.*

Concrete Classes (VDOT) to Design Compressive Strength at 28 days.

- Class A4.5 General 4,500-psi
- Class A4 General 4,000-psi
- Class A3 General 3,000-psi
- Class B2 Massive or Lightly Reinforced 2,200-psi

11-720.9 JOINT FILLER

ASPHALT EXPANSION JOINT FILLER

Material shall be in accordance with Section 212.02(c) of the VDOT *Road and Bridge Specifications*. Fiber expansion joint filler shall meet AASHTO M213, *Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types);* ASTM D1751, *Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)*; Fed Spec item HH-F-341 F, Type I; FAA Spec Item P-610-2.7. Material shall be approximately ½ inch in thickness and a width and depth equal to those of the incidental structure. Unless otherwise directed by the City Engineer or his/her designee, install expansion joint filler 1/2-inch below the concrete surface and seal with W. R. Meadows #164, "HI-SPEC, cold-applied "SOF-SEAL," or an approved equal for maximum protection from water infiltration, weathering and to assure proper performance.

11-720.10 POROUS BACKFILL AND WEEP HOLES

Porous backfill material and drain pipes for weep holes for retaining walls shall conform to requirements of Section 506 or the most recent revision of the VDOT *Road and Bridge Specifications*.

11-720.11 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

11-720.12 REINFORCEMENT

A. **REINFORCING BARS**

Reinforcing bars shall conform to the requirements Section 223, Grade 40 or 60 of the VDOT *Road and Bridge Specifications*. B.

B. **WELDED WIRE FABRIC**

Wire mesh reinforcement shall be as shown on the plans but no less than 6 x 6, 10 Ga. and shall conform to the requirements of Section 223 of VDOT Road and Bridge Specifications.

C. **AGGREGATE BASE MATERIAL**

Aggregate base materials for foundation support shall be VDOT 21A, compacted, and in compliance with Section 208 of the VDOT *Road and Bridge Specifications*.

D. **CONCRETE ADMIXTURES**

Admixtures, when specified by the City Engineer or his/her designee, shall be in conformance with Section 215, *Hydraulic Cement Concrete Admixtures*, of the VDOT *Road and Bridge Specifications*.

11-730 EXECUTION

11-730.1 GENERAL

A. Employ a competent and acceptable crew leader for concrete work. This crew leader shall be thoroughly familiar with all phases of concrete construction, including forms.

B. Be responsible for the capacity of all form work, shoring and bracing to carry all superimposed live and dead loads before, during and after concrete is poured.

C. Provide form work with adequate cleanout openings to permit inspection and easy cleaning after reinforcement has been place. Where possible, place the openings in the side of the unexposed surfaces.

11-730.2 CONSTRUCTION OF SUBGRADE

A. **SUBGRADE PREPARATION**: Excavation and subgrade preparation shall be in strict compliance with Section 305 of the VDOT *Road and Bridge Specifications*. The subgrade upon which this work is to be placed shall be shaped and compacted to a firm, even surface conforming to the elevation and cross-sections shown on the plans, the standard drawings, or as directed by the City Engineer or his/her designee. All soft, frozen, and unsuitable material shall be removed and replaced with approved material. The subgrade shall be moist when the concrete is placed.

B. **BICYCLE/GREENWAY SUBGRADE**: Concrete Pavement subgrade should be prepared in accordance with Section 305 of the VDOT *Road and Bridge specifications* and shall conform to the grade and cross-section shown on the plans.

C. **SUBGRADE FINE GRADING (Trimming)**: When forms have been set to exact grade and secured, fine grading to exact sub-grade elevation shall be completed by hand. Before pouring operations begin, the Contractor shall have forms set and grade tested and approved by the Inspector ahead of pouring operations. Subgrade fine grading shall be the responsibility of the Contractor to ensure that the subgrade conforms to the Specification Details.

11-730.3 COORDINATION OF POURS

It will be the responsibility of the Contractor to coordinate the times of pours with the inspector. Sufficient notice shall be given to the inspector so that he/she can check all aspects of the work before the pouring operations begin. Under no circumstances shall the Contractor pour concrete until the inspector has had sufficient time to make checks of the work. An inspection shall be requested at least 48 hours prior to any pouring operation.

The maximum interval between the placing of batches at the work site shall not exceed 20 minutes. See also Section 217.09 of the VDOT *Road and Bridge Specifications* for time limitations and intervals between deliveries.

11-730.4 FORMS

A. All Forms for sidewalk or curb and gutter concrete work shall be made of metal, unless otherwise approved by the City Engineer or his/her designee, and shall extend to the full depth of the concrete and shall be straight, free from warps and of sufficient strength to withstand the pressure of the concrete without springing.

B. Bracing and staking of the forms shall be such that the forms will remain in both horizontal and vertical alignment until their removal. Forms shall be cleaned of foreign matter and pre-treated with a non-petroleum, non-hazardous base release agent before concrete is placed.

C. No concrete shall be poured into forms, when ground temperature is 40 degrees or less.

11-730.5 CONSTRUCTION OF FORMS

With approval from the City Engineer or his/her designee, Wood Forms may be implemented for concrete work.

A. General**:** Construct wood forms of sound material, and of the correct shape and dimensions, constructed tightly and of sufficient strength. Brace and tie forms together so that the movement of workers, equipment, materials, or placing and vibrating the concrete will not throw them out of line or position. Forms shall be strong enough to maintain their exact shape under all imposed loads. Camber where necessary to assure level finished soffits. Construct forms that may be easily removed without damage to the concrete. Before concrete is placed in any form, the horizontal and vertical position of the form shall be carefully verified and all inaccuracies corrected. Complete all wedging and bracings in advance of placing concrete.

B. Chamfered Corners: Unless otherwise indicated, provide chamfered corners on all exposed corners. Provide three quarter (3/4) inch moldings in forms for all chamfering required.

C. Embedded Items: Make provision for sleeves, anchors, inserts, waterstops, and other features.

D. Form Ties: Use form ties of sufficient strength and in sufficient quantities to prevent spreading of the forms. Place ties at least one (1) inch away from the finished surface of the concrete. Do not use ties consisting of twisted wire loops. Leave inner rods in concrete when forms are stripped. Space all form ties equidistant, and symmetrical, and line up both vertically and horizontally.

E. Cleanouts and Access Panels: Provide removable cleanout sections or access panels at the bottom of all forms to permit inspection and effective cleaning of loose dirt, debris, and waste material. Clean all forms and surfaces to receive concrete of all chips, sawdust, and other debris and thoroughly blow out with compressed air just before concrete is placed.

F. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

11-730.6 PREPARATION FOR PLACING

A. Remove water from excavations before concrete is deposited. Divert any flow of water through proper side drains and remove water without washing over freshly deposited concrete. Remove hardened concrete, debris, ice, and other foreign materials from the interior of the forms, and from the inner surfaces of mixing and conveying equipment. Do not place on frozen ground. Secure reinforcing in position and place vapor barrier and have inspected and approved before the concrete is poured. Do not wheel equipment used to deposit concrete over reinforcement.

B. Prior to placing of any concrete, and after placement of reinforcing steel if required in the forms, must notify the City Engineer or his/her designee so that proper inspection may be made. Such notification shall be made at least 48 hours in advance of placing concrete to permit proper arrangements for inspection.

11-730.7 FORM COATING

Use a non-grain raising and a non-staining type of coating that will not leave residual matter on surface of concrete or adversely affect proper bonding of subsequent applications of other material applied to the concrete surface, such as "Nox-Crete Form Coating" as manufactured by the Nox-Crete Company, "Arcal-80" as manufactured by Arcal Chemical Corporation, "Synthex" as manufactured by Industrial Synthetics Company, or approved equal. Do not use coatings containing mineral oils or other non-drying ingredients.

11-730.8 DELIVERY

Submit a delivery ticket indicating the mix and design strength of the concrete, design slump, and time of leaving the truck mixer with each batch at the time of delivery. Record on the back of the delivery ticket:

A. The time of arrival of the truck mixer on the site;

B. The time of deposit of the concrete from the truck; and

C. The place of deposit of the concrete.

The completed delivery ticket shall be delivered to the City Engineer or his/her designee. Failure to deliver such completed ticket to the City Engineer or his/her designee will be cause for the City Engineer or his/her designee to reject the deposited concrete at any time and cause it to be removed and replaced at no additional expense to the City.

Do not use concrete on the job site when it has exceeded the allotted mixing time as specified in Section 217.09 of the VDOT *Road and Bridge Specifications*.

11-730.9 PLACEMENT – ALL CONCRETE ITEMS

A. Before placing concrete, remove all construction debris, water and ice from the places to be occupied by the concrete. Give particular attention to the removal of dirt and debris from all formed construction joints.

B. Concrete, when deposited, shall have a temperature ranging between a minimum of 40 degrees Fahrenheit and a maximum of 95 degrees Fahrenheit. When the temperature of the surrounding air is below 40 degrees or above 95 degrees Fahrenheit, concreting shall be done in accordance with the recommendations noted in ACI-306 and ACI-305 respectively.

C. Mix concrete in such quantities as required for immediate use and place prior to loss of slump. Do not re-temper concrete.

The concrete shall be placed in the forms in such a manner as to prevent the segregation of the mortar and the aggregate. The concrete shall be spaded, tamped, or vibrated sufficiently to bring the mortar to the surface. Concrete shall not be dropped a distance of more than 5 feet. No concrete shall be placed when air or ground temperature is (40 F) degrees or below without the approval of the City Engineer or his or her designee.

Prior to and during pouring operations, the Contractor's foreman or form setter shall carefully watch all alignment and grades to detect any errors in grade or misalignment. In the event any of the work is damaged from any cause or prove defective in any way, or is out of alignment or grade, the Contractor shall remove such work and replace at their own expense. The detection of poor subgrade shall also be the responsibility of the contractor.

When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. Mix shall be rodded or vibrated to eliminate voids. Concrete shall be floated to the proper grade and alignment, free from depressions or other irregularities, after which the exposed surfaces shall then be screeded with a straight edge and finished with a steel or wooden trowel. The concrete shall be troweled smooth and, before the concrete obtains full set, very lightly brushed with a brush moistened with clear water. No mortar shall be used in the finishing.

Immediately following finishing operations, the finished concrete shall be cured and protected in accordance with these specifications.

11-730.10 REMOVAL OF FORMS

After concrete has been placed, all forms, bracing and supports shall remain undisturbed long enough to allow the concrete to reach the strength necessary to support with safety its own weight plus any live load and earth pressure that might be placed upon it without causing excessive settlement or deflection or any temporary or permanent damage to the structure.

Prevent the breaking of edges and corners of concrete in the stripping of forms. Upon removal of formwork, immediately patch honeycombed areas and other voids to the satisfaction of the City Engineer or his/her designee.

Thoroughly clean forms and recoat with specified form coating before each reuse.

Do not reuse any form for exposed work which cannot be reconditioned to "like new" condition. Discard forms considered unsatisfactory by the City Engineer or his/her designee. Apply form coating to all forms in accordance with the manufacturer's specifications. Apply form coatings before placing reinforcing steel

11-730.11 FINISHING

Concrete for curb and gutter, sidewalks and driveways shall have a broomed finish. This finish shall be accomplished as follows: The surface shall be screeded and tamped to force the coarse aggregate away from the surface, floated to bring the surface to the required finish level, steel-troweled to an even smooth surface and broomed with a fiber-bristle broom / brush. The surface shall be uniform in texture. Sidewalk shall be broom finished in a manner that allows the grain of the finish to be adjacent to the flow of pedestrian movement, in order to provide adequate traction.

11-730.12 CURING

A. CURING – YEAR ROUND

Curing shall be accomplished by preventing loss of moisture, rapid temperature change, and mechanical injury from rain or flowing water for a period of 7 days when normal Portland cement has been used or 3 days when high early strength Portland cement has been used. Curing shall be started as soon as placing, finishing, and free water has disappeared from the surface of the concrete. The following methods of curing are required year round:

1. **Liquid membrane compound**: Apply membrane–curing compound for curing, sealing, and moisture retention. The entire surface of the concrete pavement shall be sprayed uniformly with a white pigmented membrane- forming compound immediately following the texturing operation. The curing compound shall be applied in 2 coats by hand.

   Perform application in accordance with manufacturer's directions but at a minimum rate of 100 to 150 square feet per gallon and not more than 350 square feet per gallon (total for both coats). Application shall be by a sprayer or long-nap roller and shall be an even, continuous membrane produced on the concrete surface. The second coat shall be applied in a direction approximately at right angles to the direction of the first coat. No puddling shall be produced. At the time of use, the compound shall be in a thoroughly mixed condition, with pigment uniformly dispersed through the vehicle. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections.

   The membrane shall harden 30 minutes after application. Personnel and equipment shall be kept off the freshly applied material to prevent damage to the seal. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for 7 days from pedestrian and vehicular traffic and from any other action which might disrupt the continuity of the membrane. If the membrane becomes damaged within the initial 72 hours, damaged portions shall be repaired immediately with additional compound.

   If removal of forms is required, exposed sections shall be protected immediately to provide a curing treatment equal to that provided for the surface.

2. **PE Film**: Concrete shall be covered with PE film. Color of film shall be white. PE Film shall be installed immediately after liquid membrane compound has obtained a sufficient set so that it is not damaged. Apply film so that marks from application are not produced.

B. COLD WEATHER CURING

Concrete Temperature: Must conform to the requirements of the *Placement Limitation section* of the most recent revision American Concrete Institute (ACI) or VDOT Road *and Bridge Specifications* for the required curing procedures and temperatures of concrete.

No concrete work of any kind shall be performed or poured without approval from the City Engineer or his/her designee when the outside temperature is (40 F) degrees and falling.

Cold weather curing shall be applied when the outside temperature is (50 F) degrees and falling.

Curing in cold weather: Protection and additional curing requirements are to be implemented during cold weather. Provide required materials and equipment to protect the concrete at the project site before cold weather concreting. Protect the concrete from the effects of cold weather throughout the process, placing, finishing, and curing the concrete.

1. Cold subgrade: No concrete is to be placed on a frozen subgrade.
2. Do not expose saturated concrete to cycles of freezing and thawing
3. In cold weather applications, calcium chloride may be used as an admixture, if approved by the City Engineer or his/her designee, and provided the concrete is not reinforced.

Curing shall be started as soon as it is possible to apply the curing medium without damaging the surface, preferably immediately upon completion of the finishing operation. A uniform coat of white

pigmented curing compound shall be applied after the surface has been broomed. Curing shall continue uninterrupted for a minimum period of 14 days. Rapid drying upon completion of the curing period shall be prevented. At no time during the curing period shall the temperature of the concrete be permitted to drop below 40 degrees Fahrenheit. Refer to Section 316.04 of VDOT Specifications.

C. INSULATION BLANKET

In addition to year-round curing, Cold weather curing requires the install of insulated blankets that must retain or supply moisture and maintain the temperature of concrete at the outermost surfaces above 50º F for at least 72 hours and above 32º F for at least an additional 48 hours. Blankets shall be left in place for a minimum of 7 days.

D. HOT WEATHER CURING

Hot weather curing shall be applied when the outside temperature is 75 degrees and rising. Care shall be taken in hot, dry, or windy weather to protect the concrete from shrinkage cracking by applying at a minimum liquid membrane compound and PE film as described in Section 11-730.12.A.2, above.

Routine hot weather measures shall include cooling forms and wetting subgrade in addition to any of the other approved measures.

Other measures for curing may be required by the City Engineer or his/her designee, such as: fog spraying, sprinkling, ponding, windbreaks, shading, or wet covering with an approved light-colored material. Such curing may be required to remain in place for a minimum of 7 days. No extra compensation will be made for curing of concrete.

11-730.13 DAMAGED CONCRETE

Any work damaged due to subgrade, alignment, appearance or finish, improper curing, freezing, rain or weather shall be replaced at the Contractor's expense.

11-730.14 TESTING

Independent Third Party Geotechnical concrete tests may be performed by a testing agency acceptable to the City Engineer or their designee.

Testing agencies: Agencies that perform testing services on concrete and concrete aggregates shall meet the requirements of ASTM C1077 and be accredited. Field tests of concrete shall be made by an ACI Concrete Field Technician—Grade 1 or equivalent. Agencies that perform testing or inspection services for concrete shall meet the requirements of ASTM E329. Testing agencies that perform testing services shall be accepted by the City Engineer or designee before performing any Work. The testing agency shall report results of tests and inspections performed during the course of all work within 3 working days of report documentation or testing.

The Contractor must provide all supporting documentation reports and testing of geotechnical testing agencies inspections to the City Engineer or their designee all observations, site condition issues and resolutions, compactions testing, records of maintaining concrete temperature and determining time for termination of curing methods as required by (ACI) and (VDOT) Standards during the curing period.

Reports must include photographs and documentation to reference site specific locations, time of day, site condition for placement of pour, weather conditions, air and ground temperature, slump and air testing, curing method and when conditions to determine time of termination for curing measures are compliant with specifications.

Strength basis: When termination of curing measures is based on the development of strength, curing measures shall not be terminated before the compressive strength of the concrete has reached 70 percent fc’ as determined by one of the following methods

1. Compressive strength basis: Mold cylinders in accordance with ASTM C-31 and test in accordance with ASTM C-39. Maintain curing until tests of at least two cylinders, field-cured alongside the concrete they represent or have reached the compressive strength specified for termination of curing.
2. Maturity method basis: Maintain curing methods until concrete attains the compressive strength specified for termination of curing.
3. Nondestructive test methods: Maintain curing methods until testing indicates that the specified compressive strength has been reached.
4. Durability basis: Maintain curing methods until specified results are achieved

The Contractor shall provide, for the use of the testing agency, adequate area for safe storage of field-cured specimens until time of test.

11-730.15 SAMPLING, TESTING, AND ENFORCEMENT

A. The Contractor shall furnish such facilities required for on-site testing and for collecting and forwarding concrete samples for testing to an approved independent laboratory approved by the City Engineer or his/her designee. The laboratory shall establish the mix proportions and test the concrete. One (1) test shall be performed for each ten (10) cu. yds. of concrete. The laboratory shall maintain records showing brand of cement, brand and quantity of admixtures, time and location of the batch from which the test was made, air content, slump, and compressive strength. The laboratory shall supply the test cylinders, slump cones, field technicians, and all equipment necessary for performance of field and laboratory testing specified herein.

B. One strength test shall consist of four field specimens. One (1) specimen for testing at seven (7) days, one (1) specimen for testing at fourteen (14) days, and two (2) specimens for testing at twenty-eight (28) days. The samples for strength tests shall be taken in accordance with "Method of Sampling Fresh Concrete" (ASTM C-172). Cylinders for acceptance tests shall be molded and laboratory- cured in accordance with "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field" (ASTM C-31) and tested in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C-39). Each strength test result shall be the average of two cylinders from the same sample tested at seven (7), fourteen (14), and twenty-eight (28) days.

C. When the frequency of testing will provide less than five strength tests for a given class of concrete, make tests from at least five randomly selected batches or from each batch if fewer than five are used. When the total quantity of a given class of concrete is less than thirty (30) cu. yds. the strength test may be waived by the City Engineer or his/her designee, if, in his judgment, adequate evidence of satisfactory strength is provided.

D. Should individual tests of laboratory-cured specimens produce results more than 500 psi below specified strength (f'c), or tests of field-cured cylinders indicated deficiencies in protection and curing, take steps to assure that load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength concrete is confirmed and computations indicated that the load-carrying capacity may have been significantly reduced, tests of cores taken from the area in

question shall be required in accordance with "Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" (ASTM C-42). Three (3) cores shall be taken for each cylinder test more than 500 psi below specified strength (f'c). If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be immersed in water for at least 48 hours and tested wet.

E. Concrete represented by the above core tests will be considered structurally adequate if the average of the three cores is equal to at least 85% of *specified compressive strength* (f'c) and no single core is less than 75 % of (f'c). To check testing accuracy, locations represented by erratic core strengths may be retested. If these strength acceptance criteria are not met by the core tests, and if structural adequacy remains in doubt, the City Engineer shall order load tests for the questionable portion of the structure, or declare the section to be defective.

F. Testing shall be in accordance with the requirements of the Acceptance Section of the VDOT *Road and Bridge Specifications*.

11-730.16 DEFECTIVE WORK

A. Defective concrete is defined as concrete in place which does not conform to strength, specifications, shapes, alignments, appearance, and/or elevations as shown on the drawings; areas which contain faulty surface areas and/or concrete surfaces not finished in accordance with these specifications.

B. Remove all defective concrete and replace in a manner meeting with the City Engineer or his/her designee's approval. Should only surface imperfections occur, patch at the discretion of, and in a manner satisfactory to, the City Engineer or his/her designee. Permission to patch the work shall not be considered as a waiver of the City's right to require complete removal and replacement of such defective work should the patching fail to satisfactorily restore the required quality and appearance of the work.

The City Engineer or his/her designee may require cores to be drilled at no cost to the City from the completed slab to verify depth measurements or concrete specifications and strength. Sections showing a deficiency of more than 3/8 inch shall be removed and replaced to the specified depth at the Contractor's expense.

The City will require the removal and replacement of any concrete items where they have been broken, cracked, chipped, have become misaligned, grades are incorrect, does not meet dimensions as shown in the standard details, improperly cured, or of a substandard or non-approved product.

Such areas designated by the City Engineer or his/her designee, shall be repaired at no cost to the City. Items replaced shall conform to the requirements for new work as to strength and construction. During removal of defective work, an amount equal to the required lengths of construction joints must be removed and replaced.

11-730.17 CONCRETE CLASS

Concrete class for combined curb and gutter, curbs, sidewalks, driveways, flumes, ditches, steps, headwalls, and islands shall be a minimum of Class A3, 3000 psi or as designated in the specifications or drawing.

Prefabricated Concrete for headwalls, manholes or box culverts shall be a minimum of Class A4, 4000 psi in the City right of way (ROW) and easements or as approved by the City Engineer and/or designated in the specifications or drawings.

11-730.18 PLACEMENT LIMITATIONS

Placement limitations shall conform to the requirements of the VDOT *Road and Bridge Specifications* or American Concrete Institute (ACI) Standards most recent revision.

11-740 STANDARD CONCRETE CURB AND COMBINED CURB AND GUTTER

11-740.1 GENERAL REQUIREMENTS

This work shall consist of a single course of Class A-3 Portland cement concrete, constructed on a prepared subgrade in accordance with these specifications. It shall have the dimensions, cross-section, and location as shown on the plans or as directed by the City Engineer or his/her designee. See VDOT *Road and Bridge Standards* Volume I for standard concrete curb, combined curb and gutter, and valley gutter sections.

Horizontal alignment of curbs and combined curb and gutter shall be in reasonably close conformity to the lines shown on the plans. Vertical alignment shall not exceed +/- 3/8 inch in 10 feet from plan grade. Before concrete obtains full set, all exposed surfaces shall be finished with a brush moistened with clear water.

When constructing curb and gutter, the Contractor will be responsible for filling and compacting material in the space left behind the curb and gutter after the forms are removed. This shall take place within 3 to 7 days from pour and the material shall be compacted to the grade of the back of the curb. No extra compensation shall be made for this work.

Dowels shall be placed in the throat plate, to tie gutter to plate as required in the use of conventional forms.

11-740.2 JOINTS FOR CURB & GUTTER

A. **TRANSVERSE JOINTS**

Transverse joints for crack control for fixed forms shall be provided at the following locations:

1. At approximately 10-foot intervals;
2. At the gutter where the curb and gutter tie to the gutter apron of drop inlets;
3. When time elapsing between consecutive concrete placements exceeds 45 minutes
4. Where no section shall be less than 6 feet in length.

Transverse joints for crack control may be formed by using one of the following methods:

1. Removable 1/8-inch-thick templates.
2. Scoring or sawing for a depth of not less than 3/4 inch when using curb machine.
3. Approved “leave-in” type insert or may be formed or created using other approved methods which will successfully induce and control the location and shape of the transverse cracks.
4. Place a joint sealant in cracks after removal of templates.

If templates are used for transverse joints, templates shall be removed by stages, but not entirely until the concrete has become thoroughly hard. After removal of the templates, there must be a clear division throughout between these sections. Edging tools will be used to form an edge along the back and front form and at each template.

B. **EXPANSION JOINTS**

See Section 212 of the VDOT *Road and Bridge Specifications* for approved expansion materials. Expansion joints shall be formed with edge of expansion joint flush with grade of walking surfaces at intervals of approximately 90 feet, at all radii points at concrete entrances and curb returns, at locations no less than 6 feet and no more than 10 feet from drop inlets, at the end of days' work, and or all cold joints.

11-740.3 FORMS

A. FIXED FORMS

Steel forms shall be used for the construction of curb and gutter. Fixed forms shall be straight, free from warp, and of such construction that there will be no interference with the inspection of grade and alignment. Metal templates, not more than 3/16 inch in thickness and manufactured in accordance with the curb and gutter section, shall be set in the places provided in the forms not more than 10 feet apart. Templates shall be adjusted to prevent short sections (less than 5 feet). Forms shall extend the entire depth of the item and shall be braced and secured so that no deflection from alignment or grade will occur during concrete placement. Radial forms shall be sufficiently flexible or otherwise designed to provide a smooth, uniform, curved surface of the required radius. When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. Face forms shall be removed as soon as concrete has attained sufficient set for the curb to stand without slumping. The exposed surface shall then be smoothed by the use of a suitable finishing tool.

B. SLIP FORMS

In some places the Contractor may desire to use the slip form method to pour curb and gutter. In such cases approval from the City Engineer or his/her designee will be required. The contractor's proposed equipment must also receive the approval of the City Engineer or his/her designee.

1. **Equipment**: The slip form equipment shall be self-propelled and shall be equipped to consolidate, form, extrude, and finish the freshly placed concrete in such a manner that a minimum of hand finishing is required to produce a dense, consolidated, homogenous product. Slip form equipment shall be controlled to line and grade by automatic sensing, guidance, and control devices such that the machine automatically senses and follows taut guidelines or other stable reference, performing any necessary corrective action to ensure the correct grade and alignment is achieved.

   Equipment used for slip forming shall conform to the general requirements of Section 108.07 of the VDOT *Road and Bridge Specifications*.

   The Contractor shall plan and stage the work to eliminate the need for the slip form machine to be stopped during placement operations.

2. **Attachments**: The forms on the equipment must meet the precise dimensions shown on the VDOT *Road & Bridge Standards* Volume I for the different types of curb. A sufficient number of vibrators shall be provided on the machine and be in good working order.

3. **Line and Grade Controls**: It shall be the Contractor's responsibility to set the line and grade controls for his machine. These controls shall be checked by the inspector before any "trimming" or pouring occurs. However, approval of these controls by the inspector shall not relieve the Contractor of the responsibility of obtaining the planned grade or alignment according to the specifications or the approved standard drawings or construction plans.

4. **Subgrade Trimming**: It shall be the responsibility of the Contractor to ensure that the subgrade conforms to the standard details. No extra payment shall be made to the Contractor for "trimming" the subgrade if such "trimming" is less than the 6-inch limit allowed for unclassified excavation as defined in Section 303 of the VDOT *Road and Bridge Specifications*, Earthwork. Before pouring operations begin, the subgrade shall be checked by a City representative.

5. **Pouring Operations**: Before the machine starts a pour, the third-party geotechnical inspector will check the slump of the concrete. This slump must be between 0 and 2 inches. In the event that the slump exceeds 2 inches, the concrete will be rejected.

If in the event the inspector feels that the poured curb or gutter does not meet the exact dimensions of the "standard drawings" or for some other reason it does not conform to these specifications, (alignment, grade, materials, etc.) then the contractor at his own expense shall remove the faulty work before concrete obtains full set. No compensation shall be made for unsatisfactory work.

The contractor shall make sure that sufficient vibration of the concrete occurs. If vibrators fail to function, all operations shall cease until they are satisfactorily repaired.

Where storm inlets are designated, the contractor shall either leave a sufficient blank space to be hand formed later or work concrete to the exact dimensions for the standard inlet specified.

11-750 STANDARD CONCRETE SIDEWALK AND DRIVEWAY ENTRANCES

11-750.1 GENERAL REQUIREMENTS

This work shall consist of the construction of class A3, 3000 psi concrete sidewalk 4" inches thick and in accordance with these specifications. Sidewalks crossing driveways entrances shall be constructed 7 inches thick. See VDOT *Road & Bridge Standards* Volume I for sidewalk and driveway entrance openings.

Unless otherwise shown on the plans and approved by the City Engineer or his/her designee, all sidewalks shall maintain a ¼ inch per foot transverse slope.

Curb cuts for driveways shall be constructed as shown on the Standard Details for the type driveway or ramp specified on the plans or as directed by the City Engineer or his/her designee.

11-750.2 CURB RAMPS

Curb Ramps shall be constructed at all street intersection corners and at other major points of pedestrian crossing. The curb ramps shall be constructed as shown on the most recent revision of the VDOT *Road and Bridge Specifications* for the type shown on the plans or as directed by the City Engineer

Detectable Warning Surfaces for curb ramps shall be 2'x4' foot or 2x2' foot solid blocks and shall be RED in color. The Detectable Warning Surface shall meet the requirements of Section 504 of the VDOT Road and Bridge Specifications, CG-12 Detectable Warning Surface and the Detectable Warning Surface material shall be from VDOT Approved Materials List 72.

Wire mesh or reinforcing steel will be used if recommended by the City Engineer or as shown on approved design plans. For installation of mesh or steel, see the applicable section of the VDOT *Road and Bridge Specifications*.

The curb ramp foundation shall be thoroughly moistened immediately prior to concrete placement. Concrete shall be placed in forms by methods that will prevent segregation. Concrete shall be spread to the full depth and brought to grade by screening and straight edging. Concrete shall be spaded adjacent to forms to prevent a honeycomb appearance, and the surface shall be floated with a wooden float to produce a surface free from irregularities. The final finish shall be obtained with an approved hand float that will produce a uniform surface texture. Light brooming may be used to hide trowel marks. Outside edges of the sidewalk slab and joints shall be edged with an edging tool having a radius of 1/4 inch.

When required as part of construction, reinforcing steel shall be properly spaced and thoroughly tied before concrete is placed.

11-750.3 SIDEWALK TOLERANCES

Horizontal alignment of sidewalks shall be to the lines and grades as shown on the plans and details. Vertical alignment shall not exceed +/- 3/8 inch in 10 feet from the plan grade.

11-750.4 JOINTS FOR CONCRETE SIDEWALK AND DRIVEWAY ENTRANCES

Transverse expansion joints shall be constructed at intervals of approximately 30 feet. Slabs shall be separated by transverse preformed joint filler, 1/2 inch in thickness that extends from the bottom of the slab to approximately 1/4 inch below the top surface.

The slab between expansion joints shall be divided into sections equal in width to the sidewalk by transverse score joints formed by a jointing tool, trowel, or other approved means. For 5-foot wide sidewalk, the slab between expansion joints shall be divided into sections approximately 5 feet in length by transverse score joints formed by a jointing tool, trowel, or other approved means. Transverse control joints shall also be provided when the time period between consecutive concrete placements is more than 45 minutes. Control joints shall extend into concrete for at least 1/4 of the depth and shall be approximately 1/8 inch in width. Where slabs are more than 7 feet in width, control joints shall be formed longitudinally to obtain secure uniform blocks that are approximately square. Transverse control joints shall also be installed where the corners of the drop inlets project into the sidewalk.

Construction joints shall be formed around appurtenances extending into and through the sidewalk. Preformed joint filler 1/4-inch thick shall be installed in these joints except that joint filler shall not be used adjacent to drop inlets. Preformed joint filler shall be securely fastened. An expansion joint shall be formed and filled with 1/4-inch preformed joint filler no less than 6 feet and no more than 10 feet from drop inlets. Preformed joint filler shall also be installed between concrete sidewalk and any adjacent fixed structure which is not tied to the sidewalk with steel dowels.

A. **PLACING CONCRETE**

See **11-730.9** Placement, above for requirements.

B. **FINISHING**

See 11-730.11 Finishing, above for requirements.

C. **CURING**

See 11-730.12 Curing, above for requirements.

11-750.5 FORMS

A. **FIXED FORMS**

See paragraph **11-740.3.A** Fixed Forms, above for requirements

B. **SLIP FORMS**

Slip form pouring shall be allowed with approval of the City Engineer or his/her designee. All portions of paragraph **11-740.3.B.** Slip Forms above, concerning pouring operations with slip forms shall apply.

11-760 FACEDOWN CONCRETE SIDEWALK

11-760.1 GENERAL REQUIREMENTS

This type of sidewalk construction shall consist of standard sidewalk as specified in above paragraph 11-740 Standard Class A3, 3000psi Concrete Sidewalk and Driveway Entrances, of these specifications, poured monolithically with a 12-inch curb as shown on VDOT *Road and Bridge Standards Volume I* See also VDOT *Road and Bridge Standards Volume I* for driveway entrance openings.

The methods of construction for facedown sidewalk shall be the same specified in Section 11-750 Standard Concrete Sidewalk and Driveway Entrances of these specifications with the following additions:

A. A joint shall be cut with an approved edging tool 6 inches from the face of the curb and parallel thereto.

B. All expansion joints in the sidewalk shall extend across the top and face of the curb.

C. The final finish for the top of the curb shall be made with a brush dampened with water, to match the finish of the adjoining structure.

11-770 CONCRETE RETAINING WALLS, HEADWALLS, STEPS, PIERS FOR STREAM CROSSINGS, FLUMES AND DITCHES, MEDIAN BARRIERS, MEDIAN STRIPS, ISLANDS, ETC.

11-770.1 GENERAL REQUIREMENTS

This work shall consist of concrete retaining walls, headwalls, steps, piers for stream crossings, flumes and ditches, median barriers, median strips, islands, etc. These structures shall be constructed to the dimensions, cross-section, and located as shown on the plans or shown on the standard details, as directed by the City Engineer or their designee or the most recent revision to VDOT *Road and Bridge Standards*.

11-770.2 REINFORCING STEEL

Reinforcement steel shall be placed in accordance with Section 406 of the VDOT *Road and Bridge Specifications,* the drawings, and the Concrete Reinforcing Steel Institute's *Placing Reinforcing Bars Recommended Practices,* the latest edition of ACI 318, *Building Code Requirements for Reinforced Concrete,* latest edition.

SECTION 11-800 PRECAST CONCRETE

11-810 GENERAL CRITERIA

11-810.1 DESCRIPTION OF WORK

Provide all plants, labor, equipment, and material to provide the precast concrete structures including manholes but excluding pipe, as called for on the approved plans, Construction Standards and this section.

11-810.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 5-300: Water Mains and Appurtenances
- Section 7-300: Sanitary Sewers and Appurtenances
- Section 11-700: Cast-In-Place Concrete

11-810.3 APPLICABLE SPECIFICATIONS

- American Society for Testing and Materials (ASTM)
- Virginia Department of Transportation (VDOT), Road and Bridge Specifications.

11-810.4 QUALITY ASSURANCE

A. All precast concrete items shall be products of one (1) or more manufacturers having demonstrated competence in the design and production of precast concrete specialties of the types specified herein for a minimum of three (3) years.

B. The referenced documents of Section 11-700 shall become a part of this section.

11-810.5 SUBMITTALS

A. Prior to delivering any materials to the project site, submit to the City Engineer for approval shop drawings for fabrication and setting of the precast concrete work, along with manufacturer's detailed descriptive literature. All shop drawings shall be certified for the intended use by a professional engineer.

B. Submit certified concrete mix design for the structures to be furnished to the job site.

C. Submit certified test reports for the aggregate, cement, admixtures, reinforcing and curing materials used in the fabrication of the structures.

11-810.6 CLASS OF CONCRETE

Portland Concrete for precast structures shall be VDOT Class A4 General Use unless stated otherwise on the approved plans.

11-820 MATERIALS

11-820.1 GENERAL

Concrete materials, methods of mixing, conveying, curing, placing, reinforcement, and the making and removal of forms shall conform to the requirements of Section 217 of the VDOT *Road and Bridge Specifications*.

11-820.2 PRECAST CONCRETE MANHOLES

A. Precast concrete manhole bases, risers and cones shall conform to requirements of ASTM C-478 with configurations as shown in the drawings. Cones shall be eccentric. Manhole sections for sanitary sewers shall be of male and female end type with a preformed groove provided in the male end for placement of a round rubber gasket ring. Rubber gasket rings shall meet the requirements of ASTM C- 361 of C-443. The gasket shall be the sole element utilized in sealing the joint from either external or internal hydrostatic pressure. Use the appropriate lubricant as directed by the manufacturer.

B. Each precast section shall be clearly marked on the inside near the top with the following information where applicable: ASTM designation, Standard detail or drawing number, station location and designation, date of manufacture and name or trademark of manufacturers. Precast concrete manholes shall be manufactured by a Precast Company as approved by the City Engineer.

11-830 EXECUTION

11-830.1 FABRICATION AND TESTING

Fabrication and testing of the precast concrete structures shall be in accordance with the stipulated execution procedures of Section 327 of the VDOT Road and Bridge Specifications.

SECTION 11-900 MASONRY

11-910 GENERAL CRITERIA

11-910.1 DESCRIPTION OF WORK

Provide all labor, materials and equipment necessary to furnish and install masonry as called for on the approved plans and as specified herein.

11-910.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-1300 : Protective Coatings

11-910.3 APPLICABLE SPECIFICATIONS

- American Society for Testing and Materials (ASTM).
- Virginia Department of Transportation (VDOT), Road and Bridge Specifications.

11-910.4 SUBMITTALS

Submit to the City Engineer, two (2) representative samples of each kind and type of masonry specified for the project and sample of anchors and ties. Do not purchase masonry until samples are approved by the City Engineer.

11-920 MATERIALS

11-920.1 MASONRY UNITS

Masonry block and brick units shall conform to Section 222 of the VDOT Specifications.

11-920.2 MORTAR AND GROUT

Mortar and grout shall conform to the latest requirements of Section 218 of the VDOT Specification.

A. Mortar for unreinforced masonry and brick.

   The mix for unreinforced masonry shall conform with ASTM C270, Type M with the following options:

   1. Portland Cement Mortar: 1 part Portland cement; 1/4 part hydrated lime and lime putty; 3-1/2 parts sand.
   2. Masonry Cement Mortar: 1 part Portland cement; 1 part masonry cement; 4-1/2 parts sand.

B. Mortar and Grout for Reinforced Masonry.

   1. The mix for reinforced masonry shall conform with ASTM C476 Type PM or PL.
   2. Mixing water shall be clean and free of organic material.

11-920.3 WELDED WIRE FABRIC

Welded wire fabric shall conform to Section 223 of the VDOT specifications.

11-920.4 STEEL REINFORCEMENT

Steel reinforcement called for on the approved plans shall be deformed bars, grade 40, in conformance with Section 223 of the VDOT specifications.

11-920.5 REINFORCEMENT, ANCHORS, AND TIES

A. Masonry joint reinforcement shall be factory fabricated from zinc coated cold-drawn steel wire, ASTM A82. Reinforcement shall consist of two or more deformed longitudinal wires minimum size No. W1.5, weld connected with minimum size No. W1.5 cross wires, forming a truss or ladder design. Zinc coating, ASTM A116, Class 1, except that cross wires used for cavity wall ties shall be Class 3. Out-to-out spacing of longitudinal wires shall be approximately two (2) inches less than the normal width of the block or wythe in which it is placed. Distance between welded contacts of cross wires with each longitudinal wire shall not exceed sixteen (16) inches. Joint reinforcement shall be furnished in flat sections ten (10) to twenty (20) feet in length, except that factory-formed corner reinforcements and other special shapes may be less in length.

B. Anchors and ties shall be zinc-coated, ferrous metal of the types specified. Zinc coating ASTM A153, Class B-1, or B-3 as applicable. Copper cladding of steel wire shall conform to the requirements as specified for Grade 30 HS wire in ASTM Specification B227.

11-930 EXECUTION

11-930.1 GENERAL

A. Build into masonry, bolts, anchors, nailing blocks, inserts, expansion joints, and other items necessary and incidental to the completion of the project.

B. Masonry shall be laid with plumb, true to line, with level courses accurately spaced with a story pole, and unless otherwise shown, with each course breaking joints with the course next below. Each unit shall be adjusted to its final position in the wall while mortar is still soft and plastic. Any unit that is disturbed after mortar has stiffened shall be kept plumb throughout. Corners and reveals shall be plumb and true. Courses shall be so spaced that backing masonry will level off flush with the face work at all joints where metal ties are used. Anchors, accessories, and other items required to be built in with masonry shall be built in as the masonry work progresses. Cutting and fitting of masonry shall be done by masonry mechanics with power-driven masonry saws.

C. Weather Requirements - Masonry Units:

D. Precondition and protect masonry units in cold weather as follows:

1. Avg. daily air temperature between 32 degrees F and 40 degrees F -- protect newly laid masonry from rain and snow for 24 hours.

2. Avg. daily air temperature between 25 degrees F and 32 degrees F -- provide heat on both sides of construction masonry; use wind breaks for winds above 15 mph; cover masonry with insulating blankets for 24 hours.

3. Avg. daily temperature below 20 degrees F -- provide enclosure and heat to maintain air at 32 degrees F for 24 hours. Do not lay masonry units at temperatures colder than 30 degrees F.

E. Weather Requirements - Mortar and Grout

1. Hot Weather: Add water as needed to supplement evaporation losses.

2. Cold Weather: When air temperatures range between 32 degrees F and 40 degrees F, heat mixing water or aggregate to between 70 degrees F and 160 degrees F maximum. When air temperature is below 32 degrees F, and only with the approval of the Engineer, heat both the mixing water and aggregate to between 70 degrees F and 160 degrees F maximum.

F. Before resuming work, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

11-930.2 STORAGE

A. Store cementitious materials on pallets under a tarpaulin cover in a dry place. Covers shall overhang two (2) feet down each side and be held securely in place.

B. Reinforcing, metal ties, and anchors shall be protected from contact with soil and before being placed shall be free from loose rust and other coatings that will destroy or reduce the bond.

C. Protect mortar and grout materials from moisture, foreign material and deterioration.

11-930.3 MORTAR AND GROUT QUALITY CONTROL

A. Prepare sample batches of mortars and grouts prior to beginning masonry work.

B. Test in accordance with ASTM C270 (Unit Masonry) or ASTM C476 (Reinforced Masonry), whichever applies. Send copies of test results to the Engineer for approval.

11-930.4 MIXING MORTAR AND GROUT

Mix mortar in accordance with ASTM C270 (Unit Masonry) and mortar and grout in accordance with ASTM C476 (Reinforced Masonry). Mortar or grout not used within 2-1/2 hours after mixing shall not be used in masonry work.

11-930.5 LAYING CONCRETE MASONRY UNITS

A. All sections herein shall apply to ordinary masonry units.

B. All concrete masonry units shall be running bond with units in the courses above regularly breaking joints with the units below, unless otherwise indicated on drawings.

C. Layout all openings before construction. The final location of openings shall be adjusted so that partial size units may be kept to a minimum.

D. Reinforcing mesh shall be installed in the three courses above all openings and shall extend three feet-nine inches (3 ft. 9 in) beyond each side of opening. Mesh shall be installed in every third course of all masonry unit walls.

E. Do not set patched, chipped, cracked, broken or otherwise defective units. Cut out defective joints and repoint.

F. All intersecting walls shall be keyed together with masonry units.

G. Cut block with a carborundum saw. Do not cut with hammer and chisel.

H. Use solid load-bearing block where required for structural purposes. Use hollow load-bearing block at all other locations.

I. Leave all necessary openings for the passage of pipes and drains. At completion of the work of other trades, return and close all openings.

J. Keep the open space at control joints and expansion joints free of mortar by using a continuous wood or metal strip temporarily set in the wall. Caulk control and expansion joints.

K. Standard width of mortar joints for both horizontal and vertical joints shall by three-eighths (3/8) inch. Joints shall have full mortar coverage on vertical and horizontal face shells, but mortar shall not extend through unit on the web edges. Compact mortar joints on the weather side of exterior walls and press tight against the edges of the units with a proper tool.

11-930.6 BRICK PLACEMENT

A. Lay all face brickwork in straight running bond, level, with joints struck flush, then tooled with a concave pointing tool. Three (3) courses shall equal eight (8) inches in height. Mortar beds shall be full. Fill voids solid with mortar. Fill all vertical joints with mortar except weepholes.

B. Carry facings and backing of exterior walls simultaneously and bond as required.

C. Set reinforcement flashing and ties every two (2) sq. ft. of wall surface.

D. Provide rope wick weepholes, spaced approximately thirty-two (32) inches on center, in vertical joints of first course, over all counter flashing and through wall flashing on all exterior walls.

E. Project bolts from the face of the masonry a sufficient distance to allow for the proper attachment intended. Oil all threads and protect by waterproof caps.

F. All joints shall be uniform and 3/8-inch thick unless otherwise indicated.

G. Joints in exposed or painted surfaces shall be tooled when thumbprint hard with a round jointer. Joints shall be flush on the vertical and concave on the horizontal.

H. Joints in unparged masonry below grade shall be pointed tight with a trowel.

I. Mortar protrusions extending into cells or cavities to be reinforced and filled shall be removed.

J. Fill horizontal joints between top of masonry partitions and underside of concrete slabs or beams with mortar.

11-930.7 BONDING WITH MASONRY BONDERS

A. Where two or more masonry units are used to make up a thickness of a wall, inner and outer wythes shall be bonded at vertical intervals not exceeding thirty four (34) inches by transverse lapping of stretcher units at least three (3) inches over units below, or by lapping with units at least three (3) inches over units below, or by lapping with units at least 50% greater in width than unit below at vertical intervals not exceeding seventeen (17) inches.

B. Bond intersecting bearing walls with metal ties at vertical intervals not to exceed sixteen (16) inches.

C. When intersecting bearing walls are carried up separately, regularly block (tooth) vertical joint with eight (8) inch maximum offsets. Provide joints with rigid steel anchors at vertical intervals not to exceed forty-eight (48) inches. When approved, blocking may be eliminated and rigid steel anchors provided at vertical intervals not to exceed twenty-four (24) inches.

D. Anchor abutting or intersecting interior non-load bearings walls with metal ties at vertical intervals not to exceed twenty-four (24) inches and extending at least four (4) inches into the masonry.

E. Construct all concrete masonry in accordance with the National Concrete Masonry Association.

11-930.8 ANGLES AND BEAMS

A. Adjust as required to keep masonry level and at proper elevation.

B. Embed beams firmly in mortar of same quality as used in laying masonry wall.

11-930.9 JOINTING AND CLEANING

A. At the completion of the work, all holes in joints of masonry surfaces, except weepholes, shall be filled with mortar and suitably tooled.

B. Dry brush masonry surface at the end of each day's work and after final pointing using wire brushes if necessary to remove mortar but exercise care not to scratch or damage work.

SECTION 11-1000 STRUCTURAL STEEL & MISCELLANEOUS METAL

11-1010 GENERAL CRITERIA

11-1010.1 DESCRIPTION OF WORK

Provide all plant labor, supervision, material and equipment to furnish and install all structural steel and miscellaneous metal items with accessories, fasteners, anchors, etc., complete in place as shown on the approved plans.

11-1010.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-1300 Protective Coatings

11-1010.3 APPLICABLE SPECIFICATIONS

- American Institute of Steel Construction (AISC).
- American Society for Testing and Materials (ASTM).
- American Welding Society (AWS).
- Virginia Department of Transportation (VDOT), Road and Bridges Specifications.

11-1010.4 SUBMITTALS

A. Before any fabrication is begun, submit detailed shop drawings of all miscellaneous metal items showing sizes of metal components, method of assembly, hardware, and anchorage or connection to other work.

B. Submittals shall include detailed descriptive literature of manufactured items specified herein.

11-1010.5 QUALITY ASSURANCE

Fabrication and installation procedures shall conform to the specifications and practices of the American Institute of Steel Construction.

11-1020 MATERIALS

11-1020.1 GENERAL

A. Standard Structural Steel Shapes and Plates shall be in conformance with ASTM A-36.

B. Steel Pipe shall be in conformance ASTM A-53, Type E or S, Grade A or B.

C. Cast Iron shall be in conformance with ASTM A-48, Class 30, unless otherwise indicated.

D. Fastenings shall be in conformance with Section 226, (e) and (f) of the VDOT specifications.

E. Welding Electrodes shall be as permitted by AWS Code D1.0.

F. The primers shall be as specified in Section 11-1300: Protective Coatings.

11-1020.2 RAILINGS

A. Material: Assemble all railings from stock components. Extrude rails, post and fittings of aluminum alloy 6063 or 6061. All fasteners shall be stainless steel. The finish shall be clear stain anodized. Railings shall be as manufactured by Vanrail Corporation, J.G. Braun Co., or approved equal. Painting of railings shall meet the requirements of Section 11-1300 of this Article.

B. Rail and Post Spacing: Post spacing shall not exceed four feet six inches (4'6") on center. Unless shown otherwise on the drawings, the top rail shall be located at a height of three feet six inches (3’6”), except stair runs shall have top rail at a height of two feet ten inches (2'10") and enclosed stair landings shall have top rail at a height of three (3) feet.

11-1020.3 GRATINGS

All gratings shall be as indicated on the standard drawings.

11-1020.4 EXPANSION BOLTS

A. Bolts shall be "Wej-It" concrete anchors as manufactured by "Wej-It" Expansion Products, Inc., Broomfield, Col., "Taper Bolt" as manufactured by U.S. Expansion Bolt Co., York, Pa., or approved equal.

B. Self-drilling expansion anchors where called for on the plans shall be "Red Heads" as manufactured by the Phillips Drill Co., Michigan City, Indiana, or approved equal.

C. Contractor shall submit certified test reports establishing shear and tensile pull out for the anchors used.

D. Bolts shall be of the same type as the members, which they support, that is Type 2024-T6 alloy for aluminum shapes and hot dipped galvanized steel for structural steel shapes. Stainless steel bolts shall be used in all process units.

11-1030 EXECUTION

11-1030.1 GENERAL

A. Furnish all bolts, nuts, screws, clips, washers, and any other fastenings necessary for proper installation of items specified or called for on the approved plans. For ferrous metal, use stainless steel on exterior. On interior, match adjacent material.

B. Metal for shop-fabricated items shall be well formed to shape and size, with crisp lines or angles. Shearing and punching shall leave clean, true lines and surfaces. Weld permanent connections and grind smooth where exposed to view. Dress all sharp edges.

C. Verify all measurements at job.

D. Field drill or punch holes; do not use cutting torch. Shearing and punching shall leave true lines and surfaces.

E. Construct to sizes indicated using rolled shapes and/or plates as detailed. Include wall and sill anchors for construction indicated.

F. Set all work plumb, true, rigid, and neatly trimmed out.

G. Grout plates, bolts, and similar items with non-shrink grout.

H. Ship railings with factory-preassembled posts and fittings. Assemble on location in accordance with manufacturer's instructions, keeping posts plumb and posts parallel to either horizontal or rake.

I. Castings subject to foot or street traffic shall have bearing surfaces machined to prevent rocking and rattling.

J. Protect all dissimilar metals from galvanized corrosion by pressure tapes, coatings, or isolators.

11-1030.2 WELDING

Perform all ferrous metal welding in accordance with AWS Code D1.0. Use only pre-qualified welding procedures in accordance with AWS paragraph 103(a) and only by operators experienced in performing the type of work indicated.

11-1030.3 BOLTED CONNECTIONS

A. In general, use bolts for field connections only and then only as detailed. Provide washers under all heads and nuts bearing on wood. Draw all nuts tight and nick threads of permanent connections to prevent loosening. Use beveled washers where bearing is on sloped surfaces.

B. Provide grating with necessary minimum clearances and fit so as to lay flat and not rock in any fashion. Provide U-clips in each corner of the grating sections.

11-1030.4 PROTECTION OF SURFACES

A. Provide protection by strippable coating, protective sleeves, polyethylene sheets, boarding, or other suitable means during fabrication, shipment, site storage, and erection to prevent damage to the finished work due to stains, discolorations, scratches, or any other cause. Replace damaged elements at no expense to the City.

B. After installation, and after danger of subsequent damage has passed, remove all protective coverings from all exposed surfaces, and clean those surfaces of all soil and discoloration, ready for acceptance.

SECTION 11-1100 ROUGH CARPENTRY

11-1110 GENERAL CRITERIA

11-1110.1 DESCRIPTION OF WORK

A. Provide all labor, material and equipment to furnish and construct with structural timber and lumber as called for on the approved plans and specified herein.

B. The work includes timber and lumber construction and all other incidental construction.

11-1110.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-200 Demolition
- Section 11-100 Clearing and Grubbing
- Section 11-1200 Wood Preservatives

11-1110.3 APPLICABLE SPECIFICATIONS

- American Lumber Standards.
- Virginia Department of Transportation (VDOT), Road and Bridge Specifications.

11-1110.4 APPLICABLE REFERENCES

- American Association of State Highway and Transportation Officials (AASHTO).

- National Forest Products Association (NFPA).

11-1110.5 PRODUCT HANDLING

All structural timber and lumber shall be delivered, stored, handled and installed in a manner to prevent twisting, warping or other damage that would preclude satisfactory installation.

11-1120 MATERIALS

11-1120.1 STRUCTURAL TIMBER

Structural timber and lumber shall conform to Section 418 of the VDOT Specifications.

11-1120.2 TREATED TIMBER

Where treated timber or lumber is required, the preservative and treatment shall be as specified in Section 11-1200 of these specifications titled: Wood Preservatives.

11-1130 EXECUTION

11-1130.1 INSPECTION

Timber and lumber shall be grade marked in accordance with grading rules and basic provisions of the "American Lumber Standards" by a lumber grading or inspection bureau or agency approved by the City Engineer.

11-1130.2 INSTALLATION

The structural timber or lumber shall be installed properly in the sizes and grades and to the alignment with fastenings as shown on the approved plans.

SECTION 11-1200 WOOD PRESERVATIVES

11-1210 GENERAL CRITERIA

11-1210.1 DESCRIPTION OF WORK

Provide all plant, labor, material and equipment to treat structural and miscellaneous timber called for on the approved plans.

11-1210.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-1300 Protective Coatings

11-1210.3 APPLICABLE SPECIFICATIONS

- American Association of State Highway Transportation Officials (AASHTO).
- Virginia Department of Transportation (VDOT), Road and Bridge Specifications.

11-1210.4 APPLICABLE REFERENCES

- American Wood Preserver's Association (AWPA).

11-1210.5 QUALITY ASSURANCE

Provide certified test reports as required by AASHTO M-133.

11-1220 MATERIALS

11-1220.1 CONFORMANCE

Materials shall conform to Section 236.02 of the VDOT Specifications.

11-1230 EXECUTION

11-1230.1 PREPARATION

Preparation, treatment, and penetration shall conform to Section 236.02 of the VDOT specifications.

SECTION 11-1300 PROTECTIVE COATINGS

11-1310 GENERAL CRITERIA

11-1310.1 DESCRIPTION OF THE WORK

Provide all labor, materials, and equipment for the complete application of protective coatings for interior and exterior surfaces as required in accordance with these specifications and where called for on the approved plans.

11-1310.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-1200 Wood Preservatives

11-1310.3 APPLICABLE SPECIFICATIONS

- American Society for Testing and Materials (ASTM).
- Steel Structures Painting Council (SSPC).

11-1310.4 SURFACES NOT TO BE PAINTED

The following surfaces are not to be painted. (If surfaces referenced below are to be coated, specific instructions will be given on the approved plans.)

- Non-ferrous metals; for example: aluminum, copper, monel, brass.
- Stainless steel
- Chain Link fencing
- Concrete walks, curbs
- Exterior concrete foundations
- Plastic
- Brick
- Galvanized steel

11-1310.5 SUBMITTALS

Submit a complete list of materials and color charts. The City Engineer will select colors.

11-1310.6 QUALITY ASSURANCE

A. Primers, Intermediate and top coats for each surface shall be supplied by one (1) manufacturer.

B. Thinners, solvents, cleaning compounds shall comply fully with the recommendations of the coatings manufacturer.

C. The protective coating systems shall be tested and inspected for acceptance in accordance with Section 11-1330 of this Article.

11-1310.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

Deliver painting materials to the site in the original manufacturer's containers with labels intact and seals unbroken. Store materials in an area specifically assigned for storage. Storage area shall be well ventilated and kept locked. Keep storage area clean. Remove oily rags daily and dispose same properly. Take all necessary precautions to avoid fires.

11-1310.8 GUARANTEE

Protective coatings shall be guaranteed for a period of one (1) year after acceptance of the project by the City. Approximately one (1) month prior to the expiration of this guarantee period, the City Engineer will notify the Contractor to coordinate inspection of the coatings. All coatings for the project shall be inspected and failures repaired at no cost to the City. Normal wear, abrasion, or physical damage as determined by the City Engineer will not be considered as failures.

11-1320 MATERIALS

11-1320.1 PROTECTIVE COATING SYSTEMS

The protective coating systems specified under this section are generic in form. The systems are manufactured by a number of acceptable manufacturers, no one of which can provide all of the systems for this contract. It is intended, therefore, that the systems be provided by the following manufacturers:

- Koppers Company, Pittsburgh, PA
- Tnemec Company, Inc., Kansas City, MO
- Hughson Chemicals, Lord Corp., Erie, PA
- Wise Chemical Company, Pittsburgh, PA
- Carboline Company, St. Louis, MO
- Pennsbury Coating Corp., Bucks Co., PA

11-1320.2 PAINT MATERIALS

The following descriptions apply to the short form identifications of the primers, intermediate and top coats specified under the various systems of Section 11-1320.3 following. Other acceptable coatings of the above named manufacturers exist, but have not been defined herein.

Coating	*Description*
Coal Tar - Black	High build coal tar solution containing 65% solids by volume.
Coal Tar Epoxy - White	High build 2-component white coal tar epoxy coating having a minimum epoxide resin content of 34% by weight in the dry film and minimum solids content of 82% by volume.
Epoxy - Polyamide	Two component Polyamide epoxy containing 55% solids by volume. With exposure at 45 degrees facing ocean exhibit no blistering, cracking delamination after 36 month's exposure. Exhibits no more than 130 mg. loss after 100 grams load of Federal Test Method Std. No. 141 Method 6192.
Epoxy - Primer - Red	Two component polyamide epoxy containing a minimum of 53% solids by volume having performance equal to the epoxy-polyamide above.
Modified Epoxy	High build decorative sand texture finish suitable for use on new and previously painted concrete and masonry and having 50% minimum solids by volume. When subject to ASTM D-2247 test for humidity will exhibit no blistering, softening, or loss of film integrity, or change in color after 1,000 hours.
Polyurethane Enamel	Two component aliphatic polyurethane highly resistant to abrasion; corrosive fumes, moisture and chemical contact and containing a minimum of 50% solids by volume. Shall show no blistering, cracking, softening or delamination of film after 5,000 hours' exposure (ASTM D-2247 humidity) and shall meet the abrasion and gloss test of the polyurethane aliphatic-1.

11-1320.3 PAINT SYSTEMS

Unless specified otherwise, it is understood that each stage of coating (primer, intermediate and top) receives only one (1) coat. Note that the dry film thicknesses (d.f.t.) specified denotes the average. The minimum acceptable in the thickness tests are noted in parentheses ().

A. Concrete and Masonry

1. System "A-1"

   Interior - Immersion or Non-immersion Primer

   Epoxy-Polyamide 5.0 mils d.f.t.

   (4.0) mils minimum)

   Final Coat

   Polyurethane Enamel 2.0 mils d.f.t.

   Semi-gloss (color) (1.5 mils minimum)

2. System "A-4"

   Interior - Immersion or non-immersion - Sewer Structures when specifically called for on the approved drawings.

   1 Coat

   Coal Tar Epoxy - White 22.0 mils d.f.t.

   (20.0 mils minimum)

3. System "A-3"

   Interior Walls or Exterior Walls Above Grade Finish Coat

   Modified Epoxy 10.0 mils d.f.t.

   (8.0 mils minimum)

4. System "A-5"

   Exterior Walls to be Backfilled

   Primer

   Coal Tar - Black 15.0 mils d.f.t.

   Final Coats

   Coal Tar - Black 15.0 mils d.f.t.

   TOTAL: 30.0 mils d.f.t.

   (27.0 mils minimum)

B. Steel and Iron

1. System "B-1"

Non-Immersion - Severe Corrosive Condition Primer

Epoxy - Polyamide	5.0 mils d.f.t.
(semi-gloss)	(4.0 mils minimum)
Top Coat	
Polyurethane Enamel	2.0 mils d.f.t.
(semi-gloss - color)	(1.5 mils minimum)

2. System "B-2"

Non-Immersion - Mild Corrosive Condition Primer

Epoxy Primer - Red	4.0 mils d.f.t.
Top Coat	(3.0 mils minimum)
Epoxy - Polyamide	5.0 mils d.f.t.
	(4.0 mils minimum)

C. Wood

1. System "C-1"

All Exposures

Primer and Top Coat

Epoxy - Polyamide	2.5 mils d.f.t.
2 coats - each coat	(2.0 mils minimum)

11-1320.4 GALVANIZING

A. All exterior and/or interior steel work, where indicated on the Contract Documents, shall be galvanized by the hot-dip process, conforming to ASTM A-386 for assembled steel products. All required hot-dip galvanizing shall be done after fabrication, in the largest sections possible. Items too large for available dip tanks shall be sprayed, by approved methods, with molten zinc to coating thicknesses of .003 inch.

B. Weight of zinc coating per square foot of actual surface shall average no less than two (2) ounces and no individual specimen shall show less than 1.8 ounces.

C. All bolts and screws for attachment of galvanized items shall be galvanized or non-corrodible material.

11-1330 EXECUTION

11-1330.1 INSPECTION

A. Complete records shall be kept by the Contractor and furnished to the City Engineer. These records shall identify the particular paints that were applied to a surface, the date of application, area coated, climatic conditions, and the following post-application quality control data:

   1. Wet film thickness; three (3) readings per one hundred (100) sq. ft.

   2. Dry film thickness; (1) reading per two hundred and fifty (250) sq. ft.

B. Repair all damaged coated areas. Apply the material in accordance with the coating manufacturer's recommendations so that the repaired area is equal to the undamaged coated areas in all respects.

11-1330.2 SURFACE PREPARATION

All surfaces to be coated shall be cleaned, free of harmful scale, rust, dirt, oil, grease, moisture, concrete mortar, loose and damaged coatings and all foreign matter.

A. Concrete: Concrete shall be fully cured prior to coating. Fully cured shall be defined as 28 days at 75 degrees F or 49 days at 50 degrees F. If admixtures or concrete substitutes are used, fully cure as follows; 37 days at 75 degrees F or 53 days at 50 degrees F. Rebuild rough, chemically attacked and/or abraded surfaces. Rebuild concrete surfaces containing air, water pits, splatter, fins, protrusions, bulges, or other surface irregularities while the concrete is still "green."

B. Steel and Iron:

   1. Remove all weld splatter. Grind all edges, projections, sharp corners and welds to a smooth, rounded contour.

   2. Remove oil and grease from surfaces by solvent cleaning in accordance with the Steel Structures Painting Council Specifications (SSPC).

   3. Abrasive blast steel and iron surfaces in accordance with SSPC-SP-10 (Near-White Blast).

   4. In areas where blasting is not feasible, obtain the approval of the City Engineer to use power tool cleaning in accordance with SSPC-SP-3.

   5. Remove dust and spent sand from the surfaces after sand blasting by brushing and vacuum cleaning.

   6. Apply the prime coat as soon as possible after the preparation is complete and before the dew point is reached. All surfaces blasted and power-tooled in one day shall be coated on the same day. Leave whip-blast or power tool areas exposed overnight.

C. Galvanized Steel Surfaces: Conform to ASTM A-384 and A-385 (Recommended Practices) pertaining to galvanizing assembled steel products. Unless otherwise permitted, do all galvanizing after fabrication, in largest sections practicable. Where galvanizing is removed by welding or other assembly procedure, touch up abraded areas with molten zinc or zinc-rich paint.

D. Concrete or Cinder Block: Concrete or cinder block substrates shall be clean, dry and free of oils and release agent contaminants. If necessary, spot clean with solvent and wash with strong detergent and warm water. Flush with high pressure water and allow to dry for approximately one (1) hour before application.

E. Brick: Clean off all mortar, uneven loose or detrimental foreign matter. Apply a cleaning compound approved by the coating manufacturer. Allow to stand on the brick for at least 15 minutes. Thoroughly remove the cleaning compound by high pressure spray delivering 1 to 3 gpm at 1,000 psi. Allow to dry for at least one (1) hour and paint as soon as possible after drying.

F. Wood: Maintain the surface in a clean and dry manner. Fill cracks and nail holes with putty after the first coat has been applied. Seal knots and sap streaks with material approved by the manufacturer. Sand surfaces to a fine smooth finish.

11-1330.3 APPLICATION

A. Mix all paint and tinting colors in strict accordance with the specifications of the paint manufacturer. Except for epoxies, mix paints at storage area and deliver to the site ready-mixed.

B. Apply coatings uniformly and in a continuous film by brush or spray, leaving no sags, holidays, pinholes, bubbles, or other defects. Coatings judged unsatisfactory by the City Engineer shall be corrected at no additional cost to the City.

C. Do not apply paint when the surrounding air temperature, as measured in the shade, is below 50 degrees F. or less than 5 degrees F. above the dew point. Do not apply paint to wet or damp surfaces or when the humidity exceeds 85%.

D. Vary the colors of successive coats.

E. Do not apply successive coats until the City Engineer has completed inspection.

F. All shop galvanized steel work necessitating field welding which in any manner removes original galvanizing shall be restored by field cold galvanizing with "Ferraloy," "Tin Easy Fluid," "Galvaloy," or approved equal.

SECTION 11-1400 WATERPROOFING

11-1410 GENERAL CRITERIA

11-1410.1 DESCRIPTION OF THE WORK

Provide all plant, labor, equipment and materials to waterproof all sanitary manholes and other structures subject to hydrostatic head.

11-1410.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-1500 Dampproofing

11-1410.3 APPLICABLE SPECIFICATIONS

- Virginia Department of Transportation, (VDOT), Road and Bridge Specifications.

11-1410.4 APPLICABLE REFERENCES

- American Association of State Highway and Transportation Officials (AASHTO).
- American Society of Testing and Materials (ASTM).

11-1410.5 QUALITY ASSURANCE

Provide certified test reports of testing required by referenced specifications.

11-1420 MATERIALS

11-1420.1 PRIMERS

Primer, asphalt, fabric and joint sealers shall conform to Section 416 of the VDOT Specifications.

11-1410.2 MEMBRANE

System A, B, C or D as specified in Section 416.02 of VDOT Specifications or preformed elastomeric waterproofing as manufactured by Polyguard (No. 650), B.G. Goodrich (20 mil vinyl water barrier), Grace (Bithuthene E M-300) or approved equal.

11-1430 EXECUTION

11-1430.1 PROCESS

Waterproof exterior, below grade structures.

11-1430.2 INSTRUCTIONS

Conform to the manufacturer's printed instructions when applying preformed elastomeric waterproofing.

SECTION 11-1500 DAMPPROOFING

11-1510 GENERAL CRITERIA

11-1510.1 DESCRIPTION OF THE WORK

Provide all plant, labor, equipment, and materials to dampproof structures subject to hydrostatic head.

11-1510.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-1400 Waterproofing

11-1510.3 APPLICABLE SPECIFICATIONS

- Virginia Department of Highways and Transportation, Road and Bridge Specifications (VDOT)

11-1510.4 APPLICABLE REFERENCES

- American Association of State Highway Transportation Officials (AASHTO).
- American Society of Testing and Materials (ASTM).

11-1510.5 QUALITY ASSURANCE

Provide certified test reports of testing required by specifications.

11-1520 MATERIALS

1-1520.1 PRIMERS

Primer and asphalt shall conform to Section 417 of the VDOT specifications.

11-1530 EXECUTION

11-1530.1 APPLICATION RATE

Conform to Section 417.03 of VDOT specifications.

SECTION 11-1600 SEALANTS AND CAULKING

11-1610 GENERAL CRITERIA

11-1610.1 DESCRIPTION OF THE WORK

Provide all labor, material, and equipment for the complete application of sealants and caulking for interior and exterior surfaces as required in accordance with these specifications and where called for on the approved plans.

11-1610.2 RELATED WORK SPECIFIED ELSEWHERE

- Section 11-1200 Wood Preservatives
- Section 11-1300 Protective Coatings

11-1610.3 APPLICABLE SPECIFICATIONS

- Federal Specifications (Fed. Spec.)

11-1610.4 SUBMITTAL

Submit samples for the following:

- One (1) cartridge of each type of sealing and caulking.
- One (1) pint of each primer.
- One (1) linear foot of backup material.
- One (1) linear foot of compression seal.

Provide referenced specification number, type and class as applicable.

11-1610.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened containers with labels intact along with referenced specification number, type and class as applicable.

B. Handle product in accordance with manufacturer's recommendations.

C. Use only recommended solvents and cleaning agents.

11-1620 MATERIALS

11-1620.1 MANUFACTURER

Caulking and sealants, primers and accessories shall be non-staining type manufactured by one of the following:

- DAP

- Dow Corning
- G.E.
- Equal

11-1620.2 SEALANTS, CAULKINGS, AND PRIMERS

A. Oil base caulking compound consisting of selected oils, fillers, plasticizers, binders, and pigments shall conform to requirements or (Fed. Spec. TT-C-598B).

B. Butyl rubber based caulking compound single component skinning type shall conform to (Fed. Spec. TTS-001657).

C. Acrylic sealant single component water based latex and single component solvent release type with limited amount of fillers and plasticizers shall conform to (Fed. Spec. TTS-230C).

D. Polysulfide based sealant shall be one (1) component and two (2) components conforming to (Fed. Spec. TTS-230C and TTS-00227E) except as modified herein. Polysulfide sealants shall not be applied in contact with joint fillers and surfaces coated with asphaltic materials, oil base materials, lacquer or paint or any other sealants in which the bonding properties and adverse effects resulting from the combination are not known.

E. Polyurethane based sealants shall be one (1) component and two (2) component formulated to provide excellent resiliency and resistance to compression and shall conform to (Fed. Spec. TTS-230C and Fed. Spec. TTS-00227E) except as modified herein. Polyurethane sealants shall not be applied in contact with joint fillers and surfaces coated with asphaltic materials, oil base materials, lacquer or paint or any other sealants in which the bonding properties and adverse effects resulting from the combination are not known.

F. Silicone sealant rubber based with pigments and fillers formulated to provide excellent weather and ultraviolet rays resistance shall conform to (Fed. Spec. TTS-001543).

G. Primers where applicable shall be in accordance with manufacturer's recommendations.

H. Provide backup materials, fillers, and joint packing in accordance with the following:

    1. Use closed cell bead or rope shaped expanded polyethylene or polyurethane foam generally.
    2. Use glass fiber or untreated jute for non-working joints.
    3. Use semi rigid vinyl or polyethylene foam, solid neoprene rod or similar approved backing for joints subject to horizontal traffic or puncture.
    4. Do not use bituminous or oily product as a backup material.
    5. The width or diameter of backup material shall be 1-1/3 to 1-1/2 times the width of the joint.

I. Unless indicated otherwise by manufacturer of sealants use backup material to control caulking depth as indicated on drawings.

11-1630 EXECUTION

11-1630.1 ENVIRONMENTAL CONDITIONS

A. Schedule caulking and sealants operations so that joints are normal size.

B. Do not apply caulking and sealants if temperature is below 40 degrees F. or above 85 degrees.

11-1630.2 MIXING

Mix in accordance with manufacturer's recommendations.

11-1630.3 PREPARATION

A. Inspect all surfaces before starting work. Thoroughly clean all joints of contaminants, oil, grease, bituminous material, bond breakers, water repellent and release agents.

B. Verify surfaces are dry and meet manufacturer's requirements.

C. Clean and remove foreign matter such as dirt, dust, moisture, frost, rust, paint, mill scale, and lacquer.

11-1630.4 INSTALLATION

Install material in strict adherence to manufacturer's instructions using appropriate approved equipment.

11-1630.5 FINISH

Finish joints to concave surface using tooling agent recommended by sealant manufacturer. Compress material to improve adhesion and repair air pockets left by tools.

SECTION 11-1700 UNDERGROUND STORAGE TANKS

The following are portions from Article "Underground Storage Tanks," by Ray Beurket, Director of Federal Programs, American Public Works Association, Washington, D.C., December 1988.

A. U.S. EPA has issued new regulations for underground storage tanks (USTs) containing petroleum or hazardous chemicals. The regulations, which were effective December 12, 1988, were written to satisfy Subtitle 1 of the Resource Conservation Recovery Act (RCRA) as amended by the Superfund Amendments and Reauthorization Act of 1986.

B. RCRA defines USTs as tanks with 10% or more of their volume underground. Excluded from the new regulations is farm and residential tanks with capacities of one thousand one hundred (1,100) gallons or less which store motor fuel for noncommercial purposes, tanks storing heating oil for use on the premises, and tanks on or above floors in underground areas such as basements or cellars.

C. New systems must now be designed to retain structural integrity for their operating life, installed using nationally recognized standards, and repaired in accordance with nationally recognized industry codes. Owners and operators must follow proper tank-filling procedures. New and upgraded UST systems must use devices that prevent overfills and control or contain spills.

D. To obtain a booklet explaining UST regulations, write U.S. EPA, Office of Underground Storage Tanks, P.O. Box 6044, Rockville, MD 20850.

11-1710 LEAK DETECTION

New Tanks:

- Monthly monitoring*
- Monthly inventory control and tank tightness testing every five years
- This choice can only be used for ten years after installation

Existing Tanks:

- Monthly monitoring
- Monthly inventory control and annual tank tightness testing (This choice can only be used until December 1998)
- Monthly inventory control and tank tightness every five years (This choice can only be used for ten years after adding corrosion protection and spill\overfill protection or until December 1998, whichever is later)

New and Existing:

- Automatic flow restrictor
- Annual line testing pressurized piping
- Annual line testing and monthly monitoring* (One from each set)
- Line testing every three years (Except automatic tank gauging)
- Monthly monitoring* (except automatic suction pipe tank gauging)
- Line testing every three years

11-1720 CORROSION PROTECTION

New Tanks:

- Coated and cathodically protected steel
- Fiberglass
- Steel tank clad with fiberglass

Existing Tanks:

- Same options as for new tanks
- Add cathodic protection system
- Interior lining
- Interior lining and cathodic protection

New Piping:

- Coated and cathodically protected steel

- Fiberglass

Existing Piping:

- Same options as for new piping

Cathodically protected steel

SECTION 11-1800 PAVEMENT RESTORATION

All pavement cut restorations shall comply with Article 9 standard detail TS-15.0, Pavement Restoration for Pavement Open Cuts.

11-1810 GENERAL

A. Description of work: Provide the necessary traffic controls, labor, materials and equipment to restore and maintain the various street pavement and driveway bases, curbs, curb and gutter, and sidewalks disturbed, damaged or demolished during the performance of the work.

B. Related Work Specified Elsewhere:

- Section 11-700 - Cast-in-Place Concrete

C. Applicable Specifications:

- American Society for Testing and Materials (ASTM).
- Virginia Department of Transportation (VDOT), Road and Bridge Specifications.

D. Applicable Reference: American Association of State Highway and Transportation Officials (AASHTO).

E. Permits: Before performing any work, secure the necessary permits to work within the City right-of-way and dedicated easements.

11-1820 MATERIALS

A. The quality of materials used in the restoration of existing pavements and driveways shall produce a street surface equal to or better than the condition before the work began.

B. Concrete shall be Class A3 air-entrained Portland cement type as specified in Section 11-720.2.

C. The base course shall be bituminous concrete consisting of course and fine aggregate combined with asphalt cement, resulting in a mixture of BM-25.0 in conformance with Section 211 of the VDOT Specifications.

D. The surface course shall be bituminous concrete consisting of crushed stone, crusted slag, or crushed gravel and the fine aggregate, slag or stone screening, or combination thereof, combined with asphalt, cement, resulting in a mixture of SM-9.5A or SM-9.5D in conformance with Section 211 of VDOT Specifications.

E. Stone aggregate shall be size 21-A in conformance with Section 205 of the VDOT Specifications. Refer to VDOT Section 308 for the required rate of compaction.

F. Joint filler shall be ½" preformed asphalt expansion joint material conforming at ASTM D1751.

G. Asphalt for a temporary patch shall be BM-25.0 or UPM Cold Mix as specified.

11-1830 EXECUTION

A. Where trenches have been opened in any roadway or street that is a part of the State of Virginia highway system, restore surfaces in accordance with the requirements of VDOT. All other restoration shall be done in accordance with the Manufacturer's Specifications or these specifications, and Section 10-700 of this Manual.

B. Excavation in the pavement area shall require that pavement surfaces be saw-cut to provide a straight and smooth edge. Cut out pavement 12 to 24-inches wider than the trench width or excavation opening as shown on Standard Detail TS-15.0 of Article 9.

C. Upon completion of installation of utility and backfill, fill the trench with stone aggregate and temporary asphalt patch until such time that the permanent pavement patch will be constructed.

D. Complete the pavement restoration for the various types of streets in conformance with Standard Detail TS-15.0 of Article 9 and this specification.

E. Concrete curb and gutter, and sidewalks, shall be restored as required to match existing construction. Replace damaged sections with complete new sections or squares; patching of damaged sections will not be permitted.

F. Maintain restored sections and surfaces for a period of one (1) year following the date of final acceptance.

G. When a manhole top requires adjustments to an elevation one (1) inch or more above the existing pavement grade and is exposed to traffic before final paving is completed, a temporary ramp shall be constructed by slope of not less than two (2) feet per one (1) inch shall be used. During the paving operation but prior to the placement of the topping course, the bituminous concrete taper shall be removed from around the manhole to a minimum depth of one inch below the top of manhole.

SECTION 11-1900 STAMPED THERMOPLASTIC CROSSWALK

Imprinted Aggregate Reinforced Preformed Thermoplastic Pavement Marking System

11-1910 USE

Use: A durable imprinted aggregate reinforced preformed thermoplastic pavement marking system (herein "System") that provides a textured, highly attractive and durable topical treatment to the surface of asphalt pavement. Typically, the system replicates, in relief, the grout lines common to brick or other types of unit pavers, but may also be used to create other patterns. It is intended for use on asphalt pavements to create traffic calming solutions and decorative crosswalks, medians, intersections and through areas in parking lots. It provides a seamless, aesthetic look without the trip hazards and ongoing maintenance often associated with pavers and stamped concrete.

A. The aggregate reinforced preformed thermoplastic is typically supplied in panels measuring 2 ft. x 2 ft. [±⅛ in.] (.61m x .61m [±3mm]).

B. The System must be able to be applied to asphalt surfaces without preheating the application surface to a specific temperature.

C. The System must be able to be applied in temperatures down to 45ºF (7ºC) without any special storage, preheating or treatment of the material before application.

D. The System is applied to asphalt pavement using proprietary reciprocating infrared heating equipment. A two-part epoxy sealer specified by the manufacturer must be applied to the substrate prior to preformed thermoplastic application to ensure proper adhesion, and to provide reinforcement for larger volumes of material. Immediately following sealer application, panels of aggregate reinforced preformed thermoplastic are positioned properly on the asphalt substrate. The preformed thermoplastic is then heated to the required melting temperature. Additional aggregate may be applied to the preformed thermoplastic surface as needed following the melting process, to achieve added friction properties and a uniform surface appearance. As the material is cooling, it is imprinted with a vibratory plate compactor and a template made from 3/8 in. (9.5 mm) flexible wire rope in the required design to create crisp, clean lines which define the pattern. For crosswalks, it is typically demarcated by applying white preformed thermoplastic transverse lines on both sides of the installation.

E. The System is available in a variety of standard colors and patterns. Color can be used to create patterns within the crosswalk area to reflect the typical white "continental" crosswalk bars for additional visibility and awareness. Within certain limitations, custom patterns and colors are available upon request.

F. The System shall utilize a resilient, aggregate reinforced preformed thermoplastic product which contains a minimum of thirty percent (30%) intermixed anti-skid/anti-slip elements and where the top surface contains anti-skid/anti-slip elements. These anti-skid/anti-slip elements must have a minimum hardness of 6 (Mohs scale).

G. The System must be resistant to the detrimental effects of motor fuels, antifreeze, lubricants, hydraulic fluids, etc.

11-1920 MANUFACTURING CONTROL AND ISO CERTIFICATION

The System manufacturer must be ISO 9001:2008 certified for design, development and manufacturing of preformed thermoplastic, and provide proof of current certification.

11-1930 PREFORMED THERMOPLASTIC MATERIAL

Must be composed of an ester modified rosin impervious to degradation by motor fuels, lubricants, etc. in conjunction with aggregates, pigments, binders, and anti-skid/anti-slip elements. Pigments and anti-skid/anti-slip elements must be uniformly distributed throughout the material. The material conforms to AASHTO designation M249, with the exception of the relevant differences due to the material being supplied in a preformed state, being non-reflective, and potentially being of a color different from white or yellow.

A. Pigments:

    1. White: The material shall be manufactured with sufficient titanium dioxide pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected.

    2. Other Colors: The pigment system must not contain heavy metals nor any carcinogen, as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

B. Skid Resistance: The surface of the material shall contain factory applied anti-skid/anti-slip elements with a minimum hardness of 6 (Mohs scale). Upon application the material shall provide a minimum skid resistance value of 60 BPN when tested according to ASTM E 303.

C. Slip Resistance: The surface of the material shall contain factory applied anti-skid/anti-slip elements with a minimum hardness of 6 (Mohs scale). Upon application the material shall provide a minimum static friction of coefficient of 0.6 when tested according to ASTM C 1028 (wet and dry), and a minimum static coefficient of friction of 0.6 when tested according to ASTM D 2047.

D. Thickness: The material must be supplied at a minimum thickness of 150 mil (3.8mm).

E. Environmental Resistance: The material must be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

F. Storage Life: The material may be stored for 12 months, if stored indoors and protected from the elements.

G. Transverse Lines to Supplement System Application: Supplied as white, retroreflective preformed thermoplastic line stripe material in 90 mil (2.3 mm) or 125 mil (3.2 mm) thicknesses, material is available in 6 in. (.15m), 8 in. (.20m) or 12 in. (.30m) widths. This preformed thermoplastic material may be supplied and applied by the certified applicator in conjunction with the System, and is available from the System manufacturer. (Consult the manufacturer's published application instructions for the preformed thermoplastic line stripe material selected, for proper application methods.

11-1940 SPECIALIZED APPLICATION EQUIPMENT

A. Stamping Templates: A wire rope template is required in the execution of the System. The template is used for imprinting the defined pattern once the preformed thermoplastic has been applied. The wire rope diameter for the imprinting template used for the specified pattern is 3/8 in. (9.5mm). The stamping templates are distributed by the System manufacturer.

B. Heating Equipment: The System manufacturer shall distribute reciprocating infrared heating equipment designed specifically to elevate the temperature of the preformed thermoplastic material and asphalt pavement without adversely affecting it. The primary heating unit must employ a bank of propane-fired infrared heaters, mounted on a track device that allows the heater bank to reciprocate back and forth over a designated area, thereby allowing the operator to monitor the temperature of the preformed thermoplastic at all times during the pavement heating process.

   1. A smaller, mobile infrared heater distributed by the System manufacturer is designed specifically to heat areas such as borders and narrow areas that are inaccessible to the primary heaters. This secondary heater also allows the operator to monitor the temperature of the preformed thermoplastic at all times during the heating process.

   2. An approved hand-held propane heat torch distributed by the System manufacturer shall be used to heat isolated areas of the preformed thermoplastic.

C. Sealer: A two-part epoxy sealer specified and distributed by the System manufacturer must be applied to the substrate prior to material application to ensure proper adhesion, and to provide reinforcement for larger volumes of material.

D. Specialized Sealer Dispensing Gun: Used to dispense the required two-part epoxy sealer onto the substrate. The sealer dispensing guns are distributed by the System manufacturer.

E. Hand Held Finishing Tool: Enables the applicator to complete the imprinting of the thermoplastic in areas around permanent structures, such as curbs and manholes covers, which may be inaccessible to the stamping template. The hand-held finishing tools are distributed by the System manufacturer.

F. Aggregate: Supplemental anti-skid/anti-slip elements to be applied to the surface of the molten thermoplastic as needed, if the factory applied anti-skid/anti-slip elements embed too deeply into the surface of the molten thermoplastic material during the heating process. (Embedded aggregate is exposed upon wear for extended skid resistance.) The aggregate is distributed by the System manufacturer.

G. Air Powered Spray Hopper: Used to spray supplemental anti-skid/anti-slip elements (aggregate) on the surface of the molten preformed thermoplastic in a uniform manner. The air powered spray hoppers are distributed by the System manufacturer.

H. Vibratory Plate Compactor (700-900 lb.): Shall be used for pressing the 3/8” (9.5mm) wire rope stamping templates into the thermoplastic to create the specified pattern in both the thermoplastic and asphalt substrate. The System manufacturer does not supply vibratory plate compactors.

11-1950 APPLICATION (ASPHALT SUBSTRATE ONLY)

A. Manufacturer Certified Applicator Requirement: The System shall be supplied and applied only by an applicator certified by the System manufacturer. The applicator shall provide proof of current

certification before commencing work. The Certified Applicator shall follow the System manufacturer's current published application procedures.

B. Substrate Condition: The System must only be applied to a stable, high quality asphalt pavement substrate over a stable base that is free of defects, as per the manufacturer published Substrate Guide. The asphalt pavement surface shall be dry and free from all foreign matter, including but not limited to dirt, dust, de-icing materials, and chemical residue.

C. Procedure: The System is applied to asphalt pavement using proprietary reciprocating infrared heating equipment. The material must be able to be applied at ambient and road temperatures down to 45ºF (7ºC) without any preheating of the pavement to a specific temperature. A two-part epoxy sealer specified by the manufacturer must be applied to the substrate prior to preformed thermoplastic application. Immediately following sealer application, the panels of aggregate reinforced preformed thermoplastic are positioned properly on the asphalt substrate with the aggregate side facing up. The preformed thermoplastic is then heated to the required melting temperature. Additional aggregate may be applied to the preformed thermoplastic surface as needed following the melting process. As the material is cooling, it is imprinted with a stamping template made from 3/8 in. (9.5 mm) flexible wire rope in the required design using a vibratory plate compactor. The preformed thermoplastic material is then allowed to cool thoroughly before being opened to vehicle or pedestrian traffic. (Consult the manufacturer's published application procedures for complete information.)

D. The System shall not be applied to Portland Cement Concrete.

11-1960 PACKAGING

The preformed thermoplastic material shall be packaged in cardboard cartons with a plastic sheet between each layer of preformed thermoplastic. The cartons in which packed shall be non-returnable and shall not exceed 25 in. (.64m) in length and 25 in. (.64m) in width. The cartons shall be labeled for ease of identification. The weight of the individual carton must not exceed seventy (70) pounds (32 kg). A protective film around the carton must be applied in order to protect the material from rain or premature aging.

11-1970 PERFORMANCE

Where applicable, the preformed thermoplastic pavement overlay material shall meet state specifications and be approved for use by the appropriate state agency.

SECTION 11-2000 STORM SEWER

Storm sewer pipe and structures shall be installed per Section 302 of the VDOT Road and Bridge Specifications except as amended in this section.

11-2010 CONCRETE BLOCK FOR STORM SEWER REQUIREMENTS

Concrete brick or block in conjunction with cement mortar shall be used to fill the voids or gaps between catch basins, storm manholes, pipe culverts and storm structures. Such materials shall be thoroughly

wetted and bonded with mortar. The remaining exterior and interior void shall be filled and sealed/slicked with mortar at a minimum thickness of (¾" or .75") to the contour of the precast structure. Concrete brick or block shall conform to the requirements of ASTM C139, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.*

11-2011 MORTAR FOR CONCRETE BLOCK AND BRICK

Mortar shall be type M, ASTM C270, *Standard Specification for Mortar for Unit Masonry* and ASTM C144, *Standard Specification for Aggregate for Masonry Mortar.* Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood beyond forty-five minutes shall be used. Proportion by volume for the different types of application shall be as follows:

Brick masonry =	1 part cement to 2 parts sand
Pointing =	1 part cement to 1 part sand

SECTION 11-2100 SURVEY REQUIREMENTS

11-2110 STAKEOUT REQUIREMENTS

A. The limits of clearing shall be identified by white flagging.

B. Construction stakeout shall be performed sufficiently in advance of the construction activities to ensure compliance with the approved construction drawings.

C. Stakes shall be placed at not more than 100-foot intervals along the centerline of public and private roads and along all pipelines on the specified offsets.

D. All utility structures and proposed entrances, including single family detached driveways, shall also be staked.

E. Field stakes must be clearly visible and description of purpose stated.

F. The construction plans and field stakes shall have a corresponding reference system.

11-2120 MONUMENTS

11-2120.1 GEODETIC CONTROL MONUMENT

For subdivisions with five (5) parcels or more, or sites greater than ten (10) acres, developers are required to tie into City/NGS/Prince William County geodetic control monuments.

11-2120.2 PERMANENT MONUMENTS

A. Permanent monuments shall be composed of concrete not less than four inches square or four inches in diameter and at least 30 inches long.

B. The top of permanent monuments shall be set not less than one inch nor more than four inches above the finished grade at their respective locations.

C. All required monuments shall be clearly visible.

D. Such monuments shall be inspected and approved by the City Engineer before any improvements are accepted by the City.

11-2120.3 PROPERTY MONUMENTS

A. All property and lot corners in subdivisions shall be monumented with iron pipes or solid iron rods not less than one-half (1/2) inch or more than one (1) inch in diameter and not less than eighteen (18) inches in length.

B. Iron pipes shall also be placed at all angle points of the subdivision boundary and at angle points and points of curvature in the right-of-way for streets within the subdivision.

C. Placement of these iron pipes shall take place after final grading and sodding and pipes shall be clearly identified (witness stakes with surveyor tape, etc.).

D. The tops of all corner pins shall be set flush to one inch above the finished grade at their respective locations.

E. These iron pipes are required for a final site inspection and prior to the release of the project's performance bond.

F. At least two (2) monuments at the subdivision corners shall be referenced to the VCS 1983. In this respect, subdivision plans must show the coordinate values of two (2) or more monuments so referenced. Additionally, the geodetic monument from which the coordinate reference is derived shall be referenced including its identifier and VCS 1983 coordinates.

G. This shall apply to all subdivisions with a number of lots greater than ten (10). It shall also apply to subdivisions with less than ten (10) lots, but greater than five (5) lots, if a geodetic control monument of second order Class II is located within one-half (1/2) mile of any exterior subdivision boundary corner or segment. Subdivisions of five (5) lots or less shall comply if the geodetic monument is within one (1) mile of any exterior subdivision boundary corner or segment.

H. The surveyor may be required to submit his or her computations to the Development Services division showing how coordinate values were obtained.

I. The surveyor is responsible for ascertaining the existence of geodetic control monuments of Second Order Class II accuracy to be utilized in his or her surveys. Assistance will be provided by Development Services to the extent of granting access to the City’s records on geodetic control data. Exceptions may be granted by Development Services with written request by the developer or surveyor.

SECTION 11-2200 MISCELLANEOUS CONSTRUCTION SPECIFICATIONS AND REQUIREMENTS

A. The methods and materials used in the construction of all streets shall conform to the current VDOT Road and Bridge Specification unless herein notified.

B. All base and subbase material and subgrade for all sidewalks and curb and gutter shall be compacted as per Section 502 and 504 of VDOT Road and Bridge Specifications.

C. Subbase shall be primed with a priming material approved by VDOT.

D. Rights-of-way shall be cleared for full width of construction, utilities shall be in place, and roadbed subgraded before bituminous material is applied on all streets. All utility structures within the roadway shall be adjusted to final grade before any paving is performed.

E. Dust control shall be maintained on those sections of the project as may be designated by the inspector.

F. Roadway and Raised Grass Median Underdrains: Underdrains for roadways and raised grass median shall be provided in areas of frost susceptible soils and high ground water on a case-by-case basis, or based upon actual field verification of such conditions. A traffic barricade shall be installed at road closings, entrance stubs for future developments or as required by the Department of Engineering.

G. Street name signs and stop signs shall be posted at the following locations:

1. All street intersections.
2. At the entrance to a parking bay for the residential units.
3. These signs, or approved temporary signs, shall be installed prior to the occupancy of any house or unit being served by the street.

H. Prior to the release of the performance bond, or during emergencies that could endanger the public health, safety and welfare, the City may require the developer of a site development project to provide the additional safety features such as:

"No Parking" signs

"Speed Limit" signs

"Stop" signs

"Pavement Markings"

“Traffic Barricades"

Any other emergency measures that may be necessary for the safety of the travelling public. These emergency items are to be installed at the developer's expense.

I. Prior to the acceptance of a street into the State Secondary System, the developer is required to post the necessary traffic control signs inclusive of pavement markings, for the safety of the travelling public. Traffic control signs shall conform to the current VDOT standards and the current edition of the Manual on Uniform Traffic Control Devices. All required pavement markings that are installed in conjunction with new developments shall be type B markings.

J. Street name signs shall be located at intersections such that they can be seen from the major (higher VPD) road at a reasonable distance.

K. Frost Line Depth: The Building Official has established the minimum frost line depth to be twenty-four (24) inches.

L. Utility Easements: Utility easement is required to be shown on the plat for all subdivision and site plans. Refer to DCSM Articles 5, 7, and 8 for water, sanitary sewer, and storm sewer easement widths. Since the location of utilities may vary, it is recommended that the individual utilities be contacted prior to the location of any easements.

M. Installation and storage of LP Facilities: LP tanks shall be shown on the site plans, installed, and protected with bollards in accordance with the Fire Marshal's specifications.

N. Debris Disposal: Every construction site shall be provided with on-site facilities adequate for the premises storage of all construction debris, refuse, and worker's litter that may be generated during construction. The number and size of receptacles shall be determined by the primary contractor; except no less than one (1) receptacle shall be place on each site.

O. Hazardous Material: Each Permittee is subject to hazardous material guidelines for data collection; disposal, handling, release, and treatment of hazardous material; site remediation; and worker safety and training. The Permittee must comply with all federal, state, and local laws regarding hazardous material. For purposes of this Subsection, hazardous material shall mean any gas, material, substance, or waste which, because of its quantity, concentration, or physical or chemical characteristics, is deemed by any federal, state, or local governmental authority to pose a present or potential hazard to human health or safety or to the environment.

SECTION 11-2300 MISCELLANEOUS DETAILS

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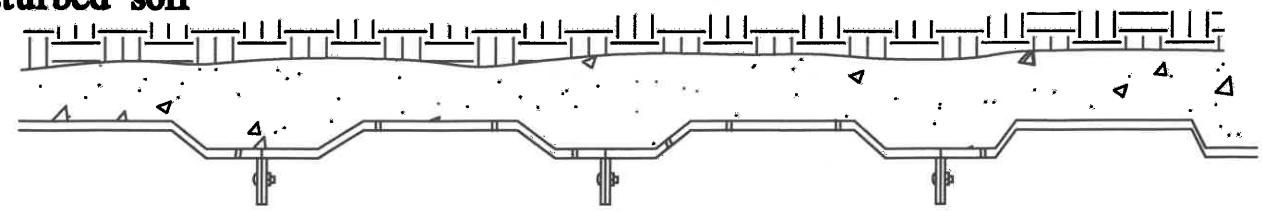
Drawing No.

Undisturbed soil



Inject grout between tunnel liner plates and tunnel wall.

12 gauge galvanized steel tunnel liner. plates.

Quick acting, coarse thread bolts & nuts as required.

SECTION A-A

12 gauge galvanized steel liner plates - 4' min. dia.

Grout

For water mains, fill annular space with sand.
For sewers, fill annular space with grout.

3 1/4" x 1 1/4" steel angles placed as shown and welded to each end of liner plates at 8'-0" intervals or other approved methods for holding pipe in place.

Ends to be closed with brick and mortar construction or min. 6" grout..

Carrier pipe (size varies)

Provide 2" pipe through bulkhead.

TYPICAL SECTION

NOTES:

1. Black steel liner plates will be allowed for conditions where pipe will be fully grouted in place.
2. Provide 6" minimum clearance between top and bottom of carrier pipe and tunnel liner plates.

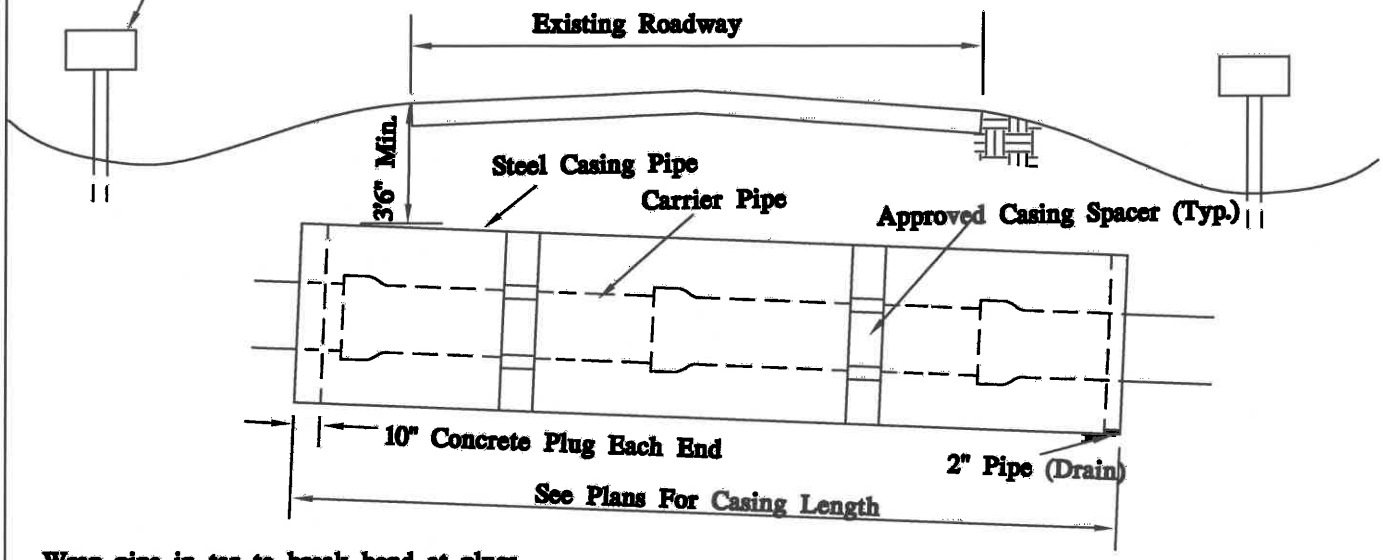
TUNNELING DETAILS

REVISION & DATE	

DIRECTOR	DATE: 4/19/96	CITY OF MANASSAS, VIRGINIA DEPARTMENT OF PUBLIC WORKS

DRAWING NUMBER
MS - 1.0

Sign: Height 5'6" above grade labeled for service
"WARNING: SEWER PIPE CROSSING" or "WARNING: WATER PIPE CROSSING"
(Typical 2 places as approved by VDOT)



Wrap pipe in tar to break bond at plugs.

Space casing spacers according to pipe or spacer manufacturers' recommendations or 2 per section of pipe, whichever is greatest, plus 1 within 2 feet of each end of casing.

For gravity sewer pipe - pump neat grout to the spring line of the carrier pipe.

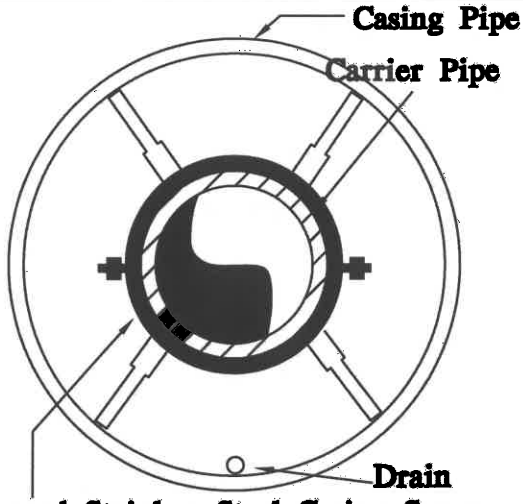
Push or pull the carrier pipe through the casing so that the carrier pipe joints are always compressed.

For watermains, fill annular space with sand. For sewers, fill annular space with grout.

Alternative methods of supporting carrier pipes may be submitted to the Engineer for approval.

CARRIER PIPE	CASING PIPE		
	MIN. CASING PIPE O.D.	MIN. CASING THICKNESS	
		COVER TO 15'	15' & OVER
4	14	1/4"	5/16"
6	16	1/4"	5/16"
8	18	1/4"	5/16"
10	18	1/4"	5/16"
12	24	1/4"	5/16"
14	24	1/4"	5/16"
16	30	3/8"	3/8"
18	30	3/8"	3/8"
20	30	3/8"	3/8"
24	36	3/8"	3/8"
30	42	7/16"	7/16"
36	48	7/16"	7/16"

PIPE IN CASING END VIEW



JACKING AND BORING DETAIL

REVISION & DATE

Director — 4/19/96 (Date)

CITY OF MANASSAS, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

DRAWING NUMBER
MS - 2.0