

## **1.0 CONTRACT REQUIREMENTS – PIPING/CULVERTS**

1.1 Pursuant to section 34-8-1(a) of the Code of Alabama, each contractor must submit with their bid, proof of licensing through the Alabama State Board of Licensing for General contractors, with approved maximum bid limits sufficient to cover the bid related to this specification. Failure to comply will be cause for rejection of the bid. A copy of the vendor's current year's license will expedite the valuation process.

1.2 Each contractor should submit with their bid, proof of liability insurance in the minimum amount of \$500,000 per occurrence, \$1,000,000 aggregate. Each contractor should further provide proof of workman's compensation insurance sufficient to satisfy all legal requirements of the State of Alabama. Failure to provide this documentation with the bid package will delay the evaluation process.

1.3 The successful bidder will be required to submit a performance bond, in the amount of the bid prior to award of the purchase order.

1.4 All documentation MUST be submitted prior to award of the purchase order. All insurance certificates and bond instrument shall indicate State of Alabama, Department of Finance, and Division of Purchasing as certificate/bond holder.

1.5 In accordance with section 41-16-59 of the Code of Alabama, the successful bidder in this solicitation is restrained from assigning or subcontracting any portion of work under this contract.

1.6 Due to the nature of this project, award will be made on "All or None" basis by group.

1.7 Vendors are hereby notified that this contract may be subject to the Alabama Gross Receipts Tax.

1.8 After the award of the contract and before materials are delivered to the job site, the contractor shall submit to the Division Maintenance Engineer a complete list of all materials proposed to be furnished and installed.

1.9 In addition, the contractor shall submit satisfactory written certification of compliance with the ASTM standards contained within this specification.

## **2.0 WORK SCOPE**

2.1 All work shall be done in compliance with applicable sections of the Alabama Department of Transportation Standard Specifications for Highway Construction, 2008 Edition, Alabama Department of Transportation Standard Drawings, and the latest edition of the MUTCD. The materials used shall be chosen from the Materials, sources, and Devices with Special Acceptance Requirements Manual. The traffic control scheme shall be submitted to the Division Traffic Engineer for his/her review seven (7) days prior to starting initial work.

2.2 The quantity stated in this solicitation is an estimate only for comparative purposes and in no way obligates the Department to any specific quantity of purchase. Actual maintenance requirements may be less than or greater than the estimated quantity as shown for each item. All quantities and dimensions are estimated and should be field verified by the contractor.

2.3 The contractor will be responsible for all traffic measures. Attention is drawn to the fact that this work will be performed under traffic conditions. The contractor will be responsible for assuring that all traffic control devices meeting the Manual for Uniform Traffic Control Devices and that they are placed on the roadway in compliance with part 6 of the same manual. The contractor will be responsible for insuring that all employees wear appropriate safety apparel in accordance with the latest edition of the MUTCD and in accordance with the standards of the ANSI 107-1999 Class 2.

## **3.0 PERFORMANCE REQUIREMENTS**

3.1 Bid price shall include all materials, hardware, supplies, tools, equipment, labor, transportation, and other necessary incidentals required for the completion of the work in an approved and satisfactory manner.

3.2 If required, on-site storage of job materials and/or equipment is to be coordinated with the District Manager prior to the beginning of work. The security of any material and/or equipment left on-site will be the responsibility of the contractor.

3.3 The performance of any work under these specifications will not be deemed complete until the contractor has satisfactorily removed all debris and cleaned up the work site. At no time during the performance of work will materials, debris or trash be allowed to accumulate in such a manner as to endanger the safe performance of the work or the safety of the traveling public.

3.4 The work to consist of the lining of pipes using shotcrete material will require:

3.4.1 The Division Maintenance Engineer may request the lining of roadway pipes/culverts as needed within the Second Division. Not all pipes/culverts inspected will necessarily be lined. Note that roadway pipes may be constructed of but are not limited to PVC, corrugated plastic, corrugated metal, bituminous coated corrugated metal, terracotta or reinforced concrete.

#### **MINIMUM SPECIFICATIONS – LINES 00020 THROUGH 00026**

3.5 The work using cured in place pipe (CIPP) and grouted in place (GIPP) material is to consist of color video inspection of roadway edge drains and roadway pipes and the lining and will require:

3.5.1 Upon the Division Maintenance Engineer's request, the contractor shall inspect by means of a video camera any roadway edge drains or roadway pipes within the Second Division on any State route. The Division Maintenance Engineer will have the pipes cleaned prior to the contractor's arrival at the site. The contractor shall deliver a report detailing the condition

of the pipes and a copy of the inspection on DVD or the latest media format to the Division Maintenance Engineer.

3.5.2 Upon review of the inspection video, the Division Maintenance Engineer may request the lining of edge drain laterals and roadway pipes as needed. Not all pipes inspected will necessarily be lined. Note that edge drain laterals and roadway pipes may be constructed of but are not limited to PVC, corrugated plastic, corrugated metal, bituminous coated corrugated metal, terracotta or reinforced concrete.

3.6 The method of lining the pipes shall be as follows:

3.6.1 For pipes from 4 to 30 inches in diameter, the cured in place (CIPP) liner shall be a continuously extruded, folded Polyvinyl Chloride (PVC) Fold-and-Form pipe liner and the blow-molding or thermoforming of the pipe liner shall fold the liner in to the shape of the existing pipe. The liner shall “Ultraliner” or equivalent product.

3.6.2 For pipes from 36 to 55 inches in diameter, the grouted in place pipe (GIPP) line shall be a High Density Polyethylene (HDPE) sheeting with studs or other texturing to provide a consistent void between the sheeting and the inside wall of the existing pipe. The sheeting shall be made continuous by an overlap welding process. The lining shall be adhered to the walls of the existing pipe by injecting epoxy grout in to the voids formed by the studs on the sheets. The liner shall be a “Trolining” or equivalent product.

3.6.3 Upon completion of the installation, the liners shall:

3.6.3.1 Extend continuously from the inlet to the outlet of each pipe section. The inlet or outlet can be a manhole, junction box, grated inlet, headwall or projection pipe.

3.6.3.2 Provide a tightly conforming fit against the inner wall of the host pipe.

3.6.3.3 Provide for complete structural integrity independent of the load carrying capacity of the host pipe.

#### **4.0 MINIMUM SPECIFICATION – lines 00001 THROUGH 00018**

4.1 Foreman shall have a minimum of four years of experience including four years as a shotcrete nozzle operator.

4.2 Nozzle operator shall have a minimum of four years experience in shotcrete construction within storm drainage systems and shall have successfully demonstrated all of the duties for which he/she shall be responsible on this project including, but not limited to the following:

4.2.1 Ensure that all surfaces to be shot are clean and free of laitance and loose material, using air and water to blast from the nozzle as required.

4.2.2 Regulate water content so as to provide a mix that will be plastic enough to give good compaction and a low percentage of rebound without sagging.

4.2.3 The nozzle should be held at a proper distance and as nearly normal to the surface as the workspace permits to secure maximum compaction with minimum rebound.

4.2.4 A sequence routine should be followed so that corners are filled with sound shotcrete and encased reinforcement without placing porous material behind the reinforcing.

4.2.5 Determine necessary operating procedures for placement of shotcrete in confined areas, over extended distances and/or around unusual obstructions where placement velocities and mix consistencies may require adjustment.

4.2.6 Crews should be directed when to start and stop the flow of material and shall stop work if the material is not arriving uniformly at the nozzle.

4.2.7 Ensure sand and slough pockets are cut out for replacement.

4.2.8 The shotcrete should be finished in a neat and workmanlike manner.

4.2.9 Crews shall successfully demonstrate all of the duties of which they shall be responsible on this project including, but not limited to, maintaining proper pressure on the cement gun to ensuring the necessary nozzle velocity and ensuring that material fed to the nozzle is uniform.

4.3 Testing Agency Qualifications:

4.3.1 Contractor shall secure, at his expense, the services of a testing laboratory meeting the requirements of ASTM E-329. The testing laboratory shall be normally engaged in the testing of concrete materials and concrete. Contractor shall submit the qualifications of the testing agency to owner for approval in accordance with the requirements for submittals contained in the specification. The materials testing laboratory shall make all tests to provide the quality control that shows that the shotcrete and shotcrete materials provided meet or exceed the requirements of this specification. As interpretations of the test results is required, contractor shall further be responsible for securing the services of an independent Professional Engineer licensed in the State of Alabama who shall review and certify the test results. Certified test results shall be submitted by contractor to owner in triplicate.

## **5.0 PRODUCTS – LINES 00001 THROUGH 00018**

### 5.1 Cement

5.1.1 Portland Cement conforming to ASTM C-150, Type 1, unless otherwise designated.

### 5.2 Aggregate

5.2.1 Aggregate shall be naturally siliceous sand conforming to the requirements of ASTM C-33, unless otherwise designated.

5.2.2 Aggregate shall contain less than 3% nor more than 6% moisture.

5.2.3 The combined gradation of coarse and fine aggregates shall conform to the following unless otherwise designated.

Sieve Size Percentage by Weight

(US Standard) Passing

Square Mesh Individual Sieve

1 inch —

3/4 inch —

1/2 inch 100

3/8 inch 95-100

No. 4 72-85

No. 8 52-73

No. 16 36-55

No. 30 20-38

No. 50 7-20

No. 100 2-12

No. 200 0-5

### 5.3 Water

5.3.1 Only fresh, potable water shall be used in mixing.

### 5.4 Admixtures

5.4.1 Admixtures shall be subject to the approval of the Engineer.

Admixtures containing calcium chloride or trichthanolamine shall not be used. Admixtures used in combination shall be physically and chemically compatible and shall be so certified by the manufacturer. Admixtures shall be products of a single manufacturer who shall provide, as necessary, assistance and advice to Engineer on the proper use of admixtures at no increase in contract price.

5.4.1.1 Chemical admixtures shall conform to ASTM C-494.

5.4.1.2 Air entrained admixtures shall conform to ASTM C-260.

5.4.1.3 Fly ash and pozzolanic materials shall conform to ASTM C-618.

5.4.1.4 Accelerating admixtures shall develop quick set and high-early strength characteristics as follows:

Time of Initial Set 3 minutes maximum

8 Hour Compressive Strength 600 psi minimums

Time of setting shall be determined by contractor in accordance with ASTM C-266, except that the accelerator shall be added to 50 grams of cement,

together with the water to produce a water to cement ratio of 0.40, in varying expected to be used to the actual shotcrete installation. The minimum possible time interval shall be used to attain the proper mixing without disturbing the initial set of the paste.

The compressive strength shall be determined by contractor in accordance with ASTM C-109, except that the accelerator in varying percentages expected to be used in the shotcrete mix design shall be added to the mortar prepared with water cement ratio of 0.40. In order to accomplish the molding of the specimen without disturbing the initial setting of the mortar, the intervals of time in the above specification are hereby waived.

## 5.5 Reinforcement

### 5.5.1 Steel Reinforcement

5.5.1.1 Reinforcing steel shall meet the requirements of ASTM A-615, Grade 60 unless otherwise designated.

5.5.1.2 Welded wire fabric or wire mesh shall conform to ASTM A-185. Unless otherwise specified, the wire mesh shall be 2 inches by 2 inches – 12/12 gauge galvanized welded wire fabric.

5.5.1.3 Metal accessories, including all spacers, ties, fasteners and other devices shall be provided for proper spacing, placing and supporting the reinforcement.

### 5.5.2 Fiber Reinforcement

5.5.2.1 Reinforcement shall be steel fibers or polypropylene fibrillated fibers conforming to the requirements of ASTM C-1116 for fiber-reinforced concrete and shotcrete. Unless otherwise designated by the Engineer, polypropylene or steel fiber shall be added to the shotcrete mix at a rate recommended by the manufacturer of fiber.

5.5.2.2 Unless otherwise specified by the Engineer, steel fibers shall be 0.016 inches in diameter, and between ½ and 1 ½ inches long in amounts up to 2 percent by volume of shotcrete; and collated polypropylene fibers in amounts greater than 0.1 percent by volume of fiber added.



## 5.6 Delivery, Storage and Handling of Materials

5.6.1 Contractor shall be solely responsible for the proper delivery, storage and handling of materials to prevent contamination, segregation or damage.

5.6.2 Cement shall be stored in weather tight enclosures to protect against moisture and contamination.

5.6.3 Aggregate shall be properly arranged and stockpiled to prevent contamination, evaporation, freezing and other damage.

5.6.4 Reinforcing steel and fibers shall be carefully bundled, tagged and stored above ground.

5.6.5 Damaged or unsuitable products shall be promptly removed from the job site and shall be replaced with suitable materials.

## 5.7 Structural Requirements

5.7.1 Shotcrete component materials shall be selected and proportioned so that as to produce a minimum 28-day compressive strength of 5000 psi and a minimum 38 day flexural strength of 800 psi.

5.7.2 Shotcrete shall be composed of Portland Cement, aggregate, water and fibers where specified, proportioned so as to produce a concrete suitable for pneumatic application and meeting the specified strength requirements herein set forth.

## 5.8 Equipment

5.8.1 Placing equipment shall consist of spray nozzle for ejection of dry material and water in an intimate mixture, separate hoses to deliver dry materials and water to the nozzle, a suitable machine to introduce the dry materials to the deliver hose under air pressure, and air and water systems. The water supply system shall consist of a local reservoir and a positive displacement pump capable of supply water through a regulating valve, easily and accurately controllable by a nozzle man, in sufficient amount and at a pressure slightly above the operating air pressure recommended by the manufacturer of the delivery machine.

5.8.2 The nozzle pressure shall be determined by the type of work involved and shall conform to the following:

50 to 70 lbs: For rough or heavy work

70-75 lbs: For high lifts or long hose to ensure against clogging

5.8.3 Maximum length of hose for the application of shotcrete shall be approximately 100 feet. Contractor may use as much as 500 feet of hose if the supply nozzle pressures are increased to maintain proper velocity upon approval from Engineer.

5.8.4 Air compressors shall have sufficient capacity to provide without interruption, the pressure and volume of air necessary for the longest hose delivery. Capacity determinations shall include allowance made for the air consumed in blowing rebound, cleaning, reinforcing and for incidental use.

5.8.5 Compressor equipment shall be of such capacity so as to ensure air pressure at the special mixer capable of producing the following material velocities:

375 to 500 feet per second using  $\frac{3}{4}$  inch or 1 inch nozzle

425 to 550 feet per second using 1  $\frac{1}{2}$  inch nozzle

5.8.6 Contractor shall maintain water pressure at approximately 20 pounds higher than the highest air pressure required for placing. The water pressure shall be uniformly steady (non-pulsating).

5.8.7 No air supply system shall be used that delivers air contaminated by oil, or that is incapable of maintaining constant pressure.

5.8.8 No hand-mixed materials shall be permitted.

5.8.9 When using fiber reinforcement, fibers shall be uniformly distributed throughout the mix. Batch proportioning and the use of screens shall be required. Continuous proportioning shall be permitted on if the feeder is carefully synchronized with the mixer to collate the fibers.

## **6.0 EXECUTION – LINES 00001 THROUGH 00018**

## 6.1 Flow Control

6.1.1 Contractor shall provide for maintenance a flow in the affected portions of the drainage system during the installation of the shotcrete lining.

## 6.2 Cleaning

6.2.1 Prior to the installation of shotcrete lining, contractor shall thoroughly clean the pipe/culvert designated to receive the liner. Cleaning shall constitute removal of all solids, roots, deposits, and other matter which would preclude the Installation of the concrete liner into the pipe line.

## 6.3 Inspection of Pipelines

6.3.1 Prior to the installation of shotcrete lining, contractor shall inspect the pipe/culvert designated to be lined.

## 6.4 Surface Preparation

6.4.1 Contractor shall remove all unsound and loose material before applying shotcrete. Contractor shall chip or scarify any area to be repaired to remove offsets which would cause an abrupt change in thickness without suitable reinforcement. All edges shall be tapered so as to leave no square shoulders at the perimeter of the cavity. After all chipping work has been completed; the entire surface shall be thoroughly sandblasted and cleaned with a compressed air blast and jet water blast using a cement gun to remove all dirt, debris and loose particles to permit a satisfactory bond between the existing surface and the shotcrete. Air pressure in the cement gun shall be less than 50psi.

6.4.2 Contractor shall sandblast existing surfaces that do not require chipping to remove paint, oil, grease, silt, slime, and other contaminants, and provide a roughened surface for proper bonding of the shotcrete. Blasting of steel surfaces shall be in compliance with SSPC-SP6.

6.4.3 The chipped and blasted surfaces shall be dampened but without visible running water. Shotcrete shall not be placed on any area where free running water exists.

6.4.4 Loose bricks, in areas are not specifically mentioned, shall be removed and the void filled with shotcrete. This shall apply only to isolated situations where only a few (one to ten) are loose.

6.4.5 Void areas that extend beyond the outside plane of the pipe line or manhole/junction box into the surrounding soil shall be filled and stabilized using pressure injected grout to the outside plane of the pipe line.

6.4.6 Contractor shall fill all voids in the pipe line and manhole/junction box with shotcrete.

6.4.7 Contractor shall repair any damage to the existing structure resulting from his cleaning or void filling operations at no cost to the owner.

6.4.8 Contractor shall remove and properly dispose of, as approved by the Engineer, all debris and rebound from the pipe/culvert that results from his cleaning and shotcrete placement operations. No debris shall be permitted to wash down into the drainage system.

6.4.9 The contractor shall contact utilities to identify all pipe and conduit in the pipe/culvert to be rehabilitated.

## 6.5 Batching and Mixing

6.5.1 The moisture content of the combined aggregate at the time of mixing with cement shall be in the range of 3% to 6% of the oven-dry weight of the aggregate.

6.5.2 The shotcrete shall be thoroughly mixed by machine and then passed through a sieve to remove all large particles before placing in the hopper of the cement gun. The mixture shall not be permitted to become damp. Each batch should be entirely discharged before recharging has begun. The mixer shall be cleaned thoroughly enough to remove all adherent materials from the mixing vanes and from the drum at regular intervals.

6.5.3 Mixed material shall be used within 45 minutes after adding cement or shall be disposed of at contractor's expense. Rebound material shall not be reused.

6.5.4 Water shall not be added to the mix before it enters the cement gun. Quantities of water shall be controlled by a valve at the nozzle of the gun. Water content shall be adjusted as required for proper placement, but shall in no case exceed four gallons per sack of cement, including the water contained in the aggregate. Contractor shall not add water other than at the nozzle.

6.5.5 The accelerating additive shall be added immediately prior to depositing the materials in the placing equipment or if in liquid form may be accurately proportioned into the water supply at the application nozzle. Dry additives shall be accurately proportioned and thoroughly mixed with the other ingredients.

6.5.6 Remixing or tampering shall not be permitted.

6.5.7 Mix proportions shall be controlled by weight batching or by volume batching meeting the requirements (except water in case of dry-mix equipment) at a rate that will provide adequate production and with an accuracy that will ensure uniformity of batches. Weighing equipment shall be capable of batching with the accuracy specified in ASTM C-94. Volumetric equipment shall be capable of batching with the accuracy specified in ASTM C-685.

## 6.6 Ready Mix Concrete

6.6.1 Ready-mixed concrete shall comply with ASTM C-94, except that it may be delivered to the shotcrete equipment in the dry state if the equipment is capable adding the water and mixing it satisfactorily with the dry ingredients, in which case it shall comply with ASTM C-685.

## 6.7 Installation of Steel Reinforcement

6.7.1 Unless otherwise specified, welded wire fabric shall be used as reinforcement. The option of using equivalent deformed bars is acceptable, if minimum depth of concrete over reinforcing will be obtained.

6.7.2 Reinforcement shall not be less than 1 inch from the surface on which the shotcrete is to be placed and there shall not be less than 1 inch between the reinforcement and the final surface of the gunite.

6.7.3 Wire fabric shall be rolled into cylinders and placed circumferentially on hook bolts or support anchors. Anchors shall be 24-inch centers each way.

6.7.4 Mesh or fabric shall be lapped at least one full mesh longitudinally and the same width in inches transversely.

6.7.5 Laps shall be tied with 16 gauge wire at 12 inch spacings.

6.7.6 The full area of reinforcement shall be held firmly on position by means of 16 gauge wire ties in a rigid position to withstand impact of the shotcrete application without displacement.

6.7.7 Installation of reinforcement shall be inspected and approved by the Engineer prior to the commencement of any shotcrete placement operations. This shall not, however, release contractor in any way from his responsibility for ensuring the proper performance of work.

6.7.8 Contractor shall provide ¼ inch by 3 inch hook bolt anchors, supports and other accessories from the Chicago Expansion Bolt Company to hold welded wire fabric in proper position while shotcrete is being placed. Use steel, 16 gauge tie wire to secure the fabric at laps and supports.

6.7.9 Contractor shall provide mechanical connections that develop at least 125 percent of the specified yield strength of the steel in tension.

6.7.10 Install #4 reinforcing steel bars at 8" center, 24" long and 2 #4 reinforcing steel bars longitudinally at the crown for the entire length of pipe line segments tied to the wire mesh. Reinforcing steel shall be placed in accordance with CRSI "Recommended Practice for Placing Reinforcing Bars." Reinforcing placement shall be reviewed by the owner's representative before concrete is placed. (Note: Typical language for installation including steel bar reinforcement. Engineer shall specify the use of steel bars and steel placement on project specific basis.)

6.7.11 Reinforcement shall be clean and free from loose mill scale, loose rust, oil or other coatings that interfere with bonding.

## 6.8 Placement of Shotcrete

6.8.1 Contractor shall place shotcrete using suitable delivery equipment and procedures that will result in shotcrete in place with minimum thickness of 2 inches with an allowable variance of 10 percent unless otherwise shown.

6.8.2 Contractor may use either wet mix or dry mix method of applying shotcrete. Contractor shall control thickness, method of support, air pressure and/or water content of shotcrete to preclude sagging or sloughing off.

Contractor shall discontinue shotcreting or provide suitable means to screen the nozzle stream if wind or air currents cause separation of the nozzle stream during placement.

6.8.3 Contractor shall dampen absorptive substrate surfaces prior to placement of shotcrete to facilitate bond and to reduce the possibility of shrinkage cracking developing from premature loss of mixture water.

6.8.4 Contractor shall fill with sound material all corners and any areas where rebound cannot escape or be blown free. Contractor shall complete the corners between the web and the flanges of structural steel before application to the flat areas.

6.8.5 Contractor shall broom or scarify the surface of freshly placed shotcrete to which, after hardening additional layers of shotcrete are to be bonded. All surfaces shall be dampened just prior to application of succeeding layers.

6.8.6 Contractor shall provide a supply of clean, dry air adequate for maintaining sufficient nozzle velocity for all parts of the work and, if required, for simultaneous operation of a suitable flow pipe for cleaning away rebound.

6.8.7 Rebound losses shall not exceed an average of 25% by weight of the material passing through the nozzle. Rebound shall be removed and disposed of at contractor's expense on a daily basis.

6.8.8 If the flow of material at the nozzle is not uniform and slugs, sand sports, or wet slough results, the nozzle man shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses at no increase in contract price.

6.8.9 Shotcreting shall be suspended if air velocity separates the cement from the sand at the nozzle.

6.8.10 The nozzle shall be held at the proper distance (minimum 3 feet except in close quarters) and at the proper angle to secure maximum compaction with minimum loss of material. This angle shall be as near perpendicular to the surface as work permits.

6.8.11 Construction joints or end of day's work joints shall be sloped off to a thin, clean 45 degree slope. Before placing the adjoining work, clean the sloped portion and adjacent shotcrete and then moisten and scour with an air jet.

#### 6.8.11.1 Placement around Reinforcing

Contractor shall not place shotcrete through more than one layer of reinforcing steel rods or mesh in one application. Contractor shall test to ascertain if any voids or sand pockets have developed around or behind the reinforcement by probing with an awl or other pointed tool after the shotcrete has achieved its initial set, by removal of randomly selected bars or by coring or other suitable means.

#### 6.8.11.2 Line and Thickness Control

-Prior to the application of the first layer of shotcrete, contractor shall furnish and install adequate ground wires, measuring pins, or other approved means to establish the thickness, surface planes, and finish lines of the shotcrete. Contractor shall maintain specified tolerances by keeping ground wires secure and taut.

-Pins shall be non-corrosive and so designed as not to cause infiltration of water through the shotcrete. Pins shall be installed on 5-foot centers in each direction and at the other locations as may be directed by the Engineer.



### 6.8.11.3 Placement Precautions

-Contractor shall not place shotcrete if drying or stiffening of the mix takes place at any time prior to delivery to the nozzle. No rebound or previously expended material shall be used in the shotcrete mix.

-Contractor shall remove all overspray or rebound prior to final set and before placement of shotcrete material on such adjacent surface.

-Contractor shall not apply shotcrete in areas where running water exists.

-Contractor shall protect shotcrete from freezing during installation and during curing period.

-Contractor shall protect in-place reinforcing from excessive construction traffic and other work.

### 6.9 Surface finish

6.9.1 Contractor shall bring the shotcrete to an even plane and well formed corners.

6.9.2 After the body coat has been placed, the surface shall be trued with a thin-edged screed to remove high areas and expose low areas. Low areas shall be properly filled with concrete to ensure a true, flat surface.

6.9.3 After the concrete surface has been trued, the entire surface shall receive a rubber float and brush application resulting in a fine brush smooth finish parallel to the direction of the flow.

### 6.10 Lateral Reinforcement or Abandonment

6.10.1 Contractor is responsible for identifying all active and abandoned laterals and their locations. The contractor shall submit a lateral abandonment plan prior to beginning work. The plan shall include the locations and sizes of all laterals and where they are active or abandoned.

6.10.2 It shall be the contractor's responsibility to determine and to assure that all live laterals are connected. Lateral reinstatement shall be completed from inside the pipe. Excavation for lateral reinstatement shall be permitted.

### 6.11 Testing and Acceptance

6.11.1 Contractor shall be responsible for testing the strength of the shotcrete according to the following:

6.11.1.1 Cores shall be cut from the finished gunite construction and tested in accordance with ASTM C-42. Contractor shall provide standard core test specimens at a rate of two each per 50 linear feet of lining. These specimens shall have a minimum length equal to twice the diameter ( $L/D=2$ ) and shall expose the bond between the shotcrete and the pipe line. They shall be cored from the completed work and shall be tested at contractor's expense in accordance with the aforementioned specification. Test specimens shall be soaked for a minimum of 40 hours prior to testing.

6.11.1.2 The 28-day compressive strength of each core shall not be less than 5,000 psi.

6.11.1.3 In addition to testing the finished shotcrete construction, contractor shall make 2 test panels per day, one in the afternoon, at least 24 inch x 24 inch. Provide the same reinforcement as in the structure in at least half of the panel to demonstrate for proper embedment of reinforcing steel. Fabricate test panels to the same thickness as the structure, but not less than 3 inches. Contractor shall take at least six cores from the panels for testing of compressive strength. Test results shall be provided to owner for both 7-day and 28 day compressive strength results.

6.11.1.4 Contractor shall plug all voids caused by the coring operation by the use of material equal to the in-place shotcrete with workmanship that ensures continuity to the lining with respect to water tightness, strength and appearance.