

**CITY OF MEMPHIS-STANDARD CONSTRUCTION SPECIFICATIONS**  
**SECTION 03370 PNEUMATICALLY PLACED CONCRETE**

**PART 1 – SCOPE**

1.01 This work shall consist of the furnishing and placing of “Pneumatically Placed Concrete” including wire mesh reinforcement for slope stabilization, for lining ditches and channels, constructing warped sections, and rebuilding of deteriorated areas of concrete bridges or culverts to original lines.

1.02 Pneumatically placed concrete as herein specified is a mixture of portland cement and sand thoroughly mixed dry, passing through a cement gun and conveyed by air through a flexible tube, to which mixture the water is added immediately previous to its expulsion from the nozzle where the hydrated mixture is pneumatically applied through the nozzle onto the prepared foundation.

**PART 2 – MATERIALS AND EQUIPMENT**

2.01 MATERIAL

A. Portland Cement.

Cement used shall be Type 1 portland cement as defined in Specification Section 03050.

B. Sand.

Sand shall be mortar sand conforming to the requirements of Specification Section 03050 and shall be well graded coarse to fine with 100 percent passing the ¼ inch sieve. The fineness modulus shall be less than or equal to 3.0.

C. Water.

Water shall be of potable quality.

D. Reinforcement.

Steel reinforcement shall be welded wire fabric as described in Specification Section 03310.

E. Proportioning.

Pneumatically placed concrete shall be mixed in a dry state in the proportion of 1 sack of portland cement to 3 cubic feet of sand. Batches may be measured by weight or volume. All lumps or particles over ¼ inch in size shall be removed by screening prior to placement in the hopper of the cement gun. Water is to be added to the dry sand and cement mixture immediately previous to its expulsion from the nozzle. Water shall be added at the rate of 3.0 to 3.5 gallons per sack of cement (94 pounds) and adjusted by the nozzle to properly place the concrete without washing or dry pockets. Unless otherwise specified, the compressive strength shall be not less than 3,000 psi in 28 days.

F. Test Specimens.

The pneumatic concrete Contractor shall furnish at his own expense, especially constructed cylinders 6 inches in diameter and 12 inches high, made of ½ inch opening hardware cloth. The test cylinders shall be made with the same pressure, nozzle tip, and hydration as the pneumatic concrete in the structure where the cylinders were made. The number of cylinders required will be approximately 6 per day; however, additional cylinders and other test methods may be required by the Owner.

2.02 EQUIPMENT

A. Equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Owner as to design, capacity, and mechanical condition. The equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly and approved.

B. Cement Gun.

**CITY OF MEMPHIS-STANDARD CONSTRUCTION SPECIFICATIONS**  
**SECTION 03370 PNEUMATICALLY PLACED CONCRETE**

The pneumatic mixing and delivering equipment shall be the vertical double chamber type. The upper chamber shall receive and pressurize the dry mix and deliver it to the lower chamber. The lower chamber shall force the pressurized mix into the delivery hose by means of the feed wheel. The type of feeder utilized should be of sufficient capacity that the lower chamber may continuously furnish all required material to the delivery hose while the upper chamber receives the recharge. All equipment must be kept in good repair. The interior of drums, feed gearing and valves shall be cleaned as often as necessary (at least once every 8 hour shift) to prevent material from caking on critical parts. Gaskets in the equipment shall be kept in good condition to avoid reduced pressure and consequent reduced velocity of material during the recharging periods.

C. Air Compressor.

Any standard type of compressor will be satisfactory if it is of sufficient capacity to provide, without interruption, the pressures and volume of air necessary for the longest hose delivery. The air compressor capacity determinations shall include allowances made for the air consumed in blowing rebound, cleaning reinforcing and for incidental use. Compressor equipment shall be of such capacity so as to insure air pressure at the mixer capable of producing the following material velocities:

1. 375 to 500 feet per second using ¾ inch nozzle.
2. 425 to 550 feet per second using 1 ½ inch nozzle. Nozzles shall be of the "Premixing" type with perforated water-feed ring inside the nozzle to direct an even distribution of water through the material at the place of application.

D. Hose and Nozzle.

The nozzle shall be the premixing type with perforated water feed ring inside the nozzle. The maximum length of material hose for the application of pneumatically placed concrete shall be approximately 100 feet although it shall be permissible to use as much as 500 feet of material hose if the supply nozzle pressures are increased to maintain proper velocity. The nozzle pressures shall be determined by the type of work involved:

1. For rough or heavy work: Nozzle pressures of 50 to 60 pounds.
2. For high lifts or long hose to insure against clogging: pressures of 70 to 75 pounds.

E. Water Pump.

Water pressures shall be maintained at approximately 20 pounds higher than the highest air pressure required for placing. Both air and water pressure shall be uniformly steady (nonpulsating).

**PART 3 – CONSTRUCTION REQUIREMENTS**

3.01 SURFACE PREPARATION.

A. The surface to receive the pneumatically placed concrete shall be graded and cleaned of loose, deteriorated, or undesirable material as directed by the Owner.

B. Pneumatically placed concrete used in slope stabilization, ditch or channel lining or construction of warped sections shall be placed on natural earth surfaces graded to the cross-sections shown on the Plans or directed by the Owner. Depressions or uneven surfaces shall be filled with suitable material excavated from the site. All fills shall be compacted to a maximum density of 90 percent as determined by ASTM D 698 (Standard Proctor). Surplus excavated material shall be removed from the site and disposed of as shown on the Plans or as directed by the Owner.

**CITY OF MEMPHIS-STANDARD CONSTRUCTION SPECIFICATIONS**  
**SECTION 03370 PNEUMATICALLY PLACED CONCRETE**

C. Pneumatically placed concrete used in the repair of concrete structures shall be placed on a surface of sound concrete. All disintegrated and spalled concrete shall be removed by chipping with pneumatic hammers and chisels to sound concrete. All cracks and cavities shall be chipped to such formation that their sides are approximately perpendicular to the exposed surface forming a mechanical shoulder for at least 2 inches in depth. All concrete surfaces to receive pneumatically placed concrete shall be cleaned by flushing or scouring with water and compressed air jets to remove all loose particles. Corroded and rusted reinforcing steel shall be cleaned by sandblasting to insure positive bond of the pneumatically placed concrete. To insure a good bond, the newly chipped and sandblasted surface shall be thoroughly moistened with water not less than one hour prior to application of the pneumatically placed concrete.

D. In no instance shall pneumatically placed concrete be applied to an area where free running water exists.

E. Reinforcement in new construction shall be placed as specified in the Plans and secured to insure no displacement from impact to the pneumatically placed concrete during application.

F. Reinforcing steel for repair of concrete structures may be welded to other exposed steel or may be grouted securely into drilled holes in the accepted manner of placing anchor dowels within the proposed repair area of concrete structures. In drilling dowel holes, care must be exercised to avoid damage to existing reinforcing steel. Spacing of the steel reinforcing will depend on the location, nature, and extent of the repair and will be determined by the Owner. Wire mesh or fabric used as reinforcement will be determined by the Owner and shall be anchored by means of ¼ inch by 4 inch expansion hook bolts spaced 24 inches on center in each direction, or by secure wire ties to existing steel. The full area of mesh or fabric shall be held firmly in position by means of 16 gauge or 18 gauge wire ties. The reinforcement shall not be less than ½ inch from the surface on which the pneumatically placed concrete is to be placed, and there shall not be more than ¾ inch between the reinforcement and the final surface of the pneumatically placed concrete. In places where the depth of the section removed exceeds 3 inches over an appreciable area, 2 or more layers of fabric shall be used. Steel bar reinforcing shall be lapped 40 diameters; mesh or fabric shall be lapped at least one full mesh longitudinally and the same width in inches transversely. Laps shall be tied with 16 or 18 gauge wire at 12 inch spacing.

**3.02 MIXING.**

A. Pneumatically placed concrete shall be thoroughly mixed in a dry state either by hand or in a mechanical mixer before placing in the hopper of the cement gun or other apparatus. The term "dry" as applied to sand, designates a normal moisture content of from 3 percent to 8 percent.

B. Water shall not be added to the mix after mixing or before using the cement gun. Remixing or tempering shall not be permitted.

**3.03 LIMITATIONS OF APPLICATION.**

A. Pneumatically placed concrete shall not be placed on a frozen surface nor when the ambient temperature is less than 40 degrees F. Pneumatically placed concrete shall not be placed when it is anticipated that the temperature during the following 24 hours will drop below 32 degrees F.

B. The application of pneumatically placed concrete shall be suspended if high winds separate the cement from the sand at the nozzle, or rain occurs which would wash out the pneumatically placed concrete.

**3.04 APPLICATION.**

**CITY OF MEMPHIS-STANDARD CONSTRUCTION SPECIFICATIONS**  
**SECTION 03370 PNEUMATICALLY PLACED CONCRETE**

A. Corners shall be filled first. "Shooting" shall be from an angle as near perpendicular to the surface as practicable, with the nozzle held approximately 3 feet from the work (except in confined control). If the flow of material at the nozzle is not uniform and slugs, sand spots, or wet sloughs result, the nozzleman shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses.

B. Sequence of application may be from bottom to top or vice versa if rebound is properly removed.

C. The time interval between successive layers in sloping, vertical or overhanging work shall be sufficient to allow initial but not final set to develop. At the time the initial set is developing, the surface shall be broomed to remove the thin film of laitance in order to provide for a bond with succeeding applications.

D. The construction joints or day's work joints shall be sloped off to a thin clean, regular edge, preferably at a 45 degree slope. Before placing the adjoining work, the sloped portion and adjacent pneumatically placed concrete shall be thoroughly cleaned as necessary, then moistened and scoured with an air jet.

E. Pneumatically placed concrete shall be applied in one or more layers to such total thickness as required to restore the area to 2 inches over the original line of the adjoining surface, unless otherwise specified by the Owner.

**3.05 FINISHING.**

A. After the pneumatically placed concrete has been placed as nearly as practicable to the required depth, the surface shall be checked with a straightedge or template, and any low spots or depressions shall be brought up to proper grade by placing additional pneumatic concrete in such a manner that the finished surface shall be reasonably smooth and uniform to the type of work involved.

B. When the body coat has been placed, the surface shall be trued with a thin edge screed to remove high areas and expose low areas. Low areas shall be properly filled to insure a true flat surface. After the surface has been trued a thin layer of pneumatically placed concrete shall be applied to the entire surface for a natural finish.

C. Loose areas of pneumatically placed concrete shall be removed and replaced by the Contractor at his expense.

**3.06 CURING.**

As soon as the fresh pneumatically placed concrete surface shows the first dry patches, a fine spray of water shall be applied to keep it moist. After the surface has hardened, it shall be kept moist for a period of 7 days.

**3.07 ADJACENT SURFACE PROTECTION.**

During progress of the work, where appearance is important, adjacent areas or grounds which may be permanently discolored, stained, or otherwise damaged by dust and rebound, shall be adequately protected and, if contacted, shall be cleaned by early scraping, brushing or washing, as the surroundings permit.

**3.08 QUALIFICATIONS AND DUTIES OR WORKMEN.**

Only experienced foremen, gunmen, nozzle men, and rodmen shall be employed and satisfactory written evidence of such experience shall be furnished the Owner upon request.

**PART 4 – MEASUREMENT**

**CITY OF MEMPHIS-STANDARD CONSTRUCTION SPECIFICATIONS**  
**SECTION 03370 PNEUMATICALLY PLACED CONCRETE**

4.01 PNEUMATICALLY PLACED CONCRETE.

The completed and accepted pneumatically placed concrete as specified and indicated on the Plans will be measured in square feet for various thicknesses. Measurement will be made over and parallel to the actual area of the pneumatically placed concrete.

**PART 5 – PAYMENT**

5.01 PNEUMATICALLY PLACED CONCRETE.

Pneumatically placed concrete measured as provided above will be paid for at the contract unit price per square foot for “Pneumatically Placed Concrete” of the various thicknesses specified. The unit price per square foot will include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing the work involved in placing pneumatically placed concrete, including preparing the foundation and reinforcement as shown on the Plans, as specified in these Specifications, and as directed by the Owner.

5.02 PAYMENT WILL BE MADE UNDER:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
03370-01	PNEUMATICALLY PLACED CONCRETE	Square Foot
03370-01.____	____” Thickness Pneumatically Placed Concrete	Square Foot

**END OF SECTION 03370**