

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 Perform all work in accordance with ACI MCP SET Parts 2 and 3.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI MCP SET (2012) Manual of Concrete Practice

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A615/A615M (2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM C1064/C1064M (2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

ASTM C1260 (2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C143/C143M (2010a) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C150/C150M (2011) Standard Specification for Portland Cement

ASTM C1567 (2011) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

ASTM C171 (2007) Standard Specification for Sheet Materials for Curing Concrete

ASTM C172/C172M (2010) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C173/C173M (2010b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C231/C231M (2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

VAMC COATESVILLE, PA
INSTALL BACKFLOW PREVENTER SOUTH PUMP BLDG 25
PROJECT NUMBER: 542-15-121

ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2012) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C494/C494M	(2011) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2011) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2012) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C685/C685M	(2011) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2012) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2011) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D2628	(1991; R 2011) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates
ASTM D98	(2005) Calcium Chloride
ASTM E1155	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers

ASTM E1155M (1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers (Metric)

ASTM E96/E96M (2010) Standard Test Methods for Water Vapor Transmission of Materials

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 400 (1963) Requirements for Water for Use in Mixing or Curing Concrete

COE CRD-C 572 (1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.3 SYSTEM DESCRIPTION

1.3.1 Obtain samples of aggregates at the point of batching in accordance with ASTM D75/D75M. Sample concrete in accordance with ASTM C172/C172M. Determine slump and air content in accordance with ASTM C143/C143M and ASTM C231/C231M, respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with ASTM C31/C31M. Test compression test specimens in accordance with ASTM C39/C39M. Take samples for strength tests not less than once each shift in which concrete is produced. Provide a minimum of three specimens from each sample; two to be tested at 28 days (90 days if pozzolan is used) for acceptance, and one will be tested at 7 days for information.

1.3.2 Strength

Acceptance test results are the average strengths of two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete is considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, $f'c$, and no individual acceptance test result falls below $f'c$ by more than 500 psi.

1.3.3 Construction Tolerances

Apply a Class "C" finish to all surfaces except those specified to receive a Class "D" finish. Apply a Class "D" finish to all post-construction surfaces which will be permanently concealed. Surface requirements for the classes of finish required are as specified in Part 4 of ACI MCP SET.

1.3.4 Concrete Mixture Proportions

Concrete mixture proportions are the responsibility of the Contractor. Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. Provide materials included in the mixture proportions of the same type and from the same source as will be used on the project. Specified compressive strength $f'c$ shall be 3,000 psi at 28 days (90 days if pozzolan is used). The maximum nominal size coarse aggregate is 1-1/2 inch, in accordance with ACI MCP SET Part 3. The air content shall be

VAMC COATESVILLE, PA
INSTALL BACKFLOW PREVENTER SOUTH PUMP BLDG 25
PROJECT NUMBER: 542-15-121

between 4.5 and 7.5 percent with a slump between 2 and 5 inches. The maximum water cement ratio is 0.45.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following:

SD-03 Product Data

Welded Wire Fabric

SD-05 Design Data

Concrete Mix Design; G

SD-06 Test Reports

Field Testing of Concrete

SD-07 Certificates

Concrete Batch Tickets

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Maintain Manufacturer's certificates of compliance, accompanied by mill test reports, attesting that the concrete materials meet the requirements of the specifications in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Also, certificates for all material conforming to EPA's Comprehensive Procurement Guidelines (CPG), in accordance with 40 CFR 247. Provide cementitious materials that conform to the appropriate specifications listed:

2.1.1.1 Portland Cement

ASTM C150/C150M, Type V

2.1.2 Aggregates

Fine and coarse aggregates shall meet the quality and grading requirements of ASTM C33/C33M Class Designations 4M or better. Maintain certificates of compliance and test reports for aggregates showing the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with an appropriate specification. Retest chemical admixtures that have been in storage at the project site, for longer than 6 months or that have been subjected to freezing, at the expense of the Contractor at the request of the Contracting Officer and will be rejected if test results are not satisfactory.

2.1.3.1 Air-Entraining Admixture

Provide air-entraining admixture that meets the requirements of ASTM C260/C260M.

2.1.3.2 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of ASTM C494/C494M, Type A, B, or D.

2.1.4 Water

Use fresh, clean, potable water for mixing and curing, free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C 400.

2.1.5 Reinforcing Steel

Provide reinforcing bars conforming to the requirements of ASTM A615/A615M, Grade 60. Welded steel wire fabric shall conform to the requirements of ASTM A185/A185M. Details of reinforcement not shown shall be in accordance with ACI MCP SET Part 3, Chapters 7 and 12.

2.1.6 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded shall be sponge rubber conforming to ASTM D1752, Type I.

2.1.7 Joint Sealants - Field Molded Sealants

Joint sealants - field molded sealants shall conform to ASTM C920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Provide polyethylene tape, coated paper, metal foil, or similar type bond breaker materials. The backup material needs to be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, clean the joint of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

2.1.8 Formwork

The design and engineering of the formwork as well as its construction, will be the responsibility of the Contractor.

2.1.9 Form Coatings

Coat forms, for exposed surfaces, with a nonstaining form oil to be applied shortly before concrete is placed.

2.2 READY-MIX CONCRETE

2.2.1 Concrete shall be ready-mix concrete with mix design data conforming to ACI MCP SET Part 2. Bill of Lading for each ready-mix concrete delivery shall be in accordance with ASTM C94/C94M.

2.2.2 Non-exposed concrete elements

3000 psi minimum compressive strength.

2.2.3 Direct-exposed concrete elements (including air-conditioned rooms)

5000 psi minimum compressive strength as determined in 28 calendar days.

2.2.4 Slump

1 to 4 inch according to ASTM C143/C143M and ACI MCP SET Part 1.

2.2.5 Portland Cement conforming to ASTM C150/C150M, Type 5.

2.2.6 Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.2.7 Air-Entraining Admixtures conforming to ASTM C260/C260M. Exterior concrete exposed to freezing needs to be air-entrained 5 to 6 percent by volume.

2.2.8 Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C494/C494M.

2.2.9 Fly Ash used as a supplementary cementitious material shall conform to ASTM C618, Class C or F with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.

2.2.10 Ground granulated blast furnace slag used as a supplementary cementitious material shall conform to ASTM C989/C989M, Grade 120 with between 25 to 50 percent maximum cement replacement by weight.

2.3 STEEL REINFORCEMENT

2.3.1 Deformed Steel Bars

Provide steel bars conforming to ASTM A615/A615M, Grade 60 ksi ACI MCP SET Parts 2 and 3.

2.4 FORMS

2.4.1 Forms shall be of wood, steel, or other approved material and conform to ACI MCP SET, Parts 2 and 3. Provide form release conforming to ACI MCP SET, Part 4.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 Prepare construction joints to expose coarse aggregate. The surface shall be clean, damp, and free of laitance. Construct ramps and walkways, as necessary, to allow safe and expeditious access for concrete and workmen. Remove snow, ice, standing or flowing water, loose particles, debris, and foreign matter. Earth foundations shall be satisfactorily compacted. Ensure spare vibrators are available.

3.1.2 Embedded Items

Secure reinforcement in place after joints, anchors, and other embedded items have been positioned. Arrange internal ties so that when the forms are removed the metal part of the tie is not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete is permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

3.1.3 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. Provide smooth form surfaces, free from irregularities, dents, sags, or holes when used for permanently exposed faces. Chamfer all exposed joints and edges, unless otherwise indicated.

3.1.4 Production of Concrete

3.1.4.1 Ready-Mixed Concrete

Provide ready-mixed concrete conforming to ASTM C94/C94M except as otherwise specified.

3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to ASTM C685/C685M.

3.2 CONVEYING AND PLACING CONCRETE

3.2.1 Concrete placement is not permitted when weather conditions prevent proper placement and consolidation. When concrete is mixed and/or transported by a truck mixer, deliver the concrete to the site of the work completing the discharge within 1-1/2 hours or 45 minutes when the placing temperature is 86 degrees F or greater unless a retarding admixture is used. Convey concrete from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Deposit concrete as close as possible to its final position in the forms and regulate it so that it may be effectively consolidated in horizontal layers

18 inches or less in thickness with a minimum of lateral movement. Carry on the placement at such a rate that the formation of cold joints will be prevented. Submit Methods and equipment for transporting, handling, depositing, and consolidating the concrete prior to the first concrete placement. Perform conveying and placing concrete in conformance with the following:

3.2.2 Consolidation

Consolidate each layer of concrete by rodding, spading, or internal vibrating equipment. External vibrating equipment may be used when authorized. Systematically accomplish internal vibration by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by approximately 4 inches. Ensure that the vibrator penetrates rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. Hold vibrator stationary until the concrete is consolidated and then withdraw it slowly at the rate of about 3 inches per second.

3.2.3 Cold-Weather Requirements

No concrete is to be mixed or placed when the ambient temperature is below 36 degrees F or if the ambient temperature is below 41 degrees F and falling. Provide suitable covering and other means as approved for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing and at a temperature above freezing for the remainder of the curing period. Do not mix salt, chemicals, or other foreign materials with the concrete to prevent freezing. Remove and replace concrete damaged by freezing at the expense of the Contractor.

3.2.4 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI MCP SET Part 2, is expected to exceed 0.2 psf per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures taken as quickly as finishing operations will allow.

3.2.5 Lifts in Concrete

Deposit concrete in horizontal layers not to exceed 24 inches in thickness. Carry on placement at a rate that prevents the formation of cold joints. Place slabs in one lift.

3.3 FORM REMOVAL

3.3.1 Do not remove forms before 24 hours after concrete placement, except as otherwise specifically authorized. Do not remove supporting forms and shoring until the concrete has cured for at least 5 days. When conditions require longer curing periods, forms shall remain in place.

3.4 FINISHING

3.4.1 Temperature Requirement

Do not finish or repair concrete when either the concrete or the ambient temperature is below 50 degrees F.

3.4.2 Finishing Formed Surfaces

Remove all fins and loose materials, and surface defects including filling of tie holes. Repair all honeycomb areas and other defects. Remove all unsound concrete from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. Brush-coat the prepared area with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filling with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured is the same as adjacent concrete.

3.4.3 Finishing Unformed Surfaces

Float finish all unformed surfaces that are not to be covered by additional concrete or backfill, to elevations shown, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be brought to the elevations shown and left as a true and regular surface. Slope exterior surfaces for drainage unless otherwise shown. Carefully make joints with a jointing tool. Finish unformed surfaces to a tolerance of 3/8 inch for a float finish and 5/16 inch for a trowel finish as determined by a 10 foot straightedge placed on surfaces shown on the drawings to be level or having a constant slope. Do not perform finishing while there is excess moisture or bleeding water on the surface. No water or cement is to be added to the surface during finishing.

3.4.4 Float Finish

Provide float finished surfaces, screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete supports a person's weight without deep imprint, complete floating. Floating shall embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

3.4.5 Flat Floor Finishes

3.4.6 Expansion and Contraction Joints

Make expansion and contraction joints in accordance with the details shown or as otherwise specified. Provide 1/2 inch thick transverse expansion joints where new work abuts an existing concrete. Cut contraction joints at

a minimum of 1 inch deep with a jointing tool after the surface has been finished.

3.5 CURING AND PROTECTION

3.5.1 Beginning immediately after placement, and continuing for at least 7 days, cure and protect all concrete from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. Provide all materials and equipment needed for adequate curing and protection at the site of the placement prior to the start of concrete placement. Accomplish moisture preservation of moisture for concrete surfaces not in contact with forms by one of the following methods:

3.5.1.1 Continuous sprinkling or ponding.

3.5.1.2 Application of absorptive mats or fabrics kept continuously wet.

3.5.1.3 Application of sand kept continuously wet.

3.5.1.4 Application of impervious sheet material conforming to ASTM C171.

3.5.1.5 Application of membrane-forming curing compound conforming to ASTM C309, Type 1-D, on surfaces permanently exposed to view. Accomplish Type 2 on other surfaces in accordance with manufacturer's instructions.

3.5.2 Accomplish the preservation of moisture for concrete surfaces placed against wooden forms by keeping the forms continuously wet for 7 days are removed prior to end of the required curing period, use other curing methods for the balance of the curing period. Do not perform protection removal if the temperature of the air in contact with the concrete may drop more than 60 degrees F within a 24 hour period.

3.6 TESTS AND INSPECTIONS

3.6.1 Field Testing Technicians

The individuals who sample and test concrete, as required in this specification, shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

3.6.1 Inspection Details and Frequency of Testing

3.6.1.1 Preparations for Placing

Inspect foundation or construction joints, forms, and embedded items in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

3.6.1.2 Air Content

Check air content at least once during each shift that concrete is placed for each class of concrete required. Obtain samples in accordance with ASTM C172/C172M and tested in accordance with ASTM C231/C231M.

3.6.1.3 Slump

Check slump at least once during each shift that concrete is produced. Obtain samples in accordance with ASTM C172/C172M and tested in accordance with ASTM C143/C143M.

3.6.1.4 Consolidation and Protection

Ensure that the concrete is properly consolidated, finished, protected, and cured.

3.6.2 Action Required

3.6.2.1 Placing

Do not permit placing to begin until the availability of an adequate number of acceptable vibrators, which are in working order and have competent operators, has been verified.

3.6.2.1 Air Content

Whenever an air content test result is outside the specification limits, adjust the dosage of the air-entrainment admixture prior to delivery of concrete to forms.

3.6.2.1 Slump

Whenever a slump test result is outside the specification limits, adjust the batch weights of water and fine aggregate prior to delivery of concrete to the forms. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the concrete mixture proportion.

3.7 FORM WORK

3.7.1 Form work shall conform to ACI MCP SET Parts 2 through 5.

3.7.2 Preparation of Form Surfaces

Forms shall be true to line and grade, mortar-tight, and sufficiently rigid to prevent objectionable deformation under load. Form surfaces for permanently exposed faces shall be smooth, free from irregularities, dents, sags, or holes. Chamfer exposed joints and exposed edges. Arrange internal ties so that when the forms are removed, the form ties are not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structure.

3.7.3 Form Coating

Coat forms, for exposed surfaces, with a nonstaining form release coating applied shortly before concrete is placed. Forms for unexposed surfaces may

be wetted in lieu of coating immediately before the placing of concrete, except that in freezing weather form release coating shall be used.

3.7.4 Removal of Forms

Remove forms carefully to prevent damage to the concrete. Do not remove forms before the expiration of the minimum time indicated below:

Arches, beams and deck-type slabs	144 hours
Columns and walls (lifts 15 feet and under)	24 hours
Columns and walls (lifts over 15 feet)	48 hours

3.8 STEEL REINFORCING

3.8.1 Reinforcement shall be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

3.8.2 Fabrication

Shop fabricate steel reinforcement in accordance with ACI MCP SET Parts 2 and 3. Shop details and bending shall be in accordance with ACI MCP SET Parts 2 and 3.

3.8.2 Splicing

Perform splices in accordance with ACI MCP SET Parts 2 and 3.

3.8.2 Supports

Secure reinforcement in place by the use of metal or concrete supports, spacers, or ties.

3.9 EMBEDDED ITEMS

3.9.1 Before placing concrete, take care to determine that all embedded items are firmly and securely fastened in place. Provide embedded items free of oil and other foreign matter, such as loose coatings of rust, paint and scale. Embedding of wood in concrete is permitted only when specifically authorized or directed.

3.10 FIELD TESTING

3.10.1 Provide samples and test concrete for quality control during placement. Sampling of fresh concrete for testing shall be in accordance with ASTM C172/C172M.

3.10.2 Test concrete for compressive strength at 7 and 28 days for each design mix. Concrete test specimens shall conform to ASTM C31/C31M. Perform Compressive strength testing conforming to ASTM C39/C39M.

3.10.3 Test Slump at the site of discharge for each design mix in accordance with ASTM C143/C143M.

VAMC COATESVILLE, PA
INSTALL BACKFLOW PREVENTER SOUTH PUMP BLDG 25
PROJECT NUMBER: 542-15-121

3.10.4 Test air content for air-entrained concrete in accordance with ASTM C231/C231M. Test concrete using lightweight or extremely porous aggregates in accordance with ASTM C173/C173M.

3.10.5 Determine temperature of concrete at time of placement in accordance with ASTM C1064/C1064M.

-- End of Section --