

03 30 00 CAST-IN-PLACE CONCRETE

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SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section covers the requirements for supply, placement, finishing and curing installation of cast-in-place concrete as indicated on the Drawings.

1.2 RELATED SECTIONS

- A. Section 03 10 00 – Concrete Forming and Accessories.
- B. Section 03 20 00 – Concrete Reinforcement.
- C. Section 03 60 00 – Grouting.
- D. Section 31 60 00 – Foundation Preparation.

1.3 REFERENCE STANDARDS

- A. The latest edition of Reference Standards shall govern, unless otherwise specified.
- B. American Concrete Institute (ACI):
 - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 304.2R - Guide to Placing concrete by Pumping Methods.
 - 4. ACI 305R - Guide to Hot Weather Concreting.
 - 5. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 - 6. ACI 308.1 - Specification for Curing Concrete.
 - 7. ACI 318 - Building Code Requirements for Structural Concrete.
 - 8. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures.
- C. ASTM International:
 - 1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C33 - Standard Specification for Concrete Aggregates.

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3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
5. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
8. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
9. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
10. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
11. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
12. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
13. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
14. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
15. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

1.4 SUBMITTALS

- A. Items listed in this section are to be submitted to the Engineer for information prior to the start of any Works, unless noted otherwise.
- B. Concrete mix designs are to be submitted to DSOD for review and approval at least two weeks in advance of desired approval date.
- C. Ready-mix concrete from a ready-mix plant: Submit for review and approval documentation demonstrating that the concrete materials achieve the project requirements indicating the following:
 1. Petrographic analysis of concrete aggregate (fine and coarse).
 2. Aggregate size and gradation.
 3. Test results for alkali-aggregate reaction.
 4. Cement and supplementary cementitious materials chemical composition.
 5. Product Data: Submit Manufacturer's information on all concrete additives and admixtures to be used.

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- D. Mix design data, submit for review and approval the following:
 - 1. Concrete ingredients and proportion, including admixtures for each strength and type of concrete.
 - 2. Compressive strength results at 7, and 28-days of each type of concrete demonstrating that each class of concrete will achieve the required strength and performance requirements either evaluated by concrete trial mixes or based on tests conducted within the previous 12 months.
 - 3. Cold weather mixing procedure and methods for protection from freezing during placing and curing in accordance with ACI 306 if work is expected to occur when atmospheric temperatures are expected to be below 40 °F.
 - 4. Hot weather procedure in accordance with ACI 305 when atmospheric temperatures are expected to exceed 85°F.
- E. Quality Control Plan.
- F. For bridges and culvert structures, see submittal requirements in Section 32 50 00.
- G. Field Quality-Control Submittals:
 - 1. Ready-mix delivery tickets.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: Comply with ASTM C150, Type I.
- B. Aggregate:
 - 1. Concrete aggregate to conform to ASTM C33. Aggregates not complying with ASTM C33, but which have shown by test and actual service to produce concrete of adequate strength and durability may be submitted for approval.
 - 2. Aggregates shall be nonreactive for alkali-silica reactivity (ASR) and shall be washed before use.
 - 3. Do not use aggregates containing soluble salts or other substances which cause stains on exposed concrete surfaces.
 - 4. Fine aggregates and coarse aggregates shall be regarded as separate ingredients.

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5. Fine aggregate shall not exceed 40 percent by weight of the combined aggregate total.
- C. Water:
1. Comply with ACI 301, ASTM C94 and ASTM C1602.
 2. Be clean and free from objectionable quantities of silty organic matter, oils, acids, alkali, salts, organics, and other impurities.
- D. Admixtures:
1. Air Entrainment: Comply with ASTM C260, be compatible with water reducing and any other admixture, and shall be subject to tests in accordance with ASTM C233. If air entraining cement is used, any additional air entraining admixture shall be of the same type as that in the cement. Air-entraining admixtures shall be added to the concrete mixture in the form of solutions rather than solids. The manufacturer's storage recommendations shall be followed.
 2. Water reducing and set retarding admixtures shall conform to ASTM C260, Types A or D and conform to ASTM C494, Type A with not more than 0.1 percent chloride ions. Use water reducing admixture to increase workability of mix.
 3. High range, water reducing admixtures used for slowing concrete cure and retarders: shall conform to ASTM C1017, Type 1.
- E. Miscellaneous Materials:
1. Waterstops:
 - a. Hydrophilic waterstop, swellable strip type with delayed action coating meeting shall be used where specified. Apply hydrophilic waterstop as per Manufacturer's recommendations.
 2. Curing and Sealing Compounds:
 - a. Liquid membrane forming, curing compound meeting requirements of ASTM C309, clear type.
 3. Polystyrene Joint Filler/Bond Breaker: Rigid closed-cell extruded polystyrene foam panels; ASTM C578, Type VI, density 1.8 pcf minimum, 2-inch thick or as required.
 4. Bond Breaker: Asphalt impregnated felts, 15 pounds, polyethylene tape, coated paper, metal foil, or other approved material.
- F. Grout:
1. Nonshrink grout: in accordance with ASTM C1107.
 2. Epoxy grout: in accordance with ASTM C881.

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2.2 CONCRETE MIX

- A. Mix Designs: Contractor shall be responsible for mix designs and related testing to the mix designs, which shall conform to the following requirements:
- B. All materials used in the work shall be subject to inspection and tests at the batch plant and at the job site.
- C. All concrete mixes shall be designed using the minimum water possible subject to workability requirements.
- D. Select proportions for normal weight concrete according to ACI 301.
- E. Performance and Design Criteria:
 - 1. All cast-in-place concrete, shall meet the following proportioning and design requirements without the use of an ASTM C494, Type F, high range water reducing admixture:
 - 2. Compressive Strength: 28-day strength as indicated in Drawings.
 - a. Provide concrete as indicated on the Drawings meeting the following requirements:

Table 1 – Concrete Requirements

28-Day Compressive Strength	Maximum w/cm (%)	Air Content (%)	Slump (inch)
4,000 psi	0.45	4 - 7	up to 5
5,000 psi	0.42	5 - 8	up to 5

- b. ASTM C494, Type F, high range water reducing admixture may be used to improve consistency and workability, for pumping concrete.
- c. Slump specified prior to the addition of superplasticizers.

2.3 SUPPLY OF PRE-CAST CONCRETE ITEMS

- A. Concrete requirements of pre-cast concrete items shall be in compliance with the requirements of this Section.

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PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare previously placed concrete by roughening surface of existing concrete to an amplitude of approximately 1/4 inch to remove laitance, coatings, and unsound materials.
- B. Preparation of soil and rock foundations shall meet the requirements stated in Section 31 60 00 – Foundation Preparation.
- C. Verify before placing concrete that reinforcement is placed to meet the requirements stated in Section 03 20 00 - Concrete Reinforcement and that all reinforcing steel is free of oil or other coatings that might impair bond with the concrete.
- D. Verify that castings, anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, clean, and free of oil or loose coatings of paint, rust, or scale, and will not interfere with placing concrete.
- E. Apply bonding agent in accordance with manufacturers recommendations.
- F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and completely fill the grout hole with non-shrink grout as specified in Section 03 20 00 - Concrete Reinforcement and Section 03 60 00 – Grouting or as specified on the Drawings.
- G. Concrete shall not be placed in formwork which has collected water, snow, or ice, in any form or manner.
- H. Preheat forms to maintain temperature at 40 °F or above.
- I. Formwork shall be cleaned of all tie wire off-cuts, nuts, bolts, rebar off-cuts, timber, Snow, ice, chips, dirt, and other debris before fresh concrete is placed inside forms. Formwork shall be completed and checked to be watertight and to the proper lines. Thoroughly wet the forms (except in freezing weather), or oil them; and remove all standing water.
- J. Thoroughly saturate existing concrete one hour before placing new concrete against existing concrete. Maintain surface of existing concrete in a moist condition until new concrete is placed.
- K. Contractor shall have all equipment and materials required for curing available at the site ready for use before placement of concrete begins.

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3.2 PRODUCTION OF CONCRETE

- A. Mix and deliver concrete according to ASTM C94, ACI 301, and ACI 318.
- B. Start agitation of concrete immediately after the pre-mixed concrete is placed in the concrete mixing truck and continue without interruption until discharged.
- C. Concrete may be furnished by batch mixing at or near the site or by ready mix methods.
- D. Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size will be avoided and that various sizes will not become intermixed before proportioning. Methods of handling and transportation of aggregates shall be such to avoid contamination, excessive breakage, or segregation.

3.3 WATERSTOPS

- A. Install waterstops in accordance with manufacturer's recommendations.
- B. Support and protect waterstops during construction.
- C. Splice waterstops using manufacturer's approved splicing procedures to form a continuous watertight joint.

3.4 CONCRETE PLACEMENT

- A. Place concrete according to ACI 301, ACI 304.2R, and ACI 318.
- B. Discharge concrete at the placing site prior to any set up of the mix.
- C. Do not place concrete for slabs or other visually exposed horizontal surfaces when rain is forecast during the placing and finishing time period unless protective enclosures are provided to prevent damage to surface of concrete from rain.
- D. Provide such equipment and place concrete as close as possible to its final position to avoid segregation of the mix.
- E. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, and forms are not disturbed during concrete placement.
- F. Do not drop concrete a free distance of more than 5 feet. For vertical drops exceeding this height, such as in walls, columns, and piles, use a tremie or other suitable approved placement method.

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- G. Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods that will prevent segregation of aggregates or loss of mortar.
- H. Place concrete so that uniform appearance of visually exposed surface will be obtained.
- I. Place concrete in continuous operation for each panel or section as determined by predetermined joints proceeding at a uniform rate so that cold joints between layers are not created. Keep the pour surface of concrete within walls generally level.
- J. Carry out placing as a continuous operation until placement of the panel or section is complete. Do not deposit fresh concrete on concrete, which has hardened sufficiently that a vibrator will not easily penetrate.
- K. Elapsed Time for Placing Concrete: Concrete shall be delivered to any monolithic unit of a structure at a rate which will permit proper handling, placing, and finishing of the concrete.
- L. Regulate the maximum interval between the placing of batches at the work site to avoid the development of cold joints. If concrete placement is discontinued when an incomplete layer is in place, the unfinished end of the layer shall be formed by a vertical bulkhead or finished to a horizontal surface. New concrete shall not be placed until the hardened concrete has cured at least 12 hours and the construction joint has been prepared in accordance with Clause 3.8.

3.5 CONCRETING IN COLD WEATHER

- A. When the atmospheric temperature may be expected to drop below 40°F at the time concrete is delivered to the work site, during placement, or any time during the curing period, the following provisions also shall apply:
 - 1. Protect concrete work from physical damage or reduced strength caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.
 - 2. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcement, and adjacent concrete surfaces are entirely free of frost, snow or ice before placing concrete.
 - 3. The temperature of the concrete at the time of placing shall not be less than 50°F nor more than 85°F. The temperature of neither aggregates nor mixing water shall be more than 100°F just prior to mixing with the cement.
 - 4. When the daily minimum temperature is less than 40°F, concrete structures shall be insulated or housed and heated after placement. The temperature of the concrete and air adjacent to the concrete shall be maintained at not less than 50°F nor more than 90°F for the duration of the curing period.

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3.6 CONCRETING IN HOT WEATHER

- A. When climatic or other conditions are such that temperature of concrete may be expected to exceed 85°F at the time of delivery at the work site, during placement, or during the first 24 hours after placement, the following provisions also shall apply:
1. Maintain the temperature of the concrete below 85°F during mixing, conveying, and placing. Methods used shall conform to ACI 305. Cool ingredients before mixing to maintain concrete temperature at time of placement. Mixing water may be chilled or chopped ice may be used to control temperature provided water equivalent of ice is calculated in total amount of mixing water.
 2. Exposed concrete surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or otherwise protected, as directed by the Engineer, from drying during the time between placement and finishing, and after finishing.
 3. Finishing of slabs and other exposed surfaces shall be started as soon as the condition of the concrete allows and shall be completed without delay.
 4. Concrete surfaces exposed to the air shall be covered as soon as the concrete has hardened sufficiently and shall be kept continuously wet for at least the first 24 hours of the curing period and for the entire curing period unless curing compound is applied.
 5. Formed surfaces shall be kept completely and continuously wet for the duration of curing period (prior to, during and after form removal) or until curing compound is applied.
 6. If moist curing is discontinued before the end of the curing period, curing compound shall be applied immediately, according to manufacturer's recommendations.

3.7 CONSOLIDATION

- A. Consolidate concrete by means of hand-tamping tool, vibrators, or finishing machines.
- B. Manipulate vibrators so as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. Supplement vibrating by hand spading with suitable tools to assure proper and adequate consolidation.
- C. Maintain at least one spare (standby) vibrator on site during concrete placement.
- D. Employ sufficient number of vibrators so that, at the required rate of placement, vibration is maintained throughout the entire volume of each layer of concrete and complete consolidation is secured.

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- E. Location, manner, and duration of application of vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface.
- F. Vibration shall be applied in the freshly deposited concrete by inserting and removing vibrator at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. The vibrator shall penetrate to the bottom of the layer and at least 6 inches into the preceding unhardened layer (where occurs), at all points, to ensure effective bond between layers.
- G. Vibration shall not be applied directly to reinforcement steel or forms, or to concrete that has hardened to the degree that it does not become plastic when vibrated.
- H. Use of vibrators to transport concrete in the forms or conveying equipment will not be permitted.

3.8 CONSTRUCTION JOINTS

- A. Locate and install construction joints at locations shown and as specified below. Contractor may submit alternate, additional, or the elimination of joint locations for Engineer's approval.
- B. Where a feather edge would be produced at a construction joint, as in the top surface of a sloping wall, an insert form shall be used so that the resulting edge thickness on either side of the joint is not less than six inches.
- C. Provide keyways at least 1-1/2 inch deep in construction joints in walls, slabs and between walls and footing; bulkheads designed for this purpose may be used for slabs.
- D. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
- E. Surfaces of concrete to be joined shall be clean, rough, and moist when new-cast-in-place concrete is applied. Clean joint surfaces to remove all unsatisfactory concrete, laitance, coatings, stains, or debris by high pressure washing or scrubbing with a wire brush or wire broom.
- F. Prepare surfaces of existing or hardened concrete by wet or dry sandblasting, water blasting with approved equipment, bush hammering, grinding, or other approved method. Clean surfaces by air/water jets and allow to dry thoroughly; drying may be accomplished by air jets. Compressed air used in cleaning and drying operations shall be free from oil or other contaminating materials.

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- G. Joints shall be thoroughly moistened prior to placing concrete. Surfaces shall be kept moist for at least one hour prior to placement of new concrete. The new concrete shall be placed directly on the cleaned and washed surface.

3.9 CONTRACTION AND EXPANSION JOINTS

- A. Locate and install contraction and expansion joints shall be made only at locations shown on the Drawings.
- B. Apply a waxed based curing compound or bituminous paint to old concrete surface prior to concrete placement to provide a bond breaker between concrete placements. Curing compound or bituminous paint shall not be removed but shall remain on these joints and be kept intact until adjoining concrete is placed.
- C. Waterstops and dowels shall be protected during application of bond breaking material to prevent them from being coated.

3.10 JOINT SEALANT

- A. Apply joint sealant to horizontal and vertical contraction joints as shown on the Drawings. Comply with manufacturer's instructions.
- B. Provide information on sealant testing.
- C. Installation of field molded sealants, joint shall be cleaned of all debris and further cleaned using water, chemical solvents or other means as recommended by sealant manufacturer.
 - 1. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

3.11 REMOVAL OF FORMS

- A. Forms shall be removed in accordance with the requirements of Section 03 10 00.
- B. Form removal shall be performed sequentially such that completion of finishing operations can be accomplished within four hours of form removal.

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3.12 SURFACE FINISH FOR FORMED SURFACES

- A. Formed Surfaces: in accordance with Section 03 10 00 – Concrete Forming and Accessories.
- B. Concrete formed surfaces shall be true and even, and shall be free from open or rough spaces, depressions, projections, or other defects in the specified surface finish or alignment.
- C. After removing forms, patch all tie holes (except where noted otherwise).
- D. All form bolts and ties shall be removed to a depth at least one inch below surface of concrete. Cavities produced by form ties and other holes of similar size and depth shall be thoroughly cleaned and, after interior surfaces have been kept continuously wet for at least three hours, shall be carefully packed with a dry patching mortar (pre shrunk) mixed not richer than one part cement to three parts sand.
 - 1. Holes left by form bolts or straps which pass through the wall shall be filled solid with mortar.
 - 2. Patching mortar shall be thoroughly compacted into place to form a dense, well bonded unit, and the in place mortar shall be sound and free from shrinkage cracks. Cure patched areas as specified.
- E. Unexposed Finished Surfaces: Provide standard rough finish to formed surfaces to be concealed in finish work, by earth or rock fill, or by other construction, unless otherwise designated. Standard rough form finish shall be the concrete surface having texture imparted by form facing material. Repair defective concrete, fill form tie holes and surface depressions deeper than one inch and remove or smooth fins and abrupt projections which exceed 1/4 inch.
- F. Exposed Finish Surfaces: Provide standard smooth finish to formed surfaces exposed to view or surfaces that convey water. Standard smooth finish shall be the as-cast concrete surface obtained with form facing material.
- G. For permanent concrete works, repair defective concrete, fill all form tie holes, remove, or smooth all abrupt irregularities greater than 1/4 inch in depth or projection, and treat all depressions such that they do not exceed 1/4 inch in depth.
- H. Related Unformed Surfaces: At top of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

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3.13 SURFACE FINISH FOR UNFORMED SURFACES

- A. Check and level surface plane with a straight edge. Cut high spots and fill low spots.
- B. Float and steel trowel finish required for permanent exposed surfaces.
- C. Broom finish by roughening the surface in a direction perpendicular to the direction of traffic: roughening the surface immediately after trowelling with a fibre bristle broom. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Do not work surface until surface has hardened sufficiently to prevent an excess of fine material from being drawn to the surface. Begin floating when surface water has disappeared, and concrete has stiffened sufficiently to permit operation of power-driven float. Excessive floating while concrete is soft will not be permitted. Consolidate surface with power-driven floats, or by hand floating using bull floats or darbies if area is small or inaccessible to power units.
- E. Tool joints and edges using molding tools on unformed surfaces that will be exposed to view that are not to be left square or have been chamfered.

3.14 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Curing period and moisture retention to comply with ACI 301. Unhardened concrete shall be protected from heavy rains and flowing water. All concrete shall be adequately protected from damage.
- C. Moist Curing: Concrete shall be moist cured by maintaining all surfaces continuously (not periodically) wet for the duration of the entire curing period. Water for curing shall be clean and free from any elements which will cause staining or discoloration of the concrete. Where forms of wood are used and left in place during curing, the wood shall be kept wet at all times.
- D. Membrane Curing: apply curing compound to surfaces, as per the manufacturer's recommendation.

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3.15 NON-CONFORMING CONCRETE

- A. This section shall apply to the permanent concrete works.
- B. Repair of formed surfaces shall be started within 48 hours after removal of the forms. All new concrete shall be secured with keys, dovetails, or anchors.
- C. Repair of non-conforming concrete shall include any poor joints, voids, honeycomb, stone pockets, or other defective areas. Where necessary, cut out and chip defective areas to a depth of not less than one inch, with the edges perpendicular to the surface.
- D. Contractor shall apply bonding agent to areas to be patched with care to keep bonding agent off of areas to remain exposed. Contractor shall apply bonding agent in accordance with manufacturer's printed instructions.
- E. Place mortar thoroughly into place and screed off so as to leave the patch slightly higher than the surrounding surface. The patch shall be left undisturbed for a period of one to two hours to permit initial shrinkage before beginning final finishing. The patch should be finished in such a manner as to match the adjoining surface. All patches shall be finished and cured in accordance with requirements for surface in which the patch occurs. The patch shall be kept moist for not less than three days after installation.
- F. Tie-holes left by withdrawal of rods, or holes left by removal of ends of ties shall be filled solidly with mortar after first being wet thoroughly. For holes passing entirely through a wall, a plunger-type grout-gun shall be used to force the mortar through the wall, starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside; and when the hole is completely filled, the excess mortar shall be struck off flush with the surface. Holes not passing entirely through the walls shall be filled with a small tool that will permit packing of the hole solidly with mortar. Any excess mortar at the surface of the wall shall be struck off flush with a cloth.
- G. Patching:
 - 1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
- H. Honeycombing or Embedded Debris in Concrete:
 - 1. Notify Engineer upon discovery.
- I. Patch imperfections according to ACI 301 or as directed by the Engineer.
- J. Defective Concrete:

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1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.

K. Repair or replacement of defective concrete will be approved by Engineer.

3.16 TOLERANCES

- A. Variation in dimensions and locations shall be in accordance with ACI 117.
- B. Concrete work shall meet the tolerance limits shown on the Drawings.

3.17 FIELD QUALITY CONTROL

- A. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
- B. Inspection and Testing: Performed by Contractor supplied testing laboratory according to ASTM C31, ASTM C172, ACI 308, and ACI 318.
- C. Sample concrete in accordance with and make one set of three cylinders in accordance with for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
- D. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
- E. Make one additional cylinder during cold weather concreting and field cure.
- F. Measure slump, temperature, and air content for each sample according to ASTM C143, ASTM C173, and ASTM C1064.
- G. Measure slump at final point of discharge from concrete delivery equipment (e.g., pump discharge, concrete mixing truck). If placement is by pump, concrete shall be sampled and fully tested at both the truck chute discharge and at the pump discharge locations.

3.18 PROTECTION AND CLEANUP

- A. At completion and during progress of the work maintain premises in a neat and orderly manner. Dispose of all rubbish, construction debris and surplus materials at least on a weekly basis.

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- B. Cover and protect the work from damage including water leakage onto curing concrete.
- C. Protect the work of other sections from damage resulting from the work of this section.

END OF SECTION 03 30 00