SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. This section covers formwork, reinforcing steel, and cast-in-place Concrete work.

B. Related Work Specified Elsewhere
   1. Manholes: Section 02605
   2. Storm Sewer Collection System: Section 02722

C. Measurement and Payment Procedures
   1. For public funded capital improvement projects, measurement and payment procedures will be determined on a project by project basis.
   2. For privately funded development projects, Owner will determine measurement and payment requirements.

1.02 REFERENCES

A. American Concrete Institute (ACI) International
   1. ACI 305 – Hot Weather Concreting
   2. ACI 306 – Cold Weather Concreting
   3. ACI 309 – Standard Practice for Consolidation of Concrete
   4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary

B. American Society for Testing and Materials (ASTM)
   1. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
   2. ASTM A185 – Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
   3. ASTM A615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   4. ASTM A996 – Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
   5. ASTM C31 – Making and Curing Concrete Test Specimens in the Field
   6. ASTM C33 – Concrete Aggregates
   7. ASTM C39 - Compressive Strength of Cylindrical Concrete Specimens
   8. ASTM C94 – Ready-Mixed Concrete
   9. ASTM C143 – Slump of Hydraulic Cement Concrete
   10. ASTM C150 – Portland Cement
   11. ASTM C171 – Sheet Materials for Curing Concrete
   12. ASTM C231 – Air Content of Freshly Mixed Concrete by the Pressure Method.
   13. ASTM C260 – Air-Entraining Admixtures for Concrete
   14. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete
   15. ASTM C494 – Chemical Admixtures for Concrete
   16. ASTM C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

1.03 SUBMITTALS

A. Concrete Reinforcement System
   1. Submit detail drawings showing rebar number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and rebar supports. Sufficient rebar details to permit installation of reinforcing. Locations where proprietary rebar mechanical splices are required or proposed for use.

B. Concrete Design Mix
   1. Submit concrete design mix, giving dry weights of cement, saturated surface-dry weights of fine and coarse aggregate, types, names and percent of admixtures, air content, and water used per cubic yard of concrete. Include field or laboratory test data.

C. Certificates of Compliance
   1. Certificates of conformance for each material furnished stating that material conforms to applicable ASTM standard(s). Aggregate sample test results shall be from samples less than 3 months old.
   2. Certifications from producing mill or supplier that steel shipped is mill certified.

D. Proprietary Materials
   1. Proprietary materials and items including forming accessories, admixtures, patching compounds, waterstops, joint systems, mechanical reinforcement splices, curing compounds, finish materials. Submit manufacturer's product data including installation instructions, and product conformation to applicable specifications.

E. Construction Joints
   1. Submit proposed construction joint locations, if not shown and/or if Contractor proposes alternate construction joint locations.

F. Embedment Drawings
   1. Appurtenant embedment drawings locating and identifying all conduits, block outs, louvers, ducts, hatches, windows, piping, pipe penetrations, and all openings in concrete and masonry members.

G. Test Results
   1. Field and laboratory quality control test results.

1.04 QUALITY ASSURANCE

A. Independent Testing Agency
   1. Contractor to employ and pay for services of a testing laboratory to perform materials evaluation and inspection

B. Testing and Inspection
   1. The Contractor's Independent Testing Agency shall perform the inspection and tests described below.
      a. Strength Specimens. Cast test cylinders for compressive strength tests for each mix design. One set of cylinders shall be made for each 50 cubic yards of concrete, minimum of one set per day. The number of test cylinders need not exceed 3 sets per day for each mix.

         A set of strength test specimens shall consist of four cylinders, one to be tested at 7 days and two at 28 days. If either of the 28 day breaks does not meet the specified strength, the fourth cylinder shall be tested at 90 days, otherwise it will be discarded. Test specimens shall be molded and

cured in accordance with ASTM C31 and tested in accordance with ASTM C39. Results of strength tests shall be reported immediately to the Inspector.

b. Air Content Testing. Measure air content when compressive strength specimens are cast. Specified air content shall be attained at point of placement into the forms. Measurement shall be in accordance with ASTM C231. Report air content along with the compressive strength data.

c. Slump Testing. Measure concrete slump when compressive strength specimens are cast. Measurement shall be in accordance with ASTM C143. Report slump along with the compressive strength data.

PART 2 PRODUCTS

2.01 FORMWORK

A. Form Construction: Materials and system used shall provide structural strength, adjustability, and finishes required.

B. Form Ties: Commercially-manufactured, removable or snap-off metal form ties designed to withstand applied stresses, prevent spreading of forms during concrete placement, and prevent concrete from spalling upon removal. Use of wire ties is prohibited.
   1. Utilize plastic cone spacers at each end of form ties to allow a full 1-1/2 inch break-back.
   2. Utilize integral fixed washers or other approved water seal device on form ties where either side of concrete section will be in contact with liquids or groundwater.

C. Forms shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used in accordance with the manufacturer's instructions. Commercial formulation form coating compounds shall not bond with, stain, nor adversely affect concrete surface's bond or adhesion, and shall not impede wetting of surfaces to be cured with water or curing compounds. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

D. Except as otherwise shown, place ¾ inch chamfer strips in exposed to view corners of forms to produce ¾ inch wide beveled edges.

2.02 REINFORCING STEEL

A. Reinforcing Steel Bars: Deformed bars rolled from new billet stock, ASTM A615, Grade 60.

B. Welded Wire Fabric: Plain, cold-drawn steel, ASTM A82 and A185.

2.03 REINFORCEMENT SUPPORTS

A. Reinforcement Supports and Spacers: Plastic coated steel or heavy duty plastic of design and strength to hold reinforcement accurately in place before and during placement of concrete.

B. An alternate method of supporting bottom reinforcement for slabs on grade shall be concrete cubes or wafers of the correct height. Wafers shall contain soft steel wires imbedded therein for fastening to reinforcing. Wafers shall have a minimum compressive strength of 3,000 psi and shall have been cured as

specific for concrete. Masonry units will not be permitted for supporting steel in bottom mats or elsewhere.

2.04 GENERAL CONCRETE REQUIREMENTS

A. Concrete shall be normal weight concrete. Water-cement ration shall not exceed 0.50 by weight. The water-cement ratio may be increased to 0.56 by weight, if a water-reducing agent is used. The use of high early or rapid set concrete may be allowed in high traffic situations but must be accepted by the Inspector in writing.

B. Concrete shall have a minimum compressive strength of 4,000 psi after 28 days.

2.05 CONCRETE MATERIALS

A. Cement
   1. All cement shall be Type I or Type II Portland Cement conforming to ASTM C150. No other cement shall be used without the written permission of the Inspector.

B. Aggregates
   1. All fine and coarse aggregate shall conform to ASTM C33.
   2. Maximum size of aggregate shall not exceed:
      a. 1/5 the narrowest dimension of concrete member.
      b. ¾ the clear spacing between reinforcing bars.
      c. 1/3 the depth of slabs.
      d. 1-1/2 inches.

C. Water
   1. Water shall be clean and free from deleterious amounts of silt, mineral or organic matter, alkali, salts, and acids and shall conform to ASTM C94.

D. Chemical Admixtures
   1. Any admixture except air entraining agents, accelerators, and retarders must be accepted by the Inspector in writing. Admixtures shall be certified to be compatible with each other. Admixtures shall not contain calcium chloride.
   2. Air-Entraining Admixture
      a. An air-entraining admixture shall be used in all concrete.
      b. Total air content shall be 5 to 8 percent.
      c. Air-entraining agents shall conform to ASTM C260.
   3. Water Reducing Admixture
      a. The use of water reducing admixture shall be accepted by the Inspector.
      b. Water reducing admixture shall conform to ASTM C494, for Type A or Type D chemical admixture.
      c. The water reducing admixture shall be compatible with the cement being used and shall not contain any calcium chloride.
   4. Accelerators
      a. Shall conform to ASTM C494 and ACI 306.

E. Fly Ash
   1. When fly ash is used in concrete, the cement replacement shall not exceed 20%.
   2. Fly ash shall conform to ASTM C618, Class C or F.
   3. Class C fly ash will not be permitted where sulfate resistant concrete is required.

2.06 READY-MIXED CONCRETE

A. Ready mixed mixes shall be in accordance with theCity mix design. Ready mixed concrete quality shall comply with ASTM C94 and the specifications herein.

2.07 GROUT

A. Non-Shrink Grout
   1. Nonmetallic, non-corrosive, non-staining, premixed with only water to be added.
   2. Grout to produce a positive but controlled expansion. Mass expansion shall not be created by gas liberation.
   3. Minimum compressive strength of non-shrink grout shall be 6,500 psi at 28 days.

B. Cement Grout
   1. Grout shall be 3/8 inch topping mix. Minimum 6.5 sack mix.
   2. Compressive strength, minimum 3,000 psi at 28 days.
   3. Air Entrainment: minimum 6.5 percent at placement.
   4. Fire aggregate, percent of total aggregate: 50 percent.

C. Epoxy Grout
   1. 3-component epoxy resin system: two liquid epoxy components and one inert aggregate filler component. Each component shall be packaged separately for mixing at jobsite.

2.08 CURING MATERIALS

A. Impervious Sheet
   1. Impervious sheet materials shall conform to ASTM C171, type optional, except that polyethylene sheet shall be white opaque.

B. Membrane-Forming Compound
   1. Membrane-forming curing compound shall conform to ASTM C309, Type 1-D or 2 except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Membrane-forming curing compound shall not be used on surfaces that are to be treated with floor hardener.
   2. Non-pigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C309 waived.

PART 3 EXECUTION

3.01 DIMENSIONAL TOLERANCES

A. Formwork: Constructed, maintained, and adjusted during concrete placement as to provide final concrete surfaces with the following tolerances:
   1. Maximum variation from level or plumb of 1/4 inch per ten feet, but not more than 1 inch.
   2. Maximum variation in cross-sectional dimensions.
      a. Minus 1/4 inch
      b. Plus 1/2 inch

3.02 FORMWORK

A. Surfaces which Contact Concrete: Coated with form coating for easy release. Keep coating material off reinforcing steel and other embedded work. Apply coatings in accordance with manufacturer's instructions.

B. Forms for Concrete, which will be Exposed in the Final Work: Tight joints and smooth faces, and with no dents, bumps, and irregular joints, which will produce corresponding irregularities in concrete surfaces.

C. Formwork: Openings, as necessary, for clean-up.

D. Slab on grade and wall forms may be removed at any time that such removal work will not damage concrete, but not less than 24 hours after concrete is placed.

E. Elevated slabs and structural beam forms may be removed at such time that removal work will not damage concrete, but shall not occur until concrete has achieved 75 percent of 28-day design strength. Live load shall not be applied to elevated slabs until concrete has achieved 28-day design strength.

3.03 REINFORCING STEEL

A. Clean and free from paint, oil, grease, form coating, mortar, dirt, mill scale, rust, or ice.

B. Accurately placed to dimensions shown on Drawings; secured in place by bar supports, spacers, chairs, wiring and nails.

C. Minimum concrete cover over reinforcing steel shall be as follows:
   1. Concrete cast against and permanently exposed to earth: 3 inches.
   2. Concrete exposed to earth or weather: 2 inches.
   3. Concrete not exposed to weather or in contact with ground: 3/4 inch.

D. Splice Lengths for Bars: Splice length shall be determined per ACI 318. Splice lengths for welded wire fabric shall be one full mesh plus 2 inches, 6 inches minimum. Offset laps to prevent continuous laps in either direction.

E. No concrete shall be placed until steel has been observed by Inspector.

F. Embedded appurtenances shall be tied to reinforcement as directed by the Inspector. In no case shall embedded appurtenances be tied to reinforcement bars along the length of the reinforcement bar.

3.04 PROTECTION

A. Cold Weather Concrete
   1. Concrete shall not be placed unless the air temperature adjacent to the concrete placement is 30 degrees F and rising, unless prior written acceptance for cold weather concrete operations is obtained from the Inspector.
   2. If cold weather concrete operations are accepted by the Inspector, when daily low temperatures are below 40 degrees F or when temperatures are predicted to be below 40 degrees F within three days of concrete placement, comply with ACI 306R. Maintain temperature records of concrete as specified in ACI 306R.
   3. Water shall not be heated to a temperature greater than 150 degrees F.
   4. If hot air heaters are used, cover exposed surfaces of concrete with impervious sheet material or curing compound to prevent dehydration of concrete. Vent heater exhaust gas outside of enclosures. Do not use open fires or salamanders.
   5. Protect slabs cast against earth, including tank bottoms, with a covering of non-staining insulating material or by other means to prevent frost penetration into the subgrade.

B. Hot Weather Concrete
   1. Concrete shall not be placed if the daily high temperature exceeds 90 degrees F unless accepted by the Inspector prior to placement of the concrete.
   2. When daily high temperature is 90 degrees F or above, or hot weather conditions exist that would impair quality and strength of concrete and hot weather concrete operations have been accepted by the Inspector, comply with ACI 305R.
   3. Temperature of concrete immediately before placement in forms shall be between 50 degrees F and 90 degrees F.
   4. To facilitate the placement of concrete in hot weather, the aggregate or the water may be cooled.

C. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

D. Do not backfill structures until structural members have achieved 28-day compressive design strength and structures designated as structures requiring leakage test have successfully passed the leakage tests.

E. Transit-Mixed Concrete: Comply with ASTM C94:
   1. Air Temperature Between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C): Reduce mixing and delivery time to 75 minutes.
   2. Air Temperature Above 90 degrees F (32 degrees C): Reduce mixing and delivery time to 60 minutes.
   3. Batch Ticket: Provide for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

3.05 PREPARATION FOR PLACING CONCRETE

A. Place embedded items accurately and secure; set inserts and anchor bolts. Where pipe or conduit passes through floor slab in new construction, pipe sleeves shall be installed.

B. Spaces to be filled with Concrete: Free of debris and foreign material.

C. Concrete Placed On or Against Earth: Moist, but not muddy.

D. Forms: Retightened as necessary.

E. Apply temporary protective covering to lower 2 feet of finished walls or other items adjacent to slabs.

3.06 JOINTS

A. Locate and install construction joints as indicated, or if not indicated, locate so as to not impair strength and appearance. Construction joints shall be perpendicular to main reinforcement, and reinforcement shall continue across joints.

B. Maximum construction joint location shall be 30 feet unless shown otherwise in the Drawings.

C. Provide keyways 1-1/2 inches deep in construction joints in walls, slabs, and between walls and footings.

D. Provide waterstops in construction joints as indicated. Support and protect exposed waterstops during work. Fabricate waterstop field joints in accordance with manufacturer's instructions.

E. Construct isolation joints with joint filler and sealant at points of contact between slabs on ground and vertical surfaces such as column pedestals, foundation walls, grade beams and elsewhere, as indicated.

F. Construct contraction (control) joints as shown or as follows. Joint spacing in feet shall not exceed 2-1/2 times the depth of slab in inches, or 15 feet maximum spacing. Joint patterns shall be as square as possible. Contraction joints shall be saw cut: 1/8-inch wide by 1/4 of slab depth deep.

3.07 PLACING CONCRETE AGAINST OTHER CONCRETE

A. In place concrete surfaces shall be roughened and cleaned with chipping hammers, water blasting, scarifiers, sandblasting, stiff wire brushing or other mechanical methods necessary to expose a sound concrete surface.

B. Cleaned and moistened surfaces of prepared concrete shall be slushed with 1/16 to 1/8 inch thick layer of neat cement grout or an epoxy bonding agent. New concrete shall be placed before grout or epoxy has attained initial set.

3.08 PLACING CONCRETE

A. Place as soon as practicable after mixing. No concrete which has commenced to set, nor any retempered concrete shall be used. Deposit so no separation or segregation of ingredients occurs. Place near to final location to avoid rehandling or flowing. Height of concrete free fall shall be limited to 4 feet. Vertical rate of placement shall not exceed design strength of concrete forms.

B. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

C. Methods of conveying and consolidating concrete shall not cause excessive slump or entrained-air losses. Vibrators to transport concrete within forms shall not be allowed.

D. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. Limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

E. Bring slab surfaces to correct level with straight edge and strikeoff. Uniformly slope surfaces to drain.

F. Immediately after screeding, consolidate and level concrete slabs using aluminum or magnesium alloy bull floats or darbies. Do not disturb slab surfaces prior to beginning finishing operations.

G. Topping: Apply bond compound in areas to receive floor topping in accordance with manufacturer's directions. Place topping mix as for slabs and screed.

3.09 UNFORMED CONCRETE FINISHES

A. Slabs shall receive a troweled finish. After slab has set so no water sheen is apparent, surface shall be further floated and troweled to smooth, hard finish, free from waves, air holes, sand spots, and trowel marks. Small amount of cement mortar (1:2) may be added to surface to produce required finish. Apply hardener to all interior slabs.

B. Apply non-slip broom finish to exterior concrete platforms, steps, ramps, manhole bases and inverts, and elsewhere indicated. Direction of final floating or brooming shall be at right angles to traffic.

C. Edging: Required on sidewalks, steps, exposed slab perimeters, and other areas specified to prevent chipping. Equipment pads, columns and corners shall receive a 3/4-inch chamfer. Edging shall be performed prior to finishing operations.

3.10 FINISH OF FORMED SURFACES

A. Rough Form Finish:
   1. Location: Formed concrete surfaces not exposed-to-view in finish work or by other construction, unless otherwise indicated.
   2. Description: Rub down or chip off texture imparted by form facing material, tie holes, defective areas repaired and patched, fins, other projections exceeding 1/4 inch in height.

B. Smooth Form Finish:
   1. Location: Formed concrete surfaces exposed-to-view, or to be covered with coating material or covering material applied directly to concrete.
   2. Description: As-cast concrete surface obtained with selected form facing material, arranged orderly, symmetrically with minimum of seams.
   3. Defective areas: Repair, patch, completely remove fins, other projections, and smooth.

C. Related Unformed Surfaces:
   1. At tops of walls, horizontal offsets, similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth, finish with texture matching adjacent formed surfaces.
   2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

D. Monolithic Slab Finishes:
   1. Scratch Finish:
      a. Location: Surfaces to receive concrete floor topping, mortar setting beds for tile, Portland cement terrazzo, other bonded applied cementitious finish flooring material, and as otherwise indicated.
      b. Surface leveling: Depressions to not exceed 1/2 inch under 10 foot straightedge. Slope uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.
   2. Float Finish:

a. Application: Surfaces to receive trowel finish and other finishes as specified, slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.
b. Floating: Do not work surface until ready for floating. Begin when surface water has disappeared or concrete has stiffened sufficiently to permit operation of power-driven floats; or both consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
c. Leveling: Check and level depressions to not exceed 5/16 inch under 10 foot straightedge. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.

3. Trowel Finish:
   a. Location: Surfaces to be exposed-to-view, curbs and sills, slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin-film finish coating system.
   b. First trowel operation: After floating, use power-driven trowel.
   c. Final troweling: When surface produces ringing sound as trowel is moved over surface, consolidate surface free of trowel plane so that depressions do not exceed 1/8 inch under 10 foot straightedge.
   d. Surface defects: Grind defects that would telegraph through applied floor covering system.
4. Trowel and Fine Broom Finish:
   a. Location: Where ceramic or quarry tile is to be installed with thin-set mortar.
   b. Application: Immediately follow trowel finish, slightly scarifying surface by fine brooming.
5. Light Broom Finish:
   a. Location: Interior garage and exterior slabs on grade.
   b. Application: Immediately follow trowel finish, slightly scarifying surface by light brooming
6. Non-Slip Broom Finish:
   a. Location: Exterior concrete platforms, steps and ramps, elsewhere as indicated.
   b. Immediately after trowel finishing, broom perpendicular to main traffic route with fiber bristle broom.
   c. Coordinate required final finish with Inspector before application.

3.11 CURING AND CARE OF CONCRETE

A. Finished concrete shall be cured by protecting it against moisture loss, rapid temperature change, and from rain, flowing water and mechanical injury for a minimum of 7 days after placement. Keep concrete surfaces wet for 7 days immediately after placement. Forms left in place will be considered suitable curing provided that surfaces are kept wet with water.

B. Concrete shall be maintained at a minimum temperature of 50 degrees F during the curing period.

C. Exposed Surfaces: Cover with 4 mil poly film or paper conforming to ASTM C171 or membrane forming curing compounds.

D. If film or paper is used, joints and edges shall be weighted down and sealed to retain moisture. Repair damage to film, paper, or membrane which may occur. Protect from physical damage.

3.12 CONCRETE SURFACE REPAIRS

A. Repair and patch defective areas as defined herein and identified by the Inspector with cement mortar immediately after removal of forms.

B. Cut out honeycomb, rock pockets, voids over 1/4 inch in dimension, and holes left by tie rods and bolts, down to solid concrete but, not less than depth of 1 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat area to be patched with cement grout or epoxy bonding agent. Place patching mortar before grout or bonding compound dries.

C. Exposed-to-view surfaces, patching mortar shall match color surrounding when dry. Provide test areas to verify mixture and color match before proceeding with patching. Compact mortar in place and strikeoff slightly higher than surrounding surface.

D. Exposed to view form lines shall be ground smooth as directed by the Inspector prior to application of grout clean finish.

E. Repair of Formed Surfaces:
   1. Defective surfaces: Remove and replace concrete if defects cannot be repaired to satisfaction of Inspector, including color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins, other projections on surface; stains, other discolorations not removable by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
   2. Concealed formed surfaces: Repair defects that affect durability of concrete where possible. If defects cannot be repaired, remove and replace.

F. Repair of Unformed Surfaces:
   1. Test for smoothness, verify surface plane to tolerances specified for each surface and finish; surfaces sloped to drain for trueness of slope and smoothness using template having required slope.
   2. Repair defects that affect durability of concrete. Surface defects include crazing, cracks wider than 0.01 inch or penetrating to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
   3. High areas: Correct by grinding, after concrete has cured at least 14 days.
   4. Correct low areas during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete.
   5. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Inspector.
   6. Defective areas not exceeding 1 inch diameter (except random crack and single holes):
      a. Cut out, replace with fresh concrete. Remove to sound concrete with clean, square cuts; expose reinforcing steel with at least 3/4-inch clearance all around.
      b. Dampen concrete surfaces in contact with patching concrete, apply bonding compound.
      c. Mix patching concrete of same materials as original concrete. Place, compact, finish to blend with adjacent finished concrete. Cure in some manner as adjacent concrete.
   7. Isolated random cracks and single holes not over 1 inch diameter:
      a. Repair by dry-pack method. Groove top of cracks and cut out holes to sound concrete; clean of dust, dirt, and loose particles.
      b. Dampen cleaned concrete surfaces, apply bonding compound.
      c. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing No. 16 mesh sieve, using only enough water as required for handling and placing.
      d. Place dry pack after bonding compound has dried. Compact mixture in place, finish to match adjacent concrete.
      e. Keep patched area continuously moist for at least 72 hours.
   8. Structural repairs: Perform with prior acceptance of Inspector for method and procedure, using specified epoxy adhesive and mortar.

3.13 GROUT CLEANED FINISH

A. Provide grout cleaned finish to the following formed concrete surfaces.
   1. Concrete exposed to view to minimum 1 foot below finish grade
   2. Concrete walls in channels.

B. Combine 1 part Portland cement to 1-1/2 parts fine sand by volume, and mix with water. Proprietary additives may be used. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so final color of dry grout will match adjacent surfaces.

C. Wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Cure finish as specified.

3.14 PATCHING AND PLUGGING

A. In new concrete structures, patch and plug openings with concrete as shown on the Drawings. Where use of concrete is impractical fill openings with non-shrink grout.

B. Openings to be closed with concrete shall have trim edges square and straight. Roughen and clean surfaces with chipping hammers, water blasting, scarifiers, sandblasting, stiff-wire brushing or other mechanical methods necessary to expose a sound concrete surface.

C. Provide reinforcing steel where required.

D. Dampen existing concrete and scrub with neat cement grout or epoxy bonding agent just prior to placing new concrete. Finish concrete to match existing adjoining work. Color shall match surrounding areas when dry.

E. Where cut edges are to remain exposed, finish edges with cement mortar at least 3/4-inch thick; apply over epoxy bonding agent and finish to match adjoining surfaces.

END OF SECTION