

## **DIVISION III - CONCRETE**

## SECTION 03310 - CONCRETE WORK

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. Work Included: Extent of concrete work is shown on drawings.
- B. Related Work:
  - 1. Documents affecting work of this Section include, but are not limited to, General Conditions, Supplementary Conditions, and Division 1 of these Specifications.

#### 1.02 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
  - 1. ACI 301 "Specifications for Structural Concrete for Buildings"
  - 2. ACI 318 "Building Code Requirements for Reinforced Concrete"
  - 3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."
- B. Concrete Testing Services
  - 1. Engage a testing laboratory acceptable to Architect/ Engineer to perform material evaluation tests and to design concrete mixes.
  - 2. Owner will engage testing laboratory to perform sampling and testing during placement of concrete.
  - 3. Owner will engage a testing laboratory to conduct tests of compression test specimens.
  - 4. Materials and installed work may require testing and retesting as directed by Architect/ Engineer, at any time during progress of work. Allow free access to material stockpiles and facilities. Re-testing of rejected materials and installed work shall be done at Contractor's expense.

#### 1.03 SUBMITTALS

- A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, and others as requested by Architect/ Engineer.
- B. Shop Drawings - Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required at openings through concrete structures.
- C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.

- D. **Material Certificates:** Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect/ Engineer. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

## **PART 2 - PRODUCTS**

### **2.01 FORM MATERIALS**

- A. **Forms for Exposed Finish Concrete:** Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection. Use plywood complying with U. S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
- B. **Forms for Unexposed Finish Concrete:** Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. **Form Coatings:** Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

### **2.02 REINFORCING MATERIALS**

- A. **Reinforcing Bars:** ASTM A615, Grade 60, deformed.
- B. **Welded Wire Fabric:** ASTM A185, welded steel wire fabric.
- C. **Supports for Reinforcement:** Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications, unless otherwise acceptable.
  - 1. For exposed-to-view concrete surfaces: Where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

### **2.03 CONCRETE MATERIALS**

- A. **Portland Cement:** ASTM C150, Type I, unless otherwise acceptable to Architect/ Engineer. Use one brand of cement throughout project, unless otherwise acceptable to Architect/ Engineer.

- B. Fly Ash: ASTM C618, Type C or Type F. Loss on ignition shall not exceed 3½%. Limit use of fly ash to not exceed 25% of total cementitious material content by weight. Higher limits are acceptable for CLSM.
- C. Normal Weight Aggregates: ASTM C33, and as herein specified. Provide aggregates from a single source for exposed concrete.
  - 1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
- D. Water: Drinkable.
- E. Admixtures: The amount of water soluble chloride ions added to the mix by the admixtures shall not exceed 0.3% by weight of cement. Provide admixture manufacturer's written certification of weight of added chloride ions per ounce for each admixture.
  - 1. Air-Entraining Admixture: ASTM C260.
  - 2. Water-Reducing Admixture: ASTM C494, Type A
  - 3. Mid-Range Water-Reducing Admixture (MRWR): ASTM C494, Type A or Type F
  - 4. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C494 Type E
  - 5. Water-Reducing, Retarding Admixture: ASTM C494, Type D

#### 2.04 RELATED MATERIALS

- A. Moisture Barrier: Provide moisture barrier cover over prepared base material where indicated. Use only materials which are resistant to decay when tested in accordance with ASTM E154, as follows:
  - 1. Polyethylene sheet not less than 8 mils thick.
- B. Non-Shrink Grout: CRD-C 621, factory pre-mixed grout.
- C. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C309, Type I, Class A with % solids not less than 19%. Moisture loss not more than 0.03 gr./sq. cm. when applied at 300 square ft./gal.
- D. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.
- E. Isolation joint (expansion joint):
  - 1. Provide preformed strips, non-extruding and resilient bituminous type, of thickness indicated, complying with ASTM D1751.
  - 2. If sealants specified in Section 07920 are used in the joints built under this Section, Contractor will provide a filler complying with ASTM D1752.

## 2.05 PROPORTIONING AND DESIGN OF MIXES

- A. Mix designs shall be prepared by personnel with KRMCA Level II Certification or equal. Prepare design mixes for each type and strength of concrete as follows:
1. Prepare concrete mixes, other than slab on grade concrete in accordance with ACI 301 Section 4.2.3
  2. Prepare slab on grade concrete mixes in accordance with ACI 302 Section 5.2.4 (Method B).
- B. Submit written reports to Architect/ Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect/ Engineer.
- C. Design mixes to provide normal weight concrete with the following properties, as indicated.
- 3500 psi 28-day compressive strength
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner, and as accepted by Architect/ Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect/ Engineer before using in work.
- E. Admixtures:
1. Use water-reducing admixture or mid range water-reducing admixture in concrete as required for placement and workability. The use of a water-reducing admixture is required for slabs on grade.
  2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F. (10 degrees C.).
  3. Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 1½% within following limits:
    - a. Concrete structures and slabs exposed to freezing and thawing or de-icer chemicals
      - 5.5% 1-1/2" maximum aggregate.
      - 6.0% 1" maximum aggregate.
      - 6.0% 3/4" maximum aggregate.
  4. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

- F. Water-Cement Ratio: Water-Cement ratio shall not exceed 0.53.
- G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
  - 1. Ramps, slabs, and sloping surfaces: 4 inches.
  - 2. Concrete containing a mid-range water-reducing admixture (MRWR): Not more than 6 inches after addition of MRWR to site verified 2 inch to 3 inch slump concrete.
  - 3. Other Concrete: 4 inches.
- H. Concrete Mixes:
  - 1. Ready-Mix Concrete: Comply with requirements of ASTM C94 and as herein specified. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required.
- I. Controlled Low Strength Material (CLSM):
  - 1. Controlled Low Strength Material (flowable fill): A low strength mixture consisting of portland cement, sand, class F fly ash and water.
  - 2. Design mixes shall comply with the recommendations of the Kentucky Ready-Mix Concrete Association.

## **PART 3 - EXECUTION**

### **3.01 FORMS**

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

- E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is 1" inside concrete and will not leave holes larger than 1" diameter in concrete surface.
- H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.
- I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

### 3.02 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

### 3.03 JOINTS

- A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect/ Engineer.

- B. Provide keyways at least 1/1-2" deep in construction joints in walls; keyways in construction joints in slabs to follow ACI recommendations for keyed construction joints.
- C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise noted.
- D. Isolation (Expansion) Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs on grade and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.
  - 1. Joint Filler and sealant materials are specified in Division 7 sections of these specifications.
- E. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown.
  - 1. Contraction joints shall be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
  - 2. Joint sealant material is specified in Division 7 sections of these specifications.

### 3.04 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
- B. Position and secure in place all embed items before placing concrete in forms.

### 3.05 PREPARATION OF FORM SURFACES

- A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- C. Thin form-coating compounds only with thinning agent of type and in amount and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- D. Coat steel forms with a non-staining, rust-preventive form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.



### 3.06 CONCRETE PLACEMENT

- A. **Preplacement Inspection:** Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
- B. Coordinate the installation of joint materials, perimeter insulation and moisture barriers with placement of forms and reinforcing steel.
- C. **General:** Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete" and as herein specified.
- D. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- E. **Placing Concrete in Forms:** Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
- F. 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 recommended practices.
- G. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- H. Maintain reinforcing in proper position during concrete placement operations.
- I. **Cold Weather Placing:** Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
  - 1. When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C.), uniformly heat water and/or aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C), and not more than 80 degrees F. (27 degrees C) at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- J. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F (32 degrees C). Mixing water may be chilled or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
  2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
  3. Fog spray forms, reinforcing steel and subgrade just before concrete is placed.
  4. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

### 3.07 FINISH OF FORMED SURFACES

- A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed to view or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
- C. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.
  1. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strikeoff smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.08 MONOLITHIC SLAB FINISHES

- A. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified.
  - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
  
- B. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system.
  - 1. After floating, begin first trowel finish operation using a power-driven trowel.
  - 2. Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
  - 3. Consolidate concrete surface by final troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to the following tolerances:
    - Overall flatness and levelness: Ff 24, Fl 18
    - Minimum flatness and levelness: Ff 18, Fl 12
  - 4. Grind smooth surface defects which would telegraph through applied floor covering system.
  
- C. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
  
- D. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps and elsewhere as indicated.
  - 1. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect/ Engineer before application.

### 3.09 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
  - 1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- B. Curing Methods: Perform curing of concrete by moist curing, moisture-retaining cover curing, or curing and sealing compound as herein specified.
1. Moist curing: Provide moist curing by covering concrete surface with absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent covers.
  2. Moisture-retaining cover curing: Provide moisture-retaining cover curing by covering concrete surfaces and edges with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  3. Curing and sealing compound: Provide curing and sealing compound to interior slabs and to exterior slabs, walks, and curbs, as follows: Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Re-coat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
  4. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting and other coatings and finish materials, unless otherwise acceptable to Architect/ Engineer.
- C. Curing Formed Surfaces: Cure formed concrete surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing methods specified above, as applicable.
- D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of curing and sealing compound unless otherwise noted.
1. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover unless otherwise directed.

### 3.10 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of walls, piers, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F. (10 degrees C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

### 3.11 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, de laminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect/ Engineer.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Grout base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.
- C. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

### 3.13 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect/ Engineer.
  - 1. Cut out honeycomb, rock pockets, and voids over 1/4" in any dimension, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
- B. For exposed to view surfaces: Blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- C. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect/ Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

- D. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
- E. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
- F. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.015" wide, spalling, pop-outs, honeycomb, rock pockets and other objectionable conditions.
- G. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
- H. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Fill areas with concrete repair mortar. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- I. Repair isolated random cracks and single holes not over 1" in diameter with concrete repair mortar. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix repair mortar in accordance with manufacturers printed instructions. Place repair mortar after bonding compound has dried. Finish to match existing concrete. Keep patched area continuously moist for not less than 72 hours.
- J. Perform structural repairs with prior approval of Architect/ Engineer for method and procedure, using specified epoxy adhesive and mortar.
- K. Repair methods not specified above may be used, subject to acceptance of Architect/ Engineer.

### 3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. The owner will engage a testing laboratory to perform and report compressive strength tests. All concrete sampling and testing shall be performed by an ACI certified level 1 technician.
- B. Sampling and testing for quality control during placement of concrete will include the following:
  - 1. Sampling Fresh Concrete: ASTM C172.
  - 2. Slump: ASTM C143: one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

3. Air Content: ASTM C173, volumetric method for lightweight or normal weight concrete; ASTM C231 pressure method for normal weight concrete; one for each day's pour of each type of concrete.
  4. Concrete Temperature: Test hourly when air temperature is 40 degrees F (4 degrees C) and below, and when 80 degrees F (27 degrees C) and above; and each time a set of compression test specimens is made.
  5. Compression Test Specimen: ASTM C31; one set of 3 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
  6. Compressive Strength Tests: ASTM C39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 100 cubic yards over and above the first 50 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
- C. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.
- D. Test results will be reported in writing to Architect/ Engineer and Owner within 24 hours that tests are made. Reports of compressive strength tests will contain the project identification name and number, date of concrete placement, slump and temperature at time of sampling, name of concrete testing service, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but will not be used as the sole basis for acceptance or rejection.
- F. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect/ Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION

## SECTION 03371 - GROUT

### PART 1 - GENERAL

- A. The general provision of the Contract, including General and Supplementary Conditions and Requirements, apply to the work specified in this section.

### PART 2 - RELATED WORK SPECIFIED ELSEWHERE

- A. Structural steel base plates, anchoring devices and leveling shims: Section 5A.

### PART 3 - DELIVERY AND STORAGE

- A. Prevent damage to or contamination of non-shrink grouting materials during delivery, handling and storage.
- B. Store all non-shrink grouting materials in undamaged condition with seals and labels intact as packaged by the manufacturer.
- C. Non-shrink grout - SonogROUT - Sonneborn - Contech by Sonneborn Building Products Division or approved equal to be used under bearing plates or for grouting rebar dowels into existing walls.

### PART 4 - MATERIALS

- A. Non-shrink grout conforming to the following requirements:
  - 1. Manufactured under rigid quality control specifically for grout used in transferring heavy loads.
  - 2. Contain metallic and non-metallic aggregates especially graded to minimize bleeding.
  - 3. Contain metallic aggregate that is ductile and capable of withstanding impact without fracturing.
  - 4. Have an initial setting time of approximately one hour at 70 degrees F.
  - 5. Produce no settlement or drying shrinkage at 3 days or thereafter.
  - 6. Have higher strength at all ages than plain cement grout of the same flowability.
  - 7. Resist attack by oil and water and have lower absorption than plain cement grout of the same flowability.
- B. Portland Cement: ASTM C 150-72, Type I.
- C. Sand: ASTM C 33-71a, Fine Aggregate.
- D. Pea Gravel: ASTM C 33-71a. Coarse aggregate, graded so that at least 90 percent passes 3/8-inch sieve and 90 percent is retained by a number 4 sieve.



## **PART 5 - MIXES**

- A. For less than 2-inch clearance, or where size or shape of space makes grouting difficult, grout mix shall consist of grout material and water.
- B. For greater than 2-inch clearances where coarse aggregate will not obstruct free passage of the grout, extend grout by adding 50 pounds of pea gravel per 100 pounds of grout material.
- C. Use the minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding.
- D. Portland cement mortar for raked-out edges of non-shrink grout: 1 part Portland cement, 2 parts sand and 0.50 parts water by weight.

## **PART 6 - MIXING**

- A. Mix non-shrink grouting materials and water in a mechanical mixer for no less than 3 minutes.
- B. Mix grout as close to the work areas as possible and transport the mixture quickly and in a manner that does not permit segregation of materials.
- C. After the grout has been mixed, do not add more water for any reason.

## **PART 7 - PROCEDURES**

- A. Installation methods and procedures shall be approved by the Engineer's representative before work is begun.

## **PART 8 - SURFACE PREPARATION**

- A. Remove all defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by bush-hammering, chipping, or other similar means, until a sound, clean concrete surface is achieved.
- B. Lightly roughen the concrete, but not enough to interfere with the proper placement of grout.
- C. Cover concrete area with waterproof membrane until ready to grout.
- D. Remove foreign materials from all steel surfaces in contact with grout.
- E. Align, level, and maintain final positioning of all components to be grouted.
- F. Take special precautions during extreme weather conditions according to the manufacturer's written instructions.

- G. Immediately before grouting, remove waterproof membranes and clean any contaminated surfaces.
- H. Saturate all concrete surfaces with clean water; remove excess water and leave none standing.

#### **PART 9 - PLACING**

- A. Place non-shrink grouting material quickly and continuously by the most practical means permissible; pouring, pumping, or under gravity pressure.
- B. Do not use either pneumatic-pressure or dry packing methods without written permission of the Architect.
- C. Apply grout from one side only to avoid entrapping air.
- D. Final installation shall be thoroughly compacted and free from air pockets.
- E. Do not vibrate the placed grout mixture, or allow it to be placed if the area is being vibrated by nearby equipment.
- F. Do not remove leveling shims for at least 48 hours after grout has been placed.
- G. After shims have been removed, fill voids with plain cement-sand grout.
- H. After the non-shrink grout has reached initial set, rake out all exposed edges approximately 1-inch into the grouted area and point with portland cement mortar.

#### **PART 10 - CURING**

- A. Cure grout for 3 days after placing by keeping wet and covering with curing paper or by another approved method.

End of Section