

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS: The General Conditions, any Supplementary General Conditions and Division 1, General Requirements, are hereby made a part of this Section as fully as if repeated herein.
- 1.2 SECTION INCLUDES
- A. Cast-in-place concrete including preparation, conveying, placement, leveling, finishing, hardening, sealing, curing, bonding, jointing, cutting, patching and grouting.
 - B. Specific elements include foundations, walls, slabs, columns, stairs, etc.
- 1.3 RELATED WORK
- A. Sections of Division 3, Concrete, as well as all other sections involving interface with concrete work.
- 1.4 QUALITY ASSURANCE
- A. Manufacturer's Representation: Arrange with the manufacturer to provide a representative to assist and instruct the trades in the proper application of his product. The manufacturer's representative shall be available to visit the site if it becomes necessary for this purpose, and certification of application.
- 1.5 REFERENCES
- A. American Concrete Institute (ACI): The following constitute part of this specification. Reference to Portland Cement shall mean type and color specified.
 - 1. 318 (ANSI A89.1) - Building Code Requirement for Reinforced Concrete.
 - 2. 306 (ANSI A144.1) - Recommended Practice for Cold Weather Concreting.
 - 3. 305 - Recommended Practice for Hot Weather Concreting.
 - 4. 211.1 (ANSI A167.1) - Recommended Practice for Selecting Proportions/Normal Weight Concrete.
 - 5. 304 (ANSI A186.1) - Recommended Practice for Measuring, Mixing and Placing Concrete
 - 6. 301 (ANSI A138.1) - Specification for Structural Concrete for Buildings.
 - 7. 311 (ANSI A188.2) - Recommended Practice for Concrete Inspection.
 - 8. 302.1 Guide for Concrete Floor and Slab Construction.
 - 9. 117 Standard Specifications for Tolerances for Concrete Construction and Materials.
 - B. American Society of Testing and Materials (ASTM):
 - 1. C-150 - Portland Cement
 - 2. C-309 - Liquid Membrane - Forming Compounds for Curing Concrete

3. E-1155 Standard Method for Determining Floor Flatness & Levelness Using the F-Number System.

1.6 SUBMITTALS

- A. Mix Designs: All classes of concrete include aggregate gradation and actual proportioning.
- B. Manufacturer's Literature: Each material and accessory includes manufacturer's directions and product specifications with recommended unit quantities.
- C. Certification:
 1. Compliance: Notarized statement issued by manufacturers of the respective products that the supplied products meet requirements and are tested in accordance with standards specified.
 2. Compatibility: Certify that curing compounds, sealers and form release agents will not discolor concrete and without removal from concrete will not be harmful to later application of setting materials.
 3. Installation: Certify that the materials have been installed/applied in accordance with the manufacturer's instructions.
- D. Delivery Tickets: Duplicate tickets with each load; stating:
 1. Producer's Name; Delivery Date; Time Dispatched; Time Delivered; Truck Number; Number of Cubic Yards; Type and Brand of Cement; Amount of Admixture; Class of Concrete or Cement Content (Bags/Cubic Yards); Amount of Water Added at Job.
- E. Qualifications of inspection agency including past experience of field personnel to perform required inspection.
- F. Testing and Inspection Reports:
 1. Results of compression cylinders.
 2. Test Reports: Indicating strength and density of furnished product.
 3. Inspection reports: Certifying rebar and weld wire fabric placement, etc. (See Section 3.16 – Testing and Inspection).

1.7 PRODUCT HANDLING

- A. Storage: Store cements in dry, well ventilated enclosures.
- B. Do not use cement showing indication of moisture damage, caking and other deterioration.

1.8 ENVIRONMENTAL CONDITIONS

- A. Excess Moisture: Place no concrete during periods of rain, sleet or snow, unless adequate and approved protection is provided; allow no rain or other weather-produced moisture to increase mixing water or to damage finished surfaces.

B. Cold Weather Concrete: ACI-306.

1. Admixtures: Do not use salt, chemicals or other foreign materials mixed with the concrete for the purpose of preventing freezing.
2. Ground freezing: Cover concrete slabs on earth, footings and walls, as required to protect the ground underneath from freezing.
3. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures by using insulating blankets or other approved method.
4. When air temperature has fallen to or is expected to fall below 40 degrees Fahrenheit uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees Fahrenheit and not more than 80 degrees Fahrenheit at point of placement.

C. Hot Weather Concrete: ACI-305. Prevent accelerated set from heat and winds. Maintain moist as required.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C-94 may be required.
2. When air temperature is between 85 degrees Fahrenheit and 90 degrees Fahrenheit, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees Fahrenheit, reduce mixing and delivery time to 60 minutes.
3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees Fahrenheit. 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.
4. 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.
5. Fog spray forms, reinforcing steel and subgrade just before concrete is placed.

D. Thermal Change: Protect all concrete from rapid drying due to wind, overheating due to the direct sun, freezing or thermal shock, to assure consistent curing for all concrete. Covering, reflective covering, shading, heating, insulating, cooling, wetting are measures which should be considered in maintaining minimal moisture loss at a relatively constant temperature during curing.

1.9 JOB CONDITIONS

- A. Design Loads: Do not place, handle or store products, equipment, or other materials on structure, before concrete has reached its design strength and in such a manner as to not exceed design loads. Check with Structural Engineer for design loads of each area and review of construction loading and proposed distribution of construction loads. Any area damaged by construction operation must be repaired or replaced at no cost to the Owner.
- B. Construction Damage: Do not permit walking or wheeling on fresh concrete until it has set for a sufficient length of time. Protect all concrete which will be permanently exposed

in finished work from damage from construction operations specifically falling tools, mortar or other objects.

- C. On the framed floors, the steel beams and metal deck have been designed to deflect under the weight of the wet concrete. The contractor shall provide additional concrete fill as necessary to produce a level floor.

PART 2 - PRODUCTS

2.1 CEMENT

- A. Portland Cement: ASTM C-150, Type I (unless otherwise approved by the Structural Engineer). Use one brand of cement throughout project unless otherwise acceptable to the Architect.
- B. Fly Ash: ASTM C-618, Type C or Type F.
 - 1. 15% - 20% fly ash may be used in concrete poured and cured above 50° Fahrenheit
- C. Blended Hydraulic Cement: ASTM C595, excluding types S and SA.
- D. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 120.
 - 1. 25% - 35% granulated slag may be used in concrete poured and cured above 50° Fahrenheit

2.2 FINE AGGREGATE

- A. Sand: ASTM C-33. Clean, hard, natural sand, or manufactured sand, or a combination of both.
 - 1. Source: From the same source throughout the work for each type of concrete. Approval subject to color evaluation.

2.3 COARSE AGGREGATE

- A. Normal Weight Concrete: ASTM C-33, ACI-211.1, ACI-304-1. Aggregate shall have similar color characteristics of sand and cement.
 - 1. Maximum Size Aggregate: Maximum of 1-1/2" (3/4" for concrete poured on metal deck) but not more than 3/4 of clear distance between forms and the reinforcing bar and 3/4 of minimum clear spacing between reinforcing bars, and as recommended in ACI-211.
- B. Grout for Masonry: ASTM C404; maximum size of aggregate shall be 3/8" but not more than 3/4" of the clear distance between the inside block face and the reinforcing bar.

2.4 WATER

- A. Clean and free from deleterious amounts of acids, alkalis or organic materials.

2.5 ADMIXTURES

- A. Modifiers: To accelerate the hardening of the concrete or to produce higher than normal strength at early periods; will not be permitted unless specifically approved. Do not use any admixture which will affect the concrete color. Do not use admixtures without written approval and strict quality control.
- B. Water-Reducing Admixtures: ANSI/ASTM C-494, Type A, and contain not more than 0.05% chloride ions.
1. Manufacturers:
 - a. Euclid Chemical Co. - "Eucon WR-75"
 - b. Master Builders Technologies - "Pozzolith Normal" or "Polyheed"
 - c. Sika Chemical Corp. - "Plastocrete 161"
 - d. Chem-Masters Corp - "Chemtard"
 2. Products are subject to compliance to all project requirements.
- C. Accelerating Admixtures: ANSI/ASTM C-494, Type C, A non-corrosive, non-chloride set accelerating admixture that accelerates cement hydration resulting in shortened setting times and increased early age strengths, especially in cooler temperatures. Admixture shall not contain not more than 0.05% chloride ions.
1. Manufacturers:
 - a. Master Builders Technologies - "Pozzolith 555"
 - b. Grace Construction Products - "PolarSet"
 2. Products are subject to compliance to all project requirements.
 3. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees Fahrenheit.
- D. Water-Reducing and Retarding Admixtures: ASTM C-494, Type D.
1. Manufacturers:
 - a. Sika Chemical Corp. - "Plastiment"
 - b. Master Builders Technologies - "Pozzolith R"
 - c. Gifford Hill - PSI 400N/PSI 400R
 2. Locations: Not permitted in footings or foundations. Retarding densifier shall be used as required by climatic conditions at the time of the pour as recommended by the manufacturer.
 3. Manufacturers Assistance: The admixture manufacturer shall be required to have available a qualified representative to assist in the proportioning and to advise on the use of the product for adjustment due to weather or job conditions.
- E. High Range Water-Reducing Admixture (Super Plasticizer): ASTM C-494, Type F or Type G and contain not more than 0.05% chloride ions.
1. Manufacturers:
 - a. W. R. Grace - "WRDA 19" or "Daracem"
 - b. Prokrete Industries, Inc. - "PSP"
 - c. Anti-Hydro - "Super P"

- d. Sika Chemical Corp. - "Sikament 300"
 - e. ICI Americas Corp. - "Mighty 150"
 - f. Euclid Chemical Co. - "Eucon 37"
 - g. Gifford-Hill - "PSI Super"
 - h. Master Builders Technologies - "Rheobuild"
2. Products are subject to compliance with all project requirements.
- F. Air Entraining Admixture: ASTM C-260; Air Content 6% +/- 1%.
- 1. Manufacturers:
 - a. W. R. Grace - "Darex AEA" or "Daravair"
 - b. Sika Chemical Corp. - "Sika-AER"
 - c. Sonneborn/Contech - "Aerolith"
 - d. Master Builders Technologies: - "MB-VR" or "Micro-Air"
 - e. Gifford Hill - "Air-tite"
 - 2. Locations: Use in all concrete which is exposed to the weather. Air Entraining Admixture shall not be used in slabs with a trowel finish.
- G. Calcium Chloride or admixture containing more than 0.05% chloride ions are not permitted.

2.6 BONDING AGENTS

- A. Presoak existing concrete surface to a saturated surface dry condition immediately prior to pouring of adjacent concrete slab sections.

2.7 NON-BONDING AGENTS

- A. Non-bonding agents shall conform to ASTM C-309, Type I and AASHTO M-148, Type I.
- B. Non-bonding agents shall be applied in strict accordance with the manufacturer's recommendations.
- C. Products: "Tilt-Eez" by Conspec Marketing and Manufacturing Company.

2.8 CURING MATERIALS

- A. Curing Compound: Liquid-Type membrane-forming; ASTM C-309, Type I, Class A. Moisture loss not more than 0.055 GR./SQ.CM. when applied at 200 SQ. FT./GAL.
 - 1. Manufacturer:
 - a. "A-H 3 Way Sealer," Anti-Hydro Co., Inc.
 - b. "Conspec #1," Conspec Marketing & Mfg. Co.
 - c. "Eucocure," Euclid Chemical Co.
 - d. "Kure-N-Seal," Sonneborn-Rexnord.
 - e. "Masterkure," Master Builders, Inc.
 - f. or approved equal
 - 2. Note: Certified compatibility with approved surface sealing agents, mastics, adhesives, colored hardeners, finishes and deferred bonding, is required, before

compound may be used where subsequent finishes are indicated.

3. Location: All concrete walls, slabs, beams, stairs and columns of the building prior to and immediately after removal of forms.

2.9 SURFACE TREATMENTS

- A. Sealing Compound: Liquid-Type, membrane forming; ASTM C-309, Type I, Class A.

1. Manufacturers:
 - a. "Conspec #1" - Conspec Marketing & Mfg. Co.
 - b. "Kure-N-Seal" - Sonneborne - Rexnord
 - c. Or approved equal.
2. Locations: All interior concrete floor slabs, stairs and concrete walls left exposed at the completion of the project.

2.10 ADJUSTABLE WEDGE INSERTS

- A. Type HW340 and LW340 with 3/4" diameter, ASTM A-307 bolts as manufactured by Hohmann and Barnard, Inc., or approved equal.

2.11 NON-SHRINK GROUT

- A. CRD C-621 and ASTM C 1107, factory pre-mixed non-metallic grout subject to compliance with requirements. Provide one of the following:
 1. "Masterflow 713"; Master Builders
 2. "SonogROUT"; Sonneborn-Contech.
 3. "Euco-NS"; Euclid Chemical Co.
 4. "Five Star Grout"; U. S. Grout Co.
 5. "Duragrout"; L & M Const. Chemical Co.
 6. "Supreme"; Gifford Hill

2.12 CONCRETE MIXES

- A. Compressive Strengths: Minimum concrete compressive strengths are as follows:
 1. 3000 psi; 28-day compressive strength; 517 lbs. cement per cu.yd. minimum W/C ratio, 0.56 maximum. (All concrete except as otherwise noted.)
 2. 3500 psi; 28 day compressive strength; 517 lbs. cement per cu. yd. minimum; W/C ratio, 0.45 maximum. (All exterior concrete.)
 3. 4000 psi; 28 day compressive strength; lightweight; 564 lbs. cement per cu. yd. minimum; W/C ratio, 0.50 maximum. (All concrete poured on metal deck.)
- B. Mix Design: Proportion by the procedure described in ACI 318. All concrete; ready-mixed; on site batch plant; mixed and transported in accordance with ASTM C-94, Alternate No. 1 or No. 2 and ACI 304.
 1. Responsibility: The Contractor is solely responsible for creating and paying for all concrete design mixes fully workable of required strengths that produce finishes acceptable to the Architect. All mixes shall be purchased from the same supplier

throughout the work.

- C. Mixing: After introduction of water to the cement and aggregates, concrete which has been mixed longer than 1-1/2 hours or 300 revolutions, shall not be placed. In no case shall concrete be used that has been mixed so long that the initial set of the concrete shall occur sooner than 15 minutes after placement.
 - 1. Truck mixing: Trucks must be equipped with water gauges and revolution counters. Defer addition of water to latest possible revolution counters. Defer addition of water to latest possible time. When temperatures or other conditions cause a deviation in slump or setting characteristics, provide approved measures to maintain normal conditions.
- D. Slumps: ACI 301, paragraph 4.2.2.2. Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Ramps, slabs, and sloping surfaces: Not more than 3".
 - 2. Reinforced foundation systems: Not less than 1" and not more than 3".
 - 3. Concrete containing HRWR admixture (super plasticizer): Not more than 8" after addition of HRWR to verified 2" - 3" slump concrete.
 - 4. Other Concrete: Not more than 4".
- E. Dry Density:
 - 1. Structural Normal Weight Concrete: 148 lbs./c.f. maximum. (all concrete except as otherwise noted)
 - 2. Structural Light Weight Concrete: 117 lbs./c.f. maximum. (all concrete poured on metal deck)

2.13 MASONRY GROUT MIX

- A. Compressive Strengths: Minimum 28 day compressive strength shall be 3000 psi; standard weight; 5.5 bags (94 lbs.)/c.f. w/c = 0.60 maximum for all masonry grout.
- B. Mix Design: Proportion per the requirements of ASTM C476-83 - "Standard Specification for Grout for Masonry" ready mixed and transported in accordance with ASTM C-94, alternate No. 1 and ACI 304.
 - 1. Responsibility: The Contractor is solely responsible for creating and paying for all grout design mixes fully workable, of required strengths that produce finishes acceptable to the architect. All mixes shall be purchased from the same supplier throughout the work.
- C. Mixing: After introduction of water to the cement and aggregates, grout that has been mixed longer than 1.5 hours should not be placed. Because of its high slump, ready mix grout shall be continuously agitated after mixing until placement. In no case shall grout be used that has been mixed so long that the initial set of the concrete shall occur sooner than 15 minutes after placement.
 - 1. Truck Mixing: Trucks must be equipped with water gauges and revolution counters.

Defer addition of water to latest possible revolution counters. Defer addition of water to latest possible time. When temperatures or other conditions cause a deviation in slump or setting characteristics, provide approved measures to maintain normal conditions.

- D. Slump: Water may be introduced at the plant to produce a maximum slump of 6". Additional water may be added at the jobsite immediately prior to placement to produce a maximum slump of 11".

2.14 PROPORTIONING LIGHTWEIGHT CONCRETE: (ASTM C-330, ACI-211-15, ASTM-304-1)

- A. Concrete shall be so proportioned using Type 1 cement, fine sand aggregates, coarse structural lightweight aggregates, water and air entraining agent as specified in ACI-211-15. The proportions shall conform to Underwriters' Laboratories Design No. D840.
- B. Water: The amount of water which is to be added to a lightweight concrete mix is to be the minimum amount which will allow the concrete to be placed properly, while still producing the required strength and finish.
- C. Water Reducer: All light weight concrete shall have a water reducer added to the concrete mix in accordance with manufacturer's recommendations based on the temperature at the site at the time of placement. Quantities of admixtures shall be varied in order that slump and water/cement content of the mix shall remain constant for all temperatures.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordination: Check forms, reinforcing steel and supports, expansion and contraction joints, and placement of built-in and embedded items. Verify drawing dimensions with actual field conditions. Inspect related work and adjacent surfaces. Report all conditions which prevent proper execution of this work.
 - 1. Do not place concrete until foregoing related work has been completed and inspected.
- B. Built-in and Embedded Items: Allow sufficient time for the various trades between erecting of forms and placing of concrete, to permit the proper installation of their work. Do not place concrete until embedded items have been coordinated and installed.
 - 1. Coordination: Refer to Formwork, also examine the drawings and specifications for work of other trades, especially for Mechanical and Electrical Work.
 - 2. Conduits: Do not allow conduits or pipes to be placed in the concrete.
 - 3. Precautions: Embedding of aluminum inserts or conduit in the concrete will not be permitted.
 - 4. Anchorage and Supports: Refer to Concrete Accessories and Miscellaneous Metals Sections for items to be embedded in the concrete. Refer to Formwork for

installation.

- C. Surface to Receive Concrete: Clean, well thawed, damp surfaces, free from standing water. Before placing concrete, remove all debris, water and ice from the places to be occupied by the concrete. Wood forms shall be thoroughly wetted (except in freezing weather) or oiled and the reinforcement cleaned of ice or other coatings. Do not place concrete on soft mud or dry porous earth (see Spec Section 31 2000).
- D. Screed Levels: Set edge forms or bulkheads and wet intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screeds required.
 - 1. Alignment: Align the concrete surface to the elevation of the screed strips by the use of strike-off templates or accepted compacted type screeds.

3.2 CONVEYING AND PLACING

- A. Reference Standard: In accordance with requirements of Building Code Requirements for Reinforced Concrete, ACI 318, Chapter 5, Concrete Quality, Mixing and Placing, Section 5.9, Conveying, and Section 5.10, Depositing, and as modified herein.
- B. Wood Runways: Provide for wheeled equipment for transporting concrete. Do not displace the resteel or vapor barrier.
- C. Conveying: Rapidly handle from mixer to forms and deposit as nearly as possible in its final position to avoid segregation due to rehandling or flowing. Do not permit concrete during passage from mixer to final positioning to come in contact with aluminum surfaces.
- D. Placement: Place concrete of required thickness, compact, level and screed to proper levels to receive finishes specified. Do not deposit partially hardened or retempered concrete. Do not place concrete contaminated by foreign matter.
 - 1. Bearing Walls and Columns: Brace and allow to cure twelve hours before placing concrete superimposed thereon, in accordance with ACI 301, section 5.3.2.4.
 - 2. Slab Reinforcement: Welded wire fabric reinforcing shall be placed at the proper height by installing support steel as specified in specification 03 2000.
 - 3. Slabs: Do not pour faster than can be properly leveled and compacted. Place at point of final repose, directly ahead of the screed bar, vibrating mass just ahead of the screed.

3.3 CONSOLIDATION: ACI 301, Section 5.3.2.5

- A. Compacting: Thoroughly tamp and spade fresh concrete to insure flow into all parts of forms and around reinforcement. Use caution when using vibrators and hand spades to prevent any injury to working face of forms or any movement of the reinforcement.
- B. Concrete shall be placed in such a manner as to insure that alignment of sleeves, embedded plates, and inserts remain unchanged. Special provisions shall be made to insure proper vibration of concrete around bearing plates and inserts.

3.4 LEVELING AND SCREEDING

- A. All top surfaces of poured concrete shall be worked smooth and level. Do not sprinkle dry cement or mixture of cement and sand directly on the surface of the concrete to absorb moisture or to stiffen mix. Surfaces shall be brought to a finish level, free from defects, blemishes, ripples, trowel marks and other irregularities, including footprints and other depressions which may be cause for rejection.
- B. Screeds: Of such type and construction, and so spaced and located as to produce surface tolerances specified.
- C. Unformed Surfaces: Bring to proper levels and slopes, using screeds, and strike-off with a straightedge. Screed twice, the first to strike a full, rough level and move the concrete mass ahead. Follow this with necessary filling of low areas and another screeding to final level. Remove any puddles of "soup," excess water, or laitance. Pull screeds and screed supports and fill all depressions.
 - 1. Floating: Float to a true and uniform surface with no coarse aggregate visible.
- D. Levels and Lines: Establish and check levels and lines by instrument, and from time to time during pours. Finally check lines and levels, again by instrument, after straight edging and screeding. Correct any settlement and/or other irregularities greater than the allowable tolerances.
 - 1. Floor slabs on grade shall be finished to the following requirements:
 - a. The F-numbers which shall apply to the whole floor shall be a flatness $F_f = 30$ or higher, and a levelness $F_l = 25$ or higher.
 - b. The minimum local F-numbers which shall apply to the floor area bound by construction and/or control joints shall be a flatness $F_f = 22$ or higher, and a levelness $F_l = 19$ or higher.
 - 2. The minimum local F-numbers for elevated concrete slab floor areas bound by a structural bay shall be a flatness $F_f = 22$ or higher, and a levelness not to exceed 3/8 inch within any structural bay.
 - 3. Exterior concrete stairs shall have the treads and landings sloped approximately 1/8" per 12" to assure that no water rests on a riser or the landings.

3.5 UNFORMED CONCRETE SURFACE FINISHES

- A. Reference Standard: All concrete finishes shall be specified designating in ACI 301 Section 5.3.4.2, except as modified herein.
- B. Troweled Finish: After concrete is sufficiently hardened to prevent drawing moisture and fines to the surface, finish trowel until matrix no longer accumulates on the trowel. Do not use cement, sand, or a mixture thereof to absorb excess moisture and do not add water to facilitate troweling. Perform second troweling until there is a distinct ringing sound under the trowel, and smooth, hard furnished surface is obtained. Use liquid curing membrane except where indicated. (See Products)
- C. Interior floor slabs shall have a smooth trowel finish.

D. Exterior floor slabs shall have a broom or belt finish.

3.6 LIMITATIONS OF OPERATIONS

A. No construction activity shall be permitted on a concrete deck pour for at least 3 days and until the concrete has achieved at least 75 percent of its specified 28-day compressive strength.

3.7 SURFACING CURING

A. Application: Apply liquid-type combination curing compound as soon as new concrete is hard enough to support applicator's weight and as soon after final troweling as possible, in such a manner as to prevent marring or damaging troweled surface. Apply in strict accordance with the manufacturer's recommendations, and with the initial application done under the direct supervision of the manufacturer's representative.

B. During period of dry winds, low humidity, high temperatures, and other conditions causing rapid drying, protect fresh concrete with an evaporation retardant (mono-molecular film) or fine fog spray of water applied immediately after screeding and bull floating. Maintain protection until final finishing and curing compounds are applied.

3.8 SURFACE SEALING

A. Sealing Compound Application: The sealing and dustproofing application should be applied when all trades are completed and structure is ready for occupancy. Surface must be free of any dust, dirt, and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required. Apply 2 coats, both at full strength to seal and dustproof the concrete. Allow first coat to dry overnight prior to application of second coat.

3.9 FORMED CONCRETE SURFACES

A. All formed concrete finishes shall be as specified in ACI 301, Section 5.3.3.4, except as modified herein.

B. Cork Floated Finish where exposed to view, unless otherwise indicated.

C. As Cast Formed Finish where not exposed to view, patch as required, unless otherwise indicated.

3.10 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:

1. Repair and patch defective areas with repair mortar such as Tamms Speedcrete – Redline immediately after removal of forms, when acceptable to Architect.
2. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, 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 to a saturated-surface-dry condition and install repair mortar in strict accordance with the manufacturer's specifications.

- 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. 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 low and 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 0.03" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, 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. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.
- I. 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 to a saturated-surface-dry condition. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
- J. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces to a saturated-surface-dry condition. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine

aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack when concrete surface is still saturated. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

- K. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive mortar.
- L. Repair methods not specified above may be used, subject to acceptance of Architect.

3.11 NONCONFORMING STRENGTH: If strength of laboratory control cylinders at 7 or 28 days for any portion of the work falls below required strengths, the Structural Engineer has the right to order a change in proportions for the remaining work, and/or may order additional reshoring and moist-curing of the sections in question. In addition, at his discretion, the Structural Engineer has the right to require tests in accordance with ASTM C-42 (cored cylinders) or order load tests on portions of buildings so affected. Perform all test changes as noted above and/or other required corrective measures as directed by the Structural Engineer at no expense to the Owner, regardless of test results. The structural Engineer is the sole interpreter of additional tests and his judgement is final.

3.12 RESPONSIBILITY

- A. The Owner shall employ and pay for services of an independent Testing Laboratory, and an Inspection Agency, acceptable to the Structural Engineer to perform the specified tests and inspection. (ACI 301, Section 1.6.1 and 1.6.2).
- B. Approvals: The design mix and/or acceptance of the test reports do not in any way relieve the Contractor of his responsibility to insure that the strength, slump and quality of the in-place concrete meets the requirements of the Contract Documents.
- C. Rejection: The Owner's representative will have the right to reject concrete which does not meet strength and other requirements of the Contract Documents.
- D. Mixing Design: If the strength of any test cylinder fails to meet the ultimate compressive strength, the Owner's representative shall have the right to require a change in proportions to ensure adequate strengths in the remainder of the project.
- E. Additional Testing: Owner's representative shall have the right to require testing of the concrete by coring, loading or other means, or removal of that portion of the construction covered by those tests, all costs of which to be borne by the Contractor.

3.13 CONTRACTOR'S DUTIES: Comply with ACI 301, Section 1.6.3 including but not limited to the following:

- A. Batch Plant Samples: If desired by Contractor, or so requested because of known or indicated problems.
- B. Storage: Provide suitable storage facilities at the job site for test cylinders.
- C. Additional Costs: Pay all costs for coring, drilling, additional testing, remedies and

corrections of work which does not meet strength and other requirements of the Contract Documents and/or if failure to perform required duties. Comply with ACI 301, Section 1.6.5.

- D. Other Test Cylinders: For other than compressive strength, such as to determine when forms may be stripped, shall be paid for by the Contractor requesting same.

3.16 TESTING AND INSPECTION

- A. Field and laboratory testing of poured in place concrete and masonry grout shall comply with the testing requirements of Section 01 4000, Quality Control. Perform specified tests and testing in accordance with ACI 301, Section 1.6.4 and ACI 311 "Recommended Practice for Concrete Inspection". Testing Agency shall meet the requirements of ASTM E 329:
- B. Slump Tests: Consistency shall be determined at the project site by means of slump test in accordance with C-143. Results of slump test shall appear on the test reports. Slump tests shall be made at the same time as test cylinders are made and when so directed by the Structural Engineer.
- C. Compression Tests: Each test consists of 4 concrete test cylinders broken under compression. Two cylinders shall be broken 7 days after making; and two cylinders shall be broken at 28 days. Strength results of all cylinders/samples broken at 7 days shall achieve a minimum of 65% of the ultimate design strength, 28 days - 100%.
 - 1. Concrete Test Cylinders: 6" diameter x 12" (or 4" diameter x 8" if maximum aggregate size is less than 1") made at the point of deposit, molded, transported cured and tested in accordance with ASTM C-31. One set of compressive test cylinders shall be made for each 100 yards poured. Make not less than one set of cylinders for each day's pour and each class of concrete.
- D. Air Content: When required, air content test shall be performed per ASTM C-173 (volumetric method for normal weight or light weight concrete) or ASTM C-231 (pressure method for normal weight concrete).
- E. Laboratory Test Reports: Submit to the Structural Engineer immediately upon completion of each test. Test reports shall contain the following information:
 - 1. Exact mix, including quantities of admixtures, etc.
 - 2. Date of pour.
 - 3. Exact location of pour in building.
 - 4. Slump (at truck or on deck specified).
 - 5. Percentage of air-entrained.
 - 6. 7-day test results for first two cylinders tested.
 - 7. 28-day test results shall be reported with both 7 and 28 day results indicated on the same report.
 - 8. Temperature at time of pour.

F. TESTING LABORATORY DUTIES

1. Furnish all materials for making concrete test cylinders.
2. At test intervals, immediately transport concrete test cylinders to the Test Laboratory.
3. Provide verbal results of concrete test cylinders when required by the contractor.
4. Provide test reports of all laboratory testing in a timely fashion to the Structural Engineer and Contractor.

G. INSPECTION AGENCY DUTIES

1. Comply with inspection requirements of Section 01 4000, Quality Control Services. Inspect concrete operations and completed work for conformance with Contract Documents and as indicated in ACI 301, Section 1.7.
2. Assign qualified personnel to be on site at all times when operations are scheduled. The Contractor shall note that no concrete operations shall be permitted in their absence.
3. Perform slump tests for all concrete, and masonry grout, and air content tests as specified above. Forward results of these tests to Testing Laboratory for incorporation into laboratory test reports.
4. Make concrete test cylinders in molds provided by Testing Laboratory.
5. Site inspection of poured in placed concrete shall include, but is not limited to the following:
 - a. Insure all concrete and masonry reinforcement is properly inspected per specifications 03 2000 and Division 4 – Masonry
 - b. Masonry grouting operation.
 - c. Slab curing procedures.
 - d. Application of concrete sealer.
6. Submit daily reports outlining conformance and exceptions of concrete operation to contract documents.
7. Submit copies of all daily reports indicating conformance and exceptions to contract documents in a timely fashion to General Contractor for distribution to design consultants, owner, subcontractors and other interested parties.
8. Final Report and Certification: The Inspection Agency shall prepare a written report that summarizes the work inspected during the course of the project. A discussion of all deviations from the contract documents and specifications, with their related impact on the final construction, shall be described in detail. The engineer of record shall review this final report, and recommend corrective measures (as deemed necessary) that must be made prior to final acceptance of the work. Prior to final payment, a written report certifying that the work meets the requirements of the contract documents, specifications, and all governing agencies shall be prepared, submitted, and approved by the Architect.

END OF SECTION