DIVISION 3 – CONCRETE

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work Included in This Section:
   1. Provide all labor, materials, equipment, and services, etc., required to furnish and install all cast-in-place plain and reinforced concrete work, as indicated on the Drawings, Specified herein, or otherwise required for a complete and proper job.

B. The Work shall include, but shall not necessarily be limited to:
   1. Forms, shoring, reinforcing, reinforcing accessories, and form removal.
   2. The furnishing, placing, finishing, curing, and protection of all above and below grade, plain and reinforced, architectural and non-architectural concrete including but not necessarily limited to:
      a. Foundations and footings.
      b. Walls, pilasters, beams, lintels, columns, pits and piers.
      c. Slabs-on-grade
      d. Ramps.
      d. Cast-in-place stairs.
      f. Encasements, miscellaneous fills and enclosures.
      g. Equipment bases and housekeeping pads (as required for all trades).
      h. Sitework concrete: walks, ramps, stairs, islands, curbs, walls, wall caps, headwalls, pads, bases, platforms, cradles, encasements, thrust blocks, etc.
   3. Vapor retarders under interior slabs-on-grade.
   4. Installation of embedded items (pipe sleeves, duct sleeves, keys, chases, boxes, bolts, anchors, reglets, inserts, expansion joint covers, etc.) furnished by other trades.
   5. Cutting and patching existing concrete.
   6. Joint filler and sealant in and around concrete slabs.
   7. Sealing of concrete slabs to remain exposed.

C. Related Work Specified Elsewhere:
   1. SECTION 05500: MISCELLANEOUS METAL WORK

1.02 SUBMITTALS

A. Product Data: Submit manufacturers' technical data, application, and installation instructions for each type of manufactured materials and product indicated.
   1. Mix Designs: Submit concrete mix designs with two (2) cylinder test results by a qualified independent testing laboratory for each type of concrete to be used, not less than ten (10) days prior to placement. NOTE: If concrete is to be pumped, separate mix design(s) shall be required. If admixtures are to be included in the mix, provide mix design with test results. Indicate quantities of mix water for addition at project site.

B. Shop Drawings:
   1. Submit reinforcing steel shop drawings detailing, bending, and placing of reinforcements, and bar lists in accordance with ACI 315 "Manual of Standard Practice for Detailing Concrete Structures".
   2. Submit for information only, formwork shop drawings prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Submit formwork, joint, and tie layout shop drawings for all architectural

concrete. The Architect will review these drawings for aesthetic considerations only. All form design and engineering shall remain the exclusive responsibility of the Contractor.

3. Submit proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing re-shoring.

C. Certificates: Submit certificates for welding procedures and personnel. Submit material certificates signed by the manufacture certifying materials comply with the project requirements for the following:
   1. Cementitious materials and aggregates.
   2. Form materials and form release agents.
   3. Steel reinforcement and reinforcement accessories.
   4. Fiber reinforcement.
   5. Admixtures.
   6. Curing materials.
   7. Floor and slab treatments.
   8. Bonding agents.
   9. Adhesives.
   10. Vapor retarders.
   11. Epoxy joint filler.
   12. Joint filler strips.
   13. Repair materials.

1.03 TESTING AND INSPECTIONS

A. Testing and inspection shall be performed as required by the building code, the Contract Documents, or as otherwise directed by the Architect. The Contractor shall employ a testing laboratory for the purpose of testing concrete, inspecting reinforcements and submitting reports. The cost of testing and inspections shall be paid for by the Contractor.

B. The Contractor shall arrange and coordinate all testing and inspections and shall give the Owner's Representative and Architect a minimum of forty-eight (48) hours notice before each concrete pour.

C. Sampling and testing for quality control during concrete placement may include the following, as directed by the Architect:
   1. Slump: ASTM C-143; 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.
   2. Air Content: ASTM C-173; volumetric method for light-weight or normal-weight concrete; ASTM C-231, pressure method for normal-weight concrete; one for each day's pour of each type of concrete mix.
   3. Concrete Temperature: ASTM C-1064; one test hourly when air temperature is 40 degrees F and below, when 80 degrees F and above, and one test for each set of compressive strength specimens.
   4. Compression Test Specimen: ASTM C-31; one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cured test specimens are required.
   5. Compressive Strength Tests: ASTM C-39; one set for each day's pour exceeding 5 cu.yd. plus additional sets for each 50 cu.yd. more than the first 25 cu.yd. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
      i. Should tests yield compressive strengths equal to or exceeding 28-day minimum requirements, discontinue testing of remaining cylinders for that sample lot.

ii. Specimens in reserve are to be disposed of upon completion of the Project.

6. Unit Weight: ASTM C567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

D. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

E. When total quantity of a given class of concrete is less than 50 cu. yd. the Architect may waive strength testing if adequate evidence of satisfactory strength is provided.

F. When strength of field cured cylinders are less than 85 percent of companion laboratory cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in place concrete.

G. 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 strength by more than 500 psi.

H. Test results will be reported in writing to the Owner's Representative, Architect, Structural Engineer, Contractor, concrete manufacturer, and Building Inspector within 2 working days. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, 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 and 28 day tests.

I. Contractor shall pay for testing conducted and any other additional testing as may be required when unacceptable concrete is verified.

J. The Contractor shall remove and replace, or strengthen, as determined by the Architect, all concrete work for which test results fall below the specified requirements.

K. Early (4-day) concrete cylinder breaks to facilitate the Contractor's schedule and operations shall be paid for by the Contractor.

1.04 PRECAUTIONS

A. No aluminum of any kind (conduit, wire, reglet, inserts, etc.) shall be placed in concrete work, except where contact surfaces are coated with an epoxy asphalt paint, approved by the Architect.

B. Use no form release agents containing materials that may affect a satisfactory finish and/or adhesion of materials to be applied to concrete by other sections.

C. Slab curing agents other than water may <u>not</u> be used, without prior written approval.

D. No conduits, pipes, ducts, or other non-structural components of any kind shall be placed <u>in</u> concrete slabs, without the Architect's prior written authorization.

1.05 QUALITY ASSURANCE

A. Codes and Standards: All concrete shall be placed, cured, and tested in accordance with all applicable sections of the American Concrete Institute (ACI) specifications, latest edition, including but not limited to the following, except where more stringent requirements are shown or specified:
   1. ACI 117 – "Specification for Tolerances for Concrete Construction and Materials".
   2. ACI 211.1 – "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete".
   3. ACI 301 – "Structural Concrete for Buildings".
   4. ACI 302.1 – "Guide for Concrete Floor and Slab Construction".
   5. ACI 304 – "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
   6. ACI 305R – "Hot Weather Concreting".
   7. ACI 308 – "Standard Practices for Curing Concrete".
   8. ACI 311 – "Recommended Practice for Concrete Inspection".
   9. ACI 315 – "Standard Practice for Detailing Reinforced Concrete Structures".
   10. ACI 318 – "Building Code Requirements for Reinforced Concrete".
   11. ACI 347 – "Recommended Practice for Concrete Formwork"
   12. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".

B. Installer Qualifications: Shall be an experienced installer who has completed concrete work similar in materials, design, and extent to that required for this project, with a record of successful completions.

C. Professional Engineer Qualifications: (for services related to formwork, shoring and re-shoring installation) Shall be a professional engineer, licensed in the United States Virgin Islands, experienced in providing engineering services of this type.

D. Ready-mix Plant Qualifications: Shall be a firm experienced in the manufacture of ready mixed concrete products complying with ASTM C94 requirements for production facilities and equipment. Manufacturer shall be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

E. Obtain each type of class of cementitious materials of the same brand from the same manufacturer's plant, each aggregate from one source and each admixture from the same manufacturer.

F. Qualify procedures and personnel according to AWS D1.4 Structural Welding Code - Reinforcing Steel".

G. Pre-installation Meeting: A pre-installation meeting to review cast-in-place concrete project requirements shall be attended by the Contractor, General Superintendent, Concrete Sub-contractor, ready-mix producer, testing and inspection agency, Owner's Representative and Architect.

1.06 PRODUCT HANDLING

A. Protection: Protect materials during transit, on-site storage, and handling to prevent deterioration and damage. Reinforcing steel shall be stored off the ground in an orderly manner to facilitate access and usage in designated locations. Repair epoxy coating on steel reinforcement according to ASTM D3963 and ASTM D3963M.

PART 2 – PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Concrete: Shall be exterior grade plywood, equal to American Plywood Association B-B Plyform, in excellent condition, free of dents, scratches or surface deposits. Forms for architectural concrete shall be HDO (High Density Overlaid) Plyform, in "like-new" condition. Use appropriate thickness of Class I, II or Structural I Plyform as recommended by APA for specific installations.

B. Forms for Concealed Concrete: May be Plyform, matched dressed lumber or steel.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Shall be metal, glass fiber reinforced plastic, paper or fiber tubes that shall provide surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass fiber reinforced plastic or formed steel stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Shall be wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.

G. Form Ties and Spreaders: Shall be factory fabricated, adjustable length, removable or snap-off metal or glass fiber reinforced plastic form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than one (1) inch to the plane of the exposed concrete surface. Do not use wire ties and wood spreaders. Where concrete is to remain exposed to view or painted, ties shall have removable tapered plastic cones of no greater than one (1") inch outside diameter. Ties for walls below grade and wall indicated to receive dampproofing or waterproofing shall incorporate water seal washers.

H. Form Release Agent: Shall be a commercial formulation with a maximum of 350 mg/l volatile organic compounds that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

I. Keyed Slab-On-Grade Form: Shall be 24-ga. Hot dipped galvanized steel with interlocking support stakes, and dowel bar knock-outs, "Model Pro-Key" as manufactured by BoMetals, Inc., or approved equal. Provide appropriate form depth for slab depth as indicated on the Drawings.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars: Shall be deformed bars complying with ASTM A-615 A and M, Grade 60. Low alloy deformed steel reinforcing bars shall conform to STM A706 A and M. Galvanized deformed reinforcing bars shall conform to ASTM 767 A and M, Grade 60, hot-dip galvanized after fabrication and bending, zinc coating Class I and II. Epoxy coated reinforcing bars shall conform to ASTM A775 A and M. Fabricated deformed epoxy coated reinforcing shall comply with ASTM A934 A and M. Steel bar mats shall conform to ASTM A184 A and M, and shall be assembled with clips.

B. Welded Wire Fabric: Deformed steel wire shall conform to ASTM A496, and sheets shall conform to ASTM A497, provide in flat sheets. Epoxy coated wire shall conform to ASTM A884 A and M, Class A, plain or deformed as indicated on the Drawings and fabric shall conform to ASTM A884 A and M, Class A. Galvanized plain steel wire shall conform to ASTM A82 and welded wire fabric shall conform to ASTM A185, provide in flat sheets. Plain steel wire shall conform to ASTM A82, welded wire fabric shall comply with ASTM A-185, provide in flat sheets.

C. Supports for Reinforcement: Shall include, but are not limited to: spacers, chairs, ties, bolsters, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric. Supports shall conform to CRSI "Manual of Standard Practice".
1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic protected or CRSI Class 2 stainless steel bar supports.
2. For epoxy coated reinforcement, use epoxy coated or other dielectric polymer coated wire bar supports.
3. For zinc coated reinforcement, use galvanized wire or dielectric polymer coated wire bar supports.

D. Joint Dowel Bars: Shall be plain steel bars conforming to ASTM A615 A and M, Grade 60, or epoxy coated bars conforming to ASTM A775A and M Grade 60, as indicated on the Drawings. Cut bars true to length with ends square and free of burrs.

E. Repair Materials: For epoxy, shall be liquid epoxy repair coating compatible with epoxy coating complying with ASTM A775 A and M. For galvanized, shall be zinc based solder paint conforming to ASTM A780.

2.03 CONCRETE MATERIALS

A. Portland Cement: Shall be domestic manufacture, complying with ASTM C-150, Type II. Only one brand of cement shall be used throughout the project.

B. Concrete Aggregates: Shall conform to the following requirements:
1. Fine Aggregate: Shall comply with ASTM C-33 and consist of clean, hard, tough and preferably siliceous material (sand), free from mineral or other coatings, soft particles, clay, loam, or other deleterious matter. Materials for exposed concrete shall come from a single source.
2. Coarse Aggregate (normal weight): Shall comply with ASTM C-33 and consist of crushed stone or gravel having clean, hard, durable, uncoated particles, free from deleterious matter. Materials for exposed concrete shall come from a single source.
3. Coarse Aggregate (light weight): Shall comply with ASTM C-33 and consist of cellular materials of mineral origin, such as shale, clay, slate, fly ash, or slag, either naturally occurring or produced by sintering, expansion, palletizing, or rotary kiln processes. Material shall have a dry loose weight of 55 lbs. per cu. ft. and graded from 3/4" to No. 4.

C. Mixing Water: Shall be potable.

D. Admixtures: Shall be used in complete accordance with the manufacturer's directions. All admixtures shall be by the same manufacturer, who shall provide at no added cost to the Owner, the services of its representative at the job to ensure proper use of each particular admixture. No admixtures containing calcium chloride (chloride ions) shall be placed in concrete work. Admixtures shall be certified by the manufacturer to contain not more than 0.1 percent water soluble chloride irons by mass of cementitious materials, to be compatible with other admixtures and cementitious materials and to comply with the following:

1. Air-entraining: ASTM C-260.
2. Water-reducing: ASTM C-494, Type A.
3. High-range, Water-reducing: ASTM C494, Type F.
4. Water-reducing and accelerating: ASTM C494, Type E.
5. Water-reducing and retarding: ASTM C494, Type D.
6. Corrosion-inhibiting: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing choride reactions with steel reinforcement in concrete.

2.04 RELATED MATERIALS

A. Curing Membrane: Shall be one of the following:
   1. White polyethylene sheeting 4 mils thick, ASTM C171; or
   2. Waterproof paper, Sisalkraft Type, ASTM C171-69 as manufactured by Fortifiber Corp., Ludlow Papers, Glas-Kraft; or
   3. Jute or kenaf, approximately 9 oz. per sq. yd., complying with AASHTO M-182, Class 2.
   4. Liquid membrane curing compound of resin or latex base conforming to ASTM C309 Type I, Class A. Confirm compatibility with subsequent surface treatments, sealers, surfacing materials adhesives, etc. prior to use. Product shall be "Kur-N-Seal" or "Kur-N-Seal NB" by Sonneborn, "Safe Cure & Seal" by Dayton Superior Corp., "Cure & Seal" by Conspec Manufacturing, or approved equal.

B. Interior Concrete Sealer: Exposed interior concrete slabs, shall have two (2) applications of sealer in accordance with manufacturer's directions. Slabs to receive finish flooring or painting shall not be treated with sealers or hardeners.

C. Exterior Concrete Sealer (Sidewalks, plazas, pads): Shall be "Silocks WB" as manufactured by Silpro, "Preserve" by Conproco, or approved equal.

D. Joint Sealant: (For joints in slabs and walks) Shall be self-leveling, multi-component polyurethane. Use primer as recommended by the manufacturer. Sealant shall be "THC-900" or "THC-901" (low sag as required by job conditions) as manufactured by Tremco, or approved equal. Color shall be as selected by the Architect.

E. Premolded Joint Filler Strips: Shall be 1/2" thick, unless otherwise noted, premolded, resilient, compressible, re-expanding, non-extruding bituminous and fiber material, made with cane fibers, uniformly saturated with not less than 35% and not more than 50% by weight of asphalt, conforming to ASTM D1751.

F. Chemical Bonding Agent: Shall be film-forming, freeze-thaw resistant compound suitable for brush or spray application, "Daraweld-G" by W.R. Grace Company, 'Eucoweld" by Euclid Chemical Company, or approved equal.

G. Slab Vapor Retarder:
   1. Shall be 10 mils thick un-reinforced polyethylene, conforming to ASTM D4397.

H. Plastic Control Joints: Shall be "Zip Cap" type as manufactured by Greenstreak Inc., A.H. Harris Co., or approved
equal. Depth shall be as required to penetrate 1/4" thickness of slab.

I. Dovetail Anchor Slots: See SECTION 04200: UNIT MASONRY AND MORTAR.

J. Repair Underlayment: Shall be cement based, polymer modified, minimum 4,100 psi strength, self-leveling product, for edge feathering to adjacent floor surfaces. Provide a surface primer as recommended by manufacturer.

K. Repair Topping: Shall be traffic bearing, cement based, polymer modified, minimum 5,700 psi strength, self-leveling product, application thickness from 1/4 inch. Provide a surface primer as recommended by manufacturer.

L. Other Materials: All other materials not specifically described herein, but required for a complete and proper installation, shall be as selected by the Contractor and approved by the Architect.

PART 3 - EXECUTION

3.01 PROPORTIONS

A. All concrete shall be ready-mixed controlled concrete and proportioned according to ACI 211 and ACI 301 for normal-weight concrete and light-weight concrete.

B. The nominal maximum size of the aggregate shall not be larger than one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, nor three-fourths of the minimum clear distance between reinforcing bars or between bars and forms, whichever is least. In general, 3/4" size will satisfy these requirements. Aggregate of 1-1/2" size shall be used for slabs on grade, which are 5" or more in thickness.

C. Concrete for every part of the Work shall be a homogeneous structure which, when cured, will have at least the strength required by design. The limiting values of concrete shown in Table A and the requirements hereinafter specified must be met.

D. Proportions of concrete ingredients shall be determined in advance of concreting operations by the testing laboratory, and shall be such as to produce a concrete fulfilling every requirement of the Contract Documents. Advance specimen shall be tested as to compliance with this requirement by standard laboratory tests of concrete made with representative samples of the cement and aggregates, which the Contractor proposes to use for each specific portion of the Work. It shall be the Contractor's responsibility to provide the concrete strengths required and to pay the cost for a laboratory to make necessary trial mixes.

E. The design strength of the concrete in this structure is based upon ultimate strength requirements of ACI 318. The minimum strength requirement stated is the strength of the concrete at 28 days when samples are cured and tested in accordance with the recommended standards of ACI 318.

F. By the water-cement ratio is meant the total quantity of water entering the mixture, including the surface water carried by the aggregates, expressed in terms of the quantity of cement.

H. All concrete exposed to the exterior shall be air-entrained concrete, typically 6% +/- 1% by volume for 3/4" aggregate and 8% +/-1% for 3/8" aggregate. Maximum air-entrainment for exterior slabs shall be 3%. Interior floor slabs shall not be air entrained.

I. The water-cement ratio shall be expressed in U.S. gallons per sack (94 lb net) of cement.

TABLE A

Minimum Allowable Compressive Strength @ 28 Days PSI	Maximum Allowable Net Water Content Gals/Sack* **	Cement Sacks Per CU. YD. Minimum Permissible Maximum	Total Water
3000	6.0	5.5	33.0
4000	5.0	6.5	32.5

* Maximum: Decrease if possible. This represents the total water in the mix at the time of mixing, and includes free water on aggregates. Reduce net allowable water content by one gallon for air-entrained concrete.
** Minimum: Increase as necessary to meet other requirements.

J. The method of measuring water and aggregates shall be such as to secure specified proportion in each batch, and in a manner that proportion of water to cement can be closely controlled and easily checked at any time.

K. The proportions of aggregates to cement for concrete for any of this work shall be such as to produce concrete that will work readily into corners and angles of the forms and around the reinforcement without excessive puddling or spading and without permitting the materials to segregate or free water to collect on the surface.

L. Light-weight concrete mix shall be proportioned as herein specified, and shall produce strength and modulus of elasticity as noted on the Drawings, or Specified herein, with a split-cylinder strength factor (Fsp) of not less than 5.5 and a dry weight of not less than 95 lbs. or more than 100 lbs. after 28 days. Shrinkage shall be limited to 0.03% at 28 days.

M. No change in source of materials or mix shall be made without the Architect's authorization. Concrete mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Such adjustments shall be at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results shall be submitted to and accepted by Architect before using in the Work.

N. Design mix reports shall include the following information:
1. Identification of aggregate source of supply.
2. Tests of aggregate for compliance with specified requirements.
3. Scale weight of each aggregate.
4. Absorbed water in each aggregate.
5. Brand, type and composition of cement.
6. Brand, type and amount of each admixture.
7. Amounts of water used in trial mixes.
8. Proportions of each material per cu. yd.
9. Gross weight and yield per cubic yard of trial mixtures.
10. Measured slump.
11. Compressive strength results of 2 representative samples at 7 and 28 days for each type of concrete to be used.

3.02 STRENGTH COMPLIANCE

A. The following more clearly defines performance:
   1. To meet the requirements of this Specification and those of ACI 318, the average of any three consecutive strength tests of laboratory-cured specimens representing each class of concrete shall be equal to or greater than the specified strength (f'c), and not more than one out of ten strength tests shall have a value of less than the specified minimum strength. In addition to the above requirement, the allowed 10% of tests below the minimum required strength shall be equal to or greater than 90% of the minimum specified strength (f'c).
   2. Should the strengths shown by the test specimens fall below the specified design strengths, the Architect shall have the right to require additional curing on those portions of the structure represented by those test specimens.
   3. When the tests on control specimens of concrete fall below the required strength, the Architect will permit, at the Contractor's expense, check tests for strengths to be made by means of Windsor Probes or typical cores drilled from the structure in accordance with ASTM C-42 and C-39. In cases of failure of the latter, the Architect, in addition to other resources, may require, at the Contractor's expense, load tests on any members in which such concrete was used. Load tests need not be made until concrete has aged 60 days.

3.03 DESIGN OF FORMWORK

A. The design, engineering, and safety of formwork, as well as its construction shall be the exclusive responsibility of the Contractor.

B. Exercise care in order to ensure that all formwork is properly designed, engineered and erected, and capable of safely supporting all loads and pressures. Forms shall be held to the dimensions indicated on the Drawings, with the tolerances established by ACI 117 concrete surface irregularities shall be limited as designated by ACI 347R.

C. Temporary openings shall be provided at the base of forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is deposited.

D. Forms shall be sufficiently tight to prevent leakage of grout or cement paste.

E. Properly set and secure all embedded items to be furnished by other trades.

F. Properly set and secure all form applications for chamfers, reglets, rustication joints, etc., as indicated on the Drawings. Chamfer exterior corners and edges of permanently exposed concrete.

3.04 PREPARATION OF FORM SURFACES AND EMBEDDING ITEMS

A. Plywood and other wood surfaces not subject to shrinkage shall be sealed against absorption of moisture from the concrete by either: (1) a field applied approved form oil or sealer; or, (2) a factory applied non-absorbent liner. All shall be subject to review for finish appearance.

B. When forms are coated to prevent bond with concrete, it shall be done prior to placing of reinforcing steel. Excess coating material shall not be allowed to stand in puddles in the forms nor allowed to come in contact with concrete against which fresh concrete will be placed.

C. Where architectural (as-cast) finishes are required, only non-staining materials shall be used at form surfaces. Where the finished surface is required to be painted or treated, the material applied to the form surface shall be compatible with the type of paint to be used.

D. All forms shall be thoroughly cleaned before reuse.

E. All necessary chamfer strips and related architectural detail strips shall be provided for as indicated on the Drawings.

F. The Contractor shall thoroughly review all Drawings for special formwork required at openings such as windows, louvers, doors, etc.

G. Set and build into form work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Set anchor rods by template to ensure proper positioning. Do not cut, core, or sleeve through footings or embed mechanical and electrical utilities in or through footings without consulting with the Architect, before any such cutting, coring, sleeving, or embedding is begun.

H. Do not place (embed) mechanical or electrical conduit, ducting, etc, in supported (suspended) concrete slabs.

I. At slabs, set edge forms, bulkheads, and intermediate screed strips to achieve required elevations, and contours in finished surfaces for slabs. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.05 CONCRETE REINFORCEMENT

A. Reinforcing bars to be embedded in concrete shall be free of oil, dirt, loose mill scale, and loose rust. Reinforcing bars with rust, mill scale, or a combination of both will be acceptable as being satisfactory with cleaning or brushing, provided that upon wire brushing, the dimensions including height of deformations and weights of a cleaned sample shall not be less than the applicable ASTM specification requirements.

B. The placement of bars shall conform to CRSI Manual of Standard Practice, Placing Reinforcing Bars. Maintain adequate space for proper concrete cover.

C. Place no concrete before installation of reinforcement has been reviewed by the independent inspection agency.

D. In event of displacement of any reinforcement, same shall be corrected and retied as necessary and in a satisfactory manner.

E. All splicing of bars, concrete cover, and bar spacings shall conform to "Building Code Requirements for Reinforced Concrete" (ACI 318) as published by the American Concrete Institute, and to recommended practices in "Splicing Reinforcing Bars" by the Concrete Reinforcing Steel Institute, or as hereinafter specified.

1. When necessary to splice reinforcement, bars shall be lapped at least 40 bar diameters, unless noted otherwise, placed in contact and wired. Laps shall be avoided at points of maximum stress. All rods shall be securely wired together at all intersections. No permanent device for fastening reinforcement shall be left in contact with the face of forms at exposed surfaces.

F. The welding of reinforcing bars shall be performed in accordance with "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections for Reinforced Concrete Construction" (AWS D12.1), as published by the American Welding Society. Welders shall be qualified by tests as prescribed in the "Standard Qualification Procedures" (AWS B3.0), as published by the American Welding Society.

G. Tack welding of reinforcing steel shall not be permitted.

H. Heat bending of reinforcing steel shall not be permitted.

I. All splicing of wire fabric shall be made with fabric lapped at least 2 meshes wide and tied at 3'-0" o.c.

J. Repair all holes in vapor retarders prior to concrete placement.

3.06 MIXING

A. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set for it in ASTM C94 and ACI 614.

B. Transit-mixed concrete shall be delivered in high-lift trucks to enable it to be easily deposited in the forms.

C. The mixing shall be continuous after the water has been added to the mix in the drum, but no concrete shall be placed in the forms more than 90 minutes after the water has been added.

3.07 CONSISTENCY

A. The consistency of the concrete is mainly dependent upon the thoroughness of the mixing and the quantity of water contained in the mix. In general, the maximum slump and minimum strengths shall be as follows:

Type of Construction	Compressive Strength Required in PSI	Maximum Slump (Inches)
All Exterior Concrete	3000 (air entrained)	4
Beams and Columns	3000	4
Footings	3000	4
Foundation Walls	3000	4
Slabs 4000	4	
Miscellaneous Concrete	3000	4

3.08 CONCRETE PLACEMENT

A. Inspection: Prior to placing concrete, all formwork, reinforcements and embedded items shall be complete and inspected by the inspection agency. All embedded items shall be checked for proper location, type, and quantity.

B. Prior to placing concrete, clean all equipment used for mixing and transporting the concrete. Remove all debris from the place to be occupied by the concrete, and check forms for dimensions, position, and adequacy.

C. Water shall be removed from excavations before any concrete is deposited. Any flow of water into an excavation shall be diverted through proper side drains to a sump, or shall be removed by other approved methods that will avoid washing the freshly deposited concrete. No pumping shall be done while the concrete is being placed.

D. Convey concrete from the mixer to the place of final deposit by rapid methods that will prevent the separation or loss of the materials. Equipment for placing concrete shall be of such size and design as to ensure delivery without segregation of the materials. All shall be in accordance with ACI 614.

E. Concrete shall not be placed by means of open chutes, the combined length of which exceeds 30', and shall not be allowed to drop freely through distances exceeding 6' or through loosely spaced reinforcing bars, conduits, etc., which will tend to segregate materials.

F. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. No concrete that has partially hardened or been contaminated by foreign material shall be deposited on the Work.

G. Once concreting is started, it shall be carried on as a continuous operation until the placing of the panel, section, or individual foundation is completed, so as not to cause formation of seams and planes of weakness within the section. If a section cannot be placed continuously, construction joints as specified and as detailed on the Drawings shall be provided. The top surface shall be generally level. When construction joints are necessary, they shall be made in as specified herein.

H. Place concrete in layers not over 12" deep, and thoroughly compact by means of vibrators, hand tamping and spading. During the operation of placing, thoroughly work the concrete around reinforcement, embedded fixtures, pipes, and conduits, and into the corners of the forms so as to prevent interior voids, honeycomb, and the patching of concrete surfaces after forms are removed. Internal vibrators should be used to aid in the compaction of the concrete. Extreme care shall be used on thin sections and exposed concrete.

3.09 WEATHER PROTECTION

A. Unless adequate protection is provided and/or approval is obtained, concrete shall not be placed during rain, sleet, snow, or freezing weather. Rainwater shall not be allowed to increase the mixing water or to damage the surface finish.

B. Hot Weather Concreting:
   1. Hot weather concreting shall be done in accordance with the recommendations of ACI 305R.
   2. Concrete deposited in hot weather shall have a placing temperature that will not cause difficulty from loss of slump, flash set, or cold joints (usually somewhat less than 90 degrees F.).
   3. In hot weather, be adequately prepared to protect the concrete from the adverse influence of heat before the placement of any concrete. Take special precautions to avoid cracking of the concrete from rapid drying during placement of concrete when air temperature exceeds 70 degrees F., particularly when the work is exposed to direct sunlight.
      a. Cool forms by fog sprayed with water or by protecting them from the direct rays of the sun.

b. If requested by the Contractor, deemed advisable by the Testing Engineer, and approved by the Architect, a retardant may be used to delay the initial set of the mix.

3.10 CONCRETE JOINTS

A. Construction joints shall be located so as to least impair the strength and watertightness of the structure. All construction joint locations shall be subject to the notification of and acceptance by the Architect, prior to placement.

B. All construction placement joints shall be keyed.

C. Reinforcement shall be continuous through construction joints and additional reinforcing placed as required. Except where otherwise specified, the surfaces of construction joints shall be prepared in a manner that will ensure bonding with concrete or grout later placed on them. Wherever practical, construction joint surfaces shall be kept continuously moist until new concrete or grout is placed.

D. Use bonding agent on existing concrete surfaces to be joined with new concrete. Use a epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

E. Place control joints perpendicular to main reinforcement. Continue reinforcement across control joints except as indicated otherwise.

F. Locate joints for beams, slabs, joists and girders in the middle third of spans. Offset joints in girder a minimum distance of twice the beam width from a beam-girder intersection. Locate horizontal joints in walls and columns at underside of floors, slabs, beams and girders and at the top of footings or floor slabs. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

3.11 JOINTS IN SLABS

A. Control (contraction and isolation) joints in slabs-on-grade shall be provided wherever new concrete abuts foundation walls, exterior slabs and to form slab panels as indicated on the Drawings, as otherwise noted, specified or detailed. All joints shall be straight and square to facilitate alignment of finish flooring movement joints where applicable. Where possible, control joints shall be located under a non-bearing partitions. All joints shall be keyed.

B. The area contained between joints shall not exceed 480 square feet. The maximum distance between joints in any direction shall not exceed 24 feet.

C. Construct isolation joints in slabs-on-grade at points of contact between slabs and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations as indicated. Extend joint filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated. Terminate full width joint filler strips not less than ½ inch or more than 1 inch below finished concrete surface where joint sealants are indicated. Install joint filler strips in lengths as long as practicable.

D. Joints shall be grooved after initial floating to a radius of 1/8 inch or joints may be sawed as soon as the surface is firm enough so that it will not be torn or damaged by the blade, usually within 4 to 12 hours after the concrete hardens, 1/8 inch wide and 1/4 of slab depth, unless otherwise indicated.

E. All exposed sawed joints shall be filled with control joint filler. Surfaces to receive finish flooring shall utilize control joint filler acceptable to the flooring manufacturer.

F. At the Contractor's option, concrete slabs to be covered by other finish flooring materials may utilize plastic control joints.

G. Expansion joints in slabs shall be constructed with expansion joint covers at locations indicated on the Drawings. Installation shall be as recommended by the manufacturer. Coordinate with the Work of SECTION 05500: MISCELLANEOUS METAL WORK.

H. Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated. Use dowel sleeves or lubricate one half of dowel length to prevent concrete bonding to one side of joint.

3.12 REMOVAL OF FORMS

A. Formwork not supporting the weight of concrete, such as sides of beams, walls, and similar parts of the work, may be removed 48 hours after placing the concrete, provided the concrete is sufficiently hard to not be damaged by the form removal operations, and provided that curing and protection operations are maintained.

B. Removal of forms shall be in a manner to ensure safety of structure and prevent damage to concrete surfaces. Particular care shall be taken in the removal of forms for concrete surfaces to remain exposed.

C. Whenever the formwork is removed during the curing period, the exposed concrete shall be cured by one of the methods specified.

D. Formwork for beams, joist, slabs and other structural elements, that support weight of concrete in place shall be left in place until the concrete has achieved at least 70 percent of its 28 day design compressive strength, as determined by testing specimens in accordance with ACI 301. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

3.13 PLACING SLABS

A. Slabs-on-grade shall be thicknesses indicated on the Drawings, placed on compacted fill as specified. Concrete shall be full thickness of slab and troweled out as specified herein. Carefully review the Drawings in order to coordinate and provide all slab recesses, depressions, and pitches required for equipment or finishes to be furnished and installed by other trades, or for proper drainage. Install pre-molded joint filler strips at slab perimeters as indicated on the Drawings.

B. Thicken and reinforce slabs-on-grade under non-bearing masonry partitions.

C. Provide a continuous slab vapor retarder under all slabs-on-grade unless specifically noted otherwise. Place, protect and repair vapor retarder sheets according to ASTM E1643 and manufacture's written instructions. Lap seams a minimum of twelve (12") inches and tape. Cover vapor retarder with granular material, moisten and compact. See SECTION 02300: EARTHWORK. Minimize traffic over uncovered vapor retarders to limit damage. Special attention shall be given to sealing vapor retarders airtight at all joints, penetrations and perimeters. Use tapes and sealants as recommended by the manufacturer. Any damage to vapor retarders

shall be repaired prior to fill placement above vapor retarders or concrete placement. Where slab vapor retarder is not required at slabs-on-grade, gravel or crushed stone shall be wetted just prior to concrete placement.

D. Concrete slabs shall have wood or metal screeds spaced not over 10' o.c. and set at the elevations shown on the Drawings. NOTE: Contractor may, at his option, use wet screeds provided that wet pads are established at not more than 10' o.c. both ways, with elevations established by use of laser equipment.

E. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section. Concrete shall be thoroughly worked around reinforcements and other embedded items and into corners.

F. Bring slab surfaces to correct level with a straight edge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. This shall be completed before free moisture rises to the surface so as to avoid bleeding. Do not disturb slab surfaces prior to beginning finishing operations.

G. Adjust concrete volume for L/360 dead load ponding at suspended slabs.

H. Maintain reinforcing in proper position on chairs during concrete placements.

3.14 FINISHING FORMED NON-ARCHITECTURAL CONCRETE SURFACES

A. Rough-Formed Finish: For concealed non-architectural finish on formed concrete with texture imparted by form material, repair tie holes and defective areas and chip off fins and projections exceeding 1/4 inch in height.

B. Smooth-Formed Finish: For exposed non-architectural finish on select formed concrete and for concrete surfaces to receive a direct coating material such as waterproofing, dampproofing, veneer plaster, painting, etc. Immediately upon removal of forms, point all form tie holes and other defects flush with surface and remove all fins and projections exceeding 1/8" for a smooth surface, or as otherwise directed by the Architect.

C. Smooth-Rubbed Finish: For exposed foundation surfaces and other smooth-formed surfaces as indicated on the Drawings, provide a smooth-rubbed finish not later than 1 day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until producing a uniform color and texture. Remove all fins, burrs, joint marks, and other projections. Do not apply cement grout other than that created by the rubbing process.

D. Grout-Cleaned Finish: For smooth-formed surfaces as indicated on the Drawings, wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at leas 36 hours.

3.15 CONCRETE SLAB FINISHES

A. Scratch Finish: Apply scratch finish to slab surfaces to receive concrete floor topping, mortar setting beds for tile, other bonded cementitious finish flooring materials and where indicated.

1. After placing slabs, plane surface to a levelness/flatness tolerance not exceeding 1/2 inch in 10 feet when tested with a 10 ft. straight edge. Slope surfaces uniformly to drains where required or as indicated. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to slab surfaces to receive trowel finish, other finishes as specified, and slab surfaces to be covered with membrane or elastic waterproofing, membrane, or elastic roofing and where indicated.
   1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or flat shoes only, when surface water has disappeared, or when 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. Check and level surface plane to a levelness/flatness tolerance not exceeding 1/4 inch in 10 ft. when tested with a 10' straight edge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply trowel finish to slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, thin-set 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. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance. Level surface plane to a tolerance not exceeding 1/4 inch in 10 feet when tested with a 10' straight edge. Grind smooth any surface defects that would telegraph through applied floor covering system.

   2. Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom as recommended by the tile manufacturer to ensure proper bonding of tile setting materials. Coordinate with the Work of SECTION 09300: CERAMIC TILE and SECTION 09330: QUARRY TILE, as applicable. Slope surfaces uniformly to drains where required or as indicated.

D. Slip-Resistant Broom Finish: Apply a non-slip broom finish to exterior concrete platforms, sidewalks, pads, steps, ramps, and elsewhere as indicated on the Drawings.
   1. Immediately after float finishing, slightly roughen concrete surface by brooming with a fiber-bristle broom perpendicular to main traffic route. Review final finish with Architect prior to application.
   2. All joints and edges shall be tooled.
   3. All surfaces shall be properly damp cured.
   4. Slab sealer shall be applied to all exposed exterior concrete slab surfaces.
   5. Surfaces shall receive sealer applied at rates and by the methods recommended by the manufacturer.

3.17 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless shown or directed, after work of other trades is in lace. Mix, place and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete the Work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on the Drawings. Set anchor bolts for machines and equipment to templates at correct elevations, complying with information provided by the equipment manufacturer.

C. Interior Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

D. Joint Sealing: Seal joint as late in the course of the work as possible to allow shrinkage to occur. Clean joints and apply elastomeric sealant in accordance with manufacturer's instructions.

3.18 CURING AND PROTECTION

A. Protect newly placed concrete against low and high temperature effects and against rapid loss of moisture. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with evaporation-control materials. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods. Moist curing shall include keeping concrete surfaces continuously wet by covering with water; using a continuous water-fog spray; or covering the concrete surface with continuously wetted burlap.
   1. Curing Slabs, Toppings and Other Flat Surfaces: Within twenty-four (24) hours after final troweling, slab finish surfaces shall be covered to moist cure for at least seven days at a temperature of at least 50 degrees F. with burlap or curing paper. Curing paper shall be lapped 4" at edges and sealed with tape at least 3" inches wide. Paper shall be weighted to prevent displacement, and holes or tears shall be immediately repaired.
   2. Curing Formed Surfaces: Moist cure with forms in place for the full seven day curing period. If the forms are removed prior to seven days, apply curing compound and cure in accordance with manufacturer's written instructions. Intermittent wetting and drying does not provide acceptable curing. Keep steel forms heated by the sun, and all wood forms in contact with the concrete, wet during the curing period.

C. Form Removal Not Supporting Weight of Concrete (footings, walls): May be removed after curing at not less than 50 degrees F. for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provide curing and protection operations are maintained.

D. Form Removal Supporting Weight of Concrete: (beams, suspended slabs, lintels and other structural elements) May not be removed in less than 14 days or until concrete has attained at least 75% of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

E. Where shored, form facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

F. Protection From Mechanical Injury: During the curing period, protect concrete from damaging mechanical disturbance, particularly load stresses and excessive vibration. Protect all finished

concrete surfaces from damage caused by construction equipment, materials, or methods and running water. Do not overload self-supporting concrete structures. Foundation walls shall not be backfilled or driven over by vehicles during the curing period.

G. Concrete floor sealer shall be applied to all exposed interior concrete slab floors, unless otherwise scheduled. Floors shall be clean and free of marks and stains. Floors shall receive sealer applied at rates and by the methods recommended by the manufacturer.

H. Exterior concrete slab surfaces shall be sealed at rates and by the methods recommended by the manufacturer. Protect fresh concrete from pedestrian and vehicular traffic for at least seven (7) days after placement.

I. Seal all concrete wall-slab perimeters and all penetrations with joint sealant as specified.

3.19 CONCRETE SURFACE REPAIRS

A. Repairing Formed Surfaces: Repair of formed architectural concrete surfaces is not allowed. Only repairing of formed non-architectural concrete surfaces is allowed. Remove and replace concrete that cannot be repaired and patched to Architect's approval. Repair and patch defective areas with cement mortar immediately after removing forms. Mix dry-pack mortar, 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.

1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
2. For surfaces exposed to view, blend white portland cement and standard portland cement so that when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
3. Remove and replace concrete having defective surface if defects cannot be repaired to the satisfaction of the Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins, other surface projections, stain, and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or pre-cast cement cone plugs secured in place with bonding agent.
4. Repair concealed formed surfaces containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

B. Repairing Slab Surfaces: Test slab surfaces for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test surface slopes to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcing or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycombs, rock pockets, and other objectionable conditions. Correct high areas in surfaces by grinding after concrete has cured at least 14 days.
2. Correct low areas in surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary cementitious underlayment compound may be used when acceptable to the Architect.

3. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same material to provide the same type or class as original concrete. Place compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

C. At concealed, non-architectural concrete, repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and remove dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

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

END OF SECTION