

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation required to complete all concrete work as shown on Drawings, as specified herein, and as required by the job conditions. This specification is not intended to address the particular requirements of Architectural Concrete.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Concrete Formwork	Section 03 10 00
Concrete Reinforcement and Embedded Assemblies	Section 03 20 00
Concrete Finishes.	Section 03 35 00
Structural Steel Framing	Section 05 12 00
Metal Fabrications	Section 05 50 00
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the drawings.

B. Standards, latest edition of each:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 207.1R – Guide to Mass Concrete.
3. ACI 237R – Self-Consolidating Concrete.
4. ACI 301 – Standard Specifications for Structural Concrete.
5. ACI 302.1R – Guide for Concrete Floor and Slab Construction.

6. ACI 304 -- Recommended Practice for Measuring, Mixing and Placing Concrete.
7. ACI 305R – Guide to Hot Weather Concreting.
8. ACI 306R – Guide to Cold Weather Concreting.
9. ACI 308R – Guide to Curing Concrete.
10. ACI 309R – Guide for Consolidation of Concrete.
11. ACI 318 – Building Code Requirements for Structural Concrete.
12. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.
13. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
14. ASTM C1202 – Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
15. AASHTO T 260 - Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials.
16. AASHTO T318 – Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.
17. National Ready Mixed Concrete Association (NRMCA) Plant Certification Checklist.
18. State of California, Department of Transportation (CalTrans) “California Test Methods,” various standard tests as listed herein.
19. United States Green Building Council (USGBC) – LEED for New Construction and Major Renovations Rating System.

C. Definitions:

1. The term “Contract Documents” in this specification is defined as the design drawings and the specifications.
2. The term “SER” in this specification is defined as the Structural Engineer of Record for the structure in its final condition.
3. The term “Design Professionals” in this specification is defined as the Owner's Architect and SER.
4. The term “Contractor” in this specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.

5. The term "Testing Agency" in this specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance observation and testing of concrete construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
6. The terms "for record" and "submit for record" in this specification are defined as Contractor submittals that do not require a response from the Design Professionals.
7. Working Days: Monday through Friday, excluding federal or state holidays.

1.5 CONCRETE CONTRACTOR QUALIFICATIONS

- A. The work of this section shall be performed by a company which specializes in the type of concrete work required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
- B. Contractor's Testing Agency Services: Required as specified in Division 1, and herein.
- C. Materials and installed work may require testing and retesting at anytime during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

- A. Where the SUBMITTALS section of this specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Do not submit items not requested.
1. Submittal Schedule: The contractor shall submit for approval a schedule at least twenty (20) working days prior to commencing submittals.
 - a. This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for approval at least twenty (20) working days before the modification or addition is proposed to take place.
 - b. If at any time the total number of shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above

2. The Contractor's Testing Agency's certificate of compliance per ASTM E329.
3. Mix Designs: Submit concrete mix designs for each type and strength of concrete required for this Project at least thirty (30) days before placing concrete. The Contractor shall perform test or assemble the necessary data indicating conformance with specifications.
 - a. Mix designs shall be prepared or reviewed by an approved independent testing agency retained by the Contractor in accordance with requirements of ACI 301 and ACI 318, signed by a registered design professional licensed to practice as a Professional Engineer in the state where the project is located, and shall be coordinated with design requirements and Contract Documents.
 - b. Before submitting to Owner's Testing Agency, submit complete mix design data for each separate mix to be used on the Project in a single submittal.
 - c. Provide a completed "Concrete Mix Design Submittal Form" (attached to the end of this Specification Section) for each proposed concrete mix.
 - d. Data shall be from the same production facility that will be used for this Project.
 - e. Samples shall be provided only as requested by the Architect.
 - i. Certification from vendor that samples originate from and are representative of each lot proposed for use.
 - f. Mix Design data shall include but not be limited to the following:
 - i. Locations on the Project where each mix design is to be used corresponding to Structural General Notes on the Drawings.
 - ii. Design Compressive Strength: As indicated on the Drawings.
 - iii. Proportions: ACI 301 and ACI 318.
 - iv. Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.
 - v. Water/cementitious material ratio.
 - vi. Certification that portland cement meets Specification requirements.
 - vii. Evaluate and classify fly ash in accordance with ASTM D 5759.
 - viii. Report chemical analysis of fly ash in accordance with ASTM C 311.
 - ix. Classify blast furnace slag in accordance with ASTM C 989.
 - x. Slump: ASTM C 143.
 - xi. Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.
 - xii. Unit Weight of Concrete: ASTM C 138.
 - xiii. Design strength at 28, 56 or 90 days, as indicated on Contract Documents: ASTM C 39.
 - a) Document strength based on basis of previous field experience or trial mixtures per ACI 318 Chapter 5. Proportioning by Water-Cement Ratio is not permitted.
 - b) Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength.
 - c) If early concrete strengths are required, contractor shall submit trial mixture results as required.

- xiv. Test records to support proposed mixtures shall be no more than 24 months old and use current cement and aggregate sources. Test records to establish standard deviation may be older if necessary to have the required number of samples.
 - xv. Manufacturer's product data for each type of admixture.
 - xvi. Manufacturer's certification that all admixtures used are compatible with each other.
 - xvii. Whether mixture is pumpable.
 - xviii. All information indicating compliance with Contract Documents including method of placement and method of curing.
 - xix. Normalweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
 - xx. Lightweight Concrete: Density per ASTM C 138.
 - a) Lightweight concrete mix design shall include an estimate of dry density per ASTM C567.
 - xxi. Certification from a qualified testing agency indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity in accordance with ASTM C 33
 - a)
4. Hot and Cold Weather Procedures: Submit for record to Design Professional's written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this specification.
5. Product Data: Submit product data clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility and limitations for each of the following:
- a. Bonding agents.
 - b. Curing compound and liquid sealer densifier. Submit for record to Design Professionals a written statement guaranteeing that the compound will not leave discoloration on concrete to be left exposed, or affect the bond for paint or other applied finishes. Include provision in written statement that in the event of failure of applied finishes to bond to membrane cured concrete, to remove the curing compound and leave suitable surfaces for bonding such finishes.
 - c. Absorptive covers and moisture retaining covers.
 - d. Vapor Retarder: See Division 7, Thermal and Moisture Protection.
 - e. Self-leveling concrete topping.
 - f. Grout: Submittal of Grout not by manufacturers listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.
 - g. Other products proposed by contractor

6. Submit Concrete Weighmaster affidavit if continuous inspection of batch plant has been waived per Section 1.9 F.
7. Concrete Joint Locations: Submit plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc that interact with the joints. Contractor to coordinate joint location with reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints. Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of finish drawings.
8. Preconstruction Survey: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals.
9. Survey of Flat Plate or Flat Slab Concrete Floors during construction: Submit for record. Survey requirements are described on Drawings. Based on survey results, SER may propose adjustments to formwork and camber.
10. Survey of As-built Floor Conditions: Submit for Record. Survey and report flatness (FF), levelness (FL), and final elevations of finished floors prior to shoring removal. For slabs that include camber, do not test for levelness (FL). Perform FF/FL testing in accordance with ASTM E 1155 requirements.
11. Structural Repairs: Submit procedures and product information.
12. Patching Defective Concrete Finishes: Submit procedures and product information.

a.

B. Submittal Process

1. Submittal of shop drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.
2. Shop drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable drawings used in the development of the shop drawings shall be referenced on each shop drawing to facilitate checking.
3. The Contractor shall submit to the Design Professionals for shop drawing review. If the Contractor and Design Team agree to process shop drawings electronically, Contractor shall submit one hardcopy and one electronic copy to the SER. The naming convention of each drawing must follow the submittal

numbering system and include the submittal number, specification number, revision number and drawing number in the prefix of the drawing name.

4. The Contractor shall allow at least ten (10) working days between receipt and release by the SER for the review of shop drawings and submittals.
5. All modifications or revisions to submittals and shop drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:
 - a. Failure to specifically cloud modifications
 - b. Unapproved revisions to previous submittals
 - c. Unapproved departure from Contract Documents
6. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal. Do not include new content not previously reviewed.
7. Resubmittals Compensation: The Contractor shall compensate the Design Professionals for submittals that must be reviewed more than twice due to contractors' errors. The Contractor shall compensate the Design Professionals at standard billing rates plus out-of-pocket expenses incurred at cost + 10%.
8. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) copies of the electronic version of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.

C. SER Submittal Review

1. The Design Professionals' review and approval of shop drawings and other submittals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:
 - a. Conforming to the Contract Documents.
 - b. Coordination with other trades.
 - c. Responsibility for all required detailing and proper fitting of construction work.
 - d. The necessity of furnishing material and workmanship required by drawings and specifications which may not be indicated on the shop drawings.
 - e. Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.
2. TYPE 1 Stamp - For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require the following actions:

- a. APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
 - b. APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
 - c. REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
 - d. NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
- 3. TYPE 2 Stamp - For submittals for building elements which are not designed by the SER but are performance specified, for items that do not form part of the completed structural system but impose loads on the structure, and for construction items or activities which have an effect on the final structure, a second stamp will be used. The responses on the stamp used by the SER require the following actions:
 - a. NO EXCEPTION TAKEN indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
 - b. EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.
 - c. REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
3. Accepted substitutions or modifications shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.
5. Compensation for Additional Services: Should additional work by Design Professionals such as design, drafting, meetings and/or visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.
6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

E. Request for Information (RFI)

1. RFIs shall be submitted by the General Contractor or Construction Manager. RFIs submitted by other entities will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
4. The response time for answering an RFI depends on the category in which it is assigned.
 - a. Upon receipt by the SER, each RFI will be assigned to one of the following categories:
 - i. No cost clarification
 - ii. Shown in Contract Documents

- iii. Change to be issued in future document revision
- iv. Previously answered
- v. Information needs to be provided by others.
- vi. Request for corrective field work
- vii. Request for substitution
- b. RFIs in categories 1, 2, 3, 4 and 5 will be turned around by the SER on average of five (5) working days.
- c. RFIs in categories 6 and 7 will be rejected and must be submitted as submittals or requests for substitution.

1.7 STORAGE, HANDLING AND DELIVERY

- A. Comply with General Conditions and Division 1.
- B. Storage:
 - 1. Store materials in accordance with ACI 304R.
 - 2. Store cement and supplementary cementitious materials in weathertight buildings, bins or silos that will exclude moisture and contaminants.
 - 3. Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.
 - 4. Keep packaged material in original containers with seals unbroken and labels intact until time of use.
- C. Handling:
 - 1. Handle fine and coarse aggregates as separate ingredients.
 - 2. Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.
 - 3. Do not use frozen or partially frozen aggregates.
 - 4. Allow sand to drain until it has reached relatively uniform moisture content before use.
 - 5. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

1.8 PRE-INSTALLATION CONFERENCE

- A. At least 30 working days prior to the start of concrete construction, the Contractor shall hold a meeting to review the approved concrete mix designs and to determine the procedures for producing proper concrete construction. The Contractor shall notify the Design Professionals of the meeting and require responsible representatives of every party who is concerned with the concrete Work to attend the conference, including but not limited to the following:

1. Contractor.
 2. Owner's Testing Agency representative
 3. Concrete Subcontractor.
 4. Ready-mix concrete producer.
 5. Admixture manufacturer(s).
- B. Minutes of the meeting shall be recorded and distributed by the Contractor to all parties concerned within five working days of the meeting. One copy of the minutes shall also be furnished to the following:
1. Design Professionals.
 2. Owner's Representative.
- C. The minutes shall include a statement by the concrete contractor and admixture manufacturer(s) indicating that the proposed mix design and placing, finishing, and curing techniques can produce the concrete properties and quality required by these specifications.
- 1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY
- A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance.
- B. Cost: Except as specifically noted otherwise, the testing agencies for quality assurance shall be engaged and paid by the Owner.
- C. Coordination with Owner's Testing Agency: The Contractor shall have sole responsibility for coordinating their work with the testing agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Owner's Testing Agency in the performance of their work and shall provide the following:
1. Information as to time of starting field construction and concrete placement schedule, one week prior to the beginning of the work. This information shall be shared with the Architect.
 2. Site File: At least one copy of each approved shop drawing shall be kept available in the contractor's field office. Drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job.
 3. Full and ample means of assistance for testing and inspection of material
 4. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field
- D. Duties of the Owner's Testing Agency:

1. Reports: The Testing Agency shall prepare daily reports of the concrete work including progress and description/area of work, tests made and results. The daily reports shall be collected and delivered to the Design Professionals, Contractor, concrete producer, Building Official and Owner weekly.
2. Rejection: The Owner's Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. The Testing Agency shall report deficiencies to Owner, Design Professionals, and Contractor immediately.
3. Remedial Work: The Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Design Professionals and Owner on a weekly basis.
4. Certification: When all work has been approved by the Testing Agency, the Testing Agency shall certify in a letter to the Design Professionals and Owner that the installation is in accordance with the design and specification requirements.

E. Waiver of Batch Plant Inspection

1. Continuous batch plant inspection may be waived in accordance with CBC Section 1705A.3.3 if the plant complies with ASTM C94 and has been certified by an agency acceptable to UCSD to comply with the requirements of the National Ready Mix Concrete Association.
2. When batch plant inspection is waived, the following requirements shall apply:
 - a. Approved inspector of the testing agency shall check the first batching at the start of work and furnish mix proportions to the licensed weighmaster.
 - b. Licensed weighmaster to positively identify materials as to quantity and certify to each load by a ticket.
 - c. Tickets shall be transmitted to the inspector of record by a truck driver with load identified thereon. The inspector will not accept the load without a load ticket identifying the mix and will keep a daily record of placements, identifying each truck, its load and time of receipt and approximate location of deposit in the structure and will transmit a copy of the daily record to the enforcement agency.
 - i. *Exception: (DSA-SS) The term "inspector of record" is synonymous with "project inspector".*
 - d. At the end of the project, the weighmaster shall furnish an affidavit to the enforcement agency certifying that all concrete furnished conforms in every particular to proportions established by mix designs.

F. Field Quality Assurance

1. General: The Owner's Testing Agency shall test and inspect concrete materials and operations as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professional for final acceptance.

Perform testing in accordance with ACI 318 and CBC Section 1903, 1913 and 17.

2. Owner's Testing Agency is responsible for monitoring concrete placement as follows:
 - a. Owner's Testing Agency shall provide qualified personnel at site to monitor concreting operations as follows:
 - i. Verify use of required design mix
 - ii. Record location of point of concrete discharge of each batch truck tested, cross referenced to grid lines.
 - iii. Record temperature of concrete at time of placement.
 - iv. Record weather conditions at time of placement, including temperature, wind speed, relative humidity, and precipitation.
 - v. Record types and amounts of admixtures added to concrete batches, including that added after departure of concrete trucks from batch plant.
 - vi. Record amounts of and monitor dosing of high-range water-reducing admixtures added at site for site-added admixtures and redosing for plant-added admixtures.
 - vii. Record amounts of and monitor dosing of high-range water-reducing admixtures added at site for site-added admixtures and redosing for plant-added admixtures.
 - viii. Record amount of water added at the site and verify that total water content does not exceed amount specified in the mix design. Addition of water at the site is subject to prior approval by the Design Professional.
 - ix. Monitor consistency and uniformity of concrete.
 - x. Monitor preparation for concreting operations, placement of concrete, and subsequent curing period for conformance with Specifications for following procedures:
 - a) Concrete curing.
 - b) Hot weather concreting operations.
 - c) Cold weather concreting operations.
3. Owner's Testing Agency shall conduct tests of concrete as follows and in accordance with ASTM C 1077:
 - a. Testing frequency: Sample sets for all tests listed below of each concrete design mix placed each day shall be taken not less than once a day, nor less than once for each 50 cu.yd. of concrete, nor less than once for each 2500 square feet of surface area for slabs or walls. Additional tests shall be performed if deemed necessary by the Owner's Testing Agency and Design Professionals. Sample all columns, regardless of other frequencies listed above. In addition, sample each truckload used for columns, regardless of other frequencies listed above. Testing frequency shall conform to CBC section 1905.1.2.
 - b. Obtain each test sample from different batches selected on a strictly random basis before commencement of concrete placement. Record location in structure of sampled concrete.

- c. Determine air content of normal weight concrete in accordance with either ASTM C 231 or ASTM C 138. Determine air content of lightweight concrete in accordance with ASTM C 173.
- d. Determine unit weight of normal weight concrete in accordance with ASTM C 138 and lightweight concrete in accordance with ASTM C 567.
- e. For concrete with air content specified in Contract Documents, conduct one test for air content for each strength test required or for every 50 cubic yards of fly ash concrete placed, whichever is less. Test in accordance with ASTM C 173 or ASTM C 231.
- f. The water content of freshly mixed concrete will be tested on a random basis, a minimum of once per 100 cubic yards or every 5000 square feet of concrete placement, during placement in accordance with AASHTO T 318 for the following concrete types:
 - i. Architecturally exposed hard troweled slabs
 - ii. Slab to receive a bonded finish floor material
 - iii. Concrete with specified compressive strength exceeding 6000 psi
- g. Conduct slump tests in accordance with ASTM C 143 and ASTM C172. Take samples for slump test at the point of placement of concrete.
- h. Conduct slump tests for concrete enhanced with high-range water-reducing admixtures as follows:
 - i. Concrete with plant added high-range water-reducing admixtures shall be sampled immediately upon arrival at job site. Batches delivered to site with slumps in excess of the range defined in the mix design submittal or with excessive segregation as defined in the ACI Manual of Standard Practice Part I shall be rejected.
 - ii. Concrete with site added high-range water-reducing admixtures shall be sampled immediately upon arrival at job site and after addition of high-range water-reducing admixtures for conformance to initial water slump and final slump requirements.
 - iii. Concrete shall also be sampled at point of initial discharge for conformance to slump and/or slump-flow requirements. Visually observe slump-flow at point of concrete placement. If slump loss is visually observed to exceed the range specified for mix design, perform additional slump test at point of discharge from concrete pump hose.
- i. Conduct strength tests of concrete as follows:
 - i. Test concrete for required compressive strength in accordance with ACI 318 Chapter 5 and CBC Section 1905.1.2.
 - ii. Secure sample sets in accordance with ASTM C 172.
 - iii. Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of cylinders listed below is based on a cylinder size of 4 inch diameter x 8 inches long. If 6 inch diameter by 12 inch long cylinders are used, the total quantity of cylinders may be reduced by one with two cylinders instead of three tested at the age designated for determination of f'c.
 - iv. Transport specimen cylinders from job to laboratory after cylinders have cured for 24-hours on site.
 - v. Test cylinders in accordance with ASTM C 39. For specified concrete strength of 10,000 psi and above, cylinders shall be ground and not capped.

- vi. For 28 day mixes mold five cylinders. Test one cylinder at seven days and three cylinders at 28 days. The 28 day strength shall be the average of the three 28 day cylinders. One cylinder shall be retained in reserve for later testing if required.
 - vii. For 56 day mixes mold six cylinders. Test one cylinder at seven days, one cylinder at 28 days, and three cylinders at 56 days. The 56 day strength shall be the average of the three 56 day cylinders. One cylinder shall be retained in reserve for later testing if required.
 - viii. For 90 day mixes mold seven cylinders. Test one cylinder at seven days, one at cylinder at 28 days, one cylinder at 56 days, and three cylinders at 90 days. The 90 day strength shall be the average of the three 90 day cylinders. One cylinder shall be retained in reserve for later testing if required.
 - ix. When high early strength concrete is required by contractor, additional cylinders shall be made and tested as required at Contractor's expense.
 - x. If one cylinder in a test manifests evidence of improper sampling, molding or other damage, discard cylinder and base test results on that of remaining cylinder.
4. Owner's Testing Agency shall evaluate concrete for conformance with Specifications as follows:
- a. Slump:
 - i. Owner's Testing Agency shall maintain a slump moving average, comprised of the average of all batches or most recent five (5) batches tested, whichever is fewer.
 - b. Strength test:
 - i. Owner's Testing Agency shall maintain a compressive strength moving average, comprised of three (3) consecutive strength test results, for each mix design used in Work.
 - ii. Strength level of concrete will be considered satisfactory provided averages of all sets of three (3) consecutive strength test results (i.e. moving average) equal or exceed specified 28-day strength, and no individual strength test result falls below specified 28-day strength by more than 500 psi.
 - iii. If strength tests fail to meet minimum requirements, concrete represented by such tests shall be considered questionable and shall, if deemed appropriate by the SER, be subject to further evaluation by core testing as specified herein.
 - c. Conduct core tests on questionable concrete in accordance with ACI 318 and ASTM C 42. Contractor to pay the Owner's Testing Agency for the cores.
 - i. Location of cores shall be coordinated with Design Professionals so as to least impair strength of structure. Before testing cores, discard and replace any that show evidence of having been damaged subsequent to or during removal from structure or which have reinforcement present.
 - ii. Cores from structure exposed to soil or constant moisture in service (e.g. basement walls, retaining walls, slab-on-grade, piers, footings, etc.) shall be tested in a fully saturated condition. Cores for all other

- concrete may be tested dry. Prior to commencement of coring, verify with Design Professionals whether cores are to be tested wet or dry.
- iii. Fill core holes with low slump concrete or mortar with a strength equal to or greater than that specified for area cored.
 - d. Concrete in area represented by core test will be considered adequate if average strength of cores is equal to at least 85% of, and if no single core is less than 75% of, specified strength.
5. Floor flatness and levelness tolerance compliance testing is to be performed within 72 hours of concrete placement by Owner's Testing Agency, and prior to the removal of shores and forms.
- G. Owner's Testing Agency shall submit inspection, observation, and/or test reports to the Owner, Contractor, concrete producer, Building Official and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete placement conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.
 - H. Immediately report deficiencies to the Contractor, Owner and Design Professionals.
- 1.10 QUALITY CONTROL BY CONTRACTOR
- A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained. The Contractor shall bear burden of proof that concrete meets minimum requirements.
 - B. The Owner's general review during construction and activities of the Owner's Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.
 - C. The Contractor shall immediately report to the Design Professionals any deficiencies in the work which are departures from the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner.
- 1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS
- A. Review: The Design Professional will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.
 - B. Compensation for Additional Services: Should additional work by Design Professionals such as design, drafting, meetings and/or visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents, the Contractor is responsible for paying for the additional work at the Design Professionals' standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

1.12 PERMITS AND WARRANTY

- A. Permits: The Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.
- B. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:
 - 1. Oily, waxy or loose residue which may interfere with the bonding or discoloration of various applied Architectural finish materials.
 - 2. Discoloration of concrete surfaces scheduled to remain exposed as a finish.
 - 3. Areas which show surface failure or defects.
 - 4. Areas which puddle water.
 - 5. Areas which are not properly prepared to receive Architectural finish materials. If necessary, the Contractor, at his own expense, shall have the Owner's Testing Agency perform appropriate tests for bond and discoloration.
 - 6. Patches that become crazed, cracked or sound hollow when tapped.
 - 7. Self-leveling concrete topping that has cracked, spalled and/or not performed in accordance with manufacturer's design criteria.

PART 2 - PRODUCTS**2.1 CONCRETE MATERIALS & PRODUCTION**

- A. Portland Cement:
 - 1. ASTM C150, Type I, Type II, Type II/V or Type V
 - 2. ASTM C150, Type III, High-early Strength Portland Cement may be used subject to review and approval of Structural Engineer. The specified 28-day concrete compressive strength shall occur within 7 days for concrete using Type III Portland Cement.
 - 3. Provide the same brand of Portland Cement produced in the United States from a single source throughout the project, as required to meet Design Professionals' requirements.
 - 4. Provide Portland Cement that is uniform in color.
- B. Aggregates for Normalweight Concrete:
 - 1. ASTM C 33

2. Coarse Aggregates: Crushed stone or gravel. It shall be free from oil, organic matter or other deleterious substances and shall not contain more than two percent by weight of shale or cherty material. Cleanliness value shall not be less than 75 when tested per CalTrans California Test 227 and conforming to CBC Section 1903A.6.
 3. Fine Aggregate: Natural sand, or sand prepared from stone or gravel, clean, hard, durable, uncoated and free from silt, loam and clay. Sand equivalent shall be not less than 75 when tested as per ASTM D2419.
 4. If the source of aggregates is changed during the Project, the Contractor shall supply test data showing that the new aggregates have a successful history of use with the portland cement used on the job.
 5. Provide aggregates from a single source throughout the project for exposed concrete.
 6. The acceptability of aggregates for the work will depend on proof that their potential alkali reactivity is not deleterious to the concrete.
 7. Do not use fine or coarse aggregates that contain substances that cause spalling.
 8. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed the following:

Size no. 57 for footings, drilled piers and caissons, slabs-on-grade, and mass concrete

Size no. 67 for all other locations

Size no. 467 or 457 for non-reinforced concrete at locations noted on drawings.
 9. Contractor shall furnish concrete with maximum 3/8" aggregate at no additional cost to the Owner if areas of high reinforcement density require it for placement and consolidation.
 10. Frozen aggregates shall not be permitted.
- C. Aggregates for Lightweight Concrete:
1. ASTM C 330.
 2. Expanded shale type with cleanliness value and sand equivalent not less than 75.
 3. Classification of Aggregates: As required to meet Design Professionals' requirements.
 4. Provide aggregates from a single source throughout the project for exposed concrete.
 5. Aggregate shall contain the minimum absorbed moisture content recommended by the manufacturer for the project prior to batching.
 6. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed 3/4".

- D. Water: ASTM C 94 and ASTM C 1602. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.
- E. Supplementary Cementitious Material
 - 1. Fly Ash:
 - a. ASTM C 618, Class C or Class F.
 - b. Shall not be used unless part of an approved mix design.
 - c. Limit Loss on Ignition to 2.5%
 - 2. Slag cement
 - a. ASTM C 989 Grade 100 or Grade 120.
 - b. Shall not be used unless part of an approved mix design.
 - 3. Silica Fume (Microsilica):
 - a. ASTM C 1240
 - b. Shall not be used unless part of an approved mix design.
 - c. Example acceptable products:
 - i. "Force 10,000"; W.R. Grace & Co.
 - ii. "Eucon MSA"; The Euclid Chemical Co.
 - iii. MasterLife SF 100" (formerly "Rheomac SF100"); BASF Corporation.
 - iv. Sika Corporation "Sikacrete 950 DP"
 - 4. Limit the maximum content of supplementary cementitious materials for concrete exposed to deicing chemicals to values shown in ACI 318, Table 4.4.2.
 - 5. The exact percentages used shall be based on successful test placement on site. Resubmit mix design if percentages change based on test placement.
 - 6. The fly ash or natural pozzolan supplier shall have an effective quality control program in place to guard against contamination of the fly ash and assure compliance with specifications.
 - 7. Fly ash and GGBFS used shall be from one source throughout the project. Substitution of sources will be acceptable only if testing of concrete mixes containing the substituted material show similar test results and if the color of concrete produced with the substituted material matches the color of previously poured concrete to the satisfaction of the Architect.
- F. Ready Mixed Concrete:
 - 1. Shall be batch-mixed and transported in accordance with ASTM C 94.
- G. Self-Consolidating Concrete:
 - 1. Produce in accordance with ACI 237R.
 - 2. Perform the following tests and provide report prior to submitting mix design:
 - a. Resistance to Segregation: Achieve a maximum static segregation percentage of 15% when tested according to ASTM C 1610 with a VSI index of 1 maximum.

- b. Slump Flow: ASTM C 1611 within a range of 20"-30".
- c. Passing Ability: ASTM C 1621 with a maximum difference of 2" between testing with and without the J-Ring.

2.2 CONCRETE MIX DESIGN

A. Concrete Strength:

- 1. Shall be as indicated on the Structural Drawings
- 2. Mix shall be designed, tested, and adjusted if necessary in ample time before first concrete is scheduled to be placed.

B. Concrete Density (Unit Weight):

- 1. Shall be as indicated on the Structural Drawings.
- 2. The range for lightweight concrete shall be +/- 3 pcf of the density specified in the General Notes.

C. Air Entrainment

- 1. For concrete exposed to freeze/thaw cycles or deicing chemicals, and concrete intended to be watertight, provide entrained air content according to ACI 318 Table 4.4.1, unless specified otherwise. This includes, but is not limited to, concrete at the following locations:
 - a. Concrete at the exterior of the structure with at least one surface exposed to weather, such as exterior face of grade beams and foundation walls.
 - b. Concrete in parking garages.
 - c. Ramps and loading docks.
- 2. For lightweight concrete less than 120 pcf density, air content may be up to 7% regardless of exposure condition.
- 3. For concrete with a specified compressive strength (f'c) greater than 5000 psi, required air content required by ACI 318 Table 4.4.1 may be reduced by 1%.
- 4. Entrained air content noted above shall occur at point of delivery.
- 5. No entrained air content is required in concrete placed in the foundation with no surface exposed to weather.
- 6. All interior steel trowel finished, normalweight slabs shall have a maximum air content of 3%.

D. Water-Cementitious Materials (W/cm) Ratio for Normalweight Concrete

- 1. Unless lower limits are stated in the contract documents, all concrete exposed to freezing and thawing in moist condition and/or required to be watertight or used in slabs-on-grade shall have a maximum W/cm ratio of 0.45.
 - a. Where the above mixes are to be pumped, water-reducing admixture (low- or high-range as required) shall be used.
- 2. All concrete exposed to deicing salts, brackish water seawater or spray from these sources shall have a maximum W/cm ratio of 0.40.

3. Absent the above conditions, all concrete with required strength of 4000 psi or higher shall have a maximum W/cm ratio of 0.50.
4. The water-cementitious materials ratio shall not exceed values indicated, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
5. Weight of fly ash or pozzolanic admixtures shall be included with the weight of cementitious materials used to determine the water-cementitious materials ratio.

E. Slump

1. Concrete design mixes shall be proportioned to meet the following slump limitations. Slump should be measured as described in the owner's testing agency responsibilities:
 - a. Concrete without high range water-reducing admixture to have a maximum slump of 8". Variation from slump value provided by Contractor to be according to ASTM C94.
 - b. Concrete for drilled piers: 6" +/-1" maximum.
 - c. Concrete with high range water-reducing admixture: Concrete slump prior to addition of high range water-reducing admixture shall not exceed 3" for normal weight concrete and 4" for lightweight concrete. After addition of water-reducing admixture, the concrete shall have a maximum slump of 9" unless otherwise approved by the SER.

F. Self-Consolidating Concrete Slump/Flow: Use for architectural concrete and heavily reinforced areas where indicated on the plans, and where conventional mixtures do not provide adequate consolidation. Minimum slump/flow diameter of [20"] or as required by the successful test placement onsite, which shall verify proper workability, finish, and setting time. All self-consolidating concrete shall contain the specified high range water-reducing admixture. All self-consolidating concrete shall contain viscosity modifying admixture as required unless proper quantity and grading of fines can be achieved.

G. Shrinkage Limit

1. Proportion all concrete for a maximum allowable length change of 0.04% measured at 28 days after curing in lime-saturated water for seven days in accordance with ASTM C 157 (using air storage thereafter).

H. Chloride Ion Content

1. The total water-soluble chloride ion content of the mix including all constituents shall not exceed the limits defined in ACI 318 Table 4.3.1 unless corrosion inhibiting admixtures are added to the mixture to offset the additional chloride.
2. If the specified level of water-soluble chloride ion content cannot be maintained, appropriate level of corrosion inhibiting admixture shall be added to the mix in accordance with the manufacturer's recommendation to offset the excess amount of chloride at no additional cost to the Owner.

I. Durability Requirements

1. Where concrete is noted as “durable” on contract documents, limit chloride ion permeability to [1200] coulombs, when tested at 56 days according to either ASTM C 1218, or AASHTO T277.

2.3 ADMIXTURES

A. General:

1. Admixtures specified below can be used only when established in the mix design with Design Professionals' prior written approval.
2. Each admixture approved by Design Professionals shall be used in strict compliance with manufacturer's published instructions.
3. Concrete supplier shall certify all admixtures to be compatible with each other. (See Submittals Section in Part 1)

B. Air Entraining Admixture:

1. ASTM C 260
2. Example acceptable product: BASF Corporation “MasterAir AE 200” (formerly “MICRO-AIR”) or “MasterAir AE 90” (formerly “MB-AE-90”)
3. Example acceptable product: W. R. Grace’s “Darex Series” or “Daravair Series”
4. Example acceptable product: Euclid Chemical’s “AEA –92 or Air 40”.
5. Example acceptable product: Sika Corporation “Sika Air Series” or “Sika AEA Series”

C. Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Example acceptable product: BASF Corporation “MasterPozzoloth 200”, “MasterPozzoloth 322”, “MasterPozzoloth 700” (formerly “POZZOLITH” Series)
3. Example acceptable product: Euclid Chemical’s “EUCON NW” or “EUCON WR 91”
4. Example acceptable product: W. R. Grace’s “WRDA’ Series or “Zyla” Series
5. Example acceptable product: Sika Corporation “Plastocrete Series”

D. Retarding Admixture:

1. ASTM C 494, Type B
2. Example acceptable product: BASF Corporation “MasterSet R 100”, “MasterSet R 300”, (formerly “POZZOLITH” Series) or “MasterSet DELVO”, “MasterSet DELVO ESC” (formerly “DELVO” Series)
3. Example acceptable product: The Euclid Chemical Company “EUCON RETARDER 100”
4. Example acceptable product: W. R. Grace’s “Daratard 17”
5. Example acceptable product: Sika Corporation “Plastiment Series”

E. Non Corrosive Accelerating Admixture:

1. ASTM C 494, Type C

2. Example acceptable product: BASF Corporation "MasterSet AC 534" (Formerly "Pozzolith NC 534")
 3. Example acceptable product: The Euclid Chemical Company "ACCELGUARD 80", "ACCELGUARD NCA" or "ACCELGUARD 90"
 4. Example acceptable product: W. R. Grace's "Daraset" Series, "Polarset", or "DCI"
 5. Example acceptable product: Sika Corporation "Sikaset NC" or "Plastocrete 161 FL" or "Sika Rapid-1"
- F. Water-Reducing and Retarding Admixture:
1. ASTM C 494, Type D
 2. Example acceptable product: BASF Corporation "MasterSet R 100", "MasterSet R 300", (formerly "POZZOLITH" Series) or "MasterSet DELVO", "MasterSet DELVO ESC" (formerly "DELVO" Series)
 3. Example acceptable product: The Euclid Chemical Company "EUCON RETARDER 75" or "EUCON DS"
 4. Example acceptable product: W. R. Grace's "Daratard 17"
 5. Example acceptable product: Sika Corporation "Plastiment Series"
- G. Water-Reducing and Accelerating Admixture:
1. ASTM C 494, Type E
 2. Example acceptable product: BASF Corporation "MasterSet FP 20" (formerly "POZZUTEC 20+")
 3. Example acceptable product: The Euclid Chemical Company "ACCELGUARD 80" or "ACCELGUARD 90"
 4. Example acceptable product: W. R. Grace's "Libricon NCA"
 5. Example acceptable product: Sika Corporation "Sikaset NC" or "Plastocrete 161 FL"
- H. Mid-Range Water-Reducing Admixture:
1. ASTM C 494, Type A
 2. Example acceptable product: W. R. Grace's "Daracem" or "Mira" Series
 3. Example acceptable product: Sika Corporation "Sikaplast Series"
 4. Example acceptable product: Euclid Chemical Company: "Eucon MR" or "Eucon MRX"
 5. Example acceptable product: BASF Corporation "MasterPolyheed" Series (formerly "PolyHeed" Series)
- I. High-Range Water-Reducing Admixture (Super-plasticizer):
1. ASTM C 494, Type F
 2. Example acceptable product: BASF Corporation "MasterRheobuild 1000" (formerly "RHEOBUILD 1000") or "MasterGlenium" Series (with the exception of "MasterGlenium 150" and "MasterGlenium 3040", which are ASTM C494 Type G, not Type F) (formerly "GLENIUM" SERIES)
 3. Example acceptable product: Euclid Chemical's "EUCON 37" or "PLASTOL SERIES"
 4. Example acceptable product: W. R. Grace's "Daracem" or "ADVA" Series

5. Example acceptable product: Sika Corporation "Viscocrete Series" or "Sikament Series"
- J. High-Range Water-Reducing and Retarding Admixture (Super-plasticizer):
1. ASTM C 494, Type G
 2. Example acceptable product: The Euclid Chemical Company "EUCON 537"
 3. Example acceptable product: W. R. Grace "Daracem Series" or "Adva Series"
 4. Example acceptable product: BASF MasterRheobuild 561
- K. Viscosity Modifying Admixture (VMA) for Self-Consolidating Concrete (SCC):
1. Example acceptable product: BASF Corporation "MasterMatrix VMA" Series (formerly "Rheomac VMA" Series)
 2. Example acceptable product: W.R. Grace "V-MAR3"
 3. Example acceptable product: "EUCON ABS" or "EUCON WO" or "Visctrol", The Euclid Chemical Company
 4. Example acceptable product: Sika Corporation "Sika Stabilizer Series"
- L. Corrosion Inhibiting Admixtures:
1. ASTM C 494, Type C, 30% + 2% solution of Calcium Nitrite
 2. Example acceptable product: W.R. Grace's "DCI or DCI-S"
 3. Example acceptable product: The Euclid Chemical Company's "EUCON CIA"
 4. Example acceptable product: Sika Chemical "Sika CNI"
 5. Example acceptable product: BASF Corporation "MasterLife CI 30" (formerly Rheocrete CNI)
- M. Shrinkage Reducing Admixtures:
1. ASTM C 157
 2. Example acceptable product: W.R. Grace "Eclipse 4500" (for use with air-entrained concrete exposed to freeze/thaw), or "Eclipse Floor 200"
 3. Example acceptable product: The Euclid Chemical Company's "EUCON SRA" or "Conex"
 4. Example acceptable product: Sika Corporation "Sika Control 40"
 5. Example acceptable product: BASF Corporation "MasterLife SRA 20"

2.4 ADHESIVES

- A. Bonding agents and adhesives shall meet the volatile organic compounds (VOC) requirements of CalGreen Section 5.504.4.1.
- B. Bonding Agent for Cured Concrete:
1. ASTM C 881 Type I and IV, Grade 3, Class B and C.

2. Example acceptable product: BASF "MasterEmaco ADH 327", Class C Only
 3. Example acceptable product: BASF "MasterEmaco ADH 326", Class C Only for bonding topping
 4. Example acceptable product: Euclid Chemical's "EUCO #452 EPOXY SYSTEM".
 5. Example acceptable product: Euclid Chemical's "DURALCRETE SERIES".
 6. Example acceptable product: Euclid Chemical Company "FLEXOCRETE System" for bonding topping
- C. Bonding Agent for Uncured Concrete (existing concrete damp or dry, less than 28 days old, no surface water):
1. ASTM C 881, Type II and V, Grade 2, Class B and C.
 2. Example acceptable product: BASF "MasterEmaco ADH 326", Class C Only
 3. Example acceptable product: Euclid Chemical's "DURALCRETE SYSTEM".
 4. Example acceptable product: Sika Corporation "Sikadur 32 Hi-Mod"
- D. Anti-Corrosive Epoxy Cementitious Bonding Compound and Corrosion Protection of Reinforcement (bonding agent for existing concrete saturated surface dry, no surface water):
1. This adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).
 2. Example acceptable product: Euclid Chemical Company "DURALPREP AC"
 3. Example acceptable product: Sika Corporation "ARMATEC 110"
 4. Example acceptable product: BASF "MasterEmaco P124"
- E. Adhesive Between Cured Concrete Elements:
1. ASTM C 881 Type I and IV, Grade 3, Class B and C
 2. Example acceptable product: Sika Corporation "Sikadur 31 Hi-Mod Gel (1:1 Mix Ratio)"
 3. Example acceptable product: BASF "MasterEmaco ADH 327"

2.5 CURING COMPOUNDS AND SEALERS

- A. Curing compounds and sealers shall meet the volatile organic compounds (VOC) requirements of CalGreen Section 5.504.4.3.
- B. Interaction with finishes:
1. See architectural drawings for finish material applied over concrete.
 2. Use only curing and sealer compounds that are compatible with finish material.
 3. Manufacturer's certification is required.
 4. Where finish material is liquid rubberized asphalt, use only strippable type curing compound.
- C. Curing and Sealing Compound (VOC Compliant, 350 g/l) :
1. ASTM C1315, Type I, Class A and ASTM C 309, Type I, Class A or B
 2. Example acceptable product: Euclid Chemical's "Super Diamond Clear VOX"

3. Example acceptable product: Symons "Kure 1315"
4. Example acceptable product: BASF "MasterKure CC 1315"
5. Example acceptable product: Creteseal "New Pour CS2000"
6. Liquid type membrane-forming curing compound, clear styrene acrylate type.

D. Curing Compound (Strippable):

1. ASTM C 309, Type I, Class A or B
2. Example acceptable product: Euclid Chemical's "Kurez DR VOX" (Dissipating) or "Kurez RC" in combination with "KUREZ RC-Off".

2.6 SEALERS

A. Sealers shall meet the volatile organic compounds (VOC) requirements of CalGreen Section 5.504.4.3.

B. Surface Sealer:

1. ASTM C 309, Type I, Class A or B, no stearates, no darkening or change of color allowed.
2. Example acceptable product: Euclid Chemical's "DIAMOND CLEAR VOX"
3. Example acceptable product: BASF "MasterKure CC 160WB"
4. Example acceptable product: Symons "Spec-Cure C309"

C. Liquid Densifier/Sealer:

1. The liquid densifier compound shall be a silicate based sealer which penetrates concrete surfaces, increases abrasion resistance and provides a "low-sheen" surface that is easy to clean and eases the problem of tire mark removal. The compound must contain a minimum solids content of 20% of which 50% is silicate. No stearates, no darkening or change of color.
2. Example acceptable product: The Euclid Chemical Company "Euco Diamond Hard"
3. Example acceptable product: W. R. Meadows Sealtight "Liqui-Hard"

D. Wax Sealer:

1. Heavy penetrating type as manufactured by approved manufacturer of clear hardener.

2.7 DRY SHAKE HARDENERS

A. Mineral Aggregate Hardener:

1. The specified mineral aggregate hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specially processed graded mineral aggregate, selected Portland cement and necessary plasticizing agents

2. Example acceptable product: The Euclid Chemical Company's, "Surflex" to be used with "Kurez DR VOX"
3. Example acceptable product: BASF, "Mastercron" to be used with "Masterkure CC 160WB"
4. Example acceptable product: L&M Construction Chemicals "Ferrocon FF" to be used with "Dress & Seal WB 30"

B. Non-Oxidizing Metallic Hardener:

1. The specified non-oxidizing metallic floor hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specially processed non-rusting aggregate, selected Portland cement and necessary plasticizing agents.
2. Example acceptable product: The Euclid Chemical Company's, "Diamond-Plate" to be used with "Kurez DR VOX"
3. Example acceptable product: BASF, "MasterTop 210 COR/Lumiplate" to be used with "MasterKure CC 160WB"

2.8 MISCELLANEOUS CONCRETE PRODUCTS

A. Nonshrink Grout

1. Provide pre-packaged natural aggregate grout, high-precision, nonshrink, ready-to-use, complying with the following requirements:
 - a. Grout minimum compressive strength shall be 6500 psi.
 - b. Grout shall conform to ASTM C 1107
2. All material used including water, mixer and pre-packaged grout must be initially at the 45°F and 90°F limits when testing is initiated.
3. Example acceptable product: BASF "MASTERFLOW 928" (anchor rods and rebar dowels)
4. Example acceptable product: BASF "MASTERFLOW 100" (columns and base plates)
5. Example acceptable product: Euclid Chemical's "HI-FLOW GROUT"
6. Example acceptable product: Five Star Products "Five Star Grout"
7. Example acceptable product: Sika Chemicals "Sikagrout 328"

B. Self-Leveling Concrete Topping - Underlayment for Interior Applications:

1. Use self-leveling underlayment concrete formulated to level concrete floors without shrinking, cracking or spalling, and capable of being placed from feathered edge to 1" thickness without aggregate in one pour. If greater than 1" thickness is required, aggregate shall be used in accordance with manufacturer's requirements. Appropriate primer shall be utilized for all underlayment applications.
2. Example acceptable product: Ardex Engineered Cements "ARDEX K-15"
3. Example acceptable product: Euclid Chemical's "Flo-Top or Super Flo-Top"
4. Example acceptable product: Sika Corporation "Sika Level Series"
5. Example acceptable product: BASF "MasterTop 110SL"

2.9 MISCELLANEOUS PRODUCTS

A. Evaporation Retarder:

1. Example acceptable product: BASF "MasterKure ER 50"
2. Example acceptable product: Euclid Chemical "Eucobar".
3. Example acceptable product: Sika Corporation "Sika Film"

B. Moisture-Retaining Covers:

Conforming to ASTM C171. A naturally colored, non-woven polypropylene fabric with a 4-mil non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention and be fungus resistant.

1. Hydracure S-16 by PNA Construction Technologies, Inc., Matthews, NC
2. Transguard 4000 by Reef Industries (Armorlon Division), Incorporated, Houston TX

C. Sand Cushion: Clean, manufactured or natural sand.

D. Structural Polystyrene used as typical fill

1. Material: Rigid cellular polystyrene thermal insulation with closed cells formed by expansion of polystyrene base resin in an extrusion process.
2. Comply with the requirements of ASTM C 578, Type VI.
3. Compressive strength, 40 psi, (280 kPa), ASTM D 1621.
4. Compressive modulus, min 1400 psi (9.6 MPa), ASTM D 1621.
5. Flexural strength, 60 psi (410 kPa), ASTM C 203.
6. Thickness as indicated on drawings.
7. Example acceptable product: STYROFOAM Highload 40, The Dow Chemical Company
8. Example acceptable product: FOAMULAR 400, Owens Corning.
9. Example acceptable product: TERRAFOAM EPS HS-40, Beaver Plastics

E. Structural Polystyrene used as formwork only.

1. Material: Extruded polystyrene foam insulation board.
2. Comply with the requirements of ASTM C 578, Type IV.
3. Compressive strength, 25 psi at 0.1-inch deformation when tested in accordance with ASTM D 1621.
4. Flexural strength, 50 psi, ASTM C 203.
5. Thickness as indicated on drawings.
6. Example acceptable product: Styrofoam Deckmate Plus, The Dow Chemical Company

F. Structural Polystyrene used as Fill for Wheel Load Applications

1. Material: Rigid cellular polystyrene thermal insulation with closed cells formed by expansion of polystyrene base resin in an extrusion process.
2. Comply with the requirements of ASTM C 578, Type V.

3. Compressive strength, 100 psi (700 kPa), ASTM D 1621.
4. Compressive modulus, min 3700 psi (25.5 MPa), ASTM D 1621.
5. Flexural strength, 100 psi, (700 kPa), ASTM C 203.
6. Thickness as indicated on drawings.
7. Example acceptable product: STYROFOAM Highload 100, The Dow Chemical Company
8. Example acceptable product: FOAMULAR 1000, Owens Corning.

G. Vapor Retarder: See Division 7, Thermal and Moisture Protection

1. Minimum 15-mil thick polyolefin geomembrane
2. Manufactured with prime virgin resins
3. Water Vapor Retarder: ASTM E 1745, meets or exceeds Class A
4. Water Vapor Transmission Rate: ASTM E 96, 0.008 gr./ft²/hr. or lower
5. Permeance Rating: ASTM E 96, 0.03 perms or lower for new material and after conditioning tests in accordance with applicable sections of ASTM E 154
6. Puncture Resistance: ASTM E 1745, minimum 2400 grams
7. Tensile Strength: ASTM E 1745, minimum 45.0 lbs./in.
8. Example acceptable product: W.R. Grace's "Florprufe 120"
9. Example acceptable product: W. R. Meadows, "Perminator"
10. Example acceptable product: Stego Industry LLC, "Stego Wrap"
11. Example acceptable product: Raven Industries, "Raven Vapor Block 15".

H. Non-Slip Aggregate:

1. Abrasive aggregate shall be composed of an aluminum oxide abrasive bonded by a vitreous ceramic material. Use hard, homogeneous, non-glazing, rustproof aggregate which is unaffected by moisture or cleaning compounds.
2. Example acceptable product: Euclid Chemical Company "NON-SLIP AGGREGATE"
3. Example acceptable product: "Alundum" by North Company
4. Example acceptable product: Anti-Hydro International "A-H A-2 Emery Shake-On"
5. Example acceptable product: Anti-Hydro International "A-H Alox" by Anti-Hydro International Abrasive
6. Example acceptable product: BASF "MasterTop 120 SR"

I. Semi Rigid Joint Filler:

1. Example acceptable product: Euclid Chemical "Euco 700"
2. Example acceptable product: Euclid Chemical "Euco QWIKjoint 200"
3. Example acceptable product: Sika Chemical Corporation "Sikadur 51 SL"
4. Example acceptable product: W.R. Meadows Sealtight "Rezi-Weld Flex"
5. Example acceptable product: BASF "MasterSeal CR190"

J. Dowels:

1. Example acceptable product: Diamond Plate Dowels: PNA's "Diamond Dowel System."

2.10 CONCRETE REPAIR MATERIALS

A. Polymer Repair Mortar

1. The following patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Design Professionals is required.
2. Example acceptable products (Horizontal Repairs): "Thin Top Supreme or Tammspatch II" by Euclid Chemical Company (for 1/16" to 3/8" thickness), or "Concrete Top Supreme" (for 3/8" to 2" thickness).
3. Example acceptable products (Horizontal Repairs): "Sikatop 121 Plus" or "Sikatop 122 Plus" by Sika Chemical Corporation.
4. Example acceptable products: (Horizontal Repairs): BASF "MasterEmaco T 1060 or T 1061" (for 3/8" to 2" thickness).
5. Example acceptable products: (Horizontal Repairs): BASF "MasterEmaco T310"
6. Example acceptable products (Vertical and Overhead Repairs): Verticoat, Verticoat Supreme, or Duraltop gel by Euclid Chemical Corporation
7. Example acceptable products (Vertical and Overhead Repairs): Chemical Corporation's, "Sikatop 123 Plus" by Sika Chemical Corporation.
8. Example acceptable products: (Vertical and Overhead repairs): BASF "MasterEmaco N425"

B. High Strength Flowing Repair Mortar

1. For forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" aggregate.
2. The product shall achieve 9000 psi @ 28-days at a 9-inch slump.
3. Prior approval by the Design Professionals is required for cold weather applications
4. Example acceptable product: The Euclid Chemical Company's, "Eucocrete"
5. Example acceptable product: BASF "MasterEmaco S440 or S440MC"
6. Example acceptable product: Sika Corporation "Sika Repair 211 SCC Plus"

C. Repair Topping

1. Latex and microsilica modified cementitious mortar topping, which meets or exceeds the bond strength requirements of ASTM C 1059.
2. Resistance to wear: The finished topping shall show a depth of wear of 0.02 mm (0.0079") or less when tested at 28 days with a Chaplin Abrasion Tester.
3. Example acceptable product: The Euclid Chemical Company, "Thin-Top Supreme or Tammspatch II"
4. Example acceptable product: Sika Corporation "Sika Repair 211 SC Plus"

D. Epoxy Injection:

1. ASTM C881, moisture insensitive maximum viscosity 350 cps at 77°F (25°C).
2. Epoxy shall meet the volatile organic compounds (VOC) requirements of CalGreen Section 5.504.4.1.
3. Acceptable Product: BASF "MasterInject 1380"

4. Acceptable Product: Euclid Chemical Company "Eucoxy Injection Resin"
 5. Acceptable Product: Sika Corporation "Sikadur 35, LV, LPL"
- E. Pressure-Injected Foam Resin:
1. Acceptable Product: DeNeef "HA Sealform"
 2. Acceptable Product: 3M "ScotchSeal 5600"
 3. Acceptable Product: Sika Corporation "SikaFix HH"
 4. Acceptable Product : BASF "Concresive 1230 IUG"
- F. Semi Rigid Epoxy:
1. Epoxy shall meet the volatile organic compounds (VOC) requirements of CalGreen Section 5.504.4.1.
 2. Acceptable Product: METZGER/McGUIRE "MM-80 Semi Rigid Epoxy Joint Filler"
 3. Acceptable Product: BASF "MasterSeal CR190"
- G. Methyl Methacrylate (MMA)
1. MMA shall meet the volatile organic compounds (VOC) requirements of CalGreen Section 5.504.4.1.
 2. Acceptable Product: Transpo Industries, Inc. "T-78 Methyl Methacrylate Polymer Crack Healer/Sealer"
- H. Sealant:
1. Silicone or Polyurethane Sealant (as selected based on project requirements such as loading, traffic, bond, coatings, etc.).
 2. Sealant shall meet the volatile organic compounds (VOC) requirements of CalGreen Section 5.504.4.1.
 3. Joint to be routed and cleaned per manufacturer's written directions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General:
1. Ensure availability of sufficient labor, equipment and materials to place concrete correctly in accordance with scheduled casting. Verify conveying equipment is clean and properly operating.
 2. Confirm that the Architect has reviewed formwork and reinforcing steel and that preparations have been checked with the Project Inspector.
 3. Protect finished surfaces adjacent to concrete-receiving places.

4. Clean transportation and handling equipment at frequent intervals and flush thoroughly with water before each day's run. Do not discharge wash water into concrete form.
- B. Subgrade:
1. Dampen subgrades not covered with membrane by sprinkling immediately before placing concrete. Do not saturate.
 - a. Omit when subgrade is already damp.
 2. Do not place on water-saturated subgrade unless placing can be done without damage to subgrade (surface is stable) and loading the subgrade does not drive free water to the surface.
 3. Do not place concrete on frozen ground.
 4. Verify depths of depressed slab conditions are correct for delayed finish noted and for proper bonding to concrete.
- C. Forms:
1. Coordinate with Section 03 10 00 Concrete Formwork.
 2. Verify that construction of formwork is complete and form ties at construction joints are tight.
 3. Remove dirt, sawdust, nails and other foreign material from formed space.
 4. Dampen wood forms by sprinkling immediately before placing.
 5. Cool metal forms by sprinkling immediately before placing.
- D. Concrete Accessories:
1. Coordinate with Section 03 10 00 Concrete Formwork.
 2. Ensure required reinforcement, inserts, and embedded items are in place.
- E. Dewatering:
1. Remove water from concrete formwork.
 2. Divert any flowing water to sump and remove by pumping.
 3. Refer to Division 1 for additional dewatering requirements.
- F. Vapor Retarder Placement: See Division 7, Thermal and Moisture Protection.
1. Vapor retarder installation shall be in accordance with manufacturer's instructions and ASTM E 1643.

2. Place vapor retarder under slabs-on-grade in position with longest dimension parallel with direction of pour.
3. Joints: Lap 6" minimum and seal with manufacturer's recommended mastic or pressure-sensitive tape.
4. Prevent damage to moisture barrier.
5. If moisture barrier is damaged, place a piece of moisture barrier over damaged area (6" larger all around) and tape in place with type of tape recommended by moisture barrier manufacturer.
6. Seal laps and intersections of walls with compatible trowel mastic or pressure-sensitive sealing tape.
7. Seal around pipes and other penetrations with compatible trowel mastic.
8. The vapor barrier must be approved prior to concrete placement.

3.2 JOINTS IN CONCRETE

- A. Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.
 1. Do not use contraction joints in framed floors or composite slabs.
 2. Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Design Professionals.
 3. Coordinate location of construction and contraction joints with locations of joints in finish materials where they exist.
 - a. Construction and contraction joints in slabs or slab on grade with terrazzo finish must be reviewed and approved by the Design Professionals.
- B. Construction Joints:
 1. Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.
 2. Horizontal Joints: Horizontal construction joints other than those shown on the drawings will not be permitted unless approved by the Architect.
 3. Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material. The existing concrete at joints shall either be (a) dampened to the point that the surface is saturated, but all standing water has been removed, promptly followed by placement and vibration of fresh concrete, or (b) not required to be dampened, with one of the specified bonding

compounds applied as appropriate for the joint condition, following manufacturer recommendations, with placement and vibration of fresh concrete to follow while the epoxy bonding agent is still tacky. Joints without epoxy bonding agent require fresh concrete with slump 7 inches or greater at horizontal joints, and fresh concrete confined to maintain pressure against the joint at vertical joints. Where such conditions are not present, or where applying water to dampen the surface is impractical, use epoxy bonding agent suitable for dry surfaces.

C. Isolation Joints:

1. Interrupt structural continuity resulting from bond, reinforcement or keyway at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

D. Contraction (Control) Joints in Floor Slabs-on-Grade:

1. Space joints at 36 times slab thickness, 15'-0" maximum, unless a smaller spacing is indicated on the Drawings, located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
2. Maximum slab area controlled by jointing is 225 square feet.
3. Contraction joints can be provided by sawcuts 1/8" by 1/4 slab depth, formed joints, hand-tooled joints, or appropriately detailed construction joints.
4. Sawcuts shall be made as soon as possible after slab finishing as may be safely done without dislodging aggregate or breaking edges. The Soff-Cut saw shall be used to a depth of 1/4 of slab thickness immediately after final finishing. Conventional saw shall be used as soon as possible after final finish without raveling to a depth as indicated on the drawings.
5. Where contraction joints coincide with construction joints, detail joint as indicated on drawings.
6. See plans for location of control joints around columns

E. Joint Fillers: Coordinate with Section 03 20 00 Concrete Reinforcement and Embedded Assemblies and Division 7 requirements.

3.3 MIXING

A. Measurement of Materials: Conforming to ASTM C 94

B. Mixing: All concrete shall be ready-mixed conforming to ASTM C 94 except as follows:

1. Provide concrete materials, proportions and properties as herein specified in lieu of ASTM C 94.
2. Method of mixing shall comply with ACI 318 Section 5.8.

3. Adjust grading to improve workability; do not add water at batch plant unless otherwise directed.
 4. Measure fine and coarse aggregates separately according to approved method that provides accurate control and easy checking.
 5. Thoroughly clean concrete equipment before use for architectural concrete mixes to avoid contamination.
 6. Use automatic metering dispenser to introduce admixture into mix. Dispenser shall be recommended and calibrated by admixture manufacturer.
 7. Water, beyond that required by the mix design, shall not be added at the Project site. Addition of water at the Project site shall be made only in the presence of the Owner's Testing Agency.
 8. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor conforming to the requirements of ASTM C 94.
 9. Mix concrete in transit mixers five minutes immediately prior to discharge in addition to mixing as called for by ACI 304 and ASTM C94.
- C. High range water reducing agents (superplasticizer), if added at the batch plant, may be added again at the Project site.
1. If superplasticizers are added at the batch plant, the concrete mix design must account for the delivery time, workability, finishability, and setting time required on the jobsite for proper placing and finishing procedures.
 2. If the superplasticizer is redosed at the jobsite in air entrained concrete, air content must be checked after mixing.
- D. Unless otherwise permitted, time for completion of discharge shall comply with ASTM C94/C94M. When discharge is permitted after more than 90 minutes have elapsed since batching or after the drum has revolved 300 revolutions, verify that air content of air-entrained concrete, slump, and temperature of concrete are as specified. When discharge is permitted after more than 90 minutes have elapsed since batching or after the drum has revolved 300 revolutions, no water may be added.
- 3.4 CONCRETE PLACEMENT
- A. Prior to Concrete Placement:
1. Mechanical vibrators are required and must be available for placing concrete. Ensure availability of spare vibrators in case of failures.
 2. Place no concrete where weather conditions prevent proper finishing and curing.
 3. Remove debris from space to be occupied with concrete.
 4. Notify Design Professionals and Owner's Testing Agency 48 hours prior to starting concrete placement.
 5. Approved mix designs must be maintained on file in Contractor's Field Office.

6. Reinforcement and accessories shall be in proper locations, clean, free of loose scale, dirt or other foreign coatings that may reduce bond to concrete, and in accordance with Section 03 20 00 and Drawings.
7. Fog spray forms, reinforcing steel, and subgrade just before pouring concrete.
8. Do not place concrete having a slump outside of allowable slump range.
9. Place concrete before initial set has occurred, but in no event after it has been discharged from the mixer more than 30 minutes. All concrete shall be placed upon clean, damp surfaces, free from puddled water, or upon properly consolidated fills, undisturbed soil or Controlled Low-Strength Material with a minimum strength of 1200 psi. Placement upon soft mud or dry earth is not permitted.
10. Unless adequate protection is provided, concrete shall not be placed during rain.
11. Rain water shall not be allowed to increase mixing water or to damage the surface finish.
12. Do not use equipment in placing and finishing concrete that contain aluminum in the finishing edges that come in contact with the concrete surface.
13. Keep subgrade moisture uniform without puddles or dry areas.
14. Place vapor retarder directly below slabs on grade as specified in contract documents.

B. For Conduits and Pipes Embedded in Concrete:

1. For concrete slab, wall, beam or column, conform to requirements of ACI 318, Chapter 6. For variations from these requirements, submit a written request for Design Professionals' review and response.
2. Conduits and pipes shall not be embedded in concrete slabs on steel deck without approval of Design Professional.
3. Provide sleeves for pipes passing vertically through concrete.
4. Do not embed aluminum materials.
5. Do not cut, bend or displace the reinforcement to facilitate placement of embedded pipes and conduits.

C. Pumping: Pumping shall be done in strict accordance with ACI 304.2R.

1. The Contractor shall demonstrate that the pumping equipment has a record of satisfactory performance under similar conditions and using a similar mix.

D. Placing Concrete in Forms:

1. Clean and prepare forms as specified in Section 03 10 00/Concrete Formwork.
2. Place concrete continuously without interruption between predetermined construction and contraction joints in walls.
3. Deposit concrete in forms in horizontal layers no deeper than 24" and in a manner to avoid inclined construction joints. Level top surface upon stopping work.
4. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
5. Avoid free falls in excess of six feet where reinforcement will cause segregation and in typical conditions unless the Architect approves otherwise.
6. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.

- a. Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.
 7. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
 8. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine to achieve timely consolidation around reinforcement, embedded items and into corners of forms.
 9. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer.
 10. Do not insert vibrators into lower layers of concrete that have begun to set.
 11. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
 12. Do not vibrate Self-Consolidating Concrete (SCC).
- E. Placing Concrete Slabs:
1. Place concrete continuously without interruption between predetermined construction and contraction joints in floors.
 - a. Place slabs on grade by the long strip cast method. Refer to ACI 302.1R for recommended methods of placement.
 2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section. Employ mechanical vibrating equipment in accordance with ACI 309R as required to achieve thorough consolidation.
 3. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
 4. Bring slab surfaces to correct level with a straightedge and strike off.
 - a. Use highway straight edges, bullfloats or darbies to smooth surface free of humps or hollows.
 - b. Do not disturb slab surfaces prior to beginning finishing operations.
 5. Maintain reinforcing in proper position on chairs during concrete placement.
 6. Do not place materials on slabs or impose loads during period of setting.
 7. Take precautions to avoid damage to under-slab moisture barrier and displacement of reinforcement and formwork.
- F. Placing Concrete on Steel Decks
1. Exercise care during concrete placement on steel decks to prevent concentrated loads or high pile-ups of concrete and to avoid impacts caused by dumping or dropping of concrete on steel decks.
 2. Do not use buggies on unprotected areas of deck. If buggies are used to place concrete, furnish and install planked runways to protect deck from damage.
- G. Placing Concrete at Construction Joints:
1. To secure full bond at construction joints, surfaces to receive concrete in a subsequent placement shall be left in a roughened state or intentionally roughened by raking while plastic or brushing and chipping immediately after removal.

2. Before new concrete is placed in contact, surfaces of hardened concrete already placed shall be thoroughly cleaned of foreign materials and laitance.
3. At hardened concrete at joints where no bonding agents are used, dampen concrete to achieve a saturated surface dry condition. Leave no standing water. Place and vibrate concrete (slump 7 inches or greater) against horizontal joints. Place and vibrate flowing concrete (slump 8 to 10 inches) while maintaining pressure against vertical joints by confinement.
4. At hardened concrete with joints not meeting conditions required for no bonding agents, apply appropriate specified bonding agent for conditions present including age and moisture per manufacturer's specifications. Place new concrete while the bonding agent is still tacky.

[Include steel pan stair concrete information in General Notes]

H. Floor Topping Slabs:

1. Place concrete topping slab to required lines and levels.
2. Minimum topping slab thickness is 2" (50mm).
3. Place dividers, edge strips and other items to be cast in place.
4. At all topping slabs, remove deleterious material before placing topping slab.
5. At topping slabs placed directly against base slab, remove deleterious material and dampen base slab with water immediately before placing concrete. Leave no standing water.
6. Unless noted as a "bonded" topping slab on the drawings, topping slabs thinner than 4" (100mm) should be placed directly against dampened base slab with no bonding agent. Topping slabs 4" (100mm) or thicker should be placed on bond breaker consisting of two sheets of plastic film.
7. Where noted on drawings as a "bonded" topping slab, broom/vacuum clean unsealed surfaces or wire brush sealed or troweled surfaces to expose bare rough surface. Then place approved bonding grout or epoxy adhesive on the base slab per manufacturer's instructions.
8. The topping mix shall have a maximum water/cement ratio of 0.45.
9. The topping mix shall have a maximum shrinkage of 0.04% in 28 days.
10. The topping mix shall contain a minimum of 5 lbs. per cubic yard (2.43 kg/m³) of macro synthetic fibers and achieve an Average Residual Strength (ARS) of 200 psi (1.4MPa) unless a higher dosage or ARS is noted on the plans.
11. The topping slab shall be moist cured for a minimum of 36 hours after placement.
12. The topping slab shall have contraction joints located to match any joints in the base slab, to eliminate restraint conditions such as re-entrant corners and to isolate the slab from columns, walls, etc. and to limit the maximum distance between joints to 15 feet (4570mm).

I. Cold-Weather Placement:

1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as specified in this section.
2. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F, and not more than 80°F, at point of placement.

3. Do not use frozen materials or materials containing ice or snow.
 - a. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Remove frost, snow and ice from forms, reinforcement and other embedments immediately prior to concrete placement.
5. Concrete shall be maintained at temperature no lower than 50 degrees Fahrenheit for minimum 7-day period after placement by means of blanket insulation, heaters, or other methods as approved by the Architect. The Contractor shall keep a record of concrete surface temperature for first 7-days after each pour. This record shall be open to inspection by the Architect.
6. Use only the specified non-corrosive accelerating admixture previously approved as part of the cold weather mixture. Addition of calcium chloride, salt, thiocyanates or admixtures containing more than 0.05 percent chloride ions is not permitted.

J. Hot-Weather Placement:

1. Hot weather is defined as air temperature at the time of delivery, protection and curing which exceeds 90°F or any combination of high temperature, low humidity and/or high wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square feet per hour as determined by ACI 305.1.
2. When hot weather conditions exist, place concrete in compliance with ACI 305R and as specified in this section.
3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C).
4. 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.
5. Use of liquid nitrogen to cool concrete is Contractor's option.
6. When concrete placement will occur late in the day and reinforcing steel will be heated by the sun, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
7. When concrete operations must be performed in direct sun, wind, high temperatures, low relative humidity, or other adverse placing conditions, the specified evaporation retarder shall be applied one or more times during the finishing operation to prevent plastic cracking.

3.5 CONCRETE FINISHES

A. General:

1. Comply with recommendations for concrete finishing established by ACI 302.1R and ACI 304R.
2. Comply with dimensional tolerance limitations given by ACI 117 except as modified in the Construction Documents.
3. Insure removal of bituminous materials, form release agents, bond breakers, curing compounds if permitted and other materials employed in work of concreting which would otherwise prevent proper application of sealants, liquid waterproofing, and other delayed finishes and treatments.
4. Where cleaning is required, take care not to damage surrounding surfaces or leave residue from cleaning agents.

5. Where fiber reinforcement is used, remove exposed fibers from concrete surface to the satisfaction of the Architect.
 6. For shored floor or slab on grade construction: Floor flatness/floor levelness tolerance compliance testing is to be performed prior to the removal of shores and forms but not later than **[72]** hours of concrete placement by Owner's Testing Agency.
 7. See architectural drawings for locations of the various finishes listed below.
 8. Comply with slab FF and FL values specified below:
 - a. If an individual test section measures less than either of the specified minimum local FF/ FL numbers, that section may be rejected and remedial measures may be required as specified in CONCRETE SURFACE REPAIRS.
 - b. If the composite value of the test surface measures less than either of the specified overall FF/ FL numbers, then the entire slab may be rejected and remedial measures may be required.
 - c. FL numbers shall not apply to unshored slabs or shored slabs with camber.
- B. Finish for monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious finish flooring material, as indicated on architectural drawings:
1. Scratch Finish. Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
 - a. Finish surface to overall value of FF=20 and FL=15 and minimum local value of FF = 14 and FL=10 measured according to ASTM E 1155.
 - b. Slope surfaces uniformly to drains where required.
 - c. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- C. Finish for monolithic slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, sand-bed terrazzo as indicated on architectural drawings:
1. Float Finish.
 - a. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
 - b. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.
 - c. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
 - d. Finish surfaces to overall value of FF=20 and FL=15 and minimum local value of FF=14 and FL=10 measured according to ASTM E 1155.
 - e. Cut down high spots and fill low spots.
 - f. Uniformly slope surfaces to drains.

- g. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Finishes for Pedestrian Sidewalks and Ramps, Exterior Platforms, Steps, as indicated on architectural drawings:
1. Sidewalks and Curbs: Light-to-medium broom finish applied with fiber-bristle broom perpendicular to direction of main traffic route immediately after float finishing.
 2. Ramps: Scored finish as applied perpendicular to direction of main traffic route immediately after float finishing.
 3. Finish surface to overall value of FF=20 and FL=15 and minimum local value of FF = 14 and FL=10 measured according to ASTM E 1155.
 4. Texture shall be approved by the Design Professionals from sample panels.
- E. Finish for interior floor slab and stair surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile on thick-set mortar, paint or another thin film-finish coating system, as indicated on architectural drawings:
1. Trowel Finish.
 - a. After floating, begin first trowel-finish operation using a power-driven trowel.
 - b. Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
 - c. The final hand-troweling operation shall result in a smooth surface, free of trowel marks, uniform in texture and appearance.
 - d. Grind smooth any surface defects that would telegraph through applied floor covering system.
 2. Finish surface to overall value of FF=25 and FL=20 and minimum local value of FF=17 and FL=14 measured according to ASTM E 1155.
 3. Floor Slopes: Where drains occur, slope floor slabs uniformly to drains, maintaining scheduled slab thickness.
 4. Floor Edges at Expansion Joints: Tool edges minimum 3/8".
 5. Defects: Remove defects of sufficient magnitude to show through floor covering by grinding.
 6. Floor Hardener: Use only where scheduled and in accordance with manufacturer's published instructions.
 7. Dry Cement: Shall not be used during finishing.
- F. Finish for thin set ceramic tile or thin set epoxy terrazzo, as indicated on architectural drawings:
1. Trowel and Fine Broom Finish:
 - a. Apply a trowel finish as specified.
 - b. Immediately follow by slightly scarifying the surface with a fine broom.
 2. Finish surface to overall value of FF=30 and FL=20 and minimum local value of FF = 20 and FL=14 measured according to ASTM E 1155.
- G. Finishes for Parking Garage Deck, Ramps, Loading Docks, Stairs:
1. Highway straight edge immediately after screeding concrete.

2. Finish surface to overall values of FF=20 and FL=15 and minimum local value of FF = 14 and FL=10 measured according to ASTM E 1155.
3. For Slabs Not Receiving Deck Coating: Medium broom finish with ridges not to exceed 1/8" in height. Texture shall be as approved by the Design Professionals from sample panels.
4. For Slabs Scheduled to Receive Deck Coating: Smooth floated finish which must be verified with coating manufacturer before finishing the slab.
 - a. Coordinate with deck coating specified in Division 7.
5. Auto Ramps: Rough texture applied perpendicular to direction of traffic. Texture shall be as approved by the Design Professionals from sample panels.
6. Finish stairs to profiles shown with cove at base of risers and radius at top: tool grooves at edge of treads as detailed.

H. Tolerances at Slab Discontinuities

Within 2 ft of slab boundaries, construction joints, isolation joints, block-outs, penetrations or other similar discontinuities, where required for travel paths, installation of finishes and partitions, or any other requirements indicated in the contract documents, the following equivalent straightedge tolerances shall apply:

Specified local FF = 14, use 1/4" over 4 ft, no offset greater than 1/16"
 Specified local FF = 20, use 1/8" over 4 ft, no offset greater than 1/32"

I. Dry Shake Finish:

1. Non-slip aggregate where indicated on drawings.
2. Non-oxidizing metallic hardener on loading docks at a rate of 1.5 lbs. per sq. ft. and in other locations so noted on the drawings.
3. Mineral aggregate hardener at a rate of 1.2 lbs. per sq. ft. where noted on the drawings.
4. Final finish type, method and tolerance as applicable by location and use.
5. Dry shake finish will be applied only where scheduled and in accordance with the manufacturer's published instructions and the methods and procedures agreed upon at the pre-installation conference.

J. Rough Formed Finish:

1. Acceptable for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated.
2. Concrete surface shall have texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4" in height rubber down or chipped off.

K. Smooth Formed Finish:

1. Required for formed concrete surfaces exposed to view, or scheduled to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system, as indicated on architectural drawings:

2. Surface is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. Repair and patch tie holes and defects. Remove fins and other projections completely.

L. Smooth Rubbed Finish:

1. "Smooth Rubbed" finish shall consist of a finish free of fins, joint marks smoothed off, blemishes removed and surfaces left smooth and unmarred.
2. Provide smooth rubbed finish to scheduled concrete surfaces, as indicated on architectural drawings, which have received smooth form finish treatment not later than one day after form removal.
3. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.
 - a. Do not apply cement grout other than that created by the rubbing process.

M. Grout-Cleaned Finish:

1. Provide grout-cleaned finish on scheduled concrete surfaces, as indicated on architectural drawings, that have received smooth-formed finish treatment.
2. Combine one part portland cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint.
3. Blend standard portland cement and white portland cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
4. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes.
5. Remove excess grout by scraping and rubbing with clean burlap.
6. Keep surface damp by fog spray for at least 36 hours after rubbing.

N. Unformed Surfaces:

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

3.6 CURING AND PROTECTION

A. Normal Conditions:

1. Protect concrete from premature drying, excessive hot or cold temperature, and damage.
2. After concrete has taken its initial set, care shall be exercised to avoid jarring forms or placing any strain on ends of projecting reinforcement.
3. Concrete shall be kept continuously moist and above 50°F (10°C) for seven days (ASTM C 150 Type I cement) or for 10 days (ASTM C 150 Type II cement). High

early strength concrete usage shall be maintained over 50°F (10°C) for three days.

4. The architect may recommend longer periods based on temperature, wind and humidity conditions.
5. Concrete and concrete patching materials shall be cured according to manufacturers published recommendations.
6. Begin curing as soon as free water has disappeared from concrete surface and finishing has been completed.
7. Comply with ACI 318 Section 5.11.
8. Do not permit curing method to affect adversely finishes or treatments applied to finish concrete.
9. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.
 - a. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
 - i. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Curing compound should be applied at upper end of manufacturer's range of application.
 - ii. Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions.
 - iii. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
 - iv. Maintain continuity of coating and repair damage during curing period.
 - v. Use curing and sealing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
 - vi. Floors to receive covering shall be cleaned thoroughly using a power scrubber and industrial strength detergent.
 - vii. Hand-brooming and sweeping is not sufficient.
 - viii. Strippable curing compound may be used in lieu of a moist curing method when approved by the Design Professionals.
 - b. Provide moist curing by the following methods:
 - i. Keep concrete surface continuously wet by covering with water.
 - ii. Use continuous water-fog spray.
 - iii. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4" lap over adjacent absorptive covers.
 - c. Provide moisture-retaining cover curing as follows:
 - i. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period using cover material and waterproof tape
10. Cure slabs on grade, concrete toppings, concrete pour strips, supported slabs, walls and columns, not subject to conditions of hot or cold weather concreting, in accordance with ACI 308.

11. Cure surfaces exposed to deicing salts, brackish water, etc, such as loading dock slabs, parking garage slabs and ramps in accordance with ACI 308 recommendations for moist curing.
12. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed.
 - a. If forms are removed, continue curing by methods specified above, as applicable.

B. Cold-Weather Protection:

1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40°F for more than 3 successive days), take additional precautions as specified in ACI 306R when placing, curing, monitoring and protecting the fresh concrete.

C. Hot-Weather Protection:

1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations with an evaporation retarder.
 - a. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
2. Hot weather curing is required if hot weather conditions occur within a 24-hour period after completion of concrete placement.

- D. Floor surfaces, wherever indicated by weather conditions, shall be sprinkled during the interval between finishing operation and the start of curing to positively ensure against the possibility of surface drying.

3.7 CONCRETE REPAIRS

- A. Where concrete is under strength, out of line, level or plumb, or shows objectionable cracks, honeycombing, rock pockets, voids, spalling, exposed reinforcement, signs of freezing or is otherwise defective, and, in the Architect's judgment, these defects impair proper strength or appearance of the work, the Architect will require its removal and replacement at the Contractor's expense.
- B. Perform patching and repairs in accordance with ACI 301.
- C. Contractor shall submit patching and repair methods and materials for review by Design Professionals.
- D. When complete, all patches and repairs shall match color and texture of adjoining surfaces.
- E. At surfaces that are exposed to view, prepare test areas at inconspicuous locations for review by design professionals to verify repair color and texture match before proceeding with repair.
- F. Apply all patching and repair materials in accordance with manufacturer's specifications.
- G. Repairing Cracks In Formed and Unformed Surfaces:

1. Contractor shall notify Design Professionals of all cracks wider than 0.02" (0.50mm) and all cracks wider than 0.01" (0.25mm) that occur in a group of at least three cracks within twelve inches (300mm), in concrete. If Design Professionals deem repairs necessary, Contractor shall be responsible for repairing all such cracks per Design Professionals recommendation at no expense to the Owner. Repairs will generally require one or more of the following: Epoxy Injection, Semi-Rigid Epoxy, Pressure Injected Foam Resin, Methyl Methacrylate and/or Sealant with joint routed and cleaned. See Concrete Repair Materials section of this Specification for acceptable products

H. Repairing Formed Surfaces

1. Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.
2. Remove all burrs, fins, and ridges before the concrete is thoroughly dry.
3. Remove stains from rust, grease and oils, from release agents, etc.
4. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Design Professionals.
 - a. Surface defects, include color and texture irregularities, cracks as defined above, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - b. Chip away defective areas, honeycomb, rock pockets, voids over 1/4" (6mm) 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" (25mm) and saw-cut edges to prevent feather edging of fill material.
5. Repair concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
6. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.
7. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" (20mm) wide all around steel to allow proper bond.

I. Repairing Unformed Surfaces:

1. High and Low areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.
 - a. Correct high areas by grinding after concrete has cured at least 14 days.
 - b. Correct low areas by applying leveling material. Finish leveling material as specified in this section.
2. Repair surfaces containing defects that affect durability of concrete.
 - a. Surface defects include crazing, cracks as defined above, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
3. Repair defective areas, except random cracks and single holes not exceeding 1" (25mm) in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4" (20mm) clearance all around.

- J. Filling In:** Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

3.8 EVALUATION AND ACCEPTANCE OF CONCRETE

- A. In accordance with ACI 301, except where otherwise specified.
- B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 - SUBMITTALS.

3.9 COORDINATION & CORRECTIVE MEASURES

- A. Conflicts: The contractor shall be solely responsible for errors of detailing, fabrication, and placement of reinforcement steel; placement of inserts and other embedded items; and the structural adequacy of all formwork.
- B. Reimbursement for Additional Services: Should additional work and/or visits be required which are necessitated by failure of the Contractor to perform his work in accordance with the contract documents, or if additional design or drafting time is required for corrective measures caused by failure to perform in accordance with the contract documents, the Contractor shall reimburse the Architect and Engineer at the rate of direct personnel expense plus 150% overhead plus out-of-pocket traveling expenses incurred.

3.10 CLEAN UP

- A. Perform Work under this Section to keep affected portions of building site neat, clean, and orderly. Remove, immediately upon completion of Work under this Section, surplus materials, rubbish, and equipment associated with or used in performance. Be aware that failure to perform clean-up operations within 24 hours of notice by Architect will be considered adequate grounds for having work done by others at no added expense to the Owner.

END OF SECTION

CONCRETE MIX DESIGN SUBMITTAL FORM

Project:	_____
City:	_____
General Contractor:	_____
Concrete Contractor:	_____
Concrete Strength:	_____
Use/Location on Job:	_____
Supplier's Mix Designation:	_____

Design Mix Information

(Please check one):

Refer to ACI 301 for requirements of data used to substantiate strength calculations.

Field Experience (Based on Standard Deviation Analysis): _____

Trial Mixture Test Data: _____

Design Characteristics:

Density:	_____	Pcf
Strength:	_____	Psi (28 day)
Air:	_____	% (specified)

Materials:	Type/Source	Specific Gravity	Weight (lb)	Absolute Vol. (cu. ft.)
Cement:				
Fly ash:				
Slag (GGBFS)				
Microsilica:				
Coarse Aggregate:				
Fine Aggregate:				
Water:				
Air:				
Other:				
TOTAL:				27.0 cu. ft.
Water/Cementitious Material Ratio (lbs. water / lbs. cementitious material) =				%

Admixtures:	Manufacturer	ASTM	Dosage (oz/cwt)
Water Reducer:			
Air Entraining Agent:			
High Range Water Reducer			
Non-corrosive Accelerator:			
Other:			

Slump before HRWR: _____ Inches

Slump after HRWR: _____ Inches

Standard Deviation Analysis (from experience records):

No. of Test Cylinders

Evaluated: _____

Standard Deviation: _____

Required Average Strength f'_{cr}

Average Strength by Tests

Equation Used (ACI Chapter 5)

(Refer to ACI 318 for increased deviation factor when less than 30 tests are available)

TRIAL MIXTURE TEST DATA

Compressive Strength:	Age (days)	Mix #1	Mix #2	Mix #3
	28 [56] [90]	psi	psi	Psi
	28 [56] [90]	psi	psi	Psi
	28 [56] [90]	psi	psi	Psi
	Average	psi	psi	psi
<i>Required Average Strength f'_{cr}</i>				
<i>Average Strength by Tests</i>				
<i>Equation Used (ACI Chapter 5)</i>				

REQUIRED ATTACHMENTS

***Please
check***

Coarse Aggregate Gradation Report	
Fine Aggregate Gradation Report	
Combined Aggregate Gradation Report: (8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smaller top size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100) (See Section 2.3.B.)	
Fly Ash (or other Supplementary Cementitious Material) Certification	
Concrete Compressive Strength Data or Trial Mixture Test Data	
Admixture Compatibility certification letters	
Chloride Ion Content Certification	
Alkali Aggregate Reactivity Certification	
Shrinkage Test Reports	

SUBMITTED BY:

Name:	<hr/>
Address:	<hr/> <hr/> <hr/>
Phone no.:	<hr/>
Main Plant Location:	<hr/>
Miles from Project:	<hr/>
Secondary Plant Location:	<hr/>
Miles from Project:	<hr/>
Date:	<hr/>
Certification by Concrete Supplier:	<hr/>
Signature:	<hr/> <hr/>
Print Name:	<hr/>
PE License Number and Expiration Date (print or stamp)	<hr/>

Structural Substitution Request Form – to be completed by Contractor

Project:		Substitution Request #
Date:		
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

4. Effect on Construction Schedule¹ (check one): ☐ NONE ☐ See Attached

5. Effect on Owner's Cost² attach data (check one): ☐ CREDIT TO OWNER ☐ EXTRA

6. Effect on Construction Documents³ (design work anticipated): ☐ NONE ☐ See Attached

7. Requesting Contractor Agrees to Pay for Design Changes (check): ☐ YES ☐ NO ☐ NOT APPLICABLE

8. Effect on Other Trades⁴:

9. Effect of Substitution on Manufacturer's Warranty (check): ☐ NONE ☐ See Attachment

Signature⁵: Date:

Company:

General Contractor Signature⁵: Date:

Notes:

- Contractor is responsible for means and methods and any problems that may arise from making the requested substitution.
- This is **NOT A CHANGE ORDER FORM**. A separate form is required to adjust costs and/or schedules.
- Contractor is responsible for any design impacts that may arise from this substitution, including redesign efforts.
- Contractor is responsible for effects on other trades from this substitution;
General Contractor must review and agree effects on other trades are fairly represented in items 4-9.
- Signature by a person having authority to legally bind his/her company to the above terms. Otherwise this request is void
- All items in form must be completed for substitution request to be considered.

Request Review Responses (completed by Architect and/or Engineer(s)):

ACCEPTED	ACCEPTED AS NOTED	REJECTED	INSUFFICIENT DATA TO SUPPORT REQUEST	ENGINEER / ARCH / MEP SIGNATURE	DATE

Engineer/Architects Comments: