ADDENDUM #2
ISSUE DATE: January 09, 2025

RE: UW MADISON LIBRARIES COLLECTIONS PRESERVATION FACILITY
UNIVERSITY OF WISCONSIN - MADISON
UWSA Project No. A-22-012

BID OPENING: For **MEP BIDDERS: 2:00 PM, THURSDAY, JANUARY 16, 2025**

For **GENERAL PRIME CONTRACTORS: 2:00 PM, THURSDAY, JANUARY 30, 2025**

FROM: Hammel, Green and Abrahamson, Inc. Architects and Engineers
333 East Erie Street
Milwaukee, WI 53202

TO: Prospective Bidders

This addendum forms a part of the Contract Documents and modifies the original Contract Documents dated **December 12, 2024** as noted below. Acknowledge receipt of this Addendum by inserting the number and issue date of this addendum in the blank space provided on the Bid Form. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of 24 pages. This text document of one (1) page; updated Specification Section 03 30 00 of twenty-three (23) pages; for a total of 24 pages.

This Addendum consists of the following:

CHANGES TO SPECIFICATIONS:

1. 03 30 00 Cast-In-Place Concrete:
    a. Replace specification section 03 30 00 with the revised specification issued in this addendum.

END OF ADDENDUM #2

Hammel, Green and Abrahamson, Inc. Architects and Engineers
333 East Erie Street, Milwaukee, WI 53202

For the Board of Regents of the University of Wisconsin
On Behalf of the University of Wisconsin – Madison
1860 Van Hise Hall, 1220 Linden Drive, Madison, WI 53703

SECTION 03 30 00
CAST-IN-PLACE CONCRETE
BASED ON DFD MASTER SPECIFICATION DATED 12/20/2023

PART 1 - GENERAL

SCOPE

Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes. The work under this section consists of providing all work, materials, labor equipment and supervision necessary to provide cast in-place concrete as required in these specifications and the drawings.

Concrete Protecting And Curing
Liquid Floor Treatments
Joint Filling
Concrete Surface Repairs
Field Quality Control
Protection Of Liquid Floor Treatments

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

03 45 00 – Precast Architectural Concrete: Precast concrete bearing and non-bearing walls.

05 12 00 - Structural Steel Framing

REFERENCES

Incorporated Guides and References

American Concrete Institute (ACI):

ACI 302.1R – Guide for Concrete Floor and Slab Construction.
ACI 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
ACI 304.2R - Placing Concrete by Pumping Methods.
ACI 305R - Hot Weather Concreting.
ACI 309R – Guide for the Consolidation of Concrete.
ACI 347 – Guide to Formwork for Concrete.
ACI SP-66 – ACI Detailing Manual.

Specifications

American Concrete Institute (ACI):

ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.
ACI 301 - Specifications for Structural Concrete.
ACI 303.1 – Specification for Cast-In-Place Architectural Concrete.
ACI 306.1 – Specification for Cold Weather Concreting.
ACI 308.1 – Specification for Curing Concrete.
ACI 315 - Details and Detailing of Concrete Reinforcement.
ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

ASTM International (ASTM):

ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
ASTM A704 – Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
ASTM A775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
ASTM A820 – Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.
ASTM A884 – Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
ASTM A934 – Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
ASTM A996 – Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
ASTM C33 – Standard Specification for Concrete Aggregates.
ASTM C94 – Standard Specification for Ready-Mixed Concrete.
ASTM C150 – Standard Specification for Portland Cement.

ASTM C156 – Standard Test Method for Water Loss (From a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.
ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete.
ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.
ASTM C1059 – Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures.
ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
ASTM D3963 – Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
ASTM E164 3 – Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
ASTM E1745 – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

DEFINITIONS

Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

W/C Ratio: The ratio by weight of water to cementitious materials.

Cured Concrete: The concrete strength at 28 days.

Dry Concrete: The measure of concrete at 80% relative humidity at 40% of the concrete slab-on-grade depth.

Self-Consolidating Concrete (SCC): a highly workable concrete that can flow through densely reinforced or complex structural elements under its own weight and adequately fill voids without segregation or excessive bleeding without the need for vibration.

Passing Ability: The ability of SCC to flow through openings such as the spaces between reinforcing bars without segregation or aggregate blocking.

J-Ring Test: Test used to determine the passing ability of SCC, or the degree to which the passage of concrete through the bars of the J-Ring apparatus is restricted.

J-Ring Flow: The distance of lateral flow of concrete using J-Ring in combination with a slump cone.

Slump Flow: Test method used to measure the unconfined flow and stability of SCC using a slump cone (upright or inverted)

Slump Flow Spread: The numerical value in inches of flow and stability of SCC using a slump cone (upright or inverted).

Slump Flow Spread: The numerical value in inches of flow determined as the average diameter of the circular deposit of SCC at the conclusion of the slump flow test.

T_{50} Value: Time (in seconds) the edge of the concrete mass takes to reach 50 cm (20 inches) diameter from the time the mold is first raised in the slump flow test.

Stability: The ability of a concrete mixture to resist segregation of the paste from the aggregates.

Static Segregation (Segregation Factor): Segregation of the mortar from the coarse aggregate that occurs after placement while the concrete is still in the plastic state.

Visual Stability Index (VSI) Rating: An assessment of the homogeneity of concrete based on the visual inspection of the concrete sample at the end of the slump flow test.

PREINSTALLATION MEETINGS

PRIOR TO SUBMITTING DESIGN MIXTURES, CONTRACTOR SHALL HOLD A MEETING TO REVIEW DETAILED REQUIREMENTS FOR PREPARING FINAL CONCRETE DESIGN MIXES AND TO ESTABLISH PROCEDURES FOR PLACING, FINISHING, CURING, AND PROTECTING CONCRETE TO MEET REQUIRED QUALITY UNDER ANTICIPATED CONDITIONS. REPRESENTATIVES OF EACH ENTITY DIRECTLY CONCERNED WITH CAST-IN-PLACE CONCRETE TO ATTEND, INCLUDING THE FOLLOWING:

Contractor's superintendent.
Architect
DFD Construction Representative
Testing Laboratory responsible for field quality control.
Ready-mix concrete supplier.
Concrete Subcontractor.
Special concrete finish Subcontractor.

Minutes of the meeting shall be recorded, typed, reproduced and distributed by Contractor to all parties concerned within five working days of meeting. Minutes shall include a statement by admixture manufacturer(s) indicating that proposed mix design and placing can produce concrete quality required by this Section.

Contractor shall notify Architect at least 10 days prior to scheduled date of meeting.

SUBMITTALS

Product Data: For each type of product.

Sustainable Design Submittals::

For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

For liquid floor treatments and curing and sealing compounds, documentation including printed statement of VOC content.

For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.

Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

Indicate amounts of mixing water to be withheld for later addition at Project site.

Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

Location of construction joints is subject to approval of the Architect.

Concrete In-Situ Relative Humidity and pH Testing.

Report all test results in chart form listing test dates and time, depth of test holes, in-situ temperature and in-situ relative humidity, as well as pH levels of concrete slab surface to determine if the concrete is too dry to receive applied floor finishes.

List test hole locations on chart and show same on 8 ½ x 11" site map (when such a map is available to testing agency.)

Prepare a report of findings for the relative humidity and pH and distribution to Architect and General Prime Contractor.

Welding certificates.

Material Certificates: For each of the following, signed by manufacturers:
- Cementitious materials.
- Admixtures.
- Form materials and form-release agents.
- Steel reinforcement and accessories.
- Fiber reinforcement
- Waterstops
- Curing compounds
- Bonding agents
- Adhesives
- Vapor retarders
- Semirigid joint filler
- Joint-filler strips
- Repair materials

Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
- Aggregates

Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

Field quality-control reports.

Minutes of preinstallation conference.

QUALITY ASSURANCE

Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

Concrete In-Situ Relative Humidity and pH:

ASTM F2170-11 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using In-Situ Probes.

ASTM F710-11 – Standard Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.

Digital “Reader” and calibrated relative humidity sensors

Factory-calibrated “Smart Sensors” using Touch-n-Sense TM technology or similar testing equipment.

National Institute of Standards for Testing (NIST) – traceable factory calibration.

Wide range pH paper, and distilled or de-ionized water.

DELIVERY, STORAGE, AND HANDLING

Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

FIELD CONDITIONS

Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

Hot-Weather Placement: Comply with ACI 301 and as follows:

Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

FORM-FACING MATERIALS

Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces.

Furnish in largest practicable sizes to minimize number of joints.

Plywood, metal, or other approved panel materials.

Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

High-density overlay, Class 1 or better.

Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.

Structural 1, B-B or better; mill oiled and edge sealed.

B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

Overlaid Finnish birch plywood.

Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

Forms for Pedestals and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

Formulate form-release agent with rust inhibitor for steel form-facing materials.

Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

STEEL REINFORCEMENT

Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **25** percent.

Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 767/A 767M, Class I zinc coated after fabrication and bending.

Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M, epoxy coated, with less than 2 percent damaged coating in each 12-inchbar length.

Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

REINFORCEMENT ACCESSORIES

Flat Plate Dowels: Saw cut from ASTM A36 hot rolled plate.

PNA Construction Technologies: Diamond Dowel

Greenstreak Group, Inc.: Speed Plate

Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

CONCRETE MATERIALS

Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

Cementitious Materials:

Portland Cement: ASTM C 150/C 150M, **Type I** or **Type I/II**.

Fly Ash: ASTM C 618, **Class F or C**.

Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

Normal-Weight Aggregates: ASTM C 33/C 33M, coarse aggregate or better, graded. Provide aggregates from a single source **with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials**.

Maximum Coarse-Aggregate Size: **1-1/2 inches** nominal.

Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

Lightweight Aggregate: ASTM C 330/C 330M, **3/4-inch** nominal maximum aggregate size.

ADMIXTURES

Admixtures to be used in the concrete mixture shall be submitted for approval as part of the mixture design. No other admixtures will be allowed except those listed without the Architect’s approval.

Air-Entraining Admixture: ASTM C 260/C 260M.

Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

Retarding Admixture: ASTM C 494/C 494M, Type B.

Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

Viscosity-Modifying Admixture: ASTM C 494/C 494M, Type S.

High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, **free of carbon black,** nonfading, and resistant to lime and other alkalis.
Color: **As selected by Architect from manufacturer's full range**.
Water: ASTM C 94/C 94M **and potable**.

FIBER REINFORCEMENT
Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, **1/2 to 1-1/2 inches** long.
Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, **1 to 2-1/4 inches** long.

WATERSTOPS
Flexible Rubber Waterstops: CE CRD-C 513, **with factory-installed metal eyelets,** for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

Profile: **Ribbed without center bulb** .

Dimensions: **6 inches by 3/8 inch thick**; nontapered.

Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

VAPOR RETARDERS
(UVB-1) Under-Slab Vapor Barrier: ASTM E 1745, Class A, except with maximum water vapor permeance of less than 0.01 perms before and after conditioning tests per ASTM E 1745, Sections 7.1.1 - 7.1.5.
Minimum Sheet Thickness, ACI 302: 15 mil.
Performance Requirements:
Maximum Water Vapor Permeance, ASTM E 1745: 0.01 perms.
Minimum Tensile Strength, ASTM E 154: 45 lbf/in.
Puncture Resistance, ASTM D 1709: 2200 grams.
Products and Manufacturers:
Ecoshield E15 by Epro Services.
VaporBlock VBLP15 by Raven Industries.
Griffolyn 15 Mil Green by Reef Industries.
Stego Wrap 15 mil by Stego Industries.
VaporCheck 16 mil by Viper.

Perminator 15 mil by W.R. Meadows.
Husky Yellow Guard 15 mil by Poly-America, L.P.

Accessories: Provide accessories manufactured by or recommended in writing by vapor barrier Manufacturer for sealing seams, penetrations and perimeter edges, including; seam tape, mastics, edge termination bar, double-sided tape, and other special tapes and accessories for complete under-slab vapor barrier assembly.

Seam Tape: 4-inch minimum width; water vapor transmission less than 0.3 perms per ASTM F 1249 or ASTM E 96.

Pipe Boots: Construct pipe boots from vapor barrier material and pressure sensitive tape in accordance with Manufacturer's instructions.

FLOOR AND SLAB TREATMENTS

Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of Portland cement, graded quartz aggregate, and plasticizing admixture.

LIQUID FLOOR TREATMENTS

Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

CURING MATERIALS

Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

Water: Potable.

Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

RELATED MATERIALS

Expansion- and Isolation-Joint-Filler Strips: **ASTM D 1751, asphalt-saturated cellulosic fiber**.

Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, **aromatic polyurea with a Type A shore durometer hardness range of 90 to 95** according to ASTM D 2240.

Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

REPAIR MATERIALS

Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

Compressive Strength: Not less than **4500 psi** at 28 days when tested according to ASTM C 109/C 109M.

Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

Compressive Strength: Not less than 4**500 psi** at 28 days when tested according to ASTM C 109/C 109M.

CONCRETE MIXTURES, GENERAL

Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

Cementitious Materials: **Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:**

Fly Ash: 25 percent.

Combined Fly Ash and Pozzolan: 25 percent.

Slag Cement: 50 percent.

Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

Limit water-soluble, chloride-ion content in hardened concrete to **0.30** percent by weight of cement.

Admixtures: Use admixtures according to manufacturer's written instructions.

Use **water-reducing, high-range water-reducing or plasticizing** admixture in concrete, as required, for placement and workability.

Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

CONCRETE MIXTURE SCHEDULE

Class	Type of Construction	Min. Comp Strength @ 28 Days (PSI)	Slump Before addn. of HRWR (in. +/- 1 in.)	Max. Agg. Size (in.)	Water Cement Ratio	Air Entrain-ment % +/- 1½%	Notes
1	Footings	4500	5	1.5	0.55	6.0	(1)

2	Interior slab-on-grade	4500	3	0.75	0.45	none	(2)
3	Walls and piers	4500	4	0.75	0.45	none	(2)
4	Metal deck topping	3500	4	0.75	0.45	none	(2)(3)
5	Metal pan stairs	3500	3	0.375	0.45	none	(2)

Notes:

(1) Use a maximum of 50% replacement of portland cement with ground granulated blast-furnace slag and fly ash at a 1:1 ratio, up to 350 pounds per cubic yard. If fly ash is used alone, limit the maximum replacement to 25%.

(2) Use a maximum of 30% replacement of portland cement with ground granulated blast-furnace slag and fly ash at a 1:1 ratio, up to 350 pounds per cubic yard, with a maximum 25% fly ash. If fly ash is used alone, limit the maximum replacement to 25%.

(3) Maximum equilibrium dry weight of lightweight aggregate mix: 115 pounds per cubic foot, as determined by section 9.5 of ASTM C 567.

FABRICATING REINFORCEMENT

Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

CONCRETE MIXING

Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M **and ASTM C 1116/C 1116M**, and furnish batch ticket information.

When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

FORMWORK INSTALLATION

Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

Class A, 1/8 inch for smooth-formed finished surfaces.

Class B, 1/4 inch for surfaces to receive plaster, stucco, or wainscoting.

Class C, 1/2 inchfor general conditions.

Class D, 1 inch for foundations permanently concealed to view.

Construct forms tight enough to prevent loss of concrete mortar.

Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

Install keyways, reglets, recesses, and the like, for easy removal.

Do not use rust-stained steel form-facing material.

Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
Chamfer exterior corners and edges of permanently exposed concrete.

Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

Determine sizes and locations from trades providing such items.

Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

EMBEDDED ITEM INSTALLATION
Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

Install dovetail anchor slots in concrete structures as indicated.

REMOVING AND REUSING FORMS
General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for **24** hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved its 28-day design compressive strength.

Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

SHORING AND RESHORING INSTALLATION

Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

Do not remove shoring or reshoring until measurement of slab tolerances is complete.

Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

VAPOR-RETARDER INSTALLATION

Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

Lap joints 6 inches and seal with manufacturer's recommended tape.

Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

STEEL REINFORCEMENT INSTALLATION

General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

JOINTS

General: Construct joints true to line with faces perpendicular to surface plane of concrete.

Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

Locate joints for slabsin the middle third of spans.

Space vertical joints in walls **as indicated** . Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least **one fourth** of concrete thickness as follows:

Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

Install flat plate dowels in concrete slab-on-grade joints where shown. Install flat plate dowels per manufacturer's written instructions.

Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, and other locations, as indicated.

Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

WATERSTOP INSTALLATION

Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

CONCRETE PLACEMENT

Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

Maintain reinforcement in position on chairs during concrete placement.

Screed slab surfaces with a straightedge and strike off to correct elevations.

Slope surfaces uniformly to drains where required.

Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

FINISHING FORMED SURFACES

Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

Apply to concrete surfaces as indicated.

Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

Apply to concrete surfaces **exposed to public view or to be covered with a coating or covering material applied directly to concrete** as indicated.

Related Unformed Surfaces: 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. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

FINISHING FLOORS AND SLABS

General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

Apply scratch finish to surfaces to receive concrete floor toppings.

Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

For bidding purposes, assume finish surfaces at picker aisles between carriages to meet the following Fmin tolerances for defined traffic floors. Final installed finish surface tolerances to be based on picker manufacturer requirements.

Fmin of 100 at Print/Archives Collection Storage topping slab
Fmin of 60 at AV/Film/Art Storage topping slab

For all other concrete surfaces, finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

Specified overall values of flatness, F(F) 100; and of levelness, F(L) 66; with minimum local values of flatness, F(F) 67; and of levelness, F(L) 44; for Print and Archives Collection Storage topping slabs other than the picker aisles. Coordinate final flatness and levelness requirements with order picker vendor.

Specified overall values of flatness, F(F) 60; and of levelness, F(L) 40; with minimum local values of flatness, F(F) 40; and of levelness, F(L) 27; for AV/Film/Art Storage topping slabs other than the picker aisles. Coordinate final flatness and levelness requirements with order picker vendor.

Specified overall values of flatness, F(F) 50; and of levelness, F(L) 30; with minimum local values of flatness, F(F) 35; and of levelness, F(L) 20; for Print and Archives Collection Storage and AV/Film/Art Storage slabs-on-grade. Refer to rack manufacturer (Spacesaver) drawings for specific rail installation requirements.

Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24; for typical slabs-on-grade.

Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
Apply dry-shake floor hardener finish where CST-3 is indicated on drawings except where Fmin or F(F) is indicated to be 100 and 60 (at Print/Archives Collection Storage topping slab and AV/Film/Art Storage topping slabs), use penetrating liquid floor treatment~~.~~.

Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.

Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.

After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

VAPOR RETARDER

QUANTIFICATION OF RELATIVE HUMIDITY AT 40% OF CONCRETE THICKNESS
Comply with the manufactures installation and equipment utilizing requirements.

The test site should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period. When a building is not under HVAC control, a recording hygrometer or data logger shall be in place recording conditions during the test period. A transcript of this information must be included with the test report.

The number of in-situ relative humidity test sites is determined by the square footage of the facility. The minimum number of tests to be placed is equal to 3 in the first 1,000 square feet, and 1 per each additional 1,000 square feet.

Determine the thickness of the concrete slab, typically from construction documents.

Utilizing a rotary-hammer drill, drill test holes to a depth equal to 40% of the concrete thickness, i.e., 2" deep for a 5" thick slab, or 1.6" deep for a 4" thick slab. Hole diameter shall not exceed outside diameter of the probe by more than 0.04". Drilling operation must be dry.

Vacuum and brush all concrete dust from test hole.

Insert a relative humidity probe (sensor) to the full depth of test hole. Place cap over probe. If appropriate provide additional security to prevent cap removal using packing tape.

Permit test holes with probes to acclimate, or equilibrate for 72 hours prior to taking relative humidity readings.

Remove the cap, insert the cylindrical reading device, and obtain reading from the in-situ probe.

Read and record temperature and relative humidity in each test hole. These test results are used to determine if the slab-on-grade has experienced moisture depletion to the relative humidity level to assist in the proper adhesion of the moisture sensitive floor coverings.

QUANTIFYING PH LEVEL

At or near the relative humidity test site perform pH test.

Place several drops of water onto the concrete surface to form a puddle approximately 1" in diameter.

Allow the water to set for approximately 60 seconds

Dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading

Record and report results. These test results are used to determine if the slab-on-grade has experienced moisture depletion to the relative humidity level to assist in the proper adhesion of the moisture sensitive floor coverings.

MISCELLANEOUS CONCRETE ITEM INSTALLATION

Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

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

Equipment Bases and Foundations:

Coordinate sizes and locations of concrete bases with actual equipment provided.

Construct concrete bases as indicated and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.

Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inchcenters around the full perimeter of concrete base.

For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.

Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

CONCRETE PROTECTING AND CURING

General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

Cure concrete according to ACI 308.1, by one or a combination of the following methods:

Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

Water.

Continuous water-fog spray.

Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat.

Maintain continuity of coating and repair damage during curing period.

LIQUID FLOOR TREATMENTS

Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

Do not apply to concrete that is less than seven days old.

Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.

Rinse with water; remove excess material until surface is dry.

Apply a second coat in a similar manner if surface is rough or porous.

Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

JOINT FILLING

Prepare, clean, and install joint filler according to manufacturer's written instructions.

Defer joint filling until concrete has aged at least **six** months. Do not fill joints until construction traffic has permanently ceased.

Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

CONCRETE SURFACE REPAIRS

Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.

Compact mortar in place and strike off slightly higher than surrounding surface.

Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

After concrete has cured at least 14 days, correct high areas by grinding.

Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
Repair materials and installation not specified above may be used, subject to Architect's approval.

FIELD QUALITY CONTROL

Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; **ASTM C 173/C 173M**one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

Compression Test Specimens: ASTM C 31/C 31M.

Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
Cast and field cure two sets of two standard cylinder specimens for each composite sample.
Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 24 hrs, 48 hrs, 7 days and one set of two specimens at 28 days.
Test one set of two field-cured specimens at 24 hrs,7 days and one set of two specimens at 28 days.

A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by

Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
Measure floor and slab flatness and levelness according to ASTM E 1155 within **24** hours of finishing.

PROTECTION OF LIQUID FLOOR TREATMENTS

Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

CONSTRUCTION VERIFICATION & COMMISSIONING

Contractor is responsible for following the construction verification process and supporting commissioning in accordance with the procedures defined in specification Section 01 91 02 for testing of level flatness under shelving only.

END OF SECTION 03 30 00