**DESIGN A/E NOTE - GUIDE SPECIFICATION CONVENTIONS**

**Color-highlighted text**

**Yellow: Editor’s Notes. Comments inserted into the text are addressed to the A/E, not the Contractor. Editor’s Notes are formatted as hidden text. Editor’s Notes are not identified with an update. Do not print Editor’s Notes in issue for distribution to Bidders/Contractors.**

**Tip: To not print Editor’s Notes (hidden text) in document choose Tools on Menu bar, click Options, Print tab, under Include with document, uncheck Hidden text (check to print text), click OK. Save.**

**Tip: To view Editor’s Notes (hidden text) in a document choose Tools on Menu bar, click Options, View tab, under Formatting marks, check Hidden text (uncheck to hide text), click OK. Save.**

**Red: Text updated in 1st quarter. April – June.**

**Strikethrough text and highlighting (not text) in previously issued quarters are deleted. Only 1st quarter highlighted updated text is indicated.**

**Turquoise: Text updated in 2nd quarter. July – September.**

**1st quarter updated text remains highlighted.**

**Pink: Text updated in 3rd quarter. October – December.**

**1st and 2nd quarter updated text remain highlighted.**

**Bright Green: Text updated in 4th quarter. January – March.**

**1st, 2nd and 3rd quarter updated text remains highlighted.**

**Text Editing**

**Select options [in brackets] and edit <notes> before issuing specifications for distribution to Bidders/Contractors.**

**Delete Strikethrough text.**

**Tip: To delete strikethrough text, choose Edit on Menu bar, click Find, Find tab, More (Search Options opens), select All, click Format, Font, check Strikethrough, OK.**

 **Click Replace tab, Replace All, OK, Close. Save.**

**Delete all highlighting of text from issue to be distributed to Bidders/Contractors.**

**Tip: To delete highlighting, locate cursor at beginning of Section and block all text in Section, press Shift + Control + End, click No Highlight icon on Formatting toolbar. Save.**

**IMPORTANT: Retain month and year under section title on first page indicating updated Guide Specification Section issue used.**

**Note: This** page **will not print when Hidden text is unchecked as indicated in Editor’s Notes Tip.**

IF THE HIDDEN GUIDE SPECIFICATION CONVENTIONS DO NOT APPEAR PRECEEDING THIS

NOTE, TURN THEM ON AS FOLLOWS.

**FOR MICROSOFT WORD 2000 and 2003**, CLICK ON SHOW/HIDE ICON IN MENU BAR OR CHOOSE

TOOLS IN MENU BAR. THEN CLICK OPTIONS, VIEW TAB, UNDER FORMATTING MARKS, CHECK

HIDDEN TEXT.

**FOR MICROSOFT WORD 2007,** CLICK ON MICROSOFT OFFICE ICON LOCATED IN UPPER LEFT

CORNER OF MENU BAR. CLICK ON WORD OPTIONS AT BOTTOM OF DROP DOWN. THEN CLICK

ON DISPLAY. CHECK THE HIDDEN TEXT BOX.

**FOR MICROSOFT OFFICE 2010,** CLICK ON FILE BUTTON LOCATED IN UPPER LEFT CORNER OF

MENU BAR. IN THE DROP DOWN, CLICK ON OPTIONS, AND A WORD OPTIONS BOX WILL

APPEAR. CLICK ON DISPLAY. CHECK THE HIDDEN TEXT BOX.

THE GUIDE SPECIFICATION CONVENTIONS SHOULD NOW BE VISIBLE IN THE DOCUMENT.

(Delete this note before printing.)

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

(Edited from DeCA June 2022 Design Criteria)

**This Section specifies** certain requirements and procedures pertaining to sustainable resources and construction practices that are to be performed by the Contractor.

**This Section does not specify** requirements for planning and design which are addressed in the DeCA Design Criteria Handbook Division 01 Section 01 33 29, Sustainable Design Reporting, that are the responsibility of the A/E.

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes:

This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

Footings.

Foundation walls.

Slabs-on-grade, including medium temperature cold storage room floor slabs. (Do not place floor slabs until building spaces are enclosed and weather-tight).

Concrete floor on metal deck.

Procedures and timing for saw cutting contraction joints in slabs-on-grade.

Procedures and timing for application of liquid floor treatments.

* + - * 1. Related Sections:

Division 01 Section Sustainable Design Reporting for recycled content of steel products.

Division 03 Section Polished Concrete Finishing for concrete floor slabs receiving a polished finish.

Division 03 Section Sealed Concrete Floor Finishing for New and Existing Construction.

Division 03 Insulated Freezer Floors.

Division 09 Sections for floor finishes requiring specialty finished cast-in place concrete floor slabs.

Division 13 Cold Storage Rooms for Concrete Protection Curbs.

Division 32 Concrete Paving for exterior concrete pavement curbs-and-gutters, and walks.

* + - 1. REFERENCES
				1. Contractor shall comply with the codes and standards including but not limited to:

ACI 117, "Specifications for Tolerances for Concrete Construction and Materials”

ACI 301, "Specification for Structural Concrete”, Sections 1 through 5”

ACI 302, “Standard Practice for Concrete Floors and Slab Construction”

ACI 304, “Guide for Measuring, Mixing, Transporting, and Placing Concrete”

ACI 310, “Guide to Decorative Concrete”

ACI 318, “Building Code Requirements for Structural Concrete”

* + - * 1. REPAIR REFERENCES

NRMCA: National Ready Mixed Concrete Association: Concrete In Practice, Technical Series, 900 Spring Street, Silver Spring, Maryland 20910, (301) 587-1400, ext.101, www.nrmca.org.

PCA: Portland Cement Association: Concrete Slab Surface Defects: Causes, Prevention, Repair, 5420 Old Orchard Road, Skokie, IL 60077, (847) 966-6200, www.cement.org.

* + - 1. DEFINITIONS
				1. Cementitious Materials:

Portland cement alone or in combination with fly ash, subject to compliance with requirements.

* + - * 1. Drainage Course:

Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

* + - * 1. W/C Ratio:

The ratio by weight of water to cementitious materials.

* + - 1. SUBMITTALS
				1. Product Data:

Admixtures.

Vapor retarders.

Floor slab treatments.

Drainage course and topping.

Curing methods or compounds.

Cementitious materials.

Waterstops.

Joint filler.

Aggregates.

* + - * 1. **[LEED Submittals:**

**Retain first subparagraph below if recycled content is required for LEED-NC or LEED-CI Credits MR 4.**

**Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.**

**Include statement indicating costs for each product having recycled content.]**

* + - * 1. Design Mixtures:

Submit mix design for each concrete mix including test results documenting average compressive strength in accordance with ACI 301. For each concrete mixture, submit data and test documentation on materials and mixture proportions. Include supplier’s data and tests for aggregates and cementitious materials including Portland cement and fly ash applicable. 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.

* + - * 1. Ready-Mixed Concrete:

Furnish batch ticket information, prepared and distributed in accordance with ASTM C 94.

Statement of Material Content and Proportions Selected: Prior to actual delivery of concrete, furnish a statement giving the dry masses of cement and saturated surface-dry-masses of fine and coarse aggregate and quantities, type, and name of admixtures (if any) and of water per cubic yard or cubic meter of concrete that will be used in the manufacture of each class of concrete specified. Furnish evidence that the materials to be used and proportions selected will produce concrete of the quality specified.

* + - * 1. Shop Drawings:

Shop and placing Drawings that detail fabrication, bending, and placement of steel reinforcement. 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.

* + - * 1. Samples:

Vapor retarder.

* + - * 1. Field Quality-Control Tests and Inspection Reports.
				2. Submittal Requirements in ACI 301:

"Specification for Structural Concrete" Sections 1 through 5.

* + - * 1. Special Inspection Reports.
				2. Saw-cutting system to be used.
				3. Qualification Data: For Floor Finishers, Ready Mix Concrete Producer, Testing Agency, Special Inspectors.
				4. Submittal List:

 Reference Submittal Item Quantity Action

 1.4A Product Data X R

 **[1.4B LEED Submittals X I]**

 1.4C Design Mixtures X R

 1.4D Ready-Mixed Concrete X R

 1.4E Shop Drawings X R

 1.4F Samples X R

 1.4G Field Tests and Reports X R

 1.4H ACI Submittals X R

 1.4I Special Inspection Reports X R

 1.4J Saw-cutting System X R

 1.4K Qualification Data X R

 X Submit quantity specified in Division 01 Section Administrative Requirements.

 R Review each submittal, mark to indicate action taken, and return.

 I Submittal is for information or record purposes only. No action will be taken*.*

* + - 1. QUALITY ASSURANCE
				1. 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".

* + - * 1. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
				2. Testing Agency Qualifications:

An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

Personnel conducting field tests shall be qualified as ACI certified Concrete Field-Testing Technician, Grade 1, according to ACI CP-01 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.

* + - * 1. Source Limitations:

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

* + - * 1. ACI Publications (other applicable construction industry standards indicated throughout this Section have the same force and effect as if listed below):

Comply with the following unless modified by requirements in the Contract Documents:

ACI 301, "Specification for Structural Concrete", Sections 1 through 5.

ACI 302.1, "Guide for Concrete Floor and Slab Construction".

ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".

* + - * 1. ASTM Publications:

Comply with the following unless modified by requirements in the Contract Documents (other applicable construction industry standards indicated throughout this Section have the same force and effect as if listed below):

ASTM E 96, "Test Methods for Water Vapor Transmission of Materials".

ASTM E 1155, "Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers".

ASTM E 1643, "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs".

ASTM E 1745, "Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs".

* + - * 1. Special Inspector Qualifications:

Special inspections for reinforced concrete shall be performed under the direct supervision of a Professional Engineer registered in the State in which the project is located. The personnel performing the inspections shall be an ICC-certified Reinforced Concrete Special Inspector or an equivalent certification program, as approved by the Contracting Officer.

* + - * 1. Floor Finisher Qualifications:

The concrete floor finishing subcontractor, Lead Finisher and two additional members of the finishing crew, shall be certified under the Concrete Flatwork Finisher Training and Certification Program as granted by the American Concrete Institute.

The concrete floor finisher subcontractor shall have experience in finishing interior floors of similar size and scope in at least 5 previous projects.

* + - * 1. Preinstallation Conference:

Conduct conference at Project site to comply with requirements in Division 01 Section Administrative Requirements.

Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring the quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

Contractor's superintendent.

Independent testing agency responsible for concrete design mixtures.

Ready-mix concrete manufacturer.

Concrete subcontractor.

Concrete floor finishing subcontractor.

Polished concrete floor finish installer (attendance may be telephonically).

Government’s Consultant.

Concrete Special Inspector.

Concrete Testing Agency Representative if different than the Special Inspector.

Government’s Authorized Technical Representative.

Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, drainage course installation, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection. Unacceptable floor slab finishes include blisters, cracking, crazing, curling, delamination, surface discoloration, dusting, efflorescence, popouts, scaling, and spalling. Sources available to the Contractor identifying causes, prevention, and repair of concrete slab surface defects are available from the Portland Cement Association and the National Ready Mix Concrete Association as identified in Paragraph 1.2 "References".

Review protection precautions relating to the polished concrete floor finish system as specified in Division 03 Section Polished Concrete Finishing including, but not limited to, the following:

No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete floor surface. Prevention is therefore essential.

Diaper hydraulic powered equipment to avoid staining concrete.

No tire embedments (rocks, nails, screws, etc.) that will scratch or pit slab surface. All lifts on site must use canvas tire bags to prohibit screws and nails from penetrating the rubber tires.

Do not park vehicles on concrete floor slab. Place drop cloths under vehicles if it is necessary to park vehicles on concrete slab to complete work.

Do not use pipe cutting machines on the concrete floor slab.

To avoid rust staining do not place steel on concrete floor slab.

Do not allow acids and acidic detergents to come into contact with concrete floor slab.

Inform all trades that the concrete floor slab must be protected at all times.

Do not use slabs as casting bed for tilt-up concrete.

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Deliver, store, and handle steel reinforcement to prevent bending and damage.
1. PRODUCTS
	* + 1. MANUFACTURERS
				1. Basis‑of‑Design Products: To establish the significant qualities related to type, function, dimension, in‑service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other manufacturers, a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation. Subject to compliance with requirements, provide either the named products or equal products.
			2. DRAINAGE COURSE BENEATH SLAB-ON-GRADE
				1. Any local state department of transportation approved road base material with 100 percent passing the 1-1/2 inch (38 mm) sieve, 15 percent to 55 percent passing the No. 4 (4.75 mm) sieve and less than 12 percent passing the No. 200 (75 mm) sieve, or a material that satisfies the requirements of ASTM D1241 with the modified allowance of less than 12 percent passing the No. 200 (75 mm) sieve.
				2. Material passing the No. 200 (75 mm) sieve shall be clean granular fill with less than 3 percent clay or friable particles.
				3. A thin layer (approximately ½ inch thick) of fine-graded material shall be compacted over the drainage course prior to installation of the vapor retarder.
			3. FILL COURSE FOR USE OVER VAPOR RETARDER
				1. Fill course shall be a trimmable, compatible, granular fill material in accordance with paragraph 2.2.A. Following compaction, the surface shall be choked off with a fine-grained material.
			4. FORM-FACING MATERIALS
				1. Smooth-Formed Finished Concrete:

Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

Plywood, metal, or other approved panel materials.

* + - * 1. 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.

* + - * 1. Form-Release Agent:

Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

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

* + - * 1. Form Ties:

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

* + - 1. STEEL REINFORCEMENT
				1. Reinforcing Bars:

ASTM A 615/A 615M, Grade 60, deformed.

* + - * 1. Plain-Steel Wire:

ASTM A 82, as drawn.

* + - 1. CONCRETE MATERIALS
				1. Cementitious Material:

Portland Cement: ASTM C 150, Type I, of the same type, brand, and source, throughout Project:

* + - * 1. Normal-Weight Aggregates:

ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

Maximum Coarse-Aggregate Size: As indicated.

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

* + - * 1. Water:

ASTM C 1602 and potable.

* + - * 1. Fly Ash:

ASTM C 618, Type F.

* + - * 1. Admixtures:

Do not use admixtures unless specifically indicated or approved by Contracting Officer.

* + - * 1. Air-Entraining Admixture:

ASTM C 260.

* + - 1. VAPOR RETARDERS
				1. Vapor Retarder:

Vapor Retarder: ASTM E 1745, Class B or A, with the following minimum criteria:

Thickness: Minimum 15 mil per ACI 302.1R, section 3.2.3.

Water-vapor permeance: Maximum 0.3 Perms as tested per ASTM E 96.

Basis-of-Design Products:

Stego Wrap (15 mil) Vapor Barrier; Stego Industries LLC.

Griffolyn Vaporguard; Reef Industries.

VaporBlock 15; Raven Industries.

Perminator (15 mil); W. R. Meadows.

* + - * 1. Accessories:

Seam Tape: Minimum 4-inch width, of high-density polyethylene with pressure sensitive adhesive on one side, or as recommended by the product manufacturer.

Barrier Penetration Boots: Constructed of the vapor retarder product or as recommended by the product manufacturer.

* + - 1. ~~FLOOR AND SLAB TREATMENTS~~
				1. ~~Acrylic Liquid Floor Sealing Treatment (ONLY TO BE APPLIED TO AREAS THAT ARE NOT RECEIVING POLISHED CONCRETE TREATMENTS):~~

~~Waterborne solution, VOC compliant, 15 percent to 20 percent total solids, that dries to form a clear, glossy, protective film that seals concrete surfaces.~~

~~Basis-of-Design Products:~~

~~Dress & Seal WB; L&M Construction Chemicals, Inc.~~

~~Aqua Cure VOX; Euclid Chemical Co.~~

~~Mastercure CC 200WB; BASF Corp.~~

* + - 1. EVAPORATION RETARDER
				1. Evaporation retarder below temporarily reduces moisture loss from concrete surfaces awaiting finishing in hot, dry, and windy conditions. Evaporation retarders are not curing compounds. ~~Do not use surface film forming evaporation retarder on floor slabs receiving floor finish specified in Division 3, Section “Polished Concrete Finishing” unless approved by polished concrete floor finish manufacturer.~~ Water cure is acceptable in addition to the products listed below.

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

Basis-of-Design Products.

ChemMasters; Spray-Film.

Dayton Superior Corporation; AquaFilm.

Euclid; Eucobar.

W. R. Meadows; Evapre.

* + - 1. CURING MATERIALS
				1. Curing and Protection:

Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures. Maintain concrete at a relatively constant temperature without drying for the period of time necessary for the hydration of the cement and proper hardening of the concrete.

* + - * 1. Penetrating Film Forming Cure or Absorptive Cover Curing Materials ~~are to be used in areas to receive polished concrete finish~~:

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

Penetrating Film Forming Dissipating Cure:

Skudo Cure; Skudo Corporations.

PCA; AmeriPolish.

Substitutions by Approval Only.

* + - * 1. Potable Water completely covering all slabs for a minimum of 7 days.
			1. RELATED MATERIALS
				1. Expansion- and Isolation-Joint-Filler Strips:

ASTM D 1751, asphalt-saturated cellulosic fiber.

* + - * 1. In areas not receiving polished concrete floor finish, refer to section 079200.

At interior column expansion joints use a Void Cap system at the surface where the top 1/2” can be easily removed and filled later.

* + - * 1. Saw-cutting System:

Power saw equipped with shatter-proof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface before concrete develops random contraction cracks. Use the following saw cutting system appropriate to procedures and timing for saw cutting contraction joints in slabs-on-grade.

Early-Entry Dry-Cut Saws:

Basis-of-Design: "Soff-cut" early drycut saws by Soff-Cut International, Inc.

Conventional Saws.

Saw-Cut Control Joint Dust Collection:

Connect a dust collection system directly to each saw being used.

Basis of Design: ProVac Dust Collection System PVG-55 by Glad Tech Inc.

* + - * 1. Wood Thermal Break at Medium Temperature Cold Storage Floor Slabs

Wood Blocking:

Provide either of the following:

Wood-preservative-treated materials in accordance with requirements specified in Division 06 Section Rough Carpentry.

Garden Grade Redwood: Construction Heart or Merchantable Heart, vertical or flat grain, seasoned or unseasoned, surfaced or unsurfaced texture.

* + - * 1. Isolation Membrane at medium temperature cold storage floor slab door opening.

Isolation membrane shall be ASTM D 226 Type II, No. 30 asphalt felt.

Retain article below only for existing projects requiring repair of slabs-on-grade.

* + - 1. CONCRETE MIXTURES, GENERAL
				1. Design Mixture Preparation:

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.

Use Option A, ASTM C 94, as a basis for determining the proportions of the concrete to produce the required quality.

* + - * 1. Cementitious Materials:

Limit percent by weight of cementitious materials other than Portland cement in concrete as follows:

Fly Ash; 5 percent maximum in floors receiving special concrete floor finish, 15 percent maximum elsewhere.

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

Combined Fly Ash or Pozzolan and Slag Cement: 15 percent Portland cement minimum with fly ash or pozzolan not exceeding 15 percent.

* + - * 1. Concrete Mixtures:

Subject to compliance with requirements, proportion normal-weight concrete mixtures and provide floor and slab final finishes for each mix type in accordance with the Concrete Mixture Schedule at the end of Part 3.

Total air content for concrete slab mixtures ~~to receive polished concrete finish~~ shall be ~~2~~ 3 percent entrapped air plus or minus 1 percent. Do not use air entrainment.

* + - * 1. Chloride-Ion Content:

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

* + - * 1. Admixtures:

Where indicated or approved, use admixtures according to manufacturer's written instructions.

* + - 1. FABRICATING REINFORCEMENT
				1. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
			2. CONCRETE MIXING
				1. Ready-Mixed Concrete:

Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, 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.

Addition of Water at Job Site: Unless the delivery ticket states the amount of water that can be added without exceeding the design water cement ratio and the slump of the mix, water cannot be added at the job site. Addition of water above the design water/cement ratio shall be cause for rejection of the concrete.

1. EXECUTION

Use the following paragraph for floors that will be polished concrete.

* + - 1. PREPARATION FOR SLABS TO RECEIVE POLISHED CONCRETE FINISH
				1. General:
1. Set forms at slab height.
2. Use pans at least two passes in each direction to further smooth out inconsistencies after screeding but before blades are used.
3. Only use plastic or combo blades for finishing
4. Take the slab to the point where it is starting to burn.
5. Slabs left “fuzzy” or porous may require additional chemical treatments prior to polishing.
6. Mechanical Edge Finishing Trowels are recommended to consolidate all edges.
7. Where possible, use a walk behind trowel going around the perimeter of the pour at least two times in a counterclockwise motion.  The walk behind trowel should be taken onto forms or onto adjacent concrete placements several inches.  This process is intended to consolidate the concrete along the edge while insuring that there are no humps or valleys adjacent to the forms or other pours.
	* + 1. FORMWORK
				1. General:

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 and ACI 301 except as specified herein.

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

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

Class C, 1/2 inch for rough-formed finished surfaces.

Construct forms tight enough to prevent loss of concrete mortar.

Fabricate 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.

Provide slab side forms, of form materials specified, full depth, with beveled, level, and smooth top surface for all slabs where SOV is greater than FF 35 / FL 25.

Provide slab side forms such that by placing a 10-foot straightedge, form does not exceed 1/8 inch variation.

* + - 1. EMBEDDED ITEMS
				1. General:

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's "Code of Standard Practice for Steel Buildings and Bridges".

Install loading dock leveler pit framing angles and anchors in accordance with dock leveler manufacturer's written instructions.

* + - 1. REMOVING AND REUSING FORMS
				1. 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, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

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

* + - * 1. Reused Forms:

Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be 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.

* + - 1. VAPOR RETARDERS
				1. Vapor Retarder Installation:

Place, protect, and repair vapor-retarders over the prepared subgrade in accordance with ACI 302.1R, ASTM E 1643 and manufacturer’s instructions, as applicable.

Place the vapor retarder sheeting over the prepared base with the longest dimension parallel with the direction of the concrete slab.

Lap joints 6 inches and seal with seam tape (or manufacturers recommended adhesive).

Lap vapor retarder over footings or onto foundation walls, or both, and seal around all penetrations such as utilities and columns in order to create a monolithic membrane between the moisture source below the slab and the slab.

* + - * 1. Vapor Retarder Protection:

Take precautions to protect vapor retarder from damage during installation of utilities, and during drainage course placement.

Avoid use of stakes driven through the retarder.

Inspect and repair all punctures, damage or opened seams in the membrane retarder immediately prior to subsequent placement of drainage course.

* + - 1. STEEL REINFORCEMENT
				1. General:

Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

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

Use concrete brick type reinforcing bar supports or steel bar support chairs.

Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would 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.

For slabs-on-grade space reinforcing bar supports not to exceed 4 feet on center in each direction.

Set wire ties with ends directed into concrete, away from exposed concrete surfaces.

* + - 1. JOINTS
				1. General:

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

Provide construction, isolation and contraction joints as indicated on Drawings and as noted below.

Bulkheads for construction joints shall be 1-1/2 inch minimum lumber. Do not use permanent preformed metal bulkheads.

Provide bulkheads the full depth of the member.

Space joints to allow one continuous placement between bulkheads.

Unless otherwise shown on Drawings, maximum spacing between contraction, construction, or isolation joints in slabs on grade shall be lesser of the following:

36 x slab thickness in inches.

Length-to-width ratio of 1-1/2: 1.

Unless otherwise shown on the Drawings, do not extend reinforcement, corner protection angles, bars or other fixed metal items through construction joints in slabs on grade or pavements or through joints between slabs on grade and vertical surfaces.

* + - * 1. Construction Joints:

Install so strength and appearance of concrete are not impaired at locations indicated or as approved by Contracting Officer.

Do not use keyed joints in floors.

Do not use an edging tool on construction joints or column block-outs.

Fill joints per 07 92 00 – Joint Sealants.

* + - * 1. Contraction Joints (Shrinkage/Crack Control Joints) in Slabs-on-Grade:

Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints 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 before concrete starts to cool, when cutting action will not tear, abrade, or otherwise damage surface, and before concrete develops random contraction cracks.

Early-Entry Dry-Cut Saw Cutting: Saw cut slab within 1 hour in hot weather to 2 hours in cold weather after completing finishing of the slab in that joint location. Minimum saw cut depth of 1 inch within time limits. Clean out joints with a diamond impregnated saw blade equipped with a dustless vacuum system to ensure sides of joint walls are clean so that joint filler can bond with them.

Conventional Saw Cutting: Saw cut slab within 4 hours in hot weather to 12 hours in cold weather after the slab has been finished in an area. Depth of saw cut using conventional saw shall be at least one-quarter of slab depth or minimum of 1 inch, whichever is greater.

Fill joints per 07 92 00 – Joint Sealants.

* + - * 1. 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, grade beams, and other locations, as indicated.

Extend joint-filler strips full width and depth of joint, terminating top of strip below finished concrete surface as indicated.

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

Form isolation joints of preformed joint-filler strips where indicated.

Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

Fill joints per 07 92 00 – Joint Sealants.

* + - * 1. Perimeter Wood Thermal Break around Cold Storage Floor Slabs:

Provide wood thermal break around cold storage room floor slabs. Discontinue wood thermal break at door openings and provide No. 30 felt isolation membrane across door opening.

* + - 1. CONCRETE PLACEMENT
				1. General:

Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

Do not add water to concrete after adding high-range water-reducing admixtures to the mixture. No water shall be added to the design mix after leaving the batch plant, unless specifically allowed by the approved mix design and within the limitations of ACI 301.

Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be 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 to not 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.

Slab on Grade Thickness: Plus (+) as required to conform to slab finished surface flatness and levelness tolerances specified, and minus (-) 1/4 inch, with the average of all thickness samples equal to or greater than the specified slab thickness.

Delete sub-paragraph below if tilt-up concrete is not applicable to project.

Where floor slab is to be used as casting bed for tilt-up concrete, provide materials and methods compatible with those specified for tilt-up concrete work.

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.

Slabs to receive polished concrete finish shall not be used as casting bed for tilt-up concrete.

* + - * 1. Cold-Weather Placement:

Comply with ACI 306.1. 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.

Immediately before placing concrete, metal embedments and other metal items in contact with concrete shall be at temperature above 32 deg F if one or more of the following conditions are met:

Metal item weighs more than 15 pounds per lineal foot.

Metal item is compact and weighs more than 50 pounds total.

Items noted on Drawings.

Subgrade shall be thawed to depth of 12 inches immediately before placing concrete.

Measure and record concrete temperature during protection period in each placement at regular time intervals, but not less than 3 times per 24-hour period.

Do not place concrete on subgrade, subbase, base or forms that have a temperature less than 35 deg F. Warm subgrade, subbase, base, or deck to a temperature of 35 deg F or more, but not more than 65 deg F.

Do not use combustion heaters during first 48 hours without precautions to prevent exposure of concrete to exhaust gases containing carbon dioxide and carbon monoxide.

* + - * 1. 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.

Concreting in Hot, Dry or Windy Weather:

When the concrete's rate of evaporation exceeds 0.2 pounds per square foot per hour, as determined by analysis, or any combination of concrete materials and weather conditions are favorable for the formation of plastic shrinkage cracks, the Contractor shall employ all necessary precautions to avoid cracking.

Maintain an accurate reading thermometer at the job site to check temperature of concrete.

Reject concrete based on following criteria: For slabs, reject concrete if its temperature before placement is 95 deg F or above unless otherwise approved by Contracting Officer. During hot weather, mixing and delivery (discharge) time shall be shorter than specified in ASTM C94 as follows unless otherwise approved by the Contracting Officer:

When air temperature is between 85 deg F and 90 deg F, reduce allowable mixing and delivery time from 90 minutes to 75 minutes.

When air temperature is over 95 deg F, reduce allowable mixing and delivery time to 60 minutes.

Do not place concrete when forms, subgrade, subbase or reinforcing bars are more than 120 deg F or the temperature differential between the forms, subbase, base, or reinforcing bars and concrete will create conditions favorable for settlement cracks or thermal cracking.

Cool with water or water-soaked burlap as necessary, but allow no standing water on surface on which concrete is placed.

* + - * 1. Precipitation Protection: Protect surfaces of exposed concrete from precipitation until adequate strength is gained to prevent damage.
				2. Enclosed Environment: Limit internal combustion sources to prevent carbonation of slab surface.
			1. FINISHING FORMED SURFACES
				1. 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 not exposed to public view.

* + - * 1. 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.

* + - * 1. 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.

* + - 1. FINISHING FLOORS AND SLABS
				1. General:

Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces.

Subject to compliance with requirements, and recommendations of floor surfacing materials manufactures, provide floor and slab final finishes indicated for each floor and slab Mix Type in the Concrete Mixture Schedule at the end of Part 3.

Do not place floor slabs until building spaces are enclosed and weather tight.

Do not add water to slab surface during finishing operations.

Do not add cement to slab surface during finishing operations.

Perform no finishing operation while water is present on slab surface.

If concrete is firm enough for floating but substantial amount of bleed water is still on surface, water may be removed by one of the following methods:

Fans or blower heaters, provided that the airflow does not dry, dust, or crust the surface or cause cracking.

If concrete surface is stiff enough to not be damaged, rubber hose may be dragged slowly over surface one time without disturbing surface.

Initial Leveling: Complete bull floating, darbying and straight-edging before any bleed water is present on slab surface.

Hand and Power Floating:

Do not start floating until following conditions are met:

Bleeding is finished.

Bleed water is gone, including water sheen on slab surface.

Concrete will sustain the weight of finishers without creating more than 1/8 to 1/4 inch indentations.

Mortar is not thrown by rotating blades of power float.

Do not use following tools for floating:

Power troweling machines with trowel blades.

Fresno or other type of wide metal trowel.

Power floating machine with water attachment for wetting concrete.

Float three times minimum with each floating at right angles to previous floating, and final pass at 45 deg to previous pass.

Normal Trowel Finish:

Hand or power float floor before starting troweling.

~~Plastic (Nylon, etc.) blades are only permitted for slabs to receive polished concrete finish.~~

For first troweling, keep blade as flat as possible and use low speed, minimizing "washboard" or "chatter marks" and "pitting".

Trowel two times minimum with first two trowelings at right angles. Some burn marks are acceptable. Cease troweling before trowel blades scratch surface.

Allow time between trowelings for concrete to stiffen and water sheen to disappear.

Do not add water to slab surface during troweling.

Do not ride trowels on existing slabs. Trowels shall be carried off of slab surfaces. When parking power trowels on fresh concrete, place on top of plywood or spray area with evaporation retarder before placing trowel on top of slab.

* + - * 1. Hard Trowel Finish:

After applying normal trowel finish, apply hard trowel finish by hand and power-driven trowel. Power trowel a minimum of three times and finally hand trowel to render finished surface essentially free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings. Unless otherwise indicated follow the finishing operations described in ACI 302.1R, for Floor Classification, Class 5.

Apply a hard trowel finish to surfaces indicated.

~~Where "Polished Concrete Floor Finish" is indicated follow the finishing operations described in ACI 302.1R, for Floor Classification, Class 9 and as follows:~~

Construct slabs in long strips less than 20 feet in width.

Adjust the slump the point of placement to within plus or minus 1/2 inch of the target slump.

Provide concrete with sufficient slump at the point of deposit to permit use of a modified highway straightedge to close the floor surface without difficulty after the initial strikeoff.

The "window of finishability" shall be sufficient to perform necessary finishing operations.

Use enough trucks to ensure an uninterrupted concrete supply.

* + - * 1. Floor Slab Finish Tolerances:

Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

Unless otherwise indicated: ~~Specified Overall Values (SOV) of flatness, F(F) 35; and of levelness, F(L) 25; with Minimum Local Values (MLV) of flatness, F(F) 26; and of levelness, F(L) 19 tolerance for troweled floors in accordance with ACI 117. An ACI certified Flatwork Finisher will not be required for finishing of these floors.~~

~~Delete sub-paragraph below if polished concrete floor finish is not applicable to project.~~

~~Where "Polished Concrete Floor Finish" is indicated:~~ Specified Overall Values (SOV) of flatness, F(F) 50 and of levelness, F(L) 40; with Minimum Local Values (MLV) of flatness, F(F) 38; and of levelness, F(L) 26 tolerance for troweled floors in accordance with ACI 117.

Remedies for out-of-tolerance work:

Remove and replace slabs-on-grade measuring below either (or both) of specified minimum local F-numbers. Do not use repair materials specified in Part 2 to correct out of tolerance work.

Remove and replace slab-on-grade areas containing craze cracking.

Remedy other out-of-tolerance work as required by Contracting Officer.

Slab areas requiring removal shall be removed to established joint pattern indicated on Drawings.

* + - * 1. Broom Finish:

Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

* + - 1. MISCELLANEOUS CONCRETE ITEMS
				1. Filling In:

Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. 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.

* + - * 1. 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.

* + - * 1. Equipment Bases and Foundations:

Provide machine and equipment bases and foundations as shown on Drawings. Coordinate sizes and locations with actual equipment provided. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from the manufacturer furnishing the machines and equipment.

* + - * 1. Steel Pan Stairs:

Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screen, tamp, and trowel concrete surfaces.

* + - 1. CONCRETE PROTECTING AND CURING
				1. General:

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Use evaporation retarders as needed to assist this process. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

Start curing as soon as concrete surface will not be damaged by curing operations.

Continuously cure concrete for at least 7 consecutive days.

During curing period, if the water cure method is used, do not allow any part of the concrete to become dry.

Do not use polyethylene sheets on exposed interior floors.

* + - * 1. 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.

Do not use evaporation retarder on floor slabs receiving floor finish specified in Division 03 Section Polished Concrete Finishing unless approved by special concrete floor finish manufacturer

* + - * 1. Formed Surfaces:

Cure formed concrete surfaces. Keep forms in contact with concrete wet during curing period unless type of form is impervious to water, such as metal or fiberglass. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period with other approved methods.

* + - * 1. Unformed Surfaces:

Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, and other surfaces.

* + - * 1. Curing:

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.

Penetrating Film Forming Cure.

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.

* + - 1. ~~LIQUID FLOOR TREATMENTS~~
				1. ~~Acrylic Liquid Floor Sealing Treatment:~~

~~Apply two coats of sealer in accordance with manufacturer's recommendations. Apply first coat of sealer after concrete has cured to the extent required by the floor sealer manufacturer. Apply second coat of sealer just before completion of project.~~

* + - 1. CONCRETE SURFACE REPAIRS (FOR NON-POLISHED CONCRETE)

Concrete surface repairs in polished concrete areas shall be governed by section 03 35 40 Interior Concrete Slab Repairs and Joint Filler Replacement.

* + - * 1. Defective Concrete:

Repair and patch defective areas when approved by Contracting Officer. Remove and replace concrete joint-to-joint that cannot be repaired and patched to Contracting Officer’s approval.

* + - * 1. Patching Mortar:

Mix dry-pack patching mortar, consisting of one-part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

* + - * 1. 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 ~~in~~ to solid concrete. Limit cut depth to ¾ 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 will match 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 Contracting Officer.

Retain paragraph and sub-paragraphs below only for existing projects requiring repair of slabs-on-grade.

* + - * 1. 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.

* + - 1. FIELD QUALITY CONTROL
				1. Testing and Inspecting:

The Contractor shall engage a testing agency to perform concrete tests.

The Contractor shall employ a concrete special inspector, approved by the Contracting Officer, to perform special inspections.

* + - * 1. Inspections:

Revise below in accordance with applicable code for Project.

The inspection program by the Special Inspector shall comply with Table 1705.3 of the 2015 International Building Code.

* + - * 1. Concrete Tests:

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

Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

When frequency of testing will provide 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, pressure method, for normal-weight 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.

Compressive-Strength Tests: ASTM C 39/C 39M.

Test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

Test one set of two field-cured specimens at 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.

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 Contracting Officer, 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.

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 Contracting Officer. 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 Contracting Officer.

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 dos not comply with the Contract Documents.

* + - * 1. Floor Flatness F(F) and Levelness F(L):

Test floor slab finished surface areas for flatness and levelness in accordance with ASTM E 1155 within 72 hours of finishing.

F-Number requirements shall be as follows for all interior floor slabs.

Slabs on Grade: F(F) / F(L) minimum overall for composite of measured values (SOV) for entire day's concrete placement; F(F) / F(L) minimum for any individual floor section (MLV) as specified in Finishing Floors And Slabs article in Part 3 above.

A test section shall consist of any subdivision of a test surface satisfying the following criteria:

No test section shall measure less than 8 feet on a side, nor comprise an area less than 320 square feet.

No portion of the test surface shall be associated with more than one test section.

When testing a concrete floor no test section boundary shall cross any construction joint.

No sample measurement line shall measure less than 11 feet in length.

No portion of any sample measurement line shall fall within 2 feet of any slab boundary, construction joint, isolation joint, block-out, penetration, or other similar discontinuity (Exception: Shrinkage crack control joints formed either by partial depth saw cuts or by partial depth inserts shall be ignored).

Complete testing, identify defective areas, and submit written report within 24 hours after testing.

END OF SECTION

**CONCRETE MIXTURE SCHEDULE**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Mix Type | Use | fcMin at 28 Days,psi | Agg SizeMaxainches | Slump Limit,inches | w/cRatioMax | Air Content, bpercent | Floor/SlabFinal Finish |
|  | Footings | 3000 | 1-1/2 | 4 | 0.68 | None | NA |
|  | Foundation Walls Not Subject to Freezing and Thawing | 3000 | 1-1/2 | 4 | 0.68 | None | NA |
|  | Foundation Walls Subject to Freezing and Thawing - Retaining Walls | 4500 | 1-1/2 | 4 | 0.44 | 6.5 | NA |
|  | Interior Slabs-on-Grade Unless Otherwise Indicated, Floor Classification 5 | 4000 | 1 | 4 | 0.47 to 0.53 | None | Hard trowel finish |
|  | Interior Slabs-on-Grade Slab Polished Concrete Floor Finish, Floor Classification 9 | 4000 | 1 | 4 | 0.47 to 0.53 | None | Hard trowel finish |
|  | Freezer Floor and Cooler / Freezer Curbs | 4000 | 1 | 4 | 0.45 | None | Hard trowel finish |
|  | Interior Concrete Floor on Metal Deck, Exposed Surface  | 3500 | 1/2 | 4 | 0.47 to 0.53 | None | Hard trowel finish |
|  | Interior Miscellaneous Concrete, Non-Structural, Exposed Surface | 3000 | 1 | 4 | 0.47 to 0.53 | None | Hard trowel finish |
|  | Interior Equipment Pads, Non-Structural, Exposed Surface | 3000 | 1 | 4 | 0.47 to 0.53 | None | Hard trowel finish |
|  | Exterior Miscellaneous Concrete, Exposed Surface | 4500 | 1 | 4 | 0.40 | 6.5 | Broom finish |
|  | Exterior Equipment Pads, Exposed Surface | 4500 | 1 | 4 | 0.40 | 6.5 | Broom finish |

Concrete Mixture Schedule Notes:

1. Maximum size of coarse aggregates: Comply with ACI 301 for minimum clearance between reinforcing bars, sides of forms, and slab or topping thickness (except in unbonded topping maximum aggregate size shall not exceed one-quarter topping thickness).
2. Air Content, when determined in accordance with ASTM C231: As indicated in Concrete Mixture Schedule for Mixes where air-entrainment is required.

NA: Not applicable.