SECTION 033000

CAST-IN-PLACE CONCRETE

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***NOTE TO SPECIFIER***

*Use this Specification Section for Mail Processing Facilities.*

***This is a Type 1 Specification with completely editable text; therefore, any portion of the text can be modified by the A/E preparing the Solicitation Package to suit the project.***

*For Design/Build projects, do not delete the Notes to Specifier in this Section so that they may be available to Design/Build entity when preparing the Construction Documents.*

*For the Design/Build entity, this specification is intended as a guide for the Architect/Engineer preparing the Construction Documents.*

*The MPF specifications may also be used for Design/Bid/Build projects. In either case, it is the responsibility of the design professional to edit the Specifications Sections as appropriate for the project.*

*Text shown in brackets must be modified as needed for project specific requirements.* *See the “Using the USPS Guide Specifications” document in Folder C for more information.*

*The last date that USPS revised this standard specification section occurs in two places, at the end of this section and in the Table of Contents. If the date in this section matches the date in the Table of Contents, then you are using the latest version. Do not delete or revise the “last revised” date at the end of the section during the development of the Project Manual.*

*The footer in this section should be edited to replace the text, “USPS MPF SPECIFICATION” with the project name, and the blank date in the center should be replaced with the submission date, for interim design reviews, or the issue date of the completed Project Manual.*

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1. GENERAL
   1. SUMMARY
      1. Includes all labor, materials and appliances, and perform all operations in connection with the installation of Concrete Work, and all related work incidental to the completion thereof, as shown on the drawings, complete, in strict accordance with the drawings and as specified herein. Section Includes:
         1. Cast-in-place (CIP) concrete in building frame elements, walls, foundations, foundation walls, slabs-on-grade, and mechanical equipment pads.
         2. Finishing of concrete floor slabs and toppings. Concrete liquid surface treatment, sealer, and slip-resistant coatings.
         3. Expansion and contraction, control joints in CIP concrete.
         4. Concrete curing and protection.
         5. Non-shrink grout including installation and forming.
         6. Testing related services.
      2. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents and References in Section 1.2.
      3. Related Sections: Related work specified elsewhere includes but may not be limited to
         1. Section 031000: Concrete Forming and Accessories
         2. Section 032000: Concrete Reinforcement
   2. REFERENCES
      1. American Concrete Institute (ACI) Codes and Standards latest editions:
         1. ACI 117, “Standard Specification for Tolerances for Concrete Construction and Materials.”
         2. ACI 301, “Specification for Structure /Concrete.”
         3. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
         4. ACI 304R, “Guide for Measuring, Mixing, Transporting, and Placing Concrete.”
         5. ACI 305, “Hot Weather Concreting.”
         6. ACI 306, “Cold Weather Concreting.”
         7. ACI 311, “Recommended Practice for Concrete Inspection.”
         8. ACI 315, “Details and Detailing of Concrete Reinforcement.”
         9. ACI 318, “Building Code Requirements for Structural Concrete.”
         10. ACI 347, “Guide to Formwork for Concrete.”

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**NOTE TO SPECIFIER**

Insert additional code references required for specific project.

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* + - 1. [ ]
    1. American Welding Society (AWS)
       1. AWS D1.4, "Structural Welding Code Reinforcing."
    2. American Society for Testing and Materials (ASTM).
       1. ASTM A615, "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."
       2. ASTM C33, "Standard Specification for Concrete Aggregates."
       3. ASTM C94, "Standard Specification for Ready-Mixed Concrete."
       4. ASTM C150, "Standard Specification for Portland Cement."

5. ASTM C260, "Standard Specification for Air Entraining Admixtures for Concrete."

6. ASTM C309, "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.”

7. ASTM C494, "Standard Specification for Chemical Admixtures for Concrete."

8. ASTM C618, "Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."

9. ASTM C989, “Standard Specification for Ground Granulated Blast-Furnace Slag for Use in

* + 1. Concrete Reinforcing Steel Institute (CRSI),
       1. CRSI "Manual of Standard Practice.”
  1. SUBMITTALS
     1. Section 013300 - Submittal Procedures: Procedures for submittals.
        1. Product Data: Provide data technical, testing, and source for mix design materials and additives, steel reinforcement, joint sealant [, and other products as specified on the drawings.]
        2. Shop Drawings: Provide shop drawings for reinforcement, layout, detailing, and placing prior to fabrication, site delivery, and installation.
           1. Mix design submittals.
           2. Rebar placing drawings (ACI 315, “Detailing Manual SP-66-(04)” or CRSI “Manual of Standard Practice MSP-2-81”): Show bar sizes, bending, placing, spacing, locations, and quantities of reinforcing and wire fabric and supporting and spacing accessories. Provide steel order lists including bending and cutting details for all reinforcement shown on the structural design drawings.
           3. Form construction details, including jointing, special formed joints or reveals, location and pattern of form tie placement [, and other items that affect exposed concrete visually.]
           4. Calculations and layout drawings for formwork, shoring and/or reshoring [, and other submittals indicated on the drawings.] Work shall be prepared and signed and sealed by a Professional Engineer.
        3. Assurance/Control Submittals:
           1. Test Reports: Prepare reports in conformance with Section 014000 - Quality Requirements
           2. Submit laboratory test reports for concrete materials and mix designs for each strength and type of concrete proposed for use.
           3. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
        4. Delivery Tickets:
           1. Copies of delivery tickets for each load of concrete delivered to site.
           2. Indicate on each ticket the exact time that the mix is batched.
           3. Mix identification number on ticket shall match number on submitted and approved mix design
           4. Submit copies to Testing Laboratory for verification of compliance with placing time.

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**NOTE TO SPECIFIER**

Retain sub-section below if LEED criteria is required for project.

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* + 1. LEED submittals:
       1. Product data and statements for credits being considered.
  1. QUALITY ASSURANCE
     1. Perform work in accordance with the Codes and Standards referenced in section 1.2 of this specification.
        1. Provide qualification data for manufacturers and installers.
     2. Pre-Installation Conference:
        1. Conduct a pre-installation conference prior to commencing Work of this Section.
     3. Crack Prevention:

1. Submit quality control plan that incorporates provisions for concrete crack prevention at least 60 days prior to any slab on grade placement. The quality control plan shall be reviewed in the pre-installation conference. If wire mesh is used, the construction manager shall employ a full time 3rd party inspector to monitor this element during all concrete placement operations to ensure that mesh is maintained in the proper position. This inspection is in addition to the other concrete material testing.

* 1. DELIVERY, STORAGE, AND HANDLING
     1. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.
     2. Deliver materials in unopened containers with labels identifying contents.
     3. Store powdered materials in dry area and in manner to prevent damage. Protect liquid materials from freezing or exceeding maximum storage temperatures set by product manufacturer.
  2. ENVIRONMENTAL REQUIREMENTS

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**NOTE TO SPECIFIER**

Specify project locations where fly ash and or ground granulated blast furnace slag are acceptable and areas where use is restricted, such as areas where rapid curing and early strength of concrete is required.

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* + 1. *Resource Management:*
       1. *Recycled Content:* 
          1. *Concrete: Fly ash may be used as a substitute for a maximum of 25 percent of Portland cement unless otherwise specified by the engineer.*
          2. Concrete: Ground granulated blast furnace slag (GCBFS) may be used as a substitute for a maximum of 30 percent of Portland cement.
          3. Steel Products: Post-consumer recycled content plus one-half of preconsumer recycled not less than [ ] percent.

1. PRODUCTS
   1. MANUFACTURERS
      1. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
         1. Applied Concrete Technology, Inc., Post Office Box 548, Grayslake, IL 60030, Toll Free: 800-228-6694, Phone: 847-548-2444, Fax: 847-548-2555. [www.protecrete.com](http://www.protecrete.com)
         2. The Euclid Chemical Company, 19218 Redwood Road, Cleveland, OH 44110, Phone: 216-1-9222, Toll Free: (800) 321-7628, Fax: 216-531-9596 [www.euclidchemical](http://www.euclidchemical).
         3. Fortifiber Corporation, 419 W. Plumb Lane, Reno, NV 89509, Toll Free: 800-773-4777, Fax: 775-333-6411, Website: [www.fortifiber.com](http://www.fortifiber.com).
         4. ChemRex Inc., Shakopee, Minnesota 55379, Toll Free: 800-433-9517, Fax: 800-496-6067.
         5. BASF Construction Chemicals North America (former Master Builders), 23700 Chagrin Boulevard, Cleveland, OH 44122, Phone: 216-839-7500, Fax: 216-839-8821.
         6. W.R. Meadows, Inc., PO Box 338, Hampshire, Illinois 60140-0338, Toll Free: 800-342-5976, Phone: 847-683-4500.
         7. Reef Industries, 9209 Almeda Genoa, Houston, Texas 77075, Phone: 713-507-4251, Toll Free: 800-231-6074, Fax: 713-507-4295.
         8. Stego Industries LLC, 27442 Calle Arroyo Suite A, San Juan, Capistrano, CA 92675, Phone: 877-464-7834, Fax: 949-493-5165, [www.stegoindustries.com](http://www.stegoindustries.com).
         9. L & M Construction Chemicals, Inc. 14851 Calhoun Rd., Omaha, NE 68152-1140; Phone: 402-453-6600, Fax: 402-453-0244.
         10. Curecrete Chemical Company, Inc., 1203 W. Spring Creek Pl., Springville, UT Phone: 801- 489-5663.
         11. Midwest Floor Care Inc., 17202 Princeton Rd, Adams, NE 68301, Phone: 402-788-2820.
         12. General Resource Technology, Inc., 2978 Center Court, Eagan, MN 55121, Phone: 800-324-8154, Fax: 651-454-4252, [www.grtinc.com](http://www.grtinc.com).
      2. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.
   2. CONCRETE MATERIALS
      1. Portland Cement: ASTM C150 – Type [ ] [supplement with] [fly ash] [ground granulated blast-furnace slag].
      2. Liquid admixtures: The following admixtures are permitted when approved in writing prior to use or are required as specified herein and shall be used in strict accordance with the manufacturer's specifications or recommendations:
         1. Calcium chloride: Conform to ACI 301. The water soluble chloride ion level shall not exceed 0.3 percent by weight of cement.
         2. Air-entraining admixtures: ASTM C260 for steel hard trowel interior slab finish, do not use air entrainment admixtures.
         3. Water-reducing admixtures: Conform to ASTM C494, Type A.
         4. Water-reducing/accelerating admixtures: Conform to ASTM C494, Type C or E.
         5. Water-reducing/retarding admixtures: Conform to ASTM C494, Type D.

High-range/water-reducing (HRWR) admixtures: Conform to ASTM C494, Type F or G super plasticizers. HRWR admixture shall be used in concrete with a maximum water/ cement ratio of 0.50 or less.

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**NOTE TO SPECIFIER**

Specify project locations where fly ash and or ground granulated blast furnace slag are acceptable and areas where use is restricted, such as areas where rapid curing and early strength of concrete is required.

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* + 1. *Fly ash: Conform to ASTM C618. The use of a quality fly ash will be permitted as a cement-reducing admixture (minimum 15 percent and maximum 25 percent) unless otherwise restricted by the engineer. Fly ash used in concrete shall be from a single source and of a single class in combination with Portland cement of a single source and single class unless otherwise approved by the Engineer.*
    2. *Granulated Blast Furnace Slag is an alternative to fly ash and shall conform to ASTM C989 Grade 100 0r 120. Granulated blast furnace slag may be used as a substitute for a maximum of 30 percent of Portland cement.*
    3. Aggregates:
       1. Normal-weight concrete - ASTM C33.
       2. Light-weight concrete – ASTM C330.
       3. Aggregates shall be from a single source.
    4. Water:
       1. Clean, potable, and free of injurious amounts of oil, acid, alkali, organic or other deleterious matter not detrimental to concrete; drinkable.
  1. GROUT/MORTARS
     1. Cement grout: Conform to ASTM C387 "Dry packaged mixtures”.

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**NOTE TO SPECIFIER**

Exposed slabs shall be sealed in a fashion compatible with the curing method specified.

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* 1. CURING/SEALING/HARDENERS
     1. Dissipating liquid membrane-forming compounds for curing concrete; Conform to ASTM C309, Type 1. Curing compound shall be compatible with floor sealer or finish used. Low VOC.
     2. Method of curing shall be approved by the finish flooring applicator where finishes are indicated.
     3. Exterior Sealers: applied to horizontal concrete surfaces permanently exposed to salts, deicer chemicals and moisture, including parking decks. The manufacturer shall provide a five-year labor and materials warranty on performance of the sealer. Sealer shall be compatible with the curing compound used.

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**NOTE TO SPECIFIER**

The following materials provide varying levels of protection, sealant and hardness. Review products for project appropriateness.

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* + 1. Liquid Densifier/Sealer/Hardener: to be applied on exposed concrete floors cured with dissipating membrane forming curing compound to harden and densify concrete surfaces. Sealers are to be clear, chemically reactive, a waterborne solution of silicate or siliconate materials and proprietary components, odorless, and colorless.
  1. JOINTS AND EMBEDDED ITEMS:
     1. Construction and Contraction Joints: Sealant shall be two-part semi- rigid epoxy and shall have minimum Shore A Hardness of 80 when measured with ASTM D2240.
     2. Isolation Joints: Fillers shall consist of 1/8-inch width strips of neoprene, synthetic rubber, or approved substitute, extending the full depth of the slab. Sealant shall be two-part elastomeric type, polyurethane base.
  2. VAPOR BARRIER/RETARDER

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**NOTE TO SPECIFIER**

In the paragraph below, select [below] or [above] based on sub grade conditions and ACI committee 302 recommendations.

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* + 1. Provide cover over prepared soil, [below][above] aggregate subbase material at slabs-on-grade, where shown on the plans with a minimum thickness of 10 mils. Use only materials which are resistant to decay.

2.7 PROPORTIONING

* + 1. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If laboratory trial batch method is used, use an independent testing facility acceptable to Contracting Officer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing and inspection unless otherwise acceptable to Contracting Officer.
    2. Submit written reports to the testing laboratory of each proposed mix for each class of concrete. Do not begin concrete production until mixes have been reviewed and approved.
    3. Concrete types and strengths: Minimum 28 Day Compressive Strength shall be per design requirements but not less than:
       1. Paving base, columns, beams, walls, foundations, and footings: 3,500 psi.
       2. Slab-on-grade:4,000 psi.
       3. Normal or Lightweight concrete on metal deck: 3,000 psi.
       4. Tilt-up: 4,000 psi.

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**NOTE TO SPECIFIER**

Insert if applicable to project.

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* + - 1. All concrete exposed to weather shall be air entrained (ASTM C260).
      2. All concrete shall be normal weight except as noted above.
      3. [ ]
    1. Durability: Conform to ACI 301.
       1. All concrete exposed to potentially destructive weathering, such as freezing and thawing, or to de-icer chemicals is to be air-entrained, [ ] +1percent.,
       2. Water-cement ratio: For concrete subject to freezing and thawing or deicer chemicals, the water-cement ratio shall not exceed 0.53 by weight including any water added.
    2. Slump: Conform to ACI 301 and to specific project mix requirements.
    3. Production of concrete: Conform to ACI 301:
       1. Cast-in-place concrete used in the work shall be produced at a single off-site batching plant or may be produced at an on-site batch plant.
       2. All concrete shall be proportioned conforming to the approved mix designs and of the materials contained in those approved mixes.
       3. Prior to adding a high-range water reducer (super plasticizer), slump shall not exceed the working limit.
       4. Ready-mixed and on-site batched concrete shall be batched, mixed, and transported in accordance with ASTM C94.
          1. The concrete producer shall furnish duplicate delivery tickets, one for the Contractor and one given to the Owner’s Representative for each batch of concrete. The information provided on the delivery ticket shall include the quantity of materials batched including the amount of free water in the aggregate and any water added onsite. Show the date, time of day batched, and if ready-mixed the time of discharge from the truck. The quantity of water that can be added at the site without exceeding the maximum water-cementitious ratio specified shall be noted on the delivery ticket.
       5. For concrete produced on site with a central batch plant, mixing shall be done in an approved batch mixer concrete shall be batched, mixed, and transported in accordance with ASTM C94.
       6. Variations in consistency during the discharge of a single batch shall not exceed 1 inch of slump, except that a greater variation will be permitted if the slump of the concrete decreases and no water is added.
       7. All other concrete: Conform to ACI 301
       8. When improved workability, pumpability, lower water-cement ratio, or high ultimate and/or early strength is required, the HRWR admixture (super plasticizer) may be used.
       9. Ensure air content for slabs with steel trowel finish is less than 3.0 percent.
       10. No water shall be added to concrete except under the direct awareness of the project inspector.
       11. Adjustments to concrete mixes: Mix design adjustments may be requested by Contractor for approval by the Engineer at no additional cost to Contracting Officer. Laboratory test data for revised mix design and strength results must be submitted and accepted before using in work.

2.8 FORMWORK

A. Section 031000: Concrete Forming and Accessories

2.9 REINFORCING MATERIALS

A. Section 032000: Concrete Reinforcement

1. EXECUTION
   1. EXAMINATION
      1. Section 017300 - Execution: Verification of existing conditions before starting work.
      2. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
      3. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
      4. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.
   2. INSTALLATION - GENERAL
      1. Install all cast-in-place concrete work in accordance with ACI 301 except as herein specified.
      2. All bearing materials shall be inspected by the Geotechnical Engineer prior to placing concrete. The Geotechnical Engineer specify site preparation requirements and provide recommendations to the Architect/Engineer prior to placing concrete.
      3. Immediately before placing concrete, spaces to be occupied by concrete shall be free from standing water, ice, mud, and debris.
      4. Concrete shall not be deposited under water or where water in motion may injure the surface finish of the concrete.
      5. Forms and the reinforcement shall be thoroughly cleaned of ice and other coatings. Remove surplus form releasing agent from the contact face of forms.
      6. Notify all trades concerned and the Owner’s Representative sufficiently in advance of the scheduled time for concrete placement to permit installation of all required work by other trades.
      7. Before placing concrete, all required embedded items, including dovetail anchor slots, anchors, inserts, curb angles, metal frames, fixtures, sleeves, drains, stair nosings, accessory devices for Mechanical and Electrical installations shall be properly located, accurately positioned and built into the construction, and maintained securely in place.
      8. Build into construction all items furnished by the Owner and other trades. Provide all offsets, pockets, slabs, chases and recesses as job conditions require.
      9. Place and properly support reinforcing steel and anchor bolts.
      10. The alignment, orientation, spacing, and embedment length of mechanical load transfer devices in slab-on-grade and pavements shall conform to dimensions and tolerances shown on the drawings.
   3. INSTALLATION - FORMWORK
      1. Section 031000 Concrete Forming and Accessories
      2. Construction and Contraction Joints: Conform to ACI 301 and recommendations of ACI 302.1R.
   4. REINFORCEMENT
      1. Placement: Section 032000 Concrete Reinforcement
   5. METHODS OF PLACEMENT AND PLACING CONCRETE
      1. Placement: Conform to ACI 301:
         1. Concrete shall be placed within 90 minutes after the water has been added to the cement and aggregates. Concrete shall be placed prior to initial concrete set.
         2. Placing of concrete will not be permitted during rainfall or when rain appears imminent. If rain should fall subsequent to placement, the concrete shall be completely protected until curing is complete.
         3. Cold-Weather Placement: Comply with provisions of ACI 306.1 “Standard Specifications for Cold-Weather Concreting” for placement at temperatures below 40 deg F (4 deg C).
            1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
            2. Concrete shall not be placed on frozen ground or placed when the ambient temperature is 40 deg F or less and dropping.
            3. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures using vented heaters and insulating blankets.
            4. Concrete temperatures shall be maintained above 50 degrees F for the first 7 days of curing.
         4. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305R “Standard Specification for Hot-Weather Concreting” for placement at temperatures above 90 deg F (32 deg C).
            1. Reject any concrete that has a temperature at the point of placement above 90 deg F unless approved otherwise by the Engineer. When air temperatures are between 80 and 90 deg F the maximum mixing and delivery time is reduced to 75 minutes. When air temperatures exceed 90 deg F, the maximum mixing and delivery time is reduced to 60 minutes.
            2. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to the Engineer.
      2. Depositing Concrete
         1. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing.
         2. The number, type, position, and design of joints shall be approved by the Engineer prior to concrete placement.
         3. Place floor slabs-on-grade in alternating strips, waiting a minimum of 3 days before placing any slab adjacent to previously placed slab.
         4. The concreting shall be carried on at such a rate that the concrete is plastic at all times and flows readily into the spaces between reinforcing bars. No concrete that has partially hardened or been contaminated by foreign materials shall be deposited in the work
         5. When concreting is started, it shall be carried on as a continuous operation until the placing of the section is completed.
         6. Except as intercepted by joints, concrete shall be placed in continuous layers.
         7. Field records shall be kept of the time and date of the placing of each concrete pour. Locations where concrete test cylinders are made shall also be recorded. Records shall be kept on file at the job until its completion and shall be subject to the inspection of the Owner’s Representative at all times.
      3. Joints
         1. Joints shall be vertical in walls and horizontal in slabs [unless otherwise specified on the drawings].
         2. Dowel bars and tie bars shall be inspected
         3. Control joints for controlling concrete shrinkage shall be provided in floor slabs, walls, decks, conduits, and channels as shown on the plans or approved by the Engineer.
         4. Joint spacing and sawcut depth for slab-on-grade and concrete pavement shall conform to that shown on the pour sequencing plan and/or drawings.
            1. Sawed control (contraction) joints for pavements and slab-on-grade shall be installed as soon as practical so as not to ravel the concrete but less than 12 hours.
            2. Joint spacing shall not exceed 15 feet on center each way unless otherwise approved by the Engineer.
         5. Joints in slabs shall align with column lines and joints in adjoining walls unless otherwise approved by the Architect/Engineer or shown in the drawings. Joints shall also line up with architectural reveals and form lines. All corners shall be relieved by cutting joint to adjacent control joint.
         6. If there is a delay in casting but prior to concrete initial set, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints.
         7. Where placing concrete is interrupted long enough for the concrete to take its initial set, the working face shall be made a construction joint.
            1. Preparation and disposition of unplanned cold joints in walls shall be approved by the Engineer.
            2. For slab-on-grade, pavements, sidewalk, and curb and gutter, concrete shall be removed back to the nearest planned joint and a construction joint installed.
         8. Unless otherwise noted on the drawings, where concrete is to be placed against existing concrete, except in the case of expansion joints, the joint face of the existing concrete shall be roughened.
         9. Corner sections of walls shall not be placed until the adjoining wall sections have cured at least 14 days.
      4. Consolidation
         1. All concrete shall be thoroughly consolidated by internal mechanical vibrators during the placing operation and shall be thoroughly worked around the reinforcement and embedded fixtures and into corners of the forms.
         2. Consolidation shall be carried on continuously with the placing of concrete.
         3. Slabs shall be placed using vibrating screed.
         4. The vibrator shall be kept in nearly a vertical position as practical. The use of vibrators to shift or drag concrete after deposition will not be permitted. Vibrators shall not be laid horizontally or laid over.
         5. Concrete shall not be placed until the previous layer has been vibrated.
         6. Unless directed otherwise by the Engineer, the top 2 feet of walls shall be re-vibrated approximately 1 hour after placement of concrete and while a running vibrator will still sink under its own weight into the concrete and liquefy it momentarily.
      5. Protection of cast concrete: Conform to ACI 301.
      6. Repair of surface defects: Conform to ACI 301.
   6. FINISHING
      1. Finishing of formed surfaces: ACI 301:
         1. Tops of forms:
            1. Strike concrete smooth at tops of forms.
            2. Float to texture comparable to formed surfaces.
         2. Formed surfaces:
            1. Finished formed surfaces shall conform accurately to the shape, alignment, grades, and sections shown on the drawings or prescribed by the Engineer.
            2. Surfaces shall be free from fins, bulges, ridges, honeycombing, or roughness of any kind and shall present a finished, smooth, continuous hard surface.
            3. Rough form finish at unfinished areas unexposed to public view. Smooth form finish at surfaces exposed to public view.
      2. Slabs: Minimum slab surface tolerance must satisfy ACI 301 and ACI 302.1R.
         1. Slabs-on-grade:
            1. For exposed slabs, install semi-rigid epoxy sealant in construction and contraction joints after slab has a minimum of 60 days or otherwise approved by the Engineer.
            2. Allowable tolerance for slab on grade surfaces, measured in accordance with ACI 117 shall meet or exceed an overall value of FF35/Fl25, with minimum local value of FF24/FL17.
         2. Suspended Floor Slab:
            1. Minimum surface tolerances: FF25 & FL20 overall and FF20 & FL15 local.
         3. Concrete Finishes:
            1. Floor Slabs: Steel trowel finish unless otherwise noted on the plans.
            2. Exposed concrete slabs sealed or sealed and hardened using a liquid compound compatible with the curing method used.
            3. Exterior Concrete Finishes: Unless otherwise noted on the drawings, floors, walkways, and roof finishes shall be sloped a minimum 0.125 inch per foot to drain water. A light steel trowel with broom finish unless otherwise noted on the plans. Apply exterior sealer to surfaces exposed to deicer chemicals that is compatible with the curing method used.
            4. Exposed Ramps, Landings and Stair Treads: A light steel trowel with broom finish unless otherwise noted on the plans. Surfaces shall be sealed or sealed and hardened using a liquid compound compatible with the curing method used.
            5. A heavy broom finish shall be provided on disabled person ramps, utility ramps, and around exterior loading docks.
   7. CURING, PROTECTION, LIQUID HARDNERS AND SEALERS
      1. Temperature, Wind, and Humidity
         1. When concrete slabs and other unformed concrete is placed in warm, dry, dusty, or windy conditions, concrete surfaces shall be protected from rapid drying by use of windbreaks, shading, fogging with properly designed nozzles, or a combination of these measures. Hot weather concreting procedures provided in ACI 305R shall be used when ambient conditions dictate.
         2. Cold weather concreting procedures provided in ACI 306R shall be used when ambient conditions dictate.
      2. Curing Compound
         1. Apply curing compound to all interior and exterior flat slab and vertical surfaces. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
         2. All curing methods shall be placed [within two hours] after final finishing. All exposed surfaces of concrete including floor slabs, whether or not they receive a finish flooring, shall be protected from premature drying for a minimum of seven days.
         3. Apply the specified curing compound in accordance with manufacturer’s written instructions.
         4. When used on an unformed concrete surface, application of the first coat of curing compound shall commence immediately after finishing operations have been completed. When curing compound is used on a formed concrete surface, the surface shall first be moistened with a fine spray of water immediately after the forms have been removed.
            1. Surfaces shall be sprayed uniformly with 2 coats of curing compound. As soon as the first coat has become dry, a second coat shall be applied in the same manner. The direction of application of the second coat shall be perpendicular to the first coat.
      3. Hardner
         1. Apply liquid densifier/sealer/hardener to all workroom, interior and exterior mail platform, and dock, BMEU, and similar floor surfaces.
         2. Apply in accordance with manufacturer instructions.
      4. Exterior Sealer
         1. Apply to all exterior horizontal traffic and pedestrian surfaces that are exposed to salts, deicer chemicals, and moisture, including parking decks.
         2. Apply in accordance with manufacturer’s instructions.
      5. Protection
         1. Freshly placed concrete shall be protected against wash by rain.
         2. Dust control shall be provided in the surrounding areas during placement.
         3. During the first 2-day period of curing, no traffic on or loading of the floors will be permitted unless otherwise approved by the Engineer.
         4. The contractor shall allow no traffic and take precautions to avoid damage to the membrane of the curing compound for a period of not less than 28 days. Damage shall be repaired immediately.
         5. Self-supporting structures shall not be loaded in such a way to overstress the concrete.
      6. All floor slabs shall be cured using products and methods compatible with selected floor adhesives, toppings, and other finish materials.
   8. PATCHING AND REPAIR
      1. All repairs of defective areas shall conform to ACI 301. On areas requiring treatment of defects and until such repairs have been completed, only water cure will be permitted
      2. At any time prior to final acceptance, concrete found to be defective, damaged, or not in accordance with the specifications shall be repaired or removed and replaced with acceptable concrete.
      3. Repair or replace concrete with excessive honeycombing due to improper placement.
         1. If approved, a bonding admixture, bonding compound, or epoxy adhesive may be used in accordance with the manufacturer’s preparation and application recommendations. Comply with ACI 301 and ACI 503.2 for standard specifications for bonding plastic concrete to hardened concrete with a multiple component epoxy adhesive.
         2. The repair concrete shall be thoroughly consolidated in place and struck off so as to leave the patch slightly higher than the surrounding surface. The concrete shall be left undisturbed for at least 1 hour to permit initial shrinkage then finished.
         3. The patched area shall be kept damp for 7 days.
         4. The color of the patch material shall match the color of the surrounding concrete. Repairs shall be made promptly while the base concrete is less than 28 days old
      4. Areas showing excessive defects as determined by the Architect/Engineer shall be removed and replaced.
      5. High spots identified in the floor flatness and levelness survey may be removed with bump grinding. Areas to be ground shall not exceed more than 10 percent of any one slab nor more than 5 percent of the total slab-on-grade area.
      6. Random hairline cracks in up to 3% of the slab panels will be accepted. Cracks in these panels shall be routed and filled with semi-rigid joint filler. If more than 3% of panels contain cracks, the number of panels exceeding the 3% limit shall be demolished and replaced at the direction of the Contracting Officer, crack repairs will not be accepted. Any panels that contain cracks wider than 0.022” shall be demolished and replaced.
      7. Interior slab-on-grade hairline cracks allowed to be repaired that are subjected to powered industrial truck traffic shall be routed and sealed with a semi-rigid epoxy sealant. Exterior slabs may be routed and sealed with the flexible joint sealant to be installed in pavement joints.
   9. GROUTING
      1. After steel columns have been installed and leveled, grout the space between the bottom of the plate and concrete, using cement grout completely filling the space and forming solid bearing for the column base plate.
   10. EVALUATION AND ACCEPTANCE OF CONCRETE
       1. Comply with ACI 301, ACI 318-Chapter 5 and ACI 311 for compressive strength, slump, and frequency of testing.
       2. The frequency of testing indicated in the aforementioned codes and standards shall be increased if concrete fails to meet the acceptance criteria or if deemed by the Engineer to be too variable.
   11. ACCEPTANCE OF STRUCTURE
       1. Comply with ACI 301 and modifications in this section.
       2. Completed concrete work, which meets all applicable requirements, will be accepted without qualification.
       3. Completed concrete work which fails to meet one or more requirements, but which has been repaired to bring it into compliance will be accepted without qualification.
       4. Completed concrete work which fails to meet one or more requirements, and which cannot be brought into compliance may be accepted or rejected by the Contracting officer. In this event, modifications may be required to assure that remaining work complies with the requirements.
       5. The costs of any additional tests or analysis, including additional architectural and engineering services, performed to prove the adequacy of the concrete work, shall be borne by the Contractor without extension of contract time.
   12. MISCELLANEOUS CONCRETE
       1. Curbs: Provide monolithic finish to interior surface of curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
       2. Equipment bases and foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment with template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
   13. FIELD QUALITY CONTROL
       1. Section 014000 - Quality Requirements: Field testing and inspection.
       2. Requirements:
          1. Provide and maintain an adequate program of quality control for the materials, production methods, and workmanship to assure conformance of all work to the project contract documents.
          2. Testing and Evaluation:
             1. Furnish and pay for the services of an independent Testing Laboratory satisfactory to the Contracting Officer. The testing laboratory shall have prime responsibility for review, verification inspection, and testing of the concrete producer's materials, operations, facilities, and quality control procedures and evaluating the results for conformance with these specifications.
             2. In addition to the requirements and duties in ACI 301 the testing laboratory shall provide the following:

One or more additional test cylinders shall be taken during cold weather concrete placement and cured on the job site under conditions of concrete represented to determine safe form-stripping period.

Inspect concrete batching, mixing, and delivery operations periodically or as directed by the Contracting Officer.

Submit to the Contracting Officer and concrete producer, during construction, the results of concrete tests.

* + - * 1. The Testing Laboratory shall assess and report floor flatness and levelness in accordance with the requirements of this specification.
        2. Field and concrete plant inspections are to be made by a competent representative of the Testing Laboratory during all structural concreting operations including periodic audit and spot check of the Producer's and/or Contractor's quality control procedures to assure proper and adequate control. When it appears that any material furnished fails to fulfill specification requirements, the Testing Laboratory is to report such deficiency immediately to the Contracting Officer and appropriately record it in his report.

END OF SECTION

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