This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

SECTION 033000 – CAST-IN-PLACE CONCRETE

1. GENERAL
   * + 1. DESCRIPTION
          1. This section describes materials and proportioning of cast‑in‑place concrete and general cast‑in‑place concrete requirements.
       2. RELATED WORK SPECIFIED ELSEWHERE
          1. Section 031100, Concrete Formwork
          2. Section 032000, Concrete Reinforcing
       3. REFERENCES
          1. ACI: American Concrete Institute:

ACI 301: Specifications for Structural Concrete.

ACI 302R: Guide to Concrete Floor and Slab Construction

ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete.

ACI 305: Specification for Hot Weather Concreting.

ACI 306: Specification for Cold Weather Concreting.

ACI 308R: Guide for Curing Concrete.

ACI 309R: Guide for Consolidation of Concrete.

* + - * 1. ASTM: American Society for Testing and Materials:

ASTM C94: Standard Specification for Ready-Mixed Concrete.

ASTM C171: Standard Specification for Sheet Materials for Curing Concrete.

ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

ASTM C494: Standard Specification for Chemical Admixtures for Concrete.

ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

* + - * 1. NRMCA: National Ready Mixed Concrete Association
      1. SUBMITTALS ‑ MIX IDENTIFICATION
         1. Submit a job mix formula at least 15 days prior to delivery of concrete to the job site.
         2. Job mix formula shall be submitted on Form 1, attached.
         3. Upon approval of the job mix formula, a mix identification number will be assigned to the mix. This number shall become the identifying designation of that mix and, as such, shall be used in all references to that mix.
         4. Concrete delivered to the job site shall be accompanied by a delivery slip bearing the assigned mix identification number.
         5. A new job mix formula may be required if unsatisfactory results occur.
      2. QUALITY CONTROL ‑ PLANT CERTIFICATION
         1. The NRMCA certifies plants which can demonstrate that their facilities are capable of furnishing good concrete. The system permits a qualified plant to display a Certificate of Conformance which assures the purchaser that the physical capability of furnishing good concrete is available.
         2. For plants which are certified by NRMCA, compliance will be assumed for production facilities within the limits set forth by ASTM C94. Applicable sections of ASTM C94 are as follows: 9. Measuring Materials, 10. Batching Plant, 11. Mixers and Agitators, 12. Mixing and Delivery, and 13. Use of Nonagitating Equipment. These sections provide assurance of facilities that are capable of furnishing good concrete.
         3. All production facilities (scales, mixers, trucks, storage bins, conveyors, etc.) shall be continuously maintained in good working condition.
         4. Use only concrete plants complying with the ASTM C94 or NRMCA minimum standards.

1. PRODUCTS
   * + 1. CONCRETE IN A FRESHLY‑MIXED AND UNHARDENED STATE
          1. Concrete in a freshly‑mixed and unhardened state shall comply with ASTM C94 except as expressly and specifically modified and designated herein. Modifications and designations shall be as follows:

Cement (See ASTM C94 5.2.1) shall contain no more than 0.80 percent total alkalies (Na20 + 0.658 K20).

Pozzolan shall conform to ASTM C618 Class F or Class C. A Certificate of Compliance shall be provided on request. Total weight of Pozzolan shall not exceed 18 percent of the weight of cement.

Quality of concrete (see ASTM C94 6.1):

Insert appropriate concrete class(es) in heading and then fill in characteristics for each class. Delete or merge unused columns.

|  |  |  |  |
| --- | --- | --- | --- |
|  | CLASS | | |
| \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
| Size of coarse aggregate, inches | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
| Slump, inches | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
| Entrained air, percent +/- 1 1/2% | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
| Alternate for determining proportions | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
| Compressive strength, PSI | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
| Age, days | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
| Probability of tests falling below specified strength, one out of | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
| Minimum content of cement plus Pozzolan lbs. per c.y. | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_ |
|  |  |  |  |
| Admixtures | Water reducing admixtures conforming to ASTM C494, Type A or D, will be permitted at the Contractor’s option. | | |

All concrete for the work shall be Class 3500‑3/4 unless indicated otherwise on the drawings.

* + - 1. JOINT FILLERS
         1. Joint fillers shall be in accordance with ASTM D1751.
         2. Slab Isolation Joint Fillers: 1/2-inch-thick, height equal to slab thickness, with a removable top section that forms a 1/2-inch-deep sealant pocket after removal.

Material: Closed cell, non-absorbent, compressible polyethylene or polymer foam in sheet form.

Products:

Sonneborn; Sonoflex F.

W.R. Meadows, Inc.; Deck-O-Foam Joint Filler with pre-scored top-strip.

Or equal.

* + - 1. BONDING AND JOINTING
         1. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059, Type II.

Products:

W.R. Meadows, Inc.; ACRY-LOK.

Dayton Superior; Acrylic Bonding Agent J40.

ChemMasters; Cretelox.

Or equal.

* + - * 1. Epoxy Bonding System: Be in accordance with ASTM C881.

Products:

W.R. Meadows, Inc.; Rezi-Weld Gel Paste, Rezi-Weld Gel Paste State, Rezi-Weld 1000, or Rezi-Weld 1000 State.

Adhesives Technology Corporation; Crackbond LR321, Crackbond SLV302, Ultrabond 2100, Ultrabond 1, Ultrabond 2, Ultrabond 4CC, or Ultrabond HS200.

Or equal.

* + - 1. GROUT
         1. Metallic: One of the following, or equal, for general applications:

“Embeco” (Master Builders Company)

“Ferrolith G” (Sonneborn Building Products, Inc.)

“Ferrotex” (National Pulverized Metals, Co., Chicago, Ill.)

* + - * 1. Non‑metallic: One of the following, or equal, for setting base plates:

“Five Star Grout” (U.S. Grout Corp.)

“Sealtight 588” (W.R. Meadows, Inc.)

“Upcon” (The Upcon Co.)

“Masterflow 928” (Master Builders Co.)

* + - * 1. Epoxy: One of the following, or equal, for setting equipment:

“Sika-Dur Hi‑Mod,” “Cement Epoxy” (Sika Chemical Corp.)

“Five Star Epoxy Grout” (U.S. Grout Corp.)

“Ceilcote 648CP” (Ceilcote Co.)

* + - 1. CURING MATERIAL

For use with floor material, add “or Type 1 with a fugitive dye” after first sentence and add a reference to applicable carpet section at the end of the paragraph.

* + - * 1. Liquid Membrane Curing Compound: ASTM C309, Type 2, formulated to be removable after 28 days. Use curing compound guaranteed to not affect the bond of applied finishes.
        2. Polyethylene Sheeting: Of approved manufacturer, 4 mils thick.
        3. Reinforced Building Paper: ASTM C171.

1. EXECUTION
   * + 1. PREPARATION
          1. Clean existing concrete surfaces thoroughly before placing abutting fresh concrete.
          2. Coordinate placement of embedded items with erection of concrete formwork and placement form accessories.
          3. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with a steel brush and applying the bonding agent in accordance with the manufacturer’s instructions.

Use an epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.

Use a latex bonding agent for non-load-bearing applications only.

* + - 1. CONCRETE PLACEMENT, CONSOLIDATION, CURING, AND PROTECTION – GENERAL
         1. Concrete shall be placed, consolidated, cured, and protected in accordance with American Concrete Institute recommended practice. The following ACI standards and reports are guides to good practice and shall be used by the Contractor:

ACI 302R Guide to Concrete Floor and Slab Construction

ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete

ACI 305 Hot Weather Concreting

ACI 306 Cold Weather Concreting

ACI 308R Guide for Curing Concrete

ACI 309R Guide for Consolidation of Concrete

* + - * 1. Ensure reinforcement, inserts, waterstops, and embedded parts will not be distrurbed during concrete placement.
        2. Place concrete continuously without construction cold joints wherever possible. Where construction joints are necessary, before next placement, prepare joint surface by removing laitance and exposing the sand and sound surface mortar by sandblasting or high-pressure water jetting.
      1. EMBEDDED ITEMS
         1. Accurately set anchorage devices and structural steel connections by line and transit, and coordinate the locating of all anchorage devices to be set for the accommodation of the work of other trades.
         2. Locate anchor bolts where shown on the drawings and on shop drawings. Obtain necessary templates for mechanical and electrical equipment as required for the proper setting of anchor bolts and other items. Install anchor bolts and embedded channels and plates, accurately located, to elevations required.
      2. CURING COMPOUND REMOVAL
         1. Remove curing compound following the procedures recommended by the manufacturer.
      3. PATCHING
         1. Comply with ACI 301, Chapter 5.3.7.
      4. FIELD QUALITY CONTROL
         1. The Port will engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement.
         2. Provide free access to concrete operations at the work site and cooperate with the inspection and testing agency.
         3. Testing of the composite samples of fresh concrete obtained in accordance with ASTM C172 will be performed by the Port’s testing and inspection agency according to the following:

Testing Frequency: At least one composite sample for each 100 cubic yards, or fraction thereof, of each concrete mix placed each day.

Slump: ASTM C143.

Air Content: ASTM C231.

Concrete Temperature: ASTM C1064.

Compression Test Specimens: ASTM C31. Based on one set of four standard molded and laboratory-cured cylinder specimens for each composite sample.

Compressive Strength Tests: ASTM C39. Based on four molded and laboratory-cured concrete test cylinders. Samples are obtained and tested for every 100 cubic yards or less of each class of concrete.

At seven days, one laboratory-cured specimen is tested.

At 28 days, two laboratory-cured specimens are tested.

One is held for later testing.

Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

* + - 1. CURING AND PROTECTION
         1. Maintain concrete with minimal moisture loss at relatively constant temperature for the period necessary for hydration of cement and hardening of concrete.

Normal Concrete: Not less than seven days or use of Port-approved curing compound.

* + - 1. FINISHING
         1. Repair surface defects, including tie holes, immediately after removing formwork.
         2. Tilt‑Up Panels: Cast panels with exterior face up. Give exterior face a light vertical broom finish. Cast a 2‑foot by 2‑foot test panel for approval. Exterior face shall match approved test panel.
         3. Exposed Concrete Surfaces: Leave with a smooth finish, even textured, and free of blemishes. As soon as the face forms are removed, remove all fins and other projections carefully, level offsets and grind where necessary. Repair, replace and point and fill voids. Patch as specified above.
         4. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:

Slabs and Floors to Receive Adhesive-Applied Flooring: Do not over trowel or burnish the floor or create a “mirror” finish as this may inhibit the adhesion of the flooring adhesives. In the event of over-finishing, mechanically clean the surface to expose absorbent surfaces to allow adhesion.

Other Surfaces to be Left Exposed: Steel trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

Scratch-Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/8 inch in one direction.

* + - 1. FLOOR FLATNESS AND LEVELNESS TOLERANCES
         1. Finish surfaces to the following tolerances, according to ASTM E115, for a randomly trafficked floor surface. Provide floor leveling or grinding as needed to meet requirements of the finish specifications.

Specified overall values of flatness, F(F) 24, and levelness, F(L) 17, for slabs-on-grade.

Specified overall values of flatness, F(F) 30, for suspended slabs.

* + - * 1. Correct the slab surface if tolerances are less than specified.
        2. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure areas by the same process.
      1. JOINTS
         1. Construct joints true to line with faces perpendicular to surface plane of concrete.
         2. Locate joints as indicated on the drawings.
         3. Construction Joints: Install so strength and appearance of concrete are not impaired, and at locations indicated or directed by the Port.

Locate joints for beams and slabs in the middle third of the spans.

Locate horizontal joints in walls at underside of floors and at the top of footings or floor slabs.

* + - * 1. Construction Joints in Slabs on Grade: Form weakened plane construction joints, sectioning concrete into areas as indicated.
        2. Isolation Joints: Use pre-formed joint filler with removable top section for the joint sealant, total height shall be equal to the thickness of the slab and set flush with the top of the slab. Install wherever necessary to separate slab from the other building members including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
        3. Contraction Joint Devices: Use pre-formed joint device with the top set flush with the top of slab.
        4. Contraction Joints: Where not otherwise indicated, use metal combination screed and key form, with a removable top section for the joint sealant.
        5. Place concrete continuously between predetermined expansion, control, and construction joints.
        6. Do not interrupt successive placement and do not permit cold joint to occur.
        7. Saw cut joints within four hours after placing, or as soon as curing equipment can be placed and operated on the slab without leaving visible marks. Use 3/16 inch thick blade, cut into the slab by the depth shown on the drawings.
      1. GROUTING
         1. Remove loose concrete particles, dust, and any other material which would prevent bonding.
         2. Perform surface preparation, mixing, placing, and finishing in accordance with the approved manufacturer’s printed instructions.

Insert project title on the blank line below. Make sure this goes to the printer as a single-side form on a right-hand page. If the page number comes out even, delete the footer so the print shop will not be confused.

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FORM 1  
JOB MIX FORMULA (READY‑MIXED CONCRETE)

Contractor’s Name

Supplier Name

Batch Plant Location

Cement Type

Pozzolan Type

Sand Type

Coarse Aggregate Type

Maximum Size of Coarse Aggregate

Entrained Air (%)

Water Reducing Agent

Slump (Inches)

PROPORTIONS

Water \_\_\_\_\_\_\_\_\_\_ Gal/C.Y \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

Cement \_\_\_\_\_\_\_\_\_\_ Bags/C.Y \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

Pozzolan \_\_\_\_\_\_\_\_\_\_% of Cement \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

Sand Size 1 \_\_\_\_\_\_\_\_\_\_% of Total Aggregate \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

Size 2 \_\_\_\_\_\_\_\_\_\_% of Total Aggregate \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

C.A. Size 1 \_\_\_\_\_\_\_\_\_\_% of Total Aggregate \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

Size 2 \_\_\_\_\_\_\_\_\_\_% of Total Aggregate \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

Size 3 \_\_\_\_\_\_\_\_\_\_% of Total Aggregate \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

Total Weight \_\_\_\_\_\_\_\_\_\_ Lbs./C.Y.

Unit Weight \_\_\_\_\_\_\_\_\_\_ Lbs./C.F.

END OF SECTION 033000