

DIVISION 3 CONCRETE

- 1 5) The strength and spacing of shores or shoring systems used, as well as the method
- 2 of shoring, bracing, shore removal, and reshoring including the minimum time
- 3 intervals between the various operations.
- 4 6) Any other loading or condition that affects the safety of serviceability of the
- 5 structure during construction.

6 1.3 DEFINITIONS

- 7 A. Words and terms used in these Specifications are defined in ACI 116R.

8 1.4 SUBMITTALS

- 9 A. Shop Drawings:
- 10 1. See Section 01340.
 - 11 2. Product technical data including:
 - 12 a. Acknowledgement that products submitted meet requirements of standards referenced.
 - 13 b. Manufacturer's installation instructions.
 - 14 c. Manufacturer and type of proposed form materials.
 - 15 d. Manufacturer and type of proposed form ties.
 - 16 e. Manufacturer and type of proposed form coating material.
 - 17 3. Formwork designer qualifications.

18 PART 2 - PRODUCTS

19 2.1 ACCEPTABLE MANUFACTURERS

- 20 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 21 acceptable:
- 22 1. Stay-in-place forms:
 - 23 a. Alabama Metal Industries Corporation.
 - 24 B. Submit requests for substitution in accordance with Specification Section 01640.

25 2.2 MATERIALS

- 26 A. Forms for Surfaces Exposed to View:
- 27 1. Wood forms:
 - 28 a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
 - 29 b. Built-in-place or prefabricated type panel.
 - 30 c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire
 - 31 area.
 - 32 d. When approved, plywood may be reused.
 - 33 2. Metal forms:
 - 34 a. Metal forms excluding aluminum may be used.
 - 35 b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide
 - 36 members of uniform thickness.
- 37 B. Forms for Surfaces Not Exposed to View:
- 38 1. Wood or metal sufficiently tight to prevent leakage. Do not use aluminum forms.

39 2.3 ACCESSORIES

- 40 A. Form Ties:
- 41 1. Commercially fabricated for use in form construction. Do not use wire ties.
 - 42 2. Constructed so that ends or end fasteners can be removed without causing spalling at
 - 43 surfaces of the concrete.
 - 44 3. 3/4 IN minimum to 1 IN maximum diameter cones on both ends.
 - 45 4. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have
 - 46 been removed.

- 1 5. Provide ties with built-in waterstops in all walls that will be in contact with process liquid
2 during plant operation.

3 **PART 3 - EXECUTION**

4 **3.1 PREPARATION**

- 5 A. Form Surface Treatment:
6 1. Before placing of either reinforcing steel or concrete, cover surfaces of forms with an
7 approved coating material that will effectively prevent absorption of moisture and prevent
8 bond with concrete, will not stain concrete or prevent bonding of future finishes. A field
9 applied form release agent or sealer of approved type or a factory applied nonabsorptive
10 liner may be used.
11 2. Do not allow excess form coating material to stand in puddles in forms nor in contact with
12 hardened concrete against which fresh concrete is to be placed.
- 13 B. Provide temporary openings at base of column and wall forms and at other points where
14 necessary to facilitate cleaning and observation immediately before concrete is placed, and to
15 limit height of free fall of concrete to prevent aggregate segregation. Temporary openings to
16 limit height of free fall of concrete shall be spaced no more than 8 FT apart.
- 17 C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated
18 mortar or grout from previous concreting and of all other foreign material before concrete is
19 placed.

20 **3.2 ERECTION**

- 21 A. Install products in accordance with manufacturer's instructions.
- 22 B. Tolerances:
23 1. Variation from plumb:
24 a. In lines and surfaces of columns, piers, walls, and in risers.
25 1) Maximum in any 10 FT of height: 1/4 IN.
26 2) Maximum for entire height: 1/2 IN.
27 b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
28 1) Maximum in any 20 FT length: 1/4 IN.
29 2) Maximum for entire length: 1/2 IN.
- 30 2. Variation from level or from grades specified:
31 a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of
32 supporting shores.
33 1) Maximum in any 10 FT of length: 1/4 IN.
34 2) Maximum in any bay or in any 20 FT length: 3/8 IN.
35 3) Maximum for entire length: 3/4 IN.
36 b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
37 1) Maximum in any bay or in 20 FT length: 1/4 IN.
38 2) Maximum for entire length: 1/2 IN.
- 39 3. Variation of linear structure lines from established position in plan and related position of
40 columns, walls, and partitions:
41 a. Maximum in any bay: 1/2 IN.
42 b. Maximum in any 20 FT of length: 1/2 IN.
43 c. Maximum for entire length: 1 IN.
- 44 4. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of
45 +1/2 IN.
- 46 5. Variation in horizontal plan location of beam, column and wall centerlines from required
47 location: Maximum of +1/2 IN.
- 48 6. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and
49 walls: Maximum of -1/4 IN, +1/2 IN.

- 1 7. Footings and foundations:
- 2 a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
- 3 b. Misplacement or eccentricity:
- 4 1) 2 percent of footing width in direction of misplacement but not more than 2 IN.
- 5 c. Thickness:
- 6 1) Decrease in specified thickness: 5 percent.
- 7 2) Increase in specified thickness: No limit except that which may interfere with other
- 8 construction.
- 9 8. Variation in steps:
- 10 a. In a flight of stairs:
- 11 1) Rise: +1/8 IN.
- 12 2) Tread: +1/4 IN.
- 13 b. In consecutive steps:
- 14 1) Rise: +1/16 IN.
- 15 2) Tread: +1/8 IN.
- 16 9. Establish and maintain in an undisturbed condition and until final completion and
- 17 acceptance of Project, sufficient control points and bench marks to be used for reference
- 18 purposes to check tolerances.
- 19 10. Regardless of tolerances listed allow no portion of structure to extend beyond legal
- 20 boundary of Project.
- 21 11. To maintain specified tolerances, camber formwork to compensate for anticipated
- 22 deflections in formwork prior to hardening of concrete.
- 23 C. Make forms sufficiently tight to prevent loss of mortar from concrete.
- 24 D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled
- 25 edges.
- 26 E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to
- 27 view over hardened concrete in previous placement by at least 1 IN. Hold forms against
- 28 hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true
- 29 surface. Where possible, locate juncture of built-in-place wood or metal forms at architectural
- 30 lines, control joints or at construction joints.
- 31 F. Where circular walls are to be formed and forms made up of straight sections are proposed for
- 32 use, provide straight lengths not exceeding 2 FT wide. Brace and tie formwork to maintain
- 33 correct position and shape of members.
- 34 G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract
- 35 swelling.
- 36 H. Anchor formwork to shores or other supporting surfaces or members so that movement of any
- 37 part of formwork system is prevented during concrete placement.
- 38 I. Provide runways for moving equipment with struts or legs, supported directly on formwork or
- 39 structural member without resting on reinforcing steel.
- 40 J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all
- 41 settlement during concrete placing operation. Securely brace forms against lateral deflection.
- 42 Fasten wedges used for final adjustment of forms prior to concrete placement in position after
- 43 final check.

44 **3.3 REMOVAL OF FORMS**

- 45 A. No construction loads shall be supported on, nor any shoring removed from, any part of the
- 46 structure under construction except when that portion of the structure in combination with
- 47 remaining forming and shoring system has sufficient strength to safely support its weight and
- 48 loads placed thereon.

- 1 B. When required for concrete curing in hot weather, required for repair of surface defects or when
2 finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently
3 to resist damage from removal operations or lack of support.
- 4 C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient
5 stiffness to prevent sagging. Perform any needed repairs or treatment required on such sloping
6 surfaces at once, followed by curing specified in Section 03311.
- 7 D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to
8 concrete.
- 9 E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete
10 may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
- 11 F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in
12 place until concrete has attained its specified 28-day compressive strength. Where a reshoring
13 procedure is planned, supporting formwork may be removed when concrete has reached the
14 concrete strength required by the formwork designer's structural calculations.
- 15 G. When shores and other vertical supports are so arranged that non-load-carrying form facing
16 material may be removed without loosening or disturbing shores and supports, facing material
17 may be removed when concrete has sufficiently hardened to resist damage from removal.

18 **3.4 RESHORING**

- 19 A. No construction loads shall be supported on, nor any shoring removed from, any part of the
20 structure under construction except when that portion of the structure in combination with
21 remaining forming and shoring system has sufficient strength to safely support its weight and
22 loads placed thereon.
- 23 B. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new
24 construction.
- 25 C. During reshoring do not subject concrete in structural members to combined dead and
26 construction loads in excess of loads that structural members can adequately support.
- 27 D. Place reshores as soon as practicable after stripping operations are complete but in no case later
28 than end of working day on which stripping occurs.
- 29 E. Tighten reshores to carry their required loads without overstressing.
- 30 F. Shoring, reshoring and supporting formwork may be removed when concrete has reached the
31 concrete strength required by the formwork designer's structural calculations.
- 32 G. For floors supporting shores under newly placed concrete leave original supporting shores in
33 place or reshore. Reshoring system shall have a capacity sufficient to resist anticipated loads.
34 Locate reshores directly under a shore position above.

35

END OF SECTION

- 1 7. Shop drawings shall be in sufficient detail to permit installation of reinforcing without
2 reference to Contract Drawings. Shop drawings shall not be prepared by reproducing the
3 plans and details indicated on the Contract Drawings but shall consist of completely
4 redrawn plans and details as necessary to indicate complete fabrication and installation of all
5 reinforcing steel.

6 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 7 A. Support and store all reinforcing above ground.
8 B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match
9 the shop drawing mark numbers.

10 **PART 2 - PRODUCTS**

11 **2.1 ACCEPTABLE MANUFACTURES**

- 12 A. Subject to compliance with Contract Documents, the following Manufacturers are acceptable:
13 1. Rebar adhesive anchors:
14 a. HIT-HY150 System by HILTI FASTENING SYSTEMS, INC.
15 b. Epcon Adhesive Anchoring System by ITW Ramset/Red Head.
16 c. Power-Fast by Powers Fastening, Inc.
17 2. Rebar mechanical splices:
18 a. Lenton Rebar Splicing by Erico, Inc.
19 b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
20 c. Bar-Grip Systems by Barsplice Products, Inc.
21 B. Submit requests for substitution in accordance with Specification Section 01640.

22 **2.2 MATERIALS**

- 23 A. Reinforcing Bars: ASTM A615, grade 60, deformed.
24 B. Reinforcing Bars to be Welded: ASTM A706.
25 C. Welded Wire Fabric: ASTM A185 or ASTM A497.
26 D. Smooth Dowel Bars: ASTM A615, grade 60 with metal end cap to allow longitudinal movement
27 equal to joint width plus 1 IN.
28 E. Proprietary Rebar Mechanical Splices: To develop in tension and compression a minimum of
29 125 percent of the yield strength of the rebars being spliced.
30 F. Rebar Adhesive Anchors:
31 1. Manufactured for the specific purpose of embedding and developing 125 percent of the
32 yield strength of rebars in hardened concrete.

33 **2.3 ACCESSORIES**

- 34 A. Metal Chairs, Runners, Bolsters, Spacers, Hangers, and Other Rebar Supports:
35 1. Plastic-coated tips in contact with forms.
36 2. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
37 B. Protective plastic caps at mechanical splices.

38 **2.4 FABRICATION**

- 39 A. Tolerances:
40 1. Sheared lengths: +1 IN.
41 2. Overall dimensions of stirrups, ties and spirals: +1/2 IN.
42 3. All other bends: +0 IN, -1/2 IN.

- 1 B. Minimum diameter of bends measured on the inside of the rebar to be as indicated in ACI 318
2 paragraph 7.2.
- 3 C. Ship rebars to jobsite with attached plastic or metal tags.
4 1. Place on each tag the mark number of the rebar corresponding to the mark number indicated
5 on the shop drawing.
6 2. Mark numbers on tags to be so placed that the numbers cannot be removed.
7 3. For epoxy-coated rebars, use only plastic tags secured to rebars by nylon or plastic ties.

8 PART 3 - EXECUTION

9 3.1 INSTALLATION

- 10 A. Tolerances:
11 1. Rebar placement:
12 a. Clear distance to formed surfaces: +1/4 IN.
13 b. Minimum spacing between bars: -1/4 IN.
14 c. Top bars in slabs and beams:
15 1) Members 8 IN deep or less: +1/4 IN.
16 2) Members between 8 IN and 2 FT deep: -1/4 IN, +1/2 IN.
17 3) Members more than 2 FT deep: -1/4 IN, +1 IN.
18 d. Crosswise of members: Spaced evenly within +1 IN.
19 e. Lengthwise of members: +2 IN.
20 2. Minimum clear distances between rebars:
21 a. Wall, slab and beam reinforcing: Distance equal to rebar diameter or 1 IN, whichever is
22 greater.
23 b. Columns: Distance equal to 1-1/2 times the rebar diameter or 1-1/2 IN, whichever is
24 greater.
25 c. Beam and slab rebars shall be threaded through the column vertical rebars without
26 displacing the column vertical rebars and still maintaining the clear distances required
27 for the beam and slab rebars.
- 28 B. Minimum concrete protective covering for reinforcement, unless indicated otherwise on
29 Drawings:
30 1. Concrete deposited against earth: 3 IN.
31 2. Formed surfaces exposed to weather or in contact with earth:
32 a. 2 IN for reinforcing bars #6 or larger.
33 b. 1-1/2 IN for reinforcing bars less than #6.
34 3. Formed surfaces exposed to or located above any liquid: 2 IN for all rebar sizes.
35 4. Interior surfaces:
36 a. 1-1/2 IN for beams, girders, and columns.
37 b. 3/4 IN for slabs, walls and joists.
- 38 C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
39 1. For rebars: Class B splice meeting the requirements of Paragraph 12.15 of ACI 318.
40 2. Provide splices of reinforcing not specifically indicated or specified subject to approval of
41 Engineer. Mechanical proprietary splice connectors may only be used when approved or
42 indicated on the Contract Drawings.
- 43 D. Welding:
44 1. Welding of reinforcing will not be permitted.
- 45 E. Placing Rebars:
46 1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials
47 that may affect or reduce bond.

2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the rebar supplied.
3. Rebar support:
 - a. Uncoated rebar:
 - 1) Support rebars and fasten together to prevent displacement by construction loads or placing of concrete.
 - 2) On ground, provide supporting concrete blocks or metal bar supports with bottom plate.
 - a) Do not use concrete blocks to support slab-on-grade reinforcing.
 - 3) Over formwork, provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other rebar support. Only tips in contact with the forms need to be plastic coated.
 4. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, rebars in the upper layers shall be placed directly above rebars in the bottom layer with clear distance between layers to be 1 IN. Place spacer rebars at 3 FT maximum centers to maintain the required 1 IN clear distance between layers.
 5. Extend reinforcement to within 2 IN of concrete perimeter edges. If perimeter edge is formed by earth, extend reinforcement to within 3 IN of the edge.
 6. To assure proper placement, furnish templates for all column vertical bars and dowels.
 7. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer. Do not bend reinforcing by means of heat.
 8. Do not tack weld reinforcing.
 9. Embed rebars into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:
 - a. Drill hole in concrete with diameter and depth as required to develop 125 percent of (unless otherwise indicated on the Drawings), the yield strength of the bar according to manufacturer's requirements.
 - b. Place adhesive in drilled hole.
 - c. Insert rebar into hole and adhesive in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

- A. Reinforcement Congestion and Interferences:
 1. Notify Engineer whenever the specified clearances between rebars cannot be met.
 2. Do not place any concrete until the Engineer submits a solution to rebar congestion problem.
 3. Rebars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
 4. If rebars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of rebars.
 5. No cutting of rebars shall be done without written approval of Engineer.
- B. Employ a testing laboratory to perform and report following:
 1. Review and approve Contractor proposed welding procedures and processes for conformance with AWS D1.4.
 2. Qualify welders in accord with AWS D1.4.
 3. Test three samples of each bar size and each type of weld in accord with AWS D1.4. The tensile strength of each test shall be not less than 125 percent of the required yield strength of the rebar tested.
 4. Conduct nondestructive field tests (radiographic or magnetic particle) on not less than one random sample for each 10 welds. In addition if any welds are found defective, test five previous welds performed by same welder.
 5. Visually inspect each weld for presence of cracks, undercuts, inadequate size and other visible defects.

END OF SECTION

1 **SECTION 03308**
2 **CONCRETE, MATERIALS AND PROPORTIONING**

3 **PART 1 - GENERAL**

4 **1.1 SUMMARY**

- 5 A. Section Includes:
- 6 1. Concrete materials, strengths and proportioning for concrete work.
 - 7 2. Grouting:
 - 8 a. Base plates for columns and equipment.
 - 9 b. Dowels and anchors into concrete.
 - 10 c. Patching cavities in concrete.
 - 11 d. As specified and indicated in the Contract Document.
- 12 B. Related Sections include but are not necessarily limited to:
- 13 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 14 2. Division 1 - General Requirements.
 - 15 3. Section 03108 – Formwork.
 - 16 4. Section 03208 – Reinforcement.
 - 17 5. Section 03348 – Concrete Finishing and Repair Surface Defects.
 - 18 6. Section 03350 - Testing.
 - 19 7. Section 03431 - Precast and Prestressed Concrete.

20 **1.2 QUALITY ASSURANCE**

- 21 A. Referenced Standards:
- 22 1. American Concrete Institute (ACI):
 - 23 a. 116R, Cement and Concrete Terminology.
 - 24 b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass
25 Concrete.
 - 26 c. 212.3R, Chemical Admixtures for Concrete.
 - 27 d. 318, Building Code Requirements for Structural Concrete.
 - 28 2. ASTM International (ASTM):
 - 29 a. C33, Standard Specification Concrete Aggregates.
 - 30 b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete
31 Specimens.
 - 32 c. C94, Standard Specification for Ready-Mixed Concrete.
 - 33 d. C150, Standard Specification for Portland Cement.
 - 34 e. C192, Standard Practice for Making and Curing Concrete Test Specimens in the
35 Laboratory.
 - 36 f. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
 - 37 g. C494, Standard Specification for Chemical Admixtures for Concrete.
 - 38 h. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan
39 for Use as a Mineral Admixture in Concrete.
 - 40 3. Corps of Engineers Specification:
 - 41 a. CRD-C621, Standard Specification for Non-Shrink Grout.
- 42 B. Building Code:
- 43 1. International Code Conference (ICC):
 - 44 a. International Building Code and associated standards, 2000 Edition, including all City
45 of Kerrville, Texas, 2000 IBC amendments, referred to herein as Building Code.

46 **1.3 DEFINITIONS**

- 47 A. Words and terms used in these Specifications are defined in ACI 116R.

1 **1.4 SUBMITTALS**

- 2 A. Shop Drawings:
3 1. See Section 01340.
4 2. Product technical data including:
5 a. Acknowledgement that products submitted meet requirements of standards referenced.
6 b. Manufacturer's instructions.
7 c. Concrete mix designs as required by Section 03350.
8 d. Manufacture and type of proposed admixtures.
9 e. Manufacturer and type of proposed non-shrink grout and grout cure/seal compound.
10 3. Certifications:
11 a. Certification of standard deviation value in psi for ready mix plant supplying the
12 concrete.
13 b. Certification that the fly ash meets the quality requirements stated in this Section, and
14 fly ash supplier's certified test reports for each shipment of fly ash delivered to concrete
15 supplier.
16 c. Certification that the class of coarse aggregate meets the requirements of ASTM C33
17 for type and location of concrete construction.
18 d. Certification of aggregate gradation.
19 4. Test reports:
20 a. Cement mill reports for all cement to be supplied.

21 **1.5 DELIVERY, STORAGE AND HANDLING**

- 22 A. Storage of Materials:
23 1. Store cement and pozzolan in weathertight buildings, bins, or silos which will exclude
24 moisture and contaminants.
25 2. Arrange aggregate stockpiles and use in a manner to avoid excessive segregation and to
26 prevent contamination with other materials or with other sizes of like aggregates.
27 3. Do not use bottom 6 IN layer of stockpiled material in contact with ground.
28 4. Allow natural sand to drain until it has reached a relatively uniform moisture content before
29 use.
30 5. Store admixtures in such a manner as to avoid contamination, evaporation, or damage.
31 a. For those used in form of suspensions or non-stable solutions, provide agitating
32 equipment to assure thorough distribution of ingredients.
33 b. Protect liquid admixtures from freezing and temperature changes which would
34 adversely affect their characteristics and performance.

35 **PART 2 - PRODUCTS**

36 **2.1 ACCEPTABLE MANUFACTURERS**

- 37 A. Subject to compliance with the Contract Documents, the following manufacturers are
38 acceptable:
39 1. Non-shrink grout:
40 a. Master Builders Technology
41 b. Gifford Hill.
42 c. U. S. Grout.
43 d. L & M Construction Chemicals, Inc.
44 e. Sika Corporation
45 2. Epoxy grout:
46 a. Ceilcote.
47 b. Exxon Chemical Co.
48 c. Sika Corporation.
49 d. U. S. Grout.

1 B. Submit requests for substitution in accordance with Specification Section 01640.

2 **2.2 MATERIALS**

3 A. Cement:

- 4 1. ASTM C150,
5 a. Type II for all cast-in-place and precast concrete unless otherwise noted.
6 b. Type I for exterior concrete pavement and concrete not exposed to chemicals or
7 sewage.
8 2. Cement type used shall correspond to that upon which selection of concrete proportions was
9 based in the mix design.

10 B. Fly Ash:

- 11 1. ASTM C618, Class F.
12 2. Non-staining.
13 3. Suited to provide hardened concrete of uniform light gray color.
14 4. Maximum loss on ignition: 4 percent.
15 5. Compatible with other concrete ingredients and having no deleterious effects on the
16 hardened concrete.
17 6. Produced by source approved by the State Highway Department in the state where the
18 project is located.
19 7. Cement and fly ash type used shall correspond to that upon which selection of concrete
20 proportions was based in the mix design.

21 C. Admixtures:

- 22 1. Air entraining: ASTM C260.
23 2. Water reducing, retarding, and accelerating: Conform to ASTM C494, Types A through E,
24 and provisions of ACI 212.3R.
25 3. High range water reducers (superplasticizers): Conform to ASTM C494, Types F or G.
26 4. Pozzolanic: ASTM C618.
27 5. Admixtures to be chloride free. Do not use calcium chloride.
28 6. Provide admixtures of same type, manufacturer and quantity as used in establishing required
29 concrete proportions in the mix design.

30 D. Water:

- 31 1. Potable.
32 2. Clean and free from deleterious substances.
33 3. Free of oils, acids and organic matter.

34 E. Aggregates for Normal Weight Concrete:

- 35 1. ASTM C33.
36 2. Fine and coarse aggregates to be regarded as separate ingredients.
37 3. Fine aggregates to be clean natural sand, not manufactured.
38 4. Coarse Aggregate: Crushed rock, natural gravel or other inert granular material.
39 5. Coarse aggregate sieve analysis:
40 a. For lean concrete, concrete topping, and integral wearing course: ASTM C33, size
41 number 7 (maximum 1/2 IN).
42 b. For foundation mats of water retaining structures; ASTM C33, size number 467
43 (maximum 1 1/2 IN).
44 c. For all other concrete: ASTM C33, size number 67 (maximum 3/4 IN).
45 d. Used only washed aggregate for liquid retaining structures.
46 6. Pozzolan or other additives shall not be used to compensate for alkali reactivity of
47 aggregates.

48 F. Maximum total chloride ion content for concrete mix including all ingredients measured as a
49 weight percent of cement:

- 50 1. 0.06 for prestressed concrete.
51 2. 0.10 for all other concrete.

- 1 G. Sand Cement Grout (Referred to as "Grout" on the Drawings):
 2 1. Approximately 3 parts sand, 1 part Portland cement, 6 +1 percent entrained air and water to
 3 produce a slump which allows grout to completely fill required areas and surround adjacent
 4 reinforcing.
 5 a. Provide sand in accordance with requirements for fine aggregate for concrete.
 6 2. Minimum 28-day compressive strength: 5000 psi.
- 7 H. Non-shrink Grout:
 8 1. Non-shrink, non-metallic, non-corrosive, and non-staining.
 9 2. Premixed with only water to be added in accordance with manufacturer's instructions at
 10 jobsite.
 11 3. Grout to produce a positive but controlled expansion. Mass expansion shall not be created
 12 by gas liberation or by other means.
 13 4. Minimum 28-day compressive strength: 6500 psi.
 14 5. Master Builders "Special LL-713 Grout";
 15 6. Gifford-Hill "Supreme Grout"; "
 16 7. U S Grout "Five Star Grout
 17 8. L & M "Crystex"; Sika Corporation "Sika Grout 212";
 18 9. Or approved equal.
 19 10. In accordance with CRD-C621.
- 20 I. Epoxy Grout:
 21 1. Three-component epoxy resin system:
 22 a. Two liquid epoxy components.
 23 b. One inert aggregate filler component.
 24 2. Adhesive:
 25 a. Ceilcote "HT648" grout.
 26 b. Exxon Chemical Company "Escoweld 2505."
 27 c. Sika "Sikadur Hi-Mod."
 28 d. U S Grout "Five Start Epoxy Grout."
 29 e. Or equal.
 30 3. Aggregate:
 31 a. Ceilcote "HT648."
 32 b. Exxon Chemical Company "Escoweld 2510."
 33 c. Sika aggregate.
 34 d. U S Grout aggregate.
 35 e. Or equal.
 36 4. Aggregate manufacturer shall be the same as the adhesive manufacturer.
 37 5. The aggregate shall be compatible with the adhesive.
 38 6. Each component furnished in separate package for mixing at jobsite.

39 **2.3 MIXES**

- 40 A. General:
 41 1. Provide concrete capable of being placed without aggregate segregation and, when cured, of
 42 developing all properties specified.
 43 2. Ready-mixed concrete shall conform to ASTM C94.
 44 3. All concrete to be normal weight concrete, weighing approximately 145 to 150 LBS per
 45 cubic foot at 28 days after placement.

46 B. Minimum 28-Day Compressive Strengths:

Normal weight concrete fill	2500 psi
Normal weight lean concrete	2500 psi
Pavements, curbs, sidewalks	3000 psi
Normal weight all other concrete	4000 psi
Normal weight precast concrete	5000 psi

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48

C. Air Entrainment:

1. Provide air entrainment in all concrete resulting in a total air content percent by volume as follows:
 - a. 1-1/2 IN maximum aggregate size: 4-1/2 to 6-1/2 percent total air content.
 - b. 1 IN maximum aggregate size: 5 to 7 percent total air content.
 - c. 3/4 IN maximum aggregate size: 5 to 7 percent total air content.
 - d. 1/2 IN maximum aggregate size: 5.5 to 8 percent total air content.

D. Slump:

1. 5 IN maximum, 1 IN minimum measured at point of discharge for beams, columns, and walls for mixes without superplasticizer.
2. 8 IN maximum after addition of superplasticizer (See "Proportioning" paragraph).
3. 4 IN maximum, 1 IN minimum measured at point of discharge into all other concrete construction members.
4. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
5. Provide additional water at ready mix plant for concrete that is to be pumped to allow for slump loss due to pumping. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified.

E. Proportioning:

1. General:
 - a. Proportion ingredients to produce a mixture which will work readily into corners and angles of forms and around reinforcement by methods of placement and consolidation employed without permitting materials to segregate or excessive free water to collect on surface.
 - b. Proportion ingredients to produce proper placability, durability, strength and other required properties.
2. Normal weight concrete minimum cement contents and maximum water cement ratios:

SPECIFIER STRENGTH (PSI)	MINIMUM CEMENT CONTENT (SACKS/CY)	MINIMUM CEMENT (LBS/CY)	MAXIMUM WATER CEMENT RATIO BY WEIGHT
2500 -3000	5-1/2	517*	0.45
4000	6-1/2	611*	0.45 (**)
5000	7	658*	0.45

* If fly ash is proposed for use, the weight of fly ash plus weight of Portland cement shall equal these values.

** If superplasticizer additive is used, limit water cement ratio to 0.40.

3. Fly Ash:

- a. For cast-in-place concrete only, a maximum of 25 percent by weight of Portland cement content per cubic yard may be replaced with fly ash at a rate of 1 LB fly ash for 1 LB cement.
- b. If fly ash is used, the water to fly ash plus cement ratio not to exceed the maximum water cement ratio specified in this Section.
- c. Concrete containing fly ash shall not be used in the construction of the precast concrete units specified in Section 03431.

4. Water reducing, retarding, and accelerating admixtures:

- a. Use in accordance with manufacturer's instructions.
- b. Add to mix at batching plant.
- c. Do not use unless required by these specifications or approved for use by Engineer.

5. High range water reducers (superplasticizers):

- a. Use in accordance with manufacturer's instructions.
- b. Do not use unless required by these Specifications or approved for use by Engineer.

- 1 c. Maximum concrete slump before addition of admixture to be 3 IN. Maximum slump
- 2 after addition to be 8 IN.
- 3 d. Maximum water-cement ratio of the concrete mix containing a high range water
- 4 reducer to be 0.40.
- 5 6. Concrete mix proportioning methods for normal weight concrete:
- 6 a. Method 1:
- 7 1) Used when combination of materials proposed is to be evaluated and proportions
- 8 selected to be on a basis of trial mixes.
- 9 2) Produce mixes having suitable proportions and consistencies based on ACI 211.1,
- 10 using at least three different water cement ratios or cement contents which will
- 11 produce a range of compressive strengths encompassing the required average
- 12 strength.
- 13 3) Design trial mixes to produce a slump within 0.75 IN of maximum specified, and
- 14 for air entrained concrete, air content within 0.5 percent specified.
- 15 4) For each water cement ratio or cement content, make at least three compression
- 16 test cylinders for specified test age, and cure in accordance with ASTM C192. Test
- 17 for strength at 28 days in accordance with ASTM C39.
- 18 5) From results of these tests, plot a curve showing relationship between water cement
- 19 ratio or cement content and compressive strength.
- 20 6) From this curve select water cement ratio or cement content to be used to produce
- 21 required average strength.
- 22 7) Use cement content and mixture proportions such that maximum water cement
- 23 ratio is not exceeded when slump is maximum specified.
- 24 8) Base field control on maintenance of proper cement content, slump, air content and
- 25 water cement ratio.
- 26 9) See paragraph hereafter for definition of required average strength.
- 27 b. Method 2:
- 28 1) In lieu of trial mixes, field test records for concrete made with similar ingredients
- 29 may be used.
- 30 2) Use of proposed concrete mix proportions based on field test records subject to
- 31 approval by Engineer based on information contained in field test records and
- 32 demonstrated ability to provide the required average strength.
- 33 3) Field test records to represent materials, proportions and conditions similar to those
- 34 specified. Changes in the materials, proportions and conditions within the test
- 35 records shall have not been more restricted than those for the proposed concrete
- 36 mix.
- 37 4) Field test records to consist of less than 30 but not less than 10 consecutive tests
- 38 provided the tests encompass a period of not less than 45 consecutive days.
- 39 5) Required concrete proportions may be established by interpolation between the
- 40 strengths and proportions of two or more test records each of which meets the
- 41 requirements of this Section.
- 42 7. Required average strength:
- 43 a. Required average strength to exceed the specified 28-day compressive strength by the
- 44 amount determined or calculated in accordance with paragraph 5.3 of ACI 318 using
- 45 the standard deviation of the proposed concrete production facility as described in
- 46 Paragraph 5.3.1 of ACI 318.

47 F. Flowable Fill:

- 48 1. Actual quantities shall be adjusted to provide a yield of 1 CY with the materials used.
- 49 2. Approximate compressive strength should be 85 to 175 psi.
- 50 3. Fine sand shall be an evenly graded material having not less than 95 percent passing the No.
- 51 4 sieve and not more than 5 percent passing the No. 200 sieve.

52 **2.4 SOURCE QUALITY CONTROL**

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

SECTION 03311
CONCRETE MIXING, PLACING, JOINTING, AND CURING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mixing, placing, jointing, and curing of concrete construction.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03108 - Formwork.
 - 4. Section 03208 - Reinforcement.
 - 5. Section 03308 - Concrete, Materials and Proportioning.
 - 6. Section 03348 - Concrete Finishing and Repair of Surface Defects.
 - 7. Section 03350 - Testing.
 - 8. Section 07900 - Joint Sealants.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - c. 304.2R, Placing Concrete by Pumping Methods.
 - d. 305R, Hot Weather Concreting.
 - e. 306R, Cold Weather Concreting.
 - f. 308, Standard Practice for Curing Concrete.
 - g. 309R, Guide for Consolidation of Concrete.
 - 2. ASTM International (ASTM):
 - a. C94, Standard Specification for Ready-Mixed Concrete.
 - b. C171, Standard Specification for Sheet Materials for Curing Concrete.
 - c. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - d. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - e. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - f. D1056, Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber.
 - g. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
 - 3. Corps of Engineers:
 - a. CRD-C572, Standard Specification for Polyvinyl Waterstops.
 - 4. National Ready Mixed Concrete Association (NRMCA):
 - a. Check List for Certification of Ready Mixed Concrete Production Facilities.
- B. Building Code:
 - 1. International Code Conference (ICC):
 - a. International Building Code and associated standards, 2000 Edition, including all City of Kerrville, Texas, 2000 IBC amendments, referred to herein as Building Code.
- C. Qualifications:

1 1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.

2 **1.3 DEFINITIONS**

3 A. Words and terms used in this Specification are defined in ACI 116R.

4 **1.4 SUBMITTALS**

5 A. Shop Drawings:

6 1. See Section 01340.

7 2. Product technical data including:

8 a. Acknowledgement that products submitted meet requirements of standards referenced.

9 b. Manufacturer's installation instructions.

10 1) Procedure for adding high-range water reducer at the jobsite.

11 c. Scaled (minimum 1/8 IN per foot) drawings showing proposed locations of
12 construction joints and joint keyway dimensions.

13 d. Manufacturers and types:

14 1) Joint fillers.

15 2) Curing agents.

16 3) Construction joint bonding adhesive.

17 4) Waterstops.

18 3. Certifications:

19 a. Ready mix concrete plant certification.

20 b. Waterstops: Products shipped meet or exceed the physical properties specified.

21 B. Miscellaneous:

22 1. Copies of concrete delivery tickets.

23 2. Description of proposed curing method.

24 **1.5 DELIVERY, STORAGE AND HANDLING**

25 A. Delivery:

26 1. Concrete:

27 a. Prepare a delivery ticket for each load of ready mixed concrete.

28 b. Truck operator shall hand ticket to Contractor at the time of delivery.

29 c. Ticket to show:

30 1) Mix identification.

31 2) Quantity delivered.

32 3) Amount of material in each batch.

33 4) Outdoor temperature in the shade.

34 5) Time at which cement was added

35 6) Time of delivery.

36 7) Time of discharge.

37 8) Amount of water added.

38 **PART 2 - PRODUCTS**

39 **2.1 COMPONENTS**

40 A. Neoprene Expansion Joint Fillers:

41 1. Manufacturers:

42 a. Permaglaze.

43 b. Rubatex.

44 c. Williams Products.

45 2. Materials:

46 a. Closed cell neoprene.

47 b. ASTM D1056, Class SC, 2 to 5 psi compression deflection, Grade SCE-41.

- 1 B. Asphalt Expansion Joint Fillers:
- 2 1. Manufacturers:
- 3 a. W R Meadows.
- 4 b. J and P Petroleum Products.
- 5 2. Materials: ASTM D994.
- 6 C. Fiber Expansion Joint Fillers:
- 7 1. Materials: ASTM D1751.
- 8 D. Waterstops, Bulb Type:
- 9 1. Manufacturers:
- 10 a. Greenstreak Plastics Products.
- 11 b. W R Meadows.
- 12 2. Materials:
- 13 a. Virgin polyvinyl chloride compound not containing any scrap or reclaimed materials or
- 14 pigment.
- 15 b. Corps of Engineers Specification CRD-C572.
- 16 3. In all joints:
- 17 a. 6 IN wide x 1/4 IN thick bulb type.
- 18 b. Similar to Greenstreak Plastics Products Style #704.
- 19 4. Factory pre-punched (12 IN centers, each edge) for wire supports.
- 20 5. Provide factory-made waterstop fabrications at all changes in direction, intersections and
- 21 transitions, leaving only straight butt splices for the field.
- 22 E. Epoxy Construction Bonding Agent:
- 23 1. Corr-Bond by Euclid.
- 24 2. "Sika Armatec 110: by Sika Corporation.
- 25 3. "CR 426" by Sto.
- 26 F. Sand cement grout, non-shrink grout and epoxy grout: See Section 03308.
- 27 G. Submit requests for substitutions in accordance with Specification Section 01640.

28 **2.2 SOURCE QUALITY CONTROL**

- 29 A. The central concrete plant shall conform to the check list for certification of Ready Mixed
- 30 Concrete Production Facilities of the NRMCA.

31 **PART 3 - EXECUTION**

32 **3.1 PREPARATION**

- 33 A. General:
- 34 1. Complete formwork.
- 35 a. See Section 03108.
- 36 2. Remove earth, snow, ice, water, and other foreign materials from areas that will receive
- 37 concrete.
- 38 3. Secure reinforcement in place.
- 39 a. See Section 03208.
- 40 4. Position expansion joint material, anchors and other embedded items.
- 41 5. Obtain approval of reinforcement erection and placement prior to placing concrete.
- 42 6. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and
- 43 approval is obtained.
- 44 a. Plan size of crews with due regard for effects of concrete temperature and atmospheric
- 45 conditions on rate of hardening of concrete as required to obtain good surfaces and
- 46 avoid unplanned cold joints.
- 47 b. Do not allow rainwater to increase mixing water nor to damage surface finish.
- 48 7. Prepare all construction joints for proper bond as indicated in Paragraph 3.4.C.

- 1 8. Remove hardened concrete and foreign materials from inner surfaces of conveying
2 equipment and formwork.
- 3 9. Provide slabs and beams of minimum indicated required depth when sloping structural
4 foundation base slabs and elevated slabs to drains. For floor slabs on grade, slope top of
5 subgrade to provide slab of required uniform thickness.

6 B. Edge Forms and Screeds:

- 7 1. Set accurately to produce designated elevations and contours of finished surface.
- 8 2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
- 9 3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to
10 contours of screed strips.

11 **3.2 CONCRETE MIXING**

12 A. General:

- 13 1. Provide all concrete from a central plant conforming to Check List for Certification of
14 Ready Mixed Concrete Production Facilities of the NRMCA.
- 15 2. Batch, mix, and transport in accordance with ASTM C94.

16 B. Control of Admixtures:

- 17 1. Charge admixtures into mixer as solutions.
 - 18 a. Measure by means of an approved mechanical dispensing device.
 - 19 b. Liquid considered a part of mixing water.
 - 20 c. Admixtures that cannot be added in solution may be weighed or measured by volume if
21 so recommended by manufacturer.
- 22 2. Add separately, when two or more admixtures are used in concrete, to avoid possible
23 interaction that might interfere with efficiency of either admixture, or adversely affect
24 concrete.
- 25 3. Complete addition of retarding admixtures within one minute after addition of water to
26 cement has been completed, or prior to beginning of last three quarters of required mixing,
27 whichever occurs first.

28 C. Tempering and Control of Mixing Water:

- 29 1. Mix concrete only in quantities for immediate use.
- 30 2. Discard concrete which has set.
- 31 3. Discharge concrete from ready mix trucks within time limit and drum revolutions stated in
32 ASTM C94.
- 33 4. Addition of water at the jobsite:
 - 34 a. See Section 03308 for specified water cement ratio and slump.
 - 35 b. Do not exceed maximum specified water cement ratio or slump.
 - 36 c. Incorporate water by additional mixing equal to at least half of total mixing required.
 - 37 d. Perform strength test on any concrete to which water has been added at the jobsite. See
38 Section 03350.
 - 39 e. Prior to addition of water at the jobsite, a water/cement ratio analysis will be performed
40 by the Contractor from information provided on the delivery ticket. Provided that the
41 total amount of water to meet the maximum water/cement ratio may be added to the
42 mix.
 - 43 f. If the maximum amount of water has been added to the mix or if insufficient data is
44 provided on the delivery ticket to determine the water/cement ratio, then no additional
45 water may be added.

46 **3.3 PLACING OF CONCRETE**

47 A. General:

- 48 1. Comply with ACI 304R and 304.2R.
- 49 2. Deposit concrete:
 - 50 a. Continuously to avoid cold joints.
 - 51 b. In layers of 12 to 18 IN.

- 1 3. Locate construction joints at locations approved by Engineer.
- 2 a. Plan size of crews with due regard for effects of concrete temperature and atmosphere
- 3 conditions to avoid unplanned cold joints.
- 4 4. Place concrete at such a rate that concrete, which is being integrated with fresh concrete, is
- 5 still workable.
- 6 5. Do not place concrete during rain, sleet or snow, unless adequate protection is provided and
- 7 approval is obtained.
- 8 6. Do not deposit concrete which has partially hardened or has been contaminated by foreign
- 9 materials.
- 10 7. Spreaders:
- 11 a. Temporary:
- 12 1) Remove as soon as concrete placing renders their function unnecessary.
- 13 b. Embedded:
- 14 1) Obtain approval of Engineer.
- 15 2) Materials: Concrete or metal.
- 16 3) Ends of metal spreaders coated with plastic coating 2 IN from each end.
- 17 8. Do not begin placing of concrete in supported elements until concrete previously placed in
- 18 supporting members is no longer plastic and has been in place at least a minimum of 2 HRS.
- 19 9. Deposit concrete as nearly as practicable in its final position to avoid segregation.
- 20 a. Maximum free fall: 4 FT.
- 21 b. Free fall exceeding 4 FT:
- 22 1) Place concrete by means of hopper, elephant trunk or tremie pipe extending down
- 23 to within 4 FT of surface placed upon.
- 24 10. Perform the following operations before bleeding water has an opportunity to collect on
- 25 surface:
- 26 a. Spread.
- 27 b. Consolidate.
- 28 c. Straightedge.
- 29 d. Darby or bull float.
- 30 B. High-Range Water Reducers (Superplasticizers):
- 31 1. Manufacturer's representative be present at the jobsite to instruct the Contractor as to the
- 32 proper use and dosage of the admixture.
- 33 2. Add superplasticizer to the concrete in the truck mixer at the jobsite.
- 34 3. Perform concrete slump test at the jobsite both prior to and after addition of the admixture to
- 35 the concrete.
- 36 C. Cold Weather Concrete Placement:
- 37 1. Comply with ACI 306R.
- 38 2. Do not place concrete on substrates that are below 32 DegF or contain frozen material.
- 39 3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete
- 40 will come in contact with free of frost, ice or snow at time of concrete placement.
- 41 4. Temperature of concrete when discharged at site:
- 42

AIR TEMPERATURE DEGF	MINIMUM CONCRETE TEMPERATURE, DEGF FOR SECTIONS WITH LEAST DIMENSION LESS THAN 12 IN	MINIMUM CONCRETE TEMPERATURE, DEGF FOR SECTIONS WITH LEAST DIMENSION 12 IN OR GREATER
30 to 45	60	55
0 to 30	65	55
below 0	70	60

- 43
- 44 5. Heat subgrade, forms, and reinforcement so the temperature of the subgrade, forms, and
- 45 reinforcement will be between 45 and 70 DegF, when temperature of surrounding air is 40
- 46 DegF or below at time concrete is placed. Remove all frost from subgrade, forms and
- 47 reinforcement before concrete is placed.

- 1 6. Combine water with aggregate in mixer before cement is added, if water or aggregate is
2 heated above 90 DegF.
- 3 7. Do not mix cement with water or with mixtures of water and aggregate having a
4 temperature greater than 90 DegF.
- 5 8. Do not place slabs on ground if temperature is below 40 DegF or if temperature surrounding
6 the slab will be below 40 DegF before structure is enclosed and heated.
- 7 D. Hot Weather Concrete Placement:
- 8 1. Comply with ACI 305R.
- 9 2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt
10 completely during mixing for all or part of mixing water if high temperature, low slump,
11 flash set, cold joints, or shrinkage cracks are encountered.
- 12 3. Temperature of concrete when placed:
- 13 a. Not to exceed 90 DegF.
- 14 b. Not so high as to cause:
- 15 1) Shrinkage cracks.
- 16 2) Difficulty in placement due to loss of slump.
- 17 3) Flash set.
- 18 4. Temperature of forms and reinforcing when placing concrete:
- 19 a. Not to exceed 90 DegF.
- 20 b. May be reduced by spraying with water to cool below 90 DegF.
- 21 1) Leave no standing water to contact concrete being placed.
- 22 5. Prevent plastic shrinkage cracking and/or slab curling due to evaporation of moisture.
- 23 E. Consolidating:
- 24 1. Consolidate in accordance with ACI 309R except as modified herein.
- 25 2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement,
26 embedded items and into corners of forms.
- 27 a. Eliminate:
- 28 1) Air or stone pockets.
- 29 2) Honeycombing or pitting.
- 30 3) Planes of weakness.
- 31 3. Internal vibrators:
- 32 a. Minimum frequency of 8000 vibrations per minute.
- 33 b. Insert and withdraw at points approximately 18 IN apart.
- 34 1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient
35 to cause segregation.
- 36 c. Use in:
- 37 1) Beams and girders of framed slabs.
- 38 2) Columns and walls.
- 39 3) Vibrating concrete around all waterstops.
- 40 d. Size of vibrators shall be in accordance with Table 5.1.5 of ACI 309R.
- 41 4. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds,
42 or other approved means.
- 43 5. Do not use vibrators to transport concrete within forms.
- 44 6. Provide spare vibrators on jobsite during all concrete placing operations.
- 45 7. Bring a full surface of mortar against form by vibration supplemented if necessary by
46 spading to work coarse aggregate back from formed surface, where concrete is to have an
47 as-cast finish.
- 48 8. Use suitable form vibrators located just below top surface of concrete, where internal
49 vibrators cannot be used in areas of congested reinforcing.
- 50 9. Prevent construction equipment, construction operations, and personnel from introducing
51 vibrations into freshly placed concrete after the concrete has been placed and consolidated.
- 52 F. Handle concrete from mixer to place of final deposit by methods which will prevent segregation
53 or loss of ingredients and in a manner which will assure that required quality of concrete is
54 maintained.

1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94.
2. Horizontal belt conveyors:
 - a. Mount at a slope which will not cause segregation or loss of ingredients.
 - b. Protect concrete against undue drying or rise in temperature.
 - c. Use an arrangement at discharge end to prevent segregation.
 - d. Do not allow mortar to adhere to return length of belt.
 - e. Discharge conveyor runs into equipment specially designed for spreading concrete.
3. Metal or metal lined chutes:
 - a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
 - b. Chutes more than 20 FT long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
 - c. Provide end of each chute with a device to prevent segregation.
4. Pumping or pneumatic conveying equipment:
 - a. Designed for concrete application and having adequate pumping capacity.
 - b. Control pneumatic placement so segregation is avoided in discharged concrete.
 - c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
 - d. Do not convey concrete through pipe made of aluminum or aluminum alloy.
 - e. Provide pumping equipment without Y sections.

3.4 JOINTS AND EMBEDDED ITEMS

A. General - Construction Joints:

1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
 - a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph B below, submit proposed construction joint location in conformance with the Specification.
2. Unplanned construction joints will not be allowed. If concrete cannot be completely placed between planned construction joints, then it must be removed.
3. Allow a minimum of 48 hrs. before placement of adjoining concrete construction.
4. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
5. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
 - a. At Contractor's option, beam pockets may be formed into concrete walls. Size pockets to allow beam reinforcing to be placed as detailed on Drawings.
6. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
7. Provide roughened construction joints at all construction joints where indicated on Drawings.
 - a. Clean the previously hardened concrete interface and remove all laitance.
 - b. Intentionally roughen the interface to a full amplitude of 1/4 IN.
 - c. Provide recessed flat surface as required to install strip type waterstops.
8. Provide continuous keyways where indicated on the Drawings. Construction joint keyways shall have the following dimensions, unless shown otherwise on Drawings or directed otherwise by Engineer.
 - a. Construction joint keyways in walls:
 - 1) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured perpendicular to wall faces.
 - 2) Keyway depth to be not less than 1-1/2 IN.
 - 3) Place keyway in wall center unless shown otherwise on Drawings.
 - b. Construction joint keyways in footings, foundations, base slabs, and structural or elevated slabs:

- 1) Keyway height not less than 1/3 and not more than 1/2 the footing or slab thickness.
- 2) Keyway depth not less than 1-1/2 IN.
- 3) Keyway in footing or slab center unless shown otherwise on Drawings.
- c. Construction joint keyways in beams:
- 1) Keyway height not less than 1/3 and not more than 1/2 the beam depth.
- 2) 2) Keyway depth not less than 1-1/2 IN.
- 3) 3) Keyway in beam center unless shown otherwise on Drawings.
9. Allow a minimum of 48 HRS before placement of adjoining concrete construction.
- B. Construction Joints - Spacing:
1. General - Structures not intended to contain liquid:
- a. Wall vertical construction joints:
- 1) 50 FT maximum centers.
- 2) At wall intersections, 15 FT maximum from corner.
- b. Wall horizontal construction joints: 20-25 FT centers.
- c. Base slab, floor, construction joints:
- 1) Placements to be approximately square.
- 2) Maximum side dimension of a slab pour to be 50 FT.
2. Structures intended to contain liquids:
- a. Wall vertical construction joints:
- 1) 30 FT maximum centers.
- 2) At wall intersections, 10 FT maximum from corner, unless otherwise noted on the Drawings.
- b. Wall horizontal construction joints: 10-15 FT centers.
- c. Base slab, floor construction joints:
- 1) Placements to be approximately square.
- 2) Maximum side dimension of a slab pour to be 45 FT.
- C. Bonding at Construction Joints:
1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints. Before new concrete is placed, all construction joints shall be coated with epoxy adhesive, cement grout, or other method approved by the Engineer.
2. General - Use cement grout or dampening for all construction joints except as otherwise specified herein.
- a. Roughen the surface of the hardened concrete to uniformly exposed the coarse aggregate.
- b. Remove laitance, loosened particles of aggregate or damaged concrete at the surface, or at the Contractor's option, use an approved chemical retarder which delays but does not prevent setting of the surface of the mortar in accordance with the manufacturer's recommendations. Retarded mortar shall be removed within 24 HRS after placing to produce a clean exposed aggregate bonding surface.
- c. Dampen the hardened concrete (but do not saturate) immediately prior to placing of fresh concrete or grout.
- d. Cover the hardened concrete of horizontal joints with a coat of cement grout (see Specification Section 03308)
- a) Place grout as thick as possible on vertical surfaces.
- b) Place 1 IN layer of grout in bottoms of wall or column lifts immediately before placing concrete and at least 1/2 IN thick on other horizontal surfaces. Vibrate grout and first layer of concrete simultaneously.
- c) Place fresh concrete before the grout has attained its initial set.
- e. Use epoxy bonding agent for walls and slabs of tanks and structures designed to contain liquids at all joints in beams, girders, walls and slabs. Exception: 1 IN layer of grout shall be used as noted above for all wall/slab and horizontal wall to wall joints.
- 1) Joints receiving an adhesive shall be prepared, and the adhesive applied in accordance with the manufacturer's recommendations.

- 1 2) Epoxy adhesive shall have adequate pot life to allow new concrete to be placed
2 while the adhesive has not set. Otherwise, use alternate Engineer approved
3 bonding method.

4 D. Waterstops:

- 5 1. Lap or connect all types of waterstop to create water tight joints as recommended by
6 manufacturer.
7 2. Do not mix different types of waterstop material in the same structure without specific
8 approval from the Engineer.
9 3. Contractor is responsible for waterstop selection and installation to provide leak-tight joints
10 to the minimum standard shown in the Contract Documents.

11 E. PVC Waterstops:

- 12 1. Position waterstop accurately in forms.
13 2. Secure waterstops in correct position using hog rings or grommets spaced along the length
14 of waterstop and tie wire to adjacent reinforcing.
15 3. Hold horizontal waterstops in place with continuous supports.
16 4. Install according to manufacturer's instructions. Do not displace reinforcement from
17 required location.
18 5. Waterstops to be continuous.
19 6. Splice ends with perpendicular butt splice using electrical splicing iron in accordance with
20 manufacturer's instructions.
21 a. Use prefabricated "T" and corner fittings.
22 7. Unless otherwise noted, use for all construction joints in new construction for all structures
23 indicated on Drawings.

24 F. Embedded Items:

- 25 1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its
26 support, prior to initiating concreting.
27 2. Do not place electrical conduit, drains, or pipes in or thru concrete slabs, walls, columns,
28 foundations, beams or other structural members unless approved by Engineer.

29 G. Placing Embedded Items:

- 30 1. Position expansion joint material, waterstops, and other embedded items accurately.
31 2. Support against displacement.
32 3. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to
33 prevent entry of concrete into voids.
34 4. Provide adequate means for anchoring waterstop in concrete.
35 a. Provide means to prevent waterstops in the forms from being folded over by the
36 concrete as it is placed.
37 b. Work concrete under the waterstops by hand, so as to avoid the formation of air and
38 rock pockets, when placing roof and floor slab concrete around waterstops.

39 **3.5 FINISHING**

40 A. See Section 03348.

- 41 1. Coordinate mixing and placing with finishing.

42 **3.6 INSTALLATION OF GROUT**

43 A. Grout Schedule of Use:

- 44 1. Sand cement grout:
45 a. General use.
46 b. Construction joint bonding as per Paragraph 3.4.C.
47 2. Non-shrinking non-metallic grout:
48 a. Filling form tie holes.
49 b. Under column and beam base plates.
50 c. Under equipment bases.
51 d. Other uses indicated on the Drawings.

- 1 e. Patching cavities in concrete.
- 2 f. Grouting of dowels and anchor bolts into existing concrete.
- 3 g. Grouting of equipment base plates where driving motor is 500 HP and above.
- 4 h. Other uses indicated on the Drawings.

- 5 B. Grout Installation:
- 6 1. Sand cement grout:
- 7 a. Cure grout by one of methods specified.
- 8 2. Non-shrink non-metallic grout:
- 9 a. Clean concrete surface to receive grout.
- 10 b. Saturate concrete with water for 24 HRS prior to grouting.
- 11 c. Mix in a mechanical mixer.
- 12 d. Use no more water than necessary to produce flowable grout.
- 13 e. Place in accordance with manufacturer's instructions.
- 14 f. Provide under beam, column, and equipment base plates, and in other locations
- 15 indicated on the Drawings.
- 16 g. Completely fill all spaces and cavities below the top of base plates.
- 17 h. Provide forms where base plates and bed plates do not confine grout.
- 18 i. Where exposed to view, finish grout edges smooth.
- 19 j. Except where a slope is indicated on the Drawings, finish edges flush at the base plate,
- 20 bed plate, member or piece of equipment.
- 21 k. Coat exposed edges of grout with cure or seal compound recommended by the grout
- 22 manufacturer.
- 23 l. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets.
- 24 Wet cure grout for 7 days minimum.
- 25 3. Epoxy grout:
- 26 a. Mix and place in accordance with manufacturer's instructions.
- 27 b. Apply only to clean, dry, sound surface.
- 28 c. Completely fill all cavities and spaces around dowels and anchors without voids.
- 29 d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
- 30 e. Obtain manufacturer's field technical assistance as required to assure proper placement.

31 **3.7 CURING AND PROTECTION**

- 32 A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical
- 33 injury immediately after placement, and maintain with minimal moisture loss at relatively
- 34 constant temperature for period necessary for hydration of cement, hardening, and compressive
- 35 strength gain. Follow recommendations of ACI 308 except as modified herein.

- 36 B. Apply one of the following curing procedures immediately after completion of placement and
- 37 finishing, for concrete surfaces not in contact with forms.
- 38 1. Ponding or continuous sprinkling.
- 39 2. Application of absorptive mats or fabric kept continuously wet.
- 40 3. Application of sand kept continuously wet.
- 41 4. Continuous application of steam (not exceeding 150 DegF) or mist spray.
- 42 5. Application of waterproof sheet materials, conforming to ASTM C171.
- 43 6. Application of other moisture retaining covering as approved.
- 44 7. Application of a curing compound conforming to ASTM C309.
- 45 a. Apply curing compound in accordance with manufacturer's recommendations
- 46 immediately after any water sheen which may develop after finishing has disappeared
- 47 from concrete surface.
- 48 b. Do not use on any surface against which additional concrete or other material is to be
- 49 bonded unless it is proven that curing compound will not prevent bond.
- 50 c. Where a vertical surface is cured with a curing compound, the vertical surface shall be
- 51 covered with a minimum of two coats of the curing compound.
- 52 1) Apply the first coat of curing compound to a vertical surface immediately after
- 53 form removal.

- 1 2) The vertical concrete surface at the time of receiving the first coat shall be damp
- 2 with no free water on the surface.
- 3 3) Allow the preceding coat to completely dry prior to applying the next coat.
- 4 4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
- 5 C. Curing Concrete In Contact with Forms:
- 6 1. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to
- 7 heating by sun by keeping forms wet and cool until they can be safely removed.
- 8 2. After form removal, cure concrete until end of time prescribed.
- 9 a. Use one of methods listed above.
- 10 3. Forms left in place shall not be used as a method of curing in hot weather.
- 11 4. The term "hot weather," where used in these specifications, is defined in ACI 305R.
- 12 5. In hot weather, remove forms from vertical surfaces as soon as concrete has gained
- 13 sufficient strength so that the formwork is no longer required to support the concrete.
- 14 D. Continue curing for at least 7 days for all concrete except high early strength concrete for which
- 15 period shall be at least 3 days. If one of curing procedures indicated above is used initially, it
- 16 may be replaced by one of other procedures indicated any time after concrete is 1 day old,
- 17 provided concrete is not permitted to become surface dry during transition.
- 18 E. Cold Weather:
- 19 1. Follow recommendations of ACI 306R.
- 20 2. Maintain temperature of concrete between 50 and 70 DegF for required curing period, when
- 21 outdoor temperature is 40 DegF, or less.
- 22 3. Use heating, covering, insulating, or housing of the concrete work to maintain required
- 23 temperature without injury due to concentration of heat.
- 24 4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete
- 25 to exhaust gases which contain carbon dioxide.
- 26 5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does
- 27 not develop in the supporting subgrade.
- 28 F. Hot Weather:
- 29 1. Follow recommendations of ACI 305R.
- 30 2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog
- 31 spraying, sprinkling, ponding, or wet covering with a light colored material.
- 32 3. Provide protective measures as quickly as concrete hardening and finishing operations will
- 33 allow.
- 34 G. Rate of Temperature Change:
- 35 1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible,
- 36 during and immediately following curing period.
- 37 2. Do not exceed a temperature change of 5 DegF in any 1 HR or 50 DegF in any 24 HR
- 38 period.
- 39 H. Protection from Mechanical Injury:
- 40 1. Protect concrete from damaging mechanical disturbances, such as load stresses, heavy
- 41 shock, and excessive vibration.
- 42 2. Protect finished concrete surfaces from damage by construction equipment, materials, or
- 43 methods, and by rain or running water.
- 44 3. Do not load self supporting structures in such a way as to overstress concrete.

45 **3.8 FIELD QUALITY CONTROL**

- 46 A. Tests in accordance with Section 03350.
- 47 1. Perform a strength test on all concrete to which water or superplasticizer, in addition to the
- 48 amount stated in the concrete mix design, has been added at the jobsite.
- 49 a. Perform strength test after water or superplasticizer has been added and additional
- 50 mixing has been performed.

- 1 B. Field samples of fabricated waterstop fittings (crosses, tees, etc.) will be selected at random by
2 the Engineer for testing by a laboratory at the Owner's expense. When tested, they shall have a
3 tensile strength across the joints equal to at least 600 psi.

4

END OF SECTION

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45

SECTION 03348
CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete finishing and repair of surface defects.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03108 - Formwork.
 - 4. Section 03308 - Concrete, Materials and Proportioning.
 - 5. Section 09905 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 301, Standard Specifications for Structural Concrete.
 - 2. ASTM International (ASTM):
 - a. C150, Standard Specification for Portland Cement.
 - b. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - 3. International Code Conference (ICC):
 - 1) International Building Code and associated standards, 2000 Edition, including all City of Kerrville, Texas, 2000 IBC amendments, referred to herein as Building Code.

1.3 DEFINITIONS

- A. Vertical Surface Defects:
 - 1. Any void in the face of the concrete deeper than 1/8 IN, such as:
 - a. Tie holes.
 - b. Air pockets (bugholes).
 - c. Honeycombs.
 - d. Rock holes.
 - 2. Scabbing:
 - a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
 - 3. Foreign material embedded in face of concrete.
 - 4. Fins 1/16 IN or more in height.
- B. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 1. Installer or applicator are synonymous.
- C. Other words and terms used in these Specifications are defined in ACI 116R.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01340.

- 1 2. Product technical data including:
- 2 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 3 b. Manufacturer's installation instructions.
- 4 3. Certifications:
- 5 a. Certification of aggregate gradation.
- 6 b. Certification that products being used will not interfere with bonding of future floor or
- 7 wall finishes.
- 8 B. Miscellaneous Submittals:
- 9 1. See Section 01340.

10 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 11 A. Comply with manufacturer's recommendations and requirements for materials used.

12 **1.6 WARRANTY**

- 13 A. Provide warranty equal to specified manufacturer's standard warranty for all products used.

14 **PART 2 - PRODUCTS**

15 **2.1 ACCEPTABLE MANUFACTURERS**

- 16 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 17 acceptable:
- 18 1. Chemical sealer:
- 19 a. L & M Construction Chemicals, Inc.
- 20 b. Euclid Chemical Co.
- 21 c. Dayton Superior.
- 22 2. Bonding agents:
- 23 a. The Euclid Chemical Co.
- 24 b. Master Builders Inc.
- 25 c. L & M Construction Chemicals Inc.
- 26 3. Two component epoxy adhesive for crack repair:
- 27 a. Sika
- 28 b. The Euclid Chemical Co.
- 29 c. Contech Group
- 30 B. Submit requests for substitution in accordance with Specification Section 01640.

31 **2.2 MATERIALS**

- 32 A. Chemical Floor Sealer:
- 33 1. Colorless low VOC water-based solution containing acrylic copolymers.
- 34 a. ASTM C1315, Class B, minimum 30 percent solids.
- 35 2. Similar to L & M Construction Chemicals Inc. Dress & Seal WB 30.
- 36 B. Bonding Agent:
- 37 1. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to
- 38 improve adhesion and mechanical properties of concrete patching mortars.
- 39 2. Euclid Chemical Co. "Flex-Con."
- 40 3. Master Builders Inc. "Acryl-Set."
- 41 4. L & M Construction Chemicals "Everbond."
- 42 5. Thoro System Products "Acryl 60."
- 43 C. Cement:
- 44 1. ASTM C150, Type II Portland for areas exposed to sewage or chemicals.
- 45 2. ASTM C150, Type I, Portland elsewhere.
- 46 D. Aggregate:

- 1 1. Sand: Maximum size #30 mesh sieve.
- 2 2. For exposed aggregate finish surfaces: Same as surrounding wall.

3 E. Water: Potable.

4 2.3 MIXES

5 A. Bonding Grout:

- 6 1. One part cement to one part aggregate.
- 7 2. Mix cement and aggregate.
- 8 3. Mix bonding agent and water together in separate container in accordance with
- 9 manufacturer's instructions.
- 10 4. Add bonding agent/water mixture to cement/aggregate mixture.
- 11 5. Mix to consistency of thick cream.
- 12 6. Bonding agent itself may be used as bonding grout if approved by manufacturer and
- 13 Engineer.

14 B. Patching Mortar:

- 15 1. One part cement to two and one-half parts aggregate by damp loose volume.
- 16 a. Substitute white Portland cement for a part of gray Portland cement to produce color
- 17 matching surrounding concrete.
- 18 2. Mix cement and aggregate.
- 19 3. Mix bonding agent and water together in separate container in accordance with
- 20 manufacturer's instructions.
- 21 4. Add only enough bonding agent/water mixture to cement/aggregate mixture to allow
- 22 handling and placing.
- 23 5. Let stand with frequent manipulation with a trowel, until mix has reached stiffest
- 24 consistency to allow placement.

25 PART 3 - EXECUTION

26 3.1 PREPARATION

27 A. Repair surface defects within 24 HRS after removal of forms.

- 28 1. Chip, wire brush or abrasive blast to completely open defects down to sound concrete.
- 29 a. If chipping is necessary, make edges perpendicular to surface or slightly undercut.
- 30 b. No feathered edges will be permitted.

31 B. Repairing Surface Defects:

- 32 1. Fill and repair using patching mortar mix specified in Article 2.3.
- 33 2. Clean surfaces to remove dust, dirt, laitance, form oil, grease, or other contaminants.
- 34 a. If required by bonding agent manufacturer, etch surfaces with a muriatic acid solution
- 35 followed by a thorough rinse with clean water.
- 36 b. Test concrete to determine pH level and continue flushing with clean water until
- 37 surface pH is within acceptable limits.
- 38 3. Dampen area to be patched and an area at least 6 IN wide surrounding it prior to application
- 39 of bonding grout.
- 40 4. Brush bonding grout into the surface after the surface water has evaporated.
- 41 5. Allow bonding grout to set for period of time required by bonding agent manufacturer
- 42 before applying premixed patching mortar.
- 43 6. Fill tie holes and areas where honeycombed or defective concrete has been removed.
- 44 a. Fill tie holes in liquid containing structures with non-shrink non-metallic grout. See
- 45 Section 03308.
- 46 b. Fill all other defects with patching mortar.
- 47 c. Consolidate grout or mortar into place and strike off so as to leave patch slightly higher
- 48 than surrounding surface.
- 49 7. Leave undisturbed for at least 60 minutes before finishing level with surrounding surface.

- 1 a. Do not use metal tools in finishing a patch in a formed wall which will be exposed or
- 2 coated with other materials.
- 3 8. Keep areas damp for 7 days or in accordance with bonding agent manufacturer's directions.
- 4 9. Repair leaking and flowing cracks with a low viscosity, swellable injection resin intended
- 5 for leak repair.
- 6 a. Contractor shall coordinate injection apparatus, crack width, injection materials, and
- 7 proposed application with the manufacturer.
- 8 b. Clean cracks by removing loose material, dirt and other contaminants.
- 9 c. Prepare cracks in accordance with resin manufacturer's instructions.
- 10 d. Remove injection apparatus and seal material from concrete surfaces.
- 11 e. Leaks shall be repaired to stop-leak condition without cause for additional
- 12 compensation.

13 3.2 INSTALLATION AND APPLICATION

- 14 A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected
- 15 to be below 50 DegF.
- 16 1. If necessary, enclose and heat area to between 50 and 70 DegF during repair of surface
- 17 defects and curing of patching material.
- 18 B. Chemical Floor Sealer Application:
- 19 1. Apply in accordance with manufacturer's recommendations in the following areas:
- 20 a. First and second floor slab in the membrane building.
- 21 2. Apply at rate recommended by manufacturer.
- 22 3. After final coat of material is applied, remove surplus in accordance with manufacturer's
- 23 recommendations.
- 24 4. Do not apply sealer to floors scheduled to receive epoxy floor finish.
- 25 C. Bonding Agent Application:
- 26 1. Apply to concrete floor slabs as required by manufacturers.
- 27 2. Use in conjunction with patching mix as noted in Article 2.3.
- 28 D. Concrete Finishes for Vertical Wall Surfaces:
- 29 1. General: Give concrete surfaces finish as specified below after removal of formwork and
- 30 repair of surface defects.
- 31 2. Finish #1 - As cast rough form finish:
- 32 a. Selected forming materials are not required.
- 33 b. Prepare surface in accordance with Paragraph 3.1A and repair the following surface
- 34 defects:
- 35 1) Tie holes.
- 36 2) Honeycombs deeper than 1/4 IN.
- 37 3) Air pockets deeper than 1/4 IN.
- 38 4) Rock holes deeper than 1/4 IN.
- 39 c. Chip or rub off fins exceeding 1/4 IN in height.
- 40 d. Provide finish at unexposed surfaces such as foundations and backfilled surfaces of
- 41 walls not to be waterproofed.
- 42 3. Finish #2 - Smooth form finish:
- 43 a. Form facing material shall produce a smooth, hard, uniform texture. Use forms
- 44 specified for surfaces exposed to view in accordance with Section 03108.
- 45 b. Prepare surface in accordance with Paragraph 3.1A and repair the following surface
- 46 defects:
- 47 1) Tie holes.
- 48 2) Honeycombs deeper than 1/8 IN or larger than 1/8 IN DIA.
- 49 3) Air pockets deeper than 1/8 IN or larger than 1/8 IN DIA.
- 50 4) Rock holes deeper than 1/8 IN or larger than 1/8 IN DIA.
- 51 5) Scabbing.
- 52 c. Chip or rub off fins exceeding 1/8 IN in height.
- 53 d. Provide finish for all interior and exterior walls above grade.

- 1 4. Finish #3 - NOT USED - (Smooth rubbed finish)
- 2 5. Finish #4 - NOT USED - (Decorative coating finish)
- 3 6. Finish #5 - NOT USED - (Grout cleaned finish)
- 4 7. Finish #6 - NOT USED -(Cork floated finish)
- 5 8. Finish #7 - NOT USED - (Abrasive blasted)

- 6 E. Related Unformed Surfaces (Except Slabs):
- 7 1. Strike smooth tops of walls or buttresses, horizontal offsets, and similar unformed surfaces
- 8 occurring adjacent to formed surfaces after concrete is placed.
- 9 2. Float surface to a texture consistent with that of formed surfaces.
- 10 a. If more than one finish occurs immediately adjacent to unformed surface, provide
- 11 surface with most stringent formed surface requirement.
- 12 3. Continue treatment uniformly across unformed surfaces.

- 13 F. Concrete Finishes for Horizontal Slab Surfaces:
- 14 1. General: Tamp concrete to force coarse aggregate down from surface. Screed with
- 15 straightedge, eliminate high and low places, bring surface to required finish elevations;
- 16 slope uniformly to drains. Dusting of surface with dry cement or sand during finishing
- 17 processes not permitted.
- 18 2. Dusting of surface with dry cement or sand during finishing operations is not permitted.
- 19 3. Water shall not be added to the surface to aid finishing.
- 20 4. Unspecified slab finish: When type of finish is not indicated, use following finishes as
- 21 applicable:
- 22 a. Surfaces intended to receive bonded applied cementitious applications: Scratched
- 23 finish.
- 24 b. Surfaces intended to receive waterproofing membranes: Floated finish.
- 25 c. Floors: Troweled finish.
- 26 d. Exterior slabs, sidewalks, platforms, steps and landings, and pedestrian ramps, not
- 27 covered by other finish materials: Broom or belt finish.
- 28 e. All slabs to receive a floated finish before final finishing.
- 29 5. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled
- 30 to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
- 31 6. Floated finish:
- 32 a. After concrete has been placed, consolidated, struck off, and leveled, do no further
- 33 work until ready for floating.
- 34 b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently
- 35 to permit operations. Use wood or cork float.
- 36 c. During or after first floating, check planeness of entire surface with a 10 FT
- 37 straightedge applied at not less than two different angles.
- 38 d. Cut down all high spots and fill all low spots to produce a surface with Class B
- 39 tolerance throughout.
- 40 e. Refloat slab immediately to a uniform texture.
- 41 7. Troweled finish:
- 42 a. Float finish surface to true, even plane.
- 43 b. Power trowel, and finally hand trowel.
- 44 c. First troweling after power troweling shall produce a smooth surface which is relatively
- 45 free of defects, but which may still show some trowel marks.
- 46 d. Perform additional trowelings by hand after surface has hardened sufficiently.
- 47 e. Final trowel when a ringing sound is produced as trowel is moved over surface.
- 48 f. Thoroughly consolidate surface by hand troweling.
- 49 g. Leave finished surface essentially free of trowel marks, uniform in texture and
- 50 appearance and plane to a Class A tolerance.
- 51 h. On surfaces intended to support floor coverings, remove any defects that would show
- 52 through floor covering by grinding.
- 53 8. Broom or belt finish: Immediately after concrete has received a float finish as specified,
- 54 give it a transverse scored texture by drawing a broom or burlap belt across surface.
- 55 9. Underside of concrete slab finish: Match finish as specified for adjacent vertical surfaces.

- 1 a. If more than one finish occurs immediately adjacent to underside of slab surface,
2 provide surface with most stringent formed surface requirement.

3 **3.3 FIELD QUALITY CONTROL**

- 4 A. Horizontal slab finishes will be accepted provided:
5 1. Applicable specification requirements are satisfied.
6 2. Water does not pond in areas sloped to drain.
7 3. Gap between a 10 FT straightedge placed anywhere and the finished surface does not
8 exceed:
9 a. Class A tolerance: 1/8 IN.
10 1) Troweled surfaces.
11 b. Class B tolerance: 1/4 IN.
12 1) Provide at all exposed to view concrete, unless otherwise noted.
13 c. Class C tolerance: 1/2 IN.
14 1) Only acceptable for surfaces not exposed to view in completed construction.
15 4. Accumulated deviation from intended true plane of finished surface does not exceed 1/2 IN.
16 5. Accuracy of floor finish does not adversely affect installation and operation of movable
17 equipment, floor supported items, or items fitted to floor (doors, tracks, etc.).
18 B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected
19 provided strength and appearance are not adversely affected. High spots to be removed by
20 grinding and/or low spots filled with a patching compound or other remedial measures to match
21 adjacent surfaces.

22 **3.4 PROTECTION**

- 23 A. All horizontal slab surfaces receiving applied toppings or sealer compound shall be kept free of
24 traffic and loads for minimum of 10 days following installation of topping or compound.

25 **END OF SECTION**

- 1 b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete
- 2 Specimens.
- 3 c. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams
- 4 of Concrete.
- 5 d. C138, Standard Method of Test for Unit Weight, Yield, and Air Content (Gravimetric)
- 6 of Concrete.
- 7 e. C143, Standard Test Method for Slump of Hydraulic Cement.
- 8 f. C172, Standard Practice for Sampling Freshly Mixed Concrete.
- 9 g. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the
- 10 Volumetric Method.
- 11 h. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the
- 12 Pressure Method.
- 13 i. C567, Standard Test Method for Unit Weight of Structural Lightweight Concrete.
- 14 j. C780, Standard Test Method for Preconstruction and Construction Evaluation of
- 15 Mortars for Plain and Reinforced Unit Masonry.
- 16 k. C1019, Standard Test Method for Sampling and Testing Grout.
- 17 l. E329, Standard Specifications for Agencies Engaged in the Testing and/or Inspection of
- 18 Materials Used in Construction.

- 19 B. Building Code:
- 20 1. International Code Conference (ICC):
- 21 a. International Building Code and associated standards, 2000 Edition, including all City
- 22 of Kerrville, Texas, 2000 IBC amendments, referred to herein as Building Code.

- 23 C. Qualifications:
- 24 1. Testing Agency:
- 25 a. Meeting requirements of ASTM E329.
- 26 b. Provide evidence of recent inspection by Cement and Concrete Reference Laboratory
- 27 of National Bureau of Standards, and correction of deficiencies noted.

28 **1.4 DEFINITIONS**

- 29 A. Testing Agency: An independent professional testing firm or service hired by Contractor or by
- 30 Owner to perform testing and analysis services on materials, mixes, structures, and other items
- 31 as directed, and as provided in the Contract Documents.

32 **1.5 SUBMITTALS**

- 33 A. Shop Drawings:
- 34 1. See Section 01340.
- 35 2. Product technical data including:
- 36 a. Concrete materials and concrete mix designs proposed for use. Include results of all
- 37 testing performed to qualify materials and to establish mix designs. Place no concrete
- 38 until approval of mix designs has been received in writing. Submittal for each concrete
- 39 mix design to include:
- 40 1) Sieve analysis and source of fine and coarse aggregates.
- 41 2) Test for aggregate organic impurities.
- 42 3) Proportioning of all materials.
- 43 4) Type of cement with mill certificate for the cement.
- 44 5) Brand, quantity and class of fly ash proposed for use along with other submittal
- 45 data as required for fly ash by Section 03308.
- 46 6) Slump.
- 47 7) Brand, type and quantity of air entrainment and any other proposed admixtures.
- 48 8) Total chloride ion content per cubic yard of concrete determined in accordance
- 49 with AASHTO T260.
- 50 9) 28-day compression test results and any other data required by Section 03308 to
- 51 establish concrete mix design.
- 52 3. Certifications:

- 1 a. Testing Agency qualifications.
- 2 4. Test results:
- 3 a. Strength test results on concrete placed during construction including dates cast and
- 4 tested, mix design, project description, slump, air content, atmospheric and concrete
- 5 temperature and unit weights.
- 6 b. Strength test results on concrete core samples of in-place construction if required.
- 7 c. Results of load testing in-place concrete construction when load testing is required.

8 **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)**

9 **PART 3 - EXECUTION**

10 **3.1 TESTING SERVICES TO BE PERFORMED BY CONTRACTOR'S TESTING AGENCY**

- 11 A. Review and test Contractor's proposed materials for compliance with the Contract Documents.
- 12 B. Review and test Contractor's proposed concrete mix design(s).
- 13 C. Conduct tests on precast concrete produced at the precast manufacturer's plant:
 - 14 1. Concrete strength tests using the following procedures:
 - 15 a. Secure concrete samples in accordance with ASTM C172. Obtain each sample from a
 - 16 different batch of concrete on a random basis, avoiding selection of test batch other
 - 17 than by a number selected at random before commencement of concrete placement.
 - 18 b. For each strength test mold and cure three cylinders from each sample in accordance
 - 19 with ASTM C31. Record any deviations from requirements on test report.
 - 20 c. Test cylinders in accordance with ASTM C39. Test two cylinders at 28 days for
 - 21 strength test result and one at 7 days for information.
 - 22 1) Strength test result: Average of strengths of two cylinders from the same sample
 - 23 tested at 28 days. If one cylinder in a test manifests evidence of improper sampling,
 - 24 molding, handling, curing, or testing, discard; strength of remaining cylinder shall
 - 25 be considered strength test result. Should both cylinders in a test show any of
 - 26 above defects, discard entire test.
 - 27 d. Frequency of Testing: One strength test consisting of 6 IN DIA x 12 IN high cylinders
 - 28 for each 10 CY of each type of concrete or fraction thereof placed.
 - 29 1) If total volume of concrete on project is such that frequency of testing required in
 - 30 above paragraph will provide less than five strength tests, tests shall then be made
 - 31 from at least five randomly selected batches or from each batch if fewer than five
 - 32 batches are provided.
 - 33 D. Determine slump of concrete sample for each strength test. Determine slump in accordance with
 - 34 ASTM C143.
 - 35 1. If consistency of concrete appears to vary, the Engineer shall be authorized to require a
 - 36 slump test for each concrete truck. This practice shall continue until the Engineer deems it
 - 37 no longer necessary.
 - 38 E. Determine air content of concrete sample for each strength test in accordance with either ASTM
 - 39 C231, ASTM C173, or ASTM C138.
 - 40 F. Determine temperature of concrete sample for each strength test.

41 **3.2 OTHER TESTING SERVICES TO BE PERFORMED BY CONTRACTOR'S TESTING**

42 **AGENCY AS NEEDED**

- 43 A. Following services to be performed by Contractor's Testing Agency when necessary at no
- 44 additional cost to Owner:
 - 45 1. Additional testing and inspection required because of changes in materials or proportions
 - 46 requested by Contractor.

- 1 2. Additional testing of materials or concrete occasioned by their failure, by test or inspection,
- 2 to meet Specification requirements.
- 3 3. Perform strength test on any concrete to which water has been added at the jobsite.
- 4 4. Other testing services needed or required by Contractor, such as; field cured test specimens
- 5 for determining when forms, form shoring or reshoring may be removed.
- 6 a. An extra strength test is required for concrete subject to either live load or shore
- 7 removal prior to 28 days after placing concrete.
- 8 B. The above services to be performed by the Contactor's Testing Agency may be performed by the
- 9 Owner's Testing Agency provided these services are performed at no additional cost to the
- 10 Owner.

11 **3.3 DUTIES AND AUTHORITIES OF TESTING AGENCY**

- 12 A. Testing Agency to inspect, sample and test materials and production of concrete as required by
- 13 these Contract Documents and by Engineer. When it appears that any material furnished or work
- 14 performed by Contractor fails to fulfill requirements of the Contract Documents, Testing Agency
- 15 to report such deficiency to Engineer and Contractor.
- 16 B. Testing Agency to report all test and inspection results to Engineer and Contractor immediately
- 17 after they are performed. All test reports to include exact location in the work at which batch
- 18 represented by a test was deposited. Reports of strength tests to include detailed information on
- 19 storage and curing of specimens prior to testing.
- 20 C. Limited Authority of Testing Agency: Any Testing Agency or agencies and their representatives
- 21 retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax,
- 22 enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any
- 23 portion of the Work.

24 **3.4 RESPONSIBILITIES AND DUTIES OF CONTRACTOR**

- 25 A. Provide necessary testing services for qualification of proposed materials and establishment of
- 26 concrete mix design(s).
- 27 B. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no
- 28 way relieve Contractor of responsibility to furnish materials and construction in full compliance
- 29 with Contract Documents.
- 30 C. To facilitate testing and inspection, perform the following:
- 31 1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at
- 32 site.
- 33 2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and
- 34 proper curing of test specimens on site for first 24 HRS as required by ASTM C31.
- 35 D. Notify Engineer and Owner's Testing Agency sufficiently in advance of operations (minimum of
- 36 24 HRS) to allow completion of quality tests for assignment of personnel and for scheduled
- 37 completion of quality tests.

38 **3.5 EVALUATION OF CONCRETE, GROUT OR MORTAR TEST RESULTS**

- 39 A. Test results for standard molded and cured test cylinders to be evaluated separately for each mix
- 40 design. Such evaluation shall be valid only if tests have been conducted in accordance with
- 41 specified quality standards. For evaluation of potential strength and uniformity, each mix design
- 42 shall be represented by at least three strength tests. A strength test shall be the average of two
- 43 cylinders from the same sample tested at 28 days.
- 44 B. Acceptance:
- 45 1. Strength level of each specified compressive strength shall be considered satisfactory if both
- 46 of the following requirements are met:
- 47 a. Average of all sets of three consecutive strength tests equal or exceed the required
- 48 specified 28-day compressive strength.

- 1 b. No individual strength test falls below the required specified 28-day compressive
2 strength by more than 500 psi.

3 **3.6 TESTING OF CONCRETE-IN-PLACE**

- 4 A. In-place testing of concrete may be required by Engineer when strength of structure is
5 considered potentially deficient as specified in Paragraph 3.7D.
- 6 B. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by
7 Engineer to determine relative strengths at various locations in the structure or for selecting
8 areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.
- 9 C. Core Tests:
- 10 1. Where required, obtain and test cores in accordance with ASTM C42. If concrete in
11 structure will be dry under service conditions, air dry cores (temperature 60 to 80 DegF,
12 relative humidity less than 60 percent) for 7 days before test then test dry. If concrete in
13 structure will be wet or subjected to high moisture atmosphere under service conditions, test
14 cores after immersion in water for at least 40 HRS and test wet. Testing wet or dry to be
15 determined by Engineer.
- 16 2. Take three representative cores from each member or area of concrete in place that is
17 considered potentially deficient. Location of cores shall be determined by Engineer so as
18 least to impair strength of structure. If, before testing, one or more of cores shows evidence
19 of having been damaged subsequent to or during removal from structure, damaged core
20 shall be replaced.
- 21 3. Concrete in area represented by a core test will be considered adequate if average strength
22 of three cores is equal to at least 85 percent of specified strength and no single core is less
23 than 75 percent of specified strength.
- 24 4. Fill core holes with nonshrink grout and finish to match surrounding surface when exposed
25 in a finished area.

26 **3.7 ACCEPTANCE**

- 27 A. Completed concrete work which meets applicable requirements will be accepted without
28 qualification.
- 29 1. Completed concrete work which fails to meet one or more requirements but which has been
30 repaired to bring it into compliance will be accepted without qualification.
- 31 2. Completed concrete work which fails to meet one or more requirements and which cannot
32 be brought into compliance may be accepted or rejected as provided in these Contract
33 Documents. In this event, modifications may be required to assure that concrete work
34 complies with requirements. Modifications, as directed by Engineer, to be made at no
35 additional cost to Owner.
- 36 B. Dimensional Tolerances:
- 37 1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be
38 considered potentially deficient in strength and subject to modifications required by
39 Engineer.
- 40 2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be
41 rejected and excess material subject to removal. If removal of excess material is permitted,
42 accomplish in such a manner as to maintain strength of section and to meet all other
43 applicable requirements of function and appearance.
- 44 3. Concrete members cast in wrong location may be rejected if strength, appearance or
45 function of structure is adversely affected or misplaced items interfere with other
46 construction.
- 47 4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed
48 to view, may be rejected. Repair or remove and replace if required.

- 1 5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or
2 appearance is not adversely affected. High spots may be removed with a grinder, low spots
3 filled with a patching compound, or other remedial measures performed as permitted or
4 required.
- 5 C. Appearance:
- 6 1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely
7 affect appearance as required by specified finish shall be repaired by approved methods.
8 2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in
9 the opinion of the Engineer, the defects impair the strength or function of the member.
- 10 D. Strength of Structure:
- 11 1. Strength of structure in place will be considered potentially deficient if it fails to comply
12 with any requirements which control strength of structure, including but not necessarily
13 limited to following:
- 14 a. Low concrete strength as specified in Article 3.5.
15 b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at
16 variance with requirements in Section 03208 or requirements of the Contract Drawings
17 or approved shop drawings.
18 c. Concrete which differs from required dimensions or location in such a manner as to
19 reduce strength.
20 d. Curing time and procedure not meeting requirements of these Specifications.
21 e. Inadequate protection of concrete from extremes of temperature during early stages of
22 hardening and strength development.
23 f. Mechanical injury, construction fires, accidents or premature removal of formwork
24 likely to result in deficient strength.
25 g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely
26 to result in deficient strength.
- 27 2. Structural analysis and/or additional testing may be required when strength of structure is
28 considered potentially deficient.
29 3. Core tests may be required when strength of concrete in place is considered potentially
30 deficient.
31 4. If core tests are inconclusive or impractical to obtain or if structural analysis does not
32 confirm safety of structure, load tests may be required and their results evaluated in
33 accordance with Chapter 20 of ACI 318.
34 5. Correct or replace concrete work judged inadequate by structural analysis or by results of
35 core tests or load tests with additional construction, as directed by Engineer, at Contractor's
36 expense.
37 6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis
38 required.

39

END OF SECTION

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48

SECTION 03431
PRECAST AND PRESTRESSED CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast and prestressed concrete.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03208 - Reinforcement.
 - 4. Section 03308 - Concrete, Materials and Proportioning.
 - 5. Section 03350 - Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. Standard Specification for Highway Bridges.
 - 2. American Concrete Institute (ACI):
 - a. 211.2, Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
 - b. 318, Building Code Requirements for Structural Concrete.
 - 3. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A108, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
 - c. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire Stress Relieved for Prestressed Concrete.
 - d. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - e. C33, Standard Specification for Concrete Aggregates.
 - f. C150, Standard Specification for Portland Cement.
 - g. C330, Standard Specification for Lightweight Aggregates for Structural Concrete.
 - h. E329, Standard Specifications for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
 - 4. American Welding Society (AWS):
 - a. A5.1, Standard Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - b. A5.5, Standard Specification for Low-Alloy Steel Covered Arc-Welding Electrodes.
 - c. D1.1, Structural Welding Code Steel.
 - d. D1.4, Structural Welding Code Reinforcing Steel.
 - 5. Prestressed Concrete Institute (PCI):
 - a. MNL-116, Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.
 - b. PCI Design Handbook Precast and Prestressed Concrete.
 - 6. Building Code:
 - a. International Code Conference (ICC):
 - 1) International Building Code and associated standards, 2000 Edition, including all City of Kerrville, Texas, 2000 IBC amendments, referred to herein as Building Code.
- B. Qualifications:
 - 1. Provide precast and prestressed concrete units produced by an active member of Prestressed Concrete Institute (PCI).

- 1 2. Provide units manufactured by plant which has regularly and continuously engaged in
- 2 manufacture of units of same type as those required for a minimum of 3 years.
- 3 3. Assure manufacturer's testing facilities meet requirements of ASTM E329.
- 4 4. Welding operators and processes to be qualified in accordance with:
- 5 a. AWS D1.1 for welding steel shapes and plates.
- 6 5. Welding operators to have passed qualification tests for type of welding required during the
- 7 previous 12 months prior to commencement of welding.

8 1.3 SUBMITTALS

9 A. Shop Drawings:

- 10 1. See Section 01340.
- 11 2. Product technical data including:
- 12 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 13 b. Manufacturer's installation instructions.
- 14 c. Sizes, types and manufacturer of neoprene bearing pads.
- 15 d. Hardware to be utilized to support suspended appurtenances.
- 16 3. Shop drawings and erection plans for precast units, their connections and supports showing:
- 17 a. Member size and location.
- 18 b. Size, configuration, location and quantity of reinforcing bars and prestressing strands.
- 19 c. Initial prestress forces.
- 20 d. Size and location of openings verified by Contractor.
- 21 e. Size, number, and locations of embedded metal items and connections.
- 22 f. Required concrete strengths.
- 23 g. Identification of each unit using same standard marking numbers as used to mark actual
- 24 units.
- 25 4. Calculations for members and connections designed by fabricator. Calculations to be sealed
- 26 by a professional Structural Engineer registered in the State of Texas. Perform calculations
- 27 using the dead load of the members plus the superimposed uniform and concentrated loads
- 28 shown on the Drawings and indicated in this Specification Section. Indicate the following:
- 29 a. Design for maximum moment, maximum shear and maximum torsion.
- 30 b. Final top and bottom flexural stresses resulting from the stresses due to maximum
- 31 moment and prestress force.
- 32 c. Ultimate moment capacity.
- 33 d. Final top and bottom flexural stresses, ultimate moment capacity, and ultimate shear
- 34 capacity, if affected, for members with reduced cross sections due to openings or
- 35 penetrations.
- 36 5. Concrete mix design(s) including submittal information defined in Section 03350.
- 37 6. Copies of source quality control tests.
- 38 7. Certification of manufacturer's testing facility qualifications.

39 PART 2 - PRODUCTS

40 2.1 ACCEPTABLE MANUFACTURERS

- 41 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 42 acceptable:
- 43 1. Headed studs and deformed bar anchors:
- 44 a. Nelson Stud Welding Div.; TRW, Inc.
- 45 b. KSM Division, Omark Industries.
- 46 B. Submit requests for substitution in accordance with Specification Section 01640.

47 2.2 MATERIALS

- 48 A. Embedded Steel Plates and Shapes: ASTM A36.

- 1 B. Bearing Pads:
2 1. Neoprene.
3 2. Section 18, Division 2 of the AASHTO Standard Specification for Highway Bridges.
4 3. 60 durometer strength.
- 5 C. Cement:
6 1. Comply with ASTM C150, Type II.
- 7 D. Aggregates for Normal Weight Concrete:
8 1. ASTM C33 with coarse aggregate meeting the gradation for size 67 as stated in ASTM C33.
9 2. Provide aggregates approved for bridge construction by the State Highway Department in
10 the state where the precast units are fabricated or in the state where the Project is located.
11 3. All fine aggregate to be natural not manufactured.
- 12 E. Water:
13 1. Potable, clean.
14 2. Free of oils, acids, and organic matter.
- 15 F. Maximum total chloride ion content contributed from all ingredients of concrete including water,
16 aggregates, cement and admixtures measured as a weight percent of cement to not exceed 0.06
17 for prestressed concrete and 0.10 for all other precast concrete.
- 18 G. Prestressing Strands:
19 1. Either 250K or 270K high tensile strength uncoated seven wire strand.
20 2. Manufacture and test strands in accordance with ASTM A416.
- 21 H. Reinforcing Steel and Welded Wire Fabric: See Section 03208.
- 22 I. Headed Studs:
23 1. ASTM A108.
24 2. Minimum yield strength: 50,000 psi.
25 3. Minimum tensile strength: 60,000 psi.
- 26 J. Deformed Bar Anchors:
27 1. ASTM A496.
28 2. Minimum tensile strength: 80,000 psi.
29 3. Minimum yield strength: 70,000 psi.
- 30 K. Electrodes:
31 1. E70 series conforming to AWS A5.1 or A5.5 for welding steel shapes and plates.
32 2. E90 series conforming to AWS A5.5 for welding rebar.
- 33 L. Concrete sand cement grout in keyways between hollow core slabs. See Section 03308.

34 **2.3 MIXES**

- 35 A. Do not begin fabrication of units until concrete mix design(s) have been approved by Engineer.
36 B. Minimum concrete 28-day compressive strength: 5000 psi.

37 **2.4 DESIGN**

- 38 A. General Design Requirements:
39 1. Design units and connections in strict accordance with ACI 318 and the PCI Design
40 Handbook Precast and Prestressed Concrete.
41 2. Design units for spans, dead load of members, dead and live loads indicated on the
42 Drawings with concentrated loads placed in their actual locations. Verify weights and
43 locations of concentrated loads.
44 3. Design units taking into account reduced cross section at openings and penetrations.
45 4. Provide all reinforcing in units as indicated. Where not indicated, design and provide all
46 reinforcing and prestressing strands subject to approval of Engineer.

47 **2.5 FABRICATION**

- 1 A. Do not fabricate units until shop drawings have been approved by Engineer and returned to
2 Contractor and support locations have been field verified by Contractor.
- 3 B. Manufacture, quality, dimensional and erection tolerances of all units to be in accordance with
4 both PCI MNL-116 and PCI Design Handbook Precast and Prestressed Concrete.
- 5 C. Produce all members such as to provide straight, true members of uniform thickness and uniform
6 color and finish.
- 7 D. Use sand cement grout mixture to fill all air pockets and voids, and to repair chipped edges.
- 8 E. Finish all repairs smooth and to match adjacent surface texture and color.
- 9 F. Where units are to receive concrete topping, provide units having heavy broom finish on top
10 surface for bond.
- 11 1. Provide roughness of top surface to provide bond with topping and design for horizontal
12 shear at topping and unit interface in accordance with requirements of paragraph 17.5 of
13 ACI 318.
- 14 2. Make all other surfaces smooth.
- 15 G. Incorporate embedded plates, angles, and flange welding strips into members at time of
16 manufacture. Provide embedded items as shown on the Drawings unless prior approval is
17 received from Engineer to do otherwise.
- 18 1. Cast lifting handles into units at or near support points. Remove lifting handles after units
19 are erected.
- 20 H. Cast openings larger than 6 IN SQ or 6 IN DIA in units at time of manufacture. Make smaller
21 openings by neat cutting or neat drilling by trades requiring them. Coordinate sizes and locations
22 of all openings before fabrication of units.
- 23 I. Make provisions for support of lighting fixtures, ducts, piping, conduits and other suspended
24 work.
- 25 1. When drilled expansion bolts or powder-driven fasteners are approved for use, coordinate
26 prestress strand location with prestress concrete member supplier so that drilled expansion
27 bolts or powder-driven fasteners do not hit or are drilled or driven into prestress strands.
- 28 2. Install powder-driven fasteners by means of a low velocity powder-actuated tool complying
29 with requirements of OSHA.
- 30 a. Assure that the load to be supported by each in place drilled expansion bolt or powder-
31 driven fastener does not exceed the maximum allowable load recommended by the bolt
32 or fastener manufacturer for the concrete strength encountered and for the type, size and
33 embedment length of expansion bolt or driven fastener installed.
- 34 J. Automatically weld headed studs and deformed bar anchors to members to provide full
35 penetration weld between studs, bar anchors and members they are attached to.
- 36 K. Weld steel shapes and plates per AWS D1.1.
- 37 L. Minimum concrete compressive strength at time of strand release: 3500 psi.
- 38 M. Mark each unit as indicated on the erection plans. Place mark on non-exposed-to-view surface.
- 39 N. Coat or finish ends of exposed prestressing strands to prevent rusting.
- 40 O. Fabricate the following types of precast and prestressed units (all units to be made with normal
41 weight concrete unless noted otherwise on Drawings):
- 42
- 43 1. Prestressed hollow core slabs of sizes indicated. Weight of hollow core slabs not to exceed
44 the following:
- 45

1

NORMAL WEIGHT	
DEPTH	CONCRETE
12 IN	80 psf

2 2. Provide connections as indicated on Drawings and as required to support all loads subject to
3 Engineer's approval.

4 **2.6 SOURCE QUALITY CONTROL**

5 A. During production of precast concrete units, conduct strength tests of concrete placed in units as
6 required in Specification Section 03350 for concrete placed during fabrication. Results of
7 strength tests to be sent immediately to Engineer, Contractor and Owner. Test reports to indicate
8 units they represent.

9 B. When approved by Engineer, strength tests may be made by precast manufacturer after he has
10 submitted certification that his testing facilities meet the requirements of ASTM E329.

11 **PART 3 - EXECUTION**

12 **3.1 PREPARATION**

13 A. Verify acceptability and location of supports to receive units. Check bearing surfaces to
14 determine that they are level and uniform.

15 B. Verify compressive strengths of concrete and masonry supports. Do not start erection of units
16 until supports have reached their 28-day required compressive strengths.

17 **3.2 INSTALLATION**

18 A. Sequence erection to provide a balance of loads.

19 B. Give consideration to possible lack of stability or capacity of partially completed frame or
20 structure.

21 C. Contractor to be responsible for guying, shoring, and bracing of frame, walls and individual
22 members as necessary to resist forces due to wind, erection, or any other source that may occur
23 before structure is completed.

24 D. Use only erection equipment adequate for placing units at lines and elevations indicated on
25 Drawings. Do not damage units or existing construction during erection. Erect units using lifting
26 handles cast into the units.

27 E. Place hollow core slabs on continuous 1/4 IN thick neoprene bearing pad whose width to equal
28 bearing length -1 IN.

29 F. After erection, verify that there is no direct contact between bottom of units and supporting
30 members. Where direct contact occurs, install additional layers of bearing material to raise units
31 off supports.

32 G. Weld steel shapes and plates per AWS D1.1.

33 H. Fill all keyways between hollow core slabs with concrete sand cement grout. See Section 03308.

34 **3.3 FIELD QUALITY CONTROL**

35 A. Causes for rejection of units include, but are not necessarily limited to the following:

36 1. Cracked units.

37 2. Chipped, broken, or spalled edges.

38 3. Units not within allowable casting tolerances.

39 4. Voids or air pockets which, in opinion of Engineer, are too numerous or too large.

40 5. Non-uniform finish or appearance.

- 1
 - 2
 - 3
 - 4
6. Low concrete strength.
 7. Improperly placed embedded items and/or openings.
 8. Exposed wire mesh, reinforcing or prestressing strands.

END OF SECTION