



Standard Specification for Underground Precast Concrete Utility Structures¹

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1. Scope

1.1 This specification covers the recommended design criteria and manufacturing practices for monolithic or sectional precast concrete utility structures. Concrete pipe and box culverts are not covered under this specification. Also, precast concrete manholes covered in Specification C 478 are excluded from this specification.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

2. Referenced Documents

2.1 ASTM Standards:²

- A 82/A 82M Specification for Steel Wire, Plain, for Concrete Reinforcement
- A 184/A 184M Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
- A 185/A 185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
- A 496/A 496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
- A 497/A 497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
- A 615/A 615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- A 706/A 706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
- A 996/A 996M Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
- C 31/C 31M Practice for Making and Curing Concrete Test Specimens in the Field

- C 33 Specification for Concrete Aggregates
 - C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - C 42/C 42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - C 94/C 94M Specification for Ready-Mixed Concrete
 - C 150 Specification for Portland Cement
 - C 192/C 192M Practice for Making and Curing Concrete Test Specimens in the Laboratory
 - C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - C 260 Specification for Air-Entraining Admixtures for Concrete
 - C 330 Specification for Lightweight Aggregates for Structural Concrete
 - C 478 Specification for Precast Reinforced Concrete Manhole Sections
 - C 494/C 494M Specification for Chemical Admixtures for Concrete
 - C 595 Specification for Blended Hydraulic Cements
 - C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - C 857 Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - C 989 Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
- 2.2 *American Concrete Institute Standard:*
- ACI 318 Building Code Requirements for Reinforced Concrete³
- 2.3 *American Welding Society Standard:*
- AWS-D1.4 Structural Welding Code Reinforcing Steel⁴

3. Terminology

3.1 Definition of Term Specific to this Standard:

3.1.1 *utility structure*—a structure that is used by electric, gas, communication, or similar industries.

¹ This specification is under the jurisdiction of ASTM Committee C27 on Precast Concrete Products and is the direct responsibility of Subcommittee C27.10 on Utility Structures.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, <http://www.aci-int.org>.

⁴ Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, <http://www.aws.org>.

4. Ordering Information

4.1 Unless otherwise stipulated by the purchaser in his order, a structure produced in accordance with this specification and constructed in accordance with the design drawings approved by the purchaser shall be acceptable.

5. Materials

5.1 Cementitious Materials:

5.1.1 *Cement*—Cement shall conform to the requirements for Portland cement of Specification C 150 or shall be Portland blast-furnace slag cement or Portland-pozzolan cement conforming to the requirements of Specification C 595, except that the pozzolan constituent in the Type IP Portland-pozzolan cement shall be fly ash.

5.1.2 *Fly Ash*—Fly ash shall conform to the requirements of Specification C 618, Class F or Class C.

5.1.3 *Ground Granulated Blast-Furnace Slag (GGBFS)*—GGBFS shall conform to the requirements of Grade 100 or 120 of Specification C 989.

5.1.4 *Allowable Combinations of Cementitious Material*—The combination of cementitious materials used in concrete shall be one of the following:

5.1.4.1 Portland cement only;

5.1.4.2 Portland blast furnace slag cement only;

5.1.4.3 Slag-modified Portland cement only;

5.1.4.4 Portland-pozzolan cement only;

5.1.4.5 A combination of Portland cement and fly ash;

5.1.4.6 A combination of Portland cement and ground granulated blast-furnace slag;

5.1.4.7 A combination of Portland cement, ground granulated blast-furnace slag (not to exceed 25 % of the total cementitious weight), and fly ash (not to exceed 25 % of the total cementitious weight).

5.2 *Aggregates*—Aggregate shall conform to Specification C 33 and light-weight aggregate shall conform to Specification C 330, except that the requirements for grading shall not apply.

5.3 *Admixtures*—Admixtures may be used provided such admixtures are not injurious to other products used in the concrete.

5.3.1 *Chemical Admixtures*—Chemical admixtures shall conform to Specification C 494/C 494M.

5.3.2 *Fly Ash and Pozzolanic Admixture*—Fly ash or other pozzolanic admixtures shall conform to Specification C 618.

5.3.3 *Air-Entraining Admixtures*—Air-entraining admixtures conforming to Specification C 260 shall be used when there is a risk that the concrete may be exposed to a freeze-thaw cycle. The concrete mixture shall contain 5.5 ± 1.5 % air by volume as determined by Specification C 231.

5.4 *Water*—Water used for curing, washing aggregate, or mixing concrete shall be clean and free of injurious amounts of oil, acids, alkalis, salts, organic materials, or other substances that may be incompatible with concrete or steel.

5.5 Steel Reinforcement:

5.5.1 *Wire Reinforcement*—Wire reinforcement shall conform to Specifications A 82/A 82M or A 496/A 496M.

5.5.2 *Wire Fabric Reinforcement*—Wire fabric reinforcement shall conform to Specifications A 185/A 185M or A 497/A 497M.

5.5.3 *Bar Reinforcement*—Bar reinforcement shall conform to Specifications A 184/A 184M, A 615/A 615M, A 706/A 706M, or A 996/A 996M.

6. Manufacture

6.1 *Forms*—Forms shall be accurately constructed and strong enough to maintain the structure's dimensions within the tolerances given in Section 8. Forms should be constructed in such a manner as to minimize the seepage of water. All casting surfaces shall be smooth nonporous material.

6.1.1 *Cleaning and Oiling*—Forms shall be cleaned before each use. New forms shall be free of paint or other protective coatings that might cling to the surface of the structure. Releasing agents applied to the form to aid in breaking the bond between the form and the concrete shall not be injurious to the concrete.

6.2 *Reinforcement*—Steel reinforcement shall conform to the requirements of this specification and shall be securely positioned in the form to maintain design concrete cover given in Section 7 during concrete placement. All chairs, bolsters, braces, and spacers in contact with form and reinforcing rod shall be of material that will not deteriorate.

6.3 *Mixture*—The aggregates shall be sized, graded, proportioned, and thoroughly mixed in a batch mixer with proportions of cement and water as will produce a homogeneous concrete having the required specified compressive strength. If Ready-Mix concrete is used, it shall be in accordance with Specification C 94/C 94M.

6.4 *Concrete Placement*—Concrete shall be deposited as nearly as practicable in its final position. Concrete shall be placed in the form at a rate such that the concrete is plastic at all times and flows readily into all parts of the form and around all reinforcement steel and embedded fixtures without segregation of materials. Concrete that has partially hardened or has been contaminated by foreign material shall not be deposited in the form.

6.5 *Curing*—Structures shall be cured by an accepted industry method that will develop the required 28-day compressive strength without affecting the long-term durability of the concrete.

7. Design Requirements

7.1 The elastic method of structural design or the strength design method of reinforced concrete design as outlined in ACI 318, shall be used to design the concrete sections, including the reinforcement required, when the structure is subjected to the loading conditions covered in Practice C 857.

7.2 *Access Openings*—The structural design shall take into consideration the number, placement, and size of access openings.

7.3 *Floors*—The minimum floor thickness resulting from slope shall be considered as the nominal floor thickness in the design of the structure.

7.4 *Terminators, Knockouts, and Sumps*—Duct terminators, knockouts, and sumps shall be designed to carry the loads imposed upon them. The basic structure shall be designed to carry all imposed loads with knockouts removed.

7.5 *Placement of Reinforcement*—The design concrete cover for reinforcing bars, mats, or fabric shall be not less than $\frac{3}{4}$ in. (19 mm) subject to the requirements of Section 8.

7.6 *Concrete Strength*—The minimum specified compressive strength for design shall be 3000 psi (21 MPa) at 28 days of age. Compressive-strength tests should be made in accordance with Practices **C 31/C 31M** and **C 192/C 192M** and Test Methods **C 39/C 39M** and **C 42/C 42M**.

7.7 *Joints*—Joints in sectional precast concrete structure shall be designed so as to be self-aligning when assembling sections of the structure.

7.7.1 The manufacturer shall provide a single joint design on all units of the same size and type to ensure interchangeability.

7.8 *Lifting Devices*—Design of lifting devices shall conform to requirements as specified in the Lifting Devices Section of Practice **C 857**.

8. Permissible Variations

8.1 *Dimensional Tolerances*—The length, width, height, or diameter measurements of the structure when measured on the inside surfaces shall not deviate from design dimensions by more than the following:

| Dimensions | Tolerance |
|-------------------------------|---|
| 0 to 5 ft (0 to 1.52 m) | $\pm \frac{1}{4}$ in. (± 6 mm) |
| 5 to 10 ft (1.52 to 3.05 m) | $\pm \frac{3}{8}$ in. (± 10 mm) |
| 10 to 20 ft (3.058 to 6.10 m) | $\pm \frac{1}{2}$ in. (± 13 mm) |
| 20 ft (6.10 m) and over | as agreed upon between the supplier and purchaser |

8.2 *Squareness Tolerance*—The inside of the precast concrete component shall be square as determined by diagonal measurements. The difference between such measurements shall not exceed the following:

| Measured Length | Allowable Difference |
|------------------------------|---|
| 0 to 10 ft (0 to 3.05 m) | $\frac{1}{2}$ in. (13 mm) |
| 10 to 20 ft (3.05 to 6.10 m) | $\frac{3}{4}$ in. (19 mm) |
| 20 ft (6.10 m) and over | as agreed upon between the supplier and purchaser |

8.3 *Joint Surfaces*—The inside joint seam gap between two sections placed together without a joint sealant shall not exceed $\frac{3}{8}$ in. (9.5 mm).

8.4 *Insert Location*—Insert locations for attachments in each component shall not deviate individually or cumulatively more than $\pm \frac{1}{8}$ in. (3.18 mm) from dimensions on specification drawings.

8.5 *Reinforcement Location*—With reference to thickness dimension of wall or slab, reinforcement shall be within $\pm \frac{1}{4}$ in. (6.3 mm) of the design location but in no case shall the

cover be less than $\frac{3}{4}$ in. (19 mm). The reinforcement spacing shall not vary more than one tenth of the designed bar spacing nor exceed $1\frac{1}{2}$ in. (38 mm) in variation, except for welded wire mesh which shall conform to Specifications **A 185/A 185M** or **A 497/A 497M**.

8.6 *Slab and Wall Thickness*—The slab and wall thickness shall not be less than that shown in the design by more than 5 % or $\frac{3}{16}$ in. (4.8 mm), whichever is greater. A thickness greater than that required in the design shall not be a cause for rejection.

9. Repairs

9.1 Precast concrete structures may be repaired. Repairs shall be performed at the direction of the manufacturer in a manner to ensure that the repaired structure conforms to the requirements of this specification.

10. Inspection

10.1 The quality of materials, process of manufacture, and the finished structure shall be subject to inspection at anytime by the purchaser or his representative.

11. Rejection

11.1 Precast concrete structures or sections of structures shall be subject to rejection upon failure to conform to any of the specified requirements contained herein, or if any of the following imperfections occur:

11.1.1 Defects that indicate any imperfect concrete mixing and molding, or

11.1.2 Surface defects indicated by honeycombed or open-texture and damaged areas where such defects would affect the structural adequacy.

12. Certification

12.1 At the request of the purchaser, the manufacturer shall, prior to the actual delivery of a structure, furnish a statement giving the source and type of cement, the source and specific gravities of the aggregates, the concrete mix proportions, strength, type, amount, and name of admixtures and mill certificates for the reinforcement steel used in manufacture.

13. Product Marking

13.1 The weight shall be marked on the outside of each component section.

13.2 The purchaser may in his order request additional information to be marked on the component section.

13.3 The method of marking shall be agreed upon between the purchaser and the supplier prior to ordering.

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