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## Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts and Storm Drains<sup>1</sup>

This standard is issued under the fixed designation C1504; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers single-cell precast conventionally reinforced concrete three-sided structures intended to be used for the construction of culverts and for the conveyance of storm water.

1.2 A complete metric companion to Specification C1504 has been developed—C1504M; therefore, no metric equivalents are presented in this specification.

NOTE 1—This specification is primarily a manufacturing and purchasing specification. The successful performance of this product depends upon the proper selection of the geometric section, bedding, backfill, and care that the installation conforms to the construction specifications. The purchaser of the precast reinforced concrete three-sided structure specified herein is cautioned that he must properly correlate the loading conditions and the field requirements with the geometric section specified and provide for inspection at the construction site.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

- A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
- A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
- A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
- A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
- A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- A616/A616M Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement (Withdrawn 1999)<sup>3</sup>
- A617/A617M Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement (Withdrawn 1999)<sup>3</sup>
- A706/A706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
- C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field
- C33 Specification for Concrete Aggregates
- C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C150 Specification for Portland Cement
- C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C494/C494M Specification for Chemical Admixtures for Concrete
- C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
- C595 Specification for Blended Hydraulic Cements
- C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C822 Terminology Relating to Concrete Pipe and Related Products
- C989 Specification for Slag Cement for Use in Concrete and Mortars
- C1116 Specification for Fiber-Reinforced Concrete and Shotcrete

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.07 on Acceptance Specifications and Precast Concrete Box Sections.

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<sup>2</sup> 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.

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

2.2 *AASHTO Standard:*  
*Standard Specifications for Highway Bridges*<sup>4</sup>

### 3. Terminology

3.1 *Definitions*—For definitions of terms relating to geometric sections, see Terminology **C822**.

### 4. Types

4.1 Precast reinforced concrete three-sided structures manufactured in accordance with this specification shall be designated by span, rise, and design earth cover.

### 5. Basis of Acceptance

5.1 Acceptability of the three-sided sections produced in accordance with Section 7 shall be determined by the results of the concrete compressive strength tests described in Section 10, by the material requirements described in Section 6, and by inspection of the finished three-sided sections.

5.2 Three-sided sections shall be considered ready for acceptance when they conform to the requirements of this specification.

### 6. Materials

6.1 *Reinforced Concrete*—The reinforced concrete shall consist of cementitious materials, mineral aggregates and water, in which steel has been embedded in such a manner that the steel and concrete act together.

6.2 *Cementitious Materials:*

6.2.1 *Cement*—Cement shall conform to the requirements for portland cement of Specification **C150** or shall be portland blast-furnace slag cement or portland-pozzolan cement conforming to the requirements of Specification **C595**, except that the pozzolan constituent in the Type IP portland pozzolan cement shall be fly ash.

6.2.2 *Fly Ash*—Fly ash shall conform to the requirements of Specification **C618**, Class F or Class C.

6.2.3 *Ground Granulated Blast-Furnace Slag (GGBFS)*—GGBFS shall conform to the requirements of Grade 100 or 120 of Specification **C989**.

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

- (1) Portland cement only,
- (2) Portland blast-furnace slag cement only,
- (3) Slag modified portland cement only,
- (4) Portland pozzolan cement only,
- (5) A combination of portland cement and fly ash,
- (6) A combination of portland cement and ground granulated blast-furnace slag,
- (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).

6.3 *Aggregates*—Aggregates shall conform to Specification **C33**, except that the requirements for gradation shall not apply.

6.4 *Admixtures and Blends*—Admixtures and blends may be used with the approval of the purchaser.

6.4.1 *Air Entraining Admixtures*—Air entraining will be required on all products produced with positive slump, wet-cast concrete and shall conform to the requirements of Specification **C494/C494M**.

6.5 *Steel Reinforcement*—Reinforcement shall consist of welded wire reinforcement conforming to Specifications **A185/A185M** or **A497/A497M** or deformed and plain steel bars for reinforced concrete conforming to Specification **A615/A615M**, Grade 60, **A616/A616M**, or **A617/A617M**. Longitudinal distribution reinforcement may consist of welded wire reinforcement or deformed billet-steel bars conforming to Specification **A615/A615M**, Grade 60.

NOTE 2—This specification does not address reinforcement with prestressing strand or any other form of pre-tensioning or post-tensioning.

6.6 *Synthetic Fibers*—Collated fibrillated virgin polypropylene fibers may be used, at the manufacturer's option, in three-sided structures as a nonstructural manufacturing material. Only type III synthetic fibers designed and manufactured specifically for use in concrete and conforming to the requirements of Specification **C1116** shall be accepted.

### 7. Design

7.1 *Design Criteria*—The three-sided section's dimensions and reinforcement details shall be as required by design, in accordance with Section 17.8 of the AASHTO Standard Specifications for Highway Bridges. The minimum concrete compressive strength shall be 5000 psi, and the minimum steel yield strength shall be 65 000 psi for welded-wire reinforcement and 60 000 psi for deformed billet-steel bars.

<sup>4</sup> American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001.