



Designation: C1433 – 20<sup>ε</sup><sup>1</sup>

# Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers<sup>1</sup>

This standard is issued under the fixed designation C1433; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

<sup>ε</sup><sup>1</sup> NOTE—Editorially corrected references in 7.3 in July 2022.

## 1. Scope\*

1.1 This specification covers single-cell precast reinforced concrete box sections cast monolithically and intended to be used for the construction of culverts and for the conveyance of storm water industrial wastes and sewage.

1.2 This specification is the companion to SI Specification C1433M; therefore, no SI equivalents are shown in this specification.

NOTE 1—This specification is primarily a manufacturing and purchasing specification. However, standard designs are included and the criteria used to develop these designs are given in Appendix X1. The successful performance of this product depends upon the proper selection of the box section, bedding, backfill, and care that the installation conforms to the construction specifications. The purchaser of the precast reinforced concrete box sections specified herein is cautioned that proper correlation of the loading conditions and the field requirements with the box section specified, and provision for inspection at the construction site, are required.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

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

- A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- A1064/A1064M Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

<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](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- A706/A706M Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field
- C33/C33M Specification for Concrete Aggregates
- C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C150/C150M Specification for Portland Cement
- C260/C260M Specification for Air-Entraining Admixtures for Concrete
- C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C494/C494M Specification for Chemical Admixtures for Concrete
- C497 Test Methods for Concrete Pipe, Concrete Box Sections, Manhole Sections, or Tile
- C595/C595M 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
- C990 Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- C989/C989M Specification for Slag Cement for Use in Concrete and Mortars
- C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete (Withdrawn 2022)<sup>3</sup>
- C1116/C1116M Specification for Fiber-Reinforced Concrete
- C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
- C1619 Specification for Elastomeric Seals for Joining Concrete Structures
- C1675 Practice for Installation of Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
- C1677 Specification for Joints for Concrete Box, Using Rubber Gaskets

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

\*A Summary of Changes section appears at the end of this standard

2.2 *AASHTO Standard*:<sup>4</sup>

**Standard Specifications for Highway Bridges**

### 3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology C822.

### 4. Types

4.1 Precast reinforced concrete box sections manufactured in accordance with this specification shall be one of two types identified in Table 1 and Table 2, and shall be designated by type, span, rise, and design earth cover.

### 5. Basis of Acceptance

5.1 Acceptability of the box sections produced in accordance with Section 7 shall be determined by the results of the concrete compressive strength tests described in Section 11, by the material requirements described in Section 6, and by inspection of the finished box sections.

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

### 6. Material

6.1 *Reinforced Concrete*—The reinforced concrete shall consist of cementitious materials, mineral aggregates, admixtures if used, 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/C150M or shall be portland blast-furnace slag cement, portland-limestone cement, or portland-pozzolan cement conforming to the requirements of Specification C595/C595M, 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 *Slag Cement*—Slag cement shall conform to the requirements of Grade 100 or 120 of Specification C989/C989M.

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

6.2.4.1 Portland cement only,

6.2.4.2 Portland blast-furnace slag cement only,

6.2.4.3 Portland pozzolan cement only,

6.2.4.4 Portland-limestone cement only,

6.2.4.5 A combination of portland cement or portland-limestone cement and fly ash,

6.2.4.6 A combination of portland cement or portland-limestone cement and slag cement,

6.2.4.7 A combination of portland cement or portland-limestone cement, slag cement, and fly ash, or

6.2.4.8 A combination of portland-pozzolan cement and fly ash.

6.3 *Aggregates*—Aggregates shall conform to Specification C33/C33M, except that the requirements for gradation shall not apply.

6.4 *Admixtures*—The following admixtures and blends are allowable:

6.4.1 Air-entraining admixture conforming to Specification C260/C260M;

6.4.2 Chemical admixture conforming to Specification C494/C494M;

6.4.3 Chemical admixture for use in producing flowing concrete conforming to Specification C1017/C1017M; and

6.4.4 Chemical admixture or blend approved by the owner.

6.5 *Steel Reinforcement*—Reinforcement shall consist of welded wire reinforcement conforming to Specification A1064/A1064M. Circumferential reinforcement areas in Tables 1 and 2 are based solely on the use of welded wire reinforcement, refer to 12.6 if alternate steel designs utilizing steel bars, Grade 60, in conjunction with or in lieu of welded wire reinforcement are to be submitted for the owner's approval. Longitudinal distribution reinforcement shall be allowed to consist of welded wire reinforcement or deformed billet-steel bars conforming to either Specification A615/A615M, Grade 60, or Specification A706/A706M, Grade 60.

6.6 *Fibers*—Synthetic fibers and nonsynthetic fibers shall be allowed to be used, at the manufacturer's option, in concrete pipe as a nonstructural manufacturing material. Synthetic fibers (Type II and Type III) and nonsynthetic fiber (Type 1) designed and manufactured specifically for use in concrete and conforming to the requirements of Specification C1116/C1116M shall be accepted.

6.7 *Water*—Water used in the production of concrete shall be potable or non-potable water that meets the requirements of Specification C1602/C1602M.

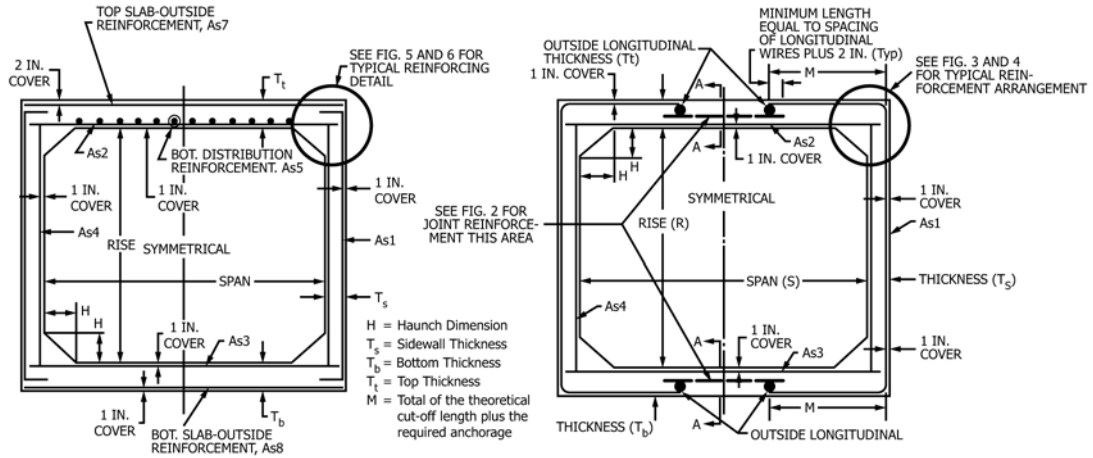
### 7. Design

7.1 *Design Tables*—The box section dimensions, compressive strength of the concrete, and reinforcement details shall be as prescribed in Table 1 or Table 2, Table A, and Figs. 1-14, subject to the provisions of Section 12. Table 1 sections are designed for combined earth dead load and AASHTO HS20 live load conditions. Table 2 sections are designed for combined earth dead load and interstate live load conditions when the interstate live loading exceeds the HS20 live loading. Criteria used to develop Tables 1 and 2 are given in Appendix X1.

NOTE 2—The tabular designs in this specification were prepared according to AASHTO Standard Specifications for Highway Bridges, 1997 Edition.

NOTE 3—(Advisory)—The reinforcing areas shown in Table 1 are based on the design earth covering and live load conditions described within this standard. Depending on the means and methods used, handling and installation loads by either the manufacturer or contractor can induce stresses not considered within the development of the tables. These loads could require additional steel reinforcement beyond the minimums shown within the standard. These handling and installation loads should be considered in the final design of the furnished precast concrete box section prior to fabrication.

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



Fill Height Less than 2 ft

Fill Height 2 ft and Greater

FIG. 1 Typical Box Sections

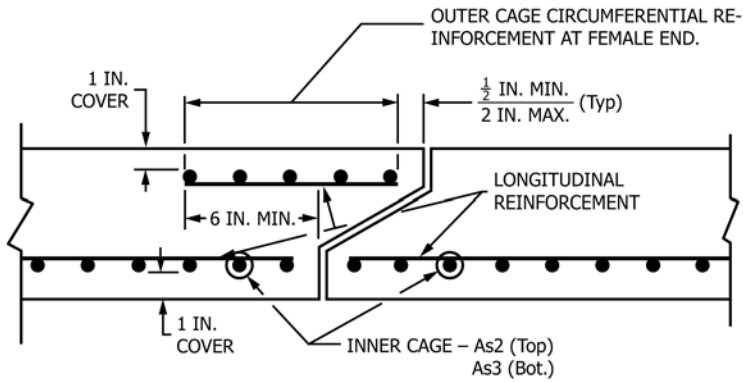


FIG. 2 Section A-A Top and Bottom Slab Joint Reinforcement

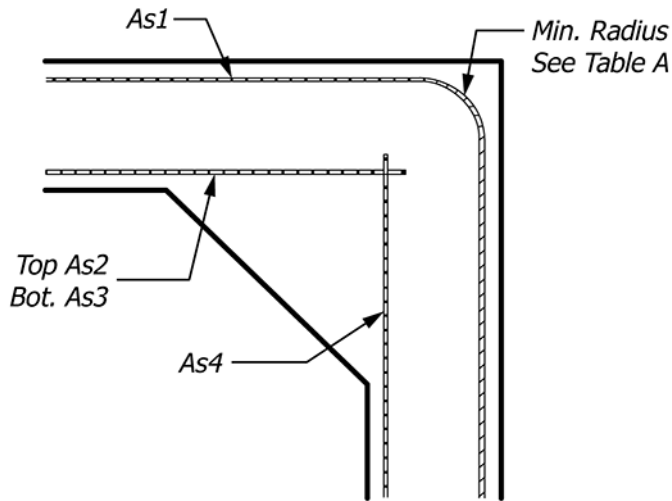


FIG. 3 Detail Inner Reinforcement

Table A—Minimum Dimensions of Bends

Bar Size and Use	Minimum Radius	Minimum Diameter
Welded Wire Reinforcement—Less than W/D 6	2.0d <sub>b</sub>	4.0d <sub>b</sub>
Welded Wire Reinforcement—W/D 6 and Larger Wire	4.0d <sub>b</sub>	8.0d <sub>b</sub>
No. 3 Through No. 5—General	3.0d <sub>b</sub>	6.0d <sub>b</sub>
No. 3 Through No. 5—Stirrups and Ties	2.0d <sub>b</sub>	4.0d <sub>b</sub>
No. 6 Through No. 8—General	3.0d <sub>b</sub>	6.0d <sub>b</sub>