INTERNATIONAL

Designation: C1786 – 19

Standard Specification for Segmental Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD[1]

This standard is issued under the fixed designation C1786; 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 (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers precast reinforced concrete box sections comprised of separate segments that once properly field assembled make the final structure. These structures are intended to be used for the construction of culverts and for the conveyance of storm water, industrial wastes and sewage.

NOTE 1—This specification is primarily a manufacturing and purchasing specification. However, box culverts manufactured to this standard are intended to meet the design requirements of the AASHTO LRFD Bridge Design Specifications, and as such, design guidance is included in Appendix X1.

NOTE 2—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.

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

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:*[2]

A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A706/A706M Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
A1064/A1064M Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
C33/C33M Specification for Concrete Aggregates
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
C989/C989M Specification for Slag Cement for Use in Concrete and Mortars
C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1116/C1116M Specification for Fiber-Reinforced Concrete
C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

2.2 *AASHTO Standards:*[3]

AASHTO LRFD Bridge Design Specifications
AASHTO LRFD Bridge Construction Specifications

2.3 *ACI Standards:*[4]

ACI 318 Building Code Requirements for Structural Concrete

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

[1] This test method 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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[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 Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

[4] Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, http://www.concrete.org.

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

3.1.1 *box section*—the completed box culvert unit with all segments adjoined (see Fig. 1 for configuration options).

3.1.2 *box segment*—the individual piece (top slab, bottom slab, or three-sided structure) that gets adjoined to other pieces to complete the final box section

3.2 *Definitions*—For definitions of terms relating to concrete box culvert sections not found above, see Terminology C822.

4. Basis of Acceptance

4.1 Acceptability of the box sections produced in accordance with this standard shall be determined by the results of the concrete compressive strength tests described in Section 10, by the material requirements described in Section 5, and by inspection of the finished box sections by the owner or their designee.

NOTE 3—The box culvert structure itself is not complete until it is fully assembled in the field. Field assembly is not included in this specification. However, a final field inspection is recommended before the box culvert is considered fit for duty.

5. Material

5.1 *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.

5.2 *Cementitious Materials:*

5.2.1 *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.

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

5.2.3 *Slag Cement*—Slag cement shall conform to the requirements of Grade 100 or 120 of Specification C989/C989M.

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

5.2.4.1 Portland cement only,

5.2.4.2 Portland blast-furnace slag cement only,

5.2.4.3 Portland-pozzolan cement only,

5.2.4.4 Portland-limestone cement only,

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

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

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

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

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

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

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

5.4.2 Chemical admixture conforming to Specification C494/C494M;

5.4.3 Chemical admixture for use in producing flowing concrete conforming to Specification C1017/C1017M.

5.4.4 Chemical admixture or blend approved by the owner.

5.5 *Steel Reinforcement*—Reinforcement shall consist of welded wire reinforcement conforming to Specification A1064/A1064M or billet-steel bars conforming to Specification A615/A615M, Grade 60 or A706/A706M, Grade 60. The box culvert segments shall be manufactured with reinforcement meeting the yield strengths designated in the design of the box culvert, but the yield strength shall not be less than 60 ksi.

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

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

6. Design

6.1 Each segment of the box shall meet the requirements of the AASHTO LRFD Bridge Design Specifications. Guidance is given in Appendix X1.

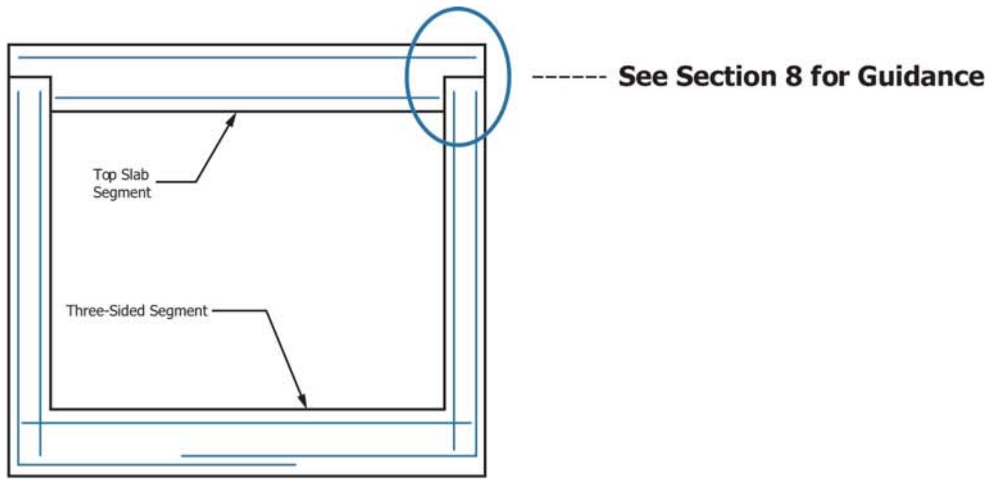
6.2 The manufacturer shall maintain on file a copy of a sealed "stamped" design by a professional engineer in accordance with the AASHTO LRFD Bridge Design Specifications and this standard for each structure manufactured.

6.3 The minimum compressive strength of concrete segments produced to this standard shall be 4000 psi, unless otherwise designated by the engineer.

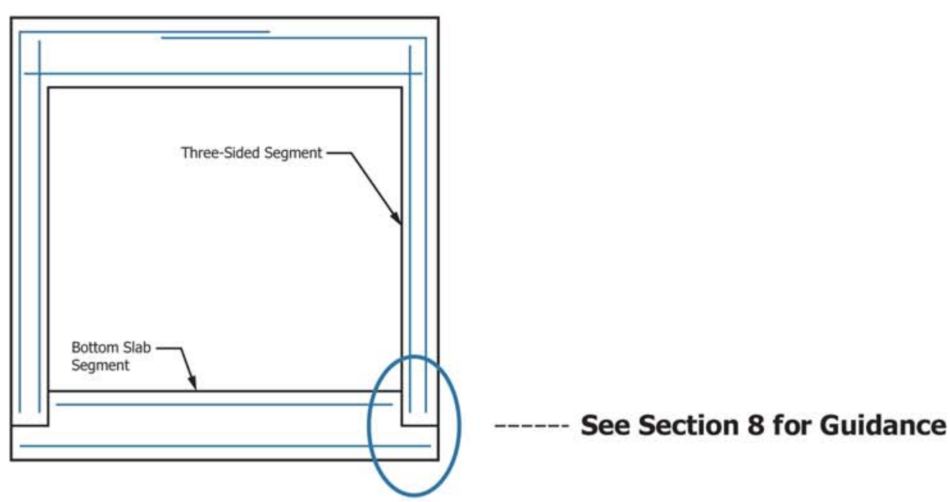
6.4 The manufacturer shall produce box culvert segments meeting the design requirements designated in the design of the segmental precast box structure. As a minimum, the box culvert segments shall meet the reinforcement layout, concrete cover, and all other manufacturing details required by this standard.

6.5 The manufacturer may request approval by the purchaser for modified designs which differ from the requirements in this standard. When such modified designs are approved, it shall be so indicated on the manufactured box with the designation "C1786–Modified."

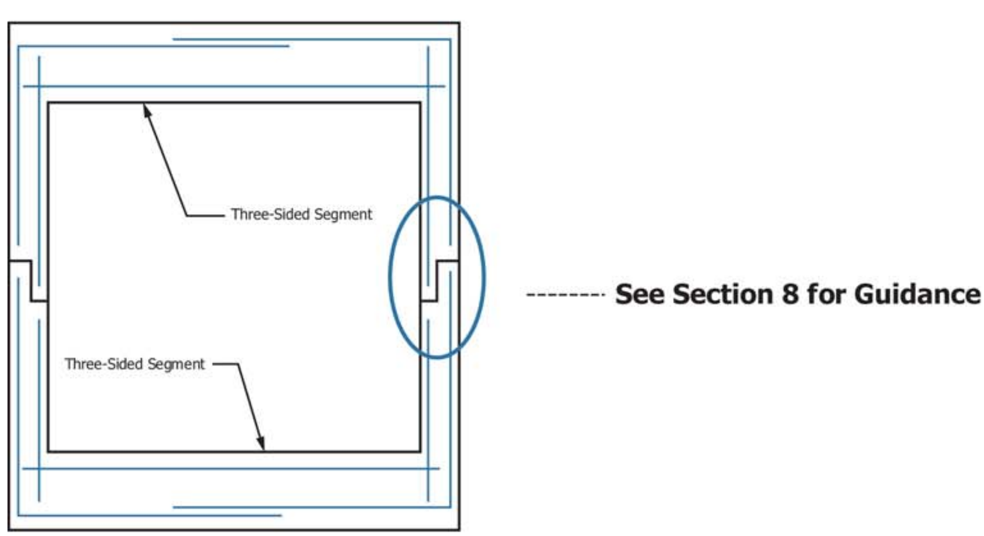
NOTE 4—(Advisory)—Construction procedures, such as heavy equipment movement or stockpiling of material over or adjacent to a box structure can induce higher loads than those used for the structure's final design. These construction and surcharge loads are allowable as long as the final steel areas in the box are equal to or larger than those required for the construction phase. The design engineer shall take into consideration the potential for higher loads induced by construction procedures in determining the final design of the box structure.



Three-sided Section with Top Slab Segment



Three-sided Section with Bottom Slab Segment



Double Three-sided (Clamshell) Configuration

FIG. 1 Segment Configuration Options