

**Designation: C 850M – 00**
METRIC

Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 0.6 m of Cover Subjected to Highway Loadings [Metric]¹

This standard is issued under the fixed designation C 850M; 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 single-cell, precast reinforced concrete box sections with less than 0.6 m of cover subjected to highway loadings and intended to be used for the construction of culverts and for the conveyance of storm water, industrial wastes, and sewage.

1.2 This metric specification is equivalent to C 850 and is compatible in technical content.

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, controlled manufacture in the plant, and care that the installation conforms to the construction specifications. The owner of the precast reinforced concrete box sections specified herein is cautioned that he must properly correlate the loading conditions and the field requirements with the box section specified and provide inspection at the construction site.

NOTE 2—Specification C 789M is to be used for box sections subjected to highway loading with 0.6 m or more earth cover, or subjected to dead load only.

2. Referenced Documents

2.1 ASTM Standards:

- A 185 Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement²
- A 497 Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement²
- A 615/A 615M Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement²
- C 33 Specification for Concrete Aggregates³
- C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens³

¹ 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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² Annual Book of ASTM Standards, Vol 01.04.

³ Annual Book of ASTM Standards, Vol 04.02.

C 150 Specification for Portland Cement⁴

C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete³

C 497M Test Methods for Concrete Pipe, Manhole Sections, or Tile (Metric)⁵

C 595 Specification for Blended Hydraulic Cements⁴

C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete³

C 789M Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers [Metric]⁵

C 822 Terminology Relating to Concrete Pipe and Related Products⁵

C 1116 Specification for Fiber-Reinforced Concrete and Shotcrete³

2.2 AASHTO Standards:⁶

Interim Specifications for Bridges, 1974 edition

Standard Specifications for Highway Bridges, Twelfth edition

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology C 822.

4. Types

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

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 10, by the material requirements described in Section 6, and by inspection of the finished box sections.

⁴ Annual Book of ASTM Standards, Vol 04.01.

⁵ Annual Book of ASTM Standards, Vol 04.05.

⁶ Available from American Association for State Highway Transportation Officials, 444 N. Capitol, Washington, DC 20001.



TABLE 1 Design Requirement for Precast Reinforced Concrete Box Sections with Less Than 0.6 m of Cover Subjected to HS20 Loading^A

NOTE 1—Reinforcement areas are based on the mass of a column of earth over the width of the box section plus live loads as defined in Appendix X1.

NOTE 2—Concrete design strength 35 MPa.

Box Section, S × R, mm ^B	Thickness, mm			Circumferential Reinforcement Areas ^C						Distribution Reinforcement Areas ^D	
	Top Slab	Bottom Slab	Wall	A _{s1}	A _{s2}	A _{s3}	A _{s4}	A _{s7}	A _{s8}	A _{s5}	A _{s6}
900 × 600	175	150	100	360	720	420	280 ^E	360 ^E	300 ^E	360 ^E	360 ^E
900 × 900	175	150	100	280 ^E	760	470	280 ^E	360 ^E	300 ^E	380	360 ^E
1200 × 600	190	150	125	440	780	420	280 ^E	380 ^E	300 ^E	380 ^E	380 ^E
1200 × 900	190	150	125	380	870	490	280 ^E	380 ^E	300 ^E	420	380 ^E
1200 × 1200	190	150	125	340	910	510	280 ^E	380 ^E	300 ^E	440	380 ^E
1500 × 900	200	175	150	470	870	470	300 ^E	400 ^E	360 ^E	400 ^E	400 ^E
1500 × 1200	200	175	150	400	930	510	300 ^E	400 ^E	360 ^E	440	400 ^E
1500 × 1500	200	175	150	340	970	550	300 ^E	400 ^E	360 ^E	470	400 ^E
1800 × 900	200	175	175	640	890	440	360 ^E	400 ^E	360 ^E	400 ^E	400 ^E
1800 × 1200	200	175	175	550	970	510	360 ^E	400 ^E	360 ^E	420	400 ^E
1800 × 1500	200	175	175	490	1020	550	360 ^E	400 ^E	360 ^E	440	400 ^E
1800 × 1800	200	175	175	420	1080	610	360 ^E	400 ^E	360 ^E	470	400 ^E
2100 × 1200	200	200	200	680	950	510	400 ^E	400 ^E	400 ^E	400 ^E	400 ^E
2100 × 1500	200	200	200	610	1020	570	400 ^E	420	400 ^E	400 ^E	400 ^E
2100 × 1800	200	200	200	570	1080	610	400 ^E	420	400 ^E	420	400 ^E
2100 × 2100	200	200	200	530	1120	680	400 ^E	490	400 ^E	440	400 ^E
2400 × 1200	200	200	200	780	1080	570	400 ^E	400 ^E	400 ^E	400 ^E	400 ^E
2400 × 1500	200	200	200	720	1120	640	400 ^E	400 ^E	400 ^E	440	400 ^E
2400 × 1800	200	200	200	680	1190	700	400 ^E	530	400 ^E	440	400 ^E
2400 × 2100	200	200	200	640	1230	740	400 ^E	570	470	470	400 ^E
2400 × 2400	200	200	200	590	1270	800	490	610	550	470	400 ^E
2700 × 1500	225	225	225	720	1060	610	470 ^E	470 ^E	470 ^E	470 ^E	470 ^E
2700 × 1800	225	225	225	680	1120	680	470 ^E	470 ^E	470 ^E	470 ^E	470 ^E
2700 × 2100	225	225	225	640	1160	740	470 ^E	530	470 ^E	470 ^E	470 ^E
2700 × 2400	225	225	225	590	1210	800	470 ^E	570	510	470 ^E	470 ^E
2700 × 2700	225	225	225	570	1230	870	530	640	590	470 ^E	470 ^E
3000 × 1500	250	250	250	720	1020	610	510 ^E	510 ^E	510 ^E	510 ^E	510 ^E
3000 × 1800	250	250	250	680	1060	680	510 ^E	510 ^E	510 ^E	510 ^E	510 ^E
3000 × 2100	250	250	250	660	1100	740	510 ^E	510 ^E	510 ^E	510 ^E	510 ^E
3000 × 2400	250	250	250	610	1140	800	510 ^E	550	510 ^E	510 ^E	510 ^E
3000 × 2700	250	250	250	570	1160	850	510 ^E	590	550	510 ^E	510 ^E
3000 × 3000	250	250	250	570	1210	910	570	680	660	510 ^E	510 ^E
3300 × 1200	275	275	275	800	930	550 ^E	550 ^E	550 ^E	550 ^E	550 ^E	550 ^E
3300 × 1800	275	275	275	700	1020	680	550 ^E	550 ^E	550 ^E	550 ^E	550 ^E
3300 × 2400	275	275	275	610	1080	800	550 ^E	550 ^E	550 ^E	550 ^E	550 ^E
3300 × 3000	275	275	275	590	1140	910	550 ^E	610	610	550 ^E	550 ^E
3300 × 3300	275	275	275	590	1190	970	640	720	720	550 ^E	550 ^E
3600 × 1200	300	300	300	850	890	610 ^E	610 ^E	610 ^E	610 ^E	610 ^E	610 ^E
3600 × 1800	300	300	300	740	970	680	610 ^E	610 ^E	610 ^E	610 ^E	610 ^E
3600 × 2400	300	300	300	660	1040	800	610 ^E	610 ^E	610 ^E	610 ^E	610 ^E
3600 × 3000	300	300	300	610 ^E	1120	910	610 ^E	610 ^E	610 ^E	610 ^E	610 ^E
3600 × 3600	300	300	300	610 ^E	1210	1060	700	760	780	610 ^E	610 ^E

^A Design requirements are based on maximum effects resulting from cover conditions ranging from 0 to 0.6 m and the material and soil properties and loading data shown in Appendix X1. For modified or special designs see 7.2.

^B The box section designation, for example, 900 by 600, indicates interior horizontal span, in millimetres, by interior vertical rise, in millimetres.

^C Design reinforcement areas in square millimetres per linear metre of box section length at those locations as shown in Fig. 2.

^D Design reinforcement areas in square millimetres per linear metre of box section width at those locations as shown in Fig. 2.

^E Minimum reinforcement area is specified.

5.2 Box 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 C 150 or shall be portland blast-furnace slag cement or portland-pozzolan cement con-

forming to the requirements of Specification C 595, 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 C 618, Class F or Class C.

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

6.2.3.1 Portland cement only.

6.2.3.2 Portland blast furnace slag cement only.

6.2.3.3 Portland pozzolan cement only.

6.2.3.4 A combination of portland cement and fly ash.