
Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to the *AASHTO LRFD Bridge Design Specifications*

AASHTO Designation: M 259-24¹

Technically Revised: 2024

Editorially Revised: 2024

Technical Subcommittee: 4a, Concrete Drainage Structures

ASTM Designation: C1577-20^{e1}



American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004

Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to the *AASHTO LRFD Bridge Design Specifications*

AASHTO Designation: M 259-24¹

AASHTO

Technically Revised: 2024

Editorially Revised: 2024

Technical Subcommittee: 4a, Concrete Drainage Structures

ASTM Designation: C1577-20^{e1}

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.
- Note 1**—This specification is primarily a manufacturing and purchasing specification. However, standard designs per the *AASHTO LRFD Bridge Design Specifications* are included and the criteria used to develop these designs are given in Appendix X1. The successful performance of this product depends on the proper selection of the box section, bedding, and backfill, and care that the installation conforms to the construction specifications. The owner of the precast reinforced concrete box sections specified herein is cautioned that the loading conditions and the field requirements must properly correlate with the box section specified and that inspection at the construction site must be provided.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 6, Fine Aggregate for Hydraulic Cement Concrete
 - M 31M/M 31, Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
 - M 80, Coarse Aggregate for Hydraulic Cement Concrete
 - M 85, Portland Cement
 - M 154M/M 154, Air-Entraining Admixtures for Concrete
 - M 157, Ready-Mixed Concrete
 - M 194M/M 194, Chemical Admixtures for Concrete
 - M 240M/M 240, Blended Hydraulic Cement
 - M 262, Concrete Pipe and Related Products
 - M 295, Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - M 302, Slag Cement for Use in Concrete and Mortars

- M 336M/M 336, Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement
- M 339M/M 339, Thermometers Used in the Testing of Construction Materials
- T 280M/T 280, Concrete Pipe, Manhole Sections, or Tile
- *AASHTO LRFD Bridge Design Specifications*
- *AASHTO LRFD Bridge Construction Specifications*

2.2. *ASTM Standards:*

- A 706/A 706M, Standard Specification for Deformed and Plain Low Alloy Steel Bars for Concrete Reinforcement
- A 1064/A 1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- C 309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C 990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- C 1017/C 1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete (withdrawn 2022; use latest historical version)
- C 1116/C 1116M, Standard Specification for Fiber-Reinforced Concrete
- C 1619, Standard Specification for Elastomeric Seals for Joining Concrete Structures
- C 1677, Standard Specification for Joints for Concrete Box, Using Rubber Gaskets
- E 1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E 230/E 230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E 2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standard:*

- IEC 60584-1:2013, Thermocouples - Part 1: EMF Specifications and Tolerances

2.4. *Other Standard:*

- ACI 318, Building Code

3. TERMINOLOGY

- 3.1. *Definitions*—For definitions of terms relating to concrete pipe and box culverts, see M 262.

4. TYPES

- 4.1. Precast reinforced concrete box sections manufactured in accordance with this specification shall be legibly marked with the specification designation, span, rise, and design earth cover.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions

Note 2—Design earth loads and reinforcement areas are based on the weight of a column of earth over the width of the box section multiplied by a soil structure interaction factor as defined in Appendix X1.

Note 3—Concrete design strength is 5000 psi.

Note 4—Steel areas are based on an HL-93 live load without the lane load, as permitted by the *AASHTO LRFD Bridge Design Specifications*, using either the design truck or the design tandem and taking the controlling case.

Note 5—The design earth cover indicated is the height of fill above the top of the box section. Design requirements are based on the material and soil properties, load data, and typical section as included in Appendix X1. For alternative designs, see Section 7.2.

Note 6—Design steel areas in square inches per linear foot of box section are at those locations that are indicated on the typical section shown in Figure 1.

Note 7—The top section designation, for example 3 ft by 2 ft by 4 in., indicates the interior horizontal span in feet by the interior vertical rise in feet by the wall and slab thickness in inches.

Note 8—In accordance with the acceptance criteria in Section 7.2, the manufacturer is not prohibited from interpolating steel area requirements or submitting independent designs for fill heights between noted increments.

Note 9—The M dimension given in the tables is the required distance that A_{s1} shall be extended into the top and bottom slabs if it is used as reinforcement for the negative moment in these areas. This distance is based on the location where the negative moment in the slab becomes zero, plus an additional development length. Because the live load can be applied at any location along the top slab as the truck drives over it, it is possible for the M dimension to exceed one-half the length of the slab.

Note 10—The reinforcement areas are based on 4 in. circumferential wire spacing. Under design conditions where crack control governs, an analysis following the design criteria in Table X1.1 with closer steel spacing may result in a reduction in steel area over those in the table.

3 ft by 2 ft by 4 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							<i>M</i> (in.)
	<i>A</i> _{s1}	<i>A</i> _{s2}	<i>A</i> _{s3}	<i>A</i> _{s4}	<i>A</i> _{s5}	<i>A</i> _{s7}	<i>A</i> _{s8}	
0 < 2 ^a	0.17	0.25	0.16	0.10	0.17	0.17	0.14	
2 < 3	0.13	0.19	0.18	0.10	—	—	—	31
3 to 5	0.10	0.11	0.12	0.10	—	—	—	31
10	0.10	0.10	0.10	0.10	—	—	—	31
15	0.10	0.13	0.13	0.10	—	—	—	31
20	0.11	0.17	0.17	0.10	—	—	—	31
25	0.14	0.21	0.21	0.10	—	—	—	31
30	0.17	0.25	0.25	0.10	—	—	—	31
35	0.20	0.29	0.30	0.10	—	—	—	31

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

3 ft by 3 ft by 4 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^a	0.17	0.27	0.17	0.10	0.17	0.17	0.14	
2 < 3	0.10	0.22	0.21	0.10	—	—	—	31
3 to 5	0.10	0.14	0.14	0.10	—	—	—	31
10	0.10	0.11	0.11	0.10	—	—	—	31
15	0.10	0.14	0.15	0.10	—	—	—	31
20	0.10	0.18	0.19	0.10	—	—	—	31
25	0.10	0.23	0.23	0.10	—	—	—	31
30	0.12	0.27	0.28	0.10	—	—	—	31
35	0.14	0.32	0.32	0.10	—	—	—	31

4 ft by 2 ft by 5 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^b	0.18	0.27	0.15	0.12	0.18	0.18	0.14	
2 < 3	0.18	0.19	0.17	0.12	—	—	—	38
3 to 5	0.13	0.13	0.13	0.12	—	—	—	38
10	0.12	0.12	0.12	0.12	—	—	—	38
15	0.14	0.16	0.16	0.12	—	—	—	38
20	0.18	0.20	0.21	0.12	—	—	—	38
25	0.23	0.25	0.25	0.12	—	—	—	38
30	0.28	0.30	0.30	0.12	—	—	—	38

4 ft by 3 ft by 5 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^b	0.18	0.31	0.18	0.12	0.18	0.18	0.14	
2 < 3	0.15	0.23	0.20	0.12	—	—	—	38
3 to 5	0.12	0.16	0.16	0.12	—	—	—	38
10	0.12	0.14	0.14	0.12	—	—	—	38
15	0.12	0.18	0.18	0.12	—	—	—	38
20	0.14	0.23	0.24	0.12	—	—	—	38
25	0.17	0.29	0.29	0.12	—	—	—	38
30	0.21	0.35	0.35	0.12	—	—	—	38

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

4 ft by 4 ft by 5 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^b	0.18	0.33	0.20	0.12	0.18	0.18	0.14	
2 < 3	0.12	0.26	0.23	0.12	—	—	—	38
3 to 5	0.12	0.18	0.18	0.12	—	—	—	38
10	0.12	0.15	0.15	0.12	—	—	—	38
15	0.12	0.19	0.20	0.12	—	—	—	38
20	0.12	0.25	0.25	0.12	—	—	—	38
25	0.14	0.31	0.31	0.12	—	—	—	38
30	0.17	0.37	0.37	0.12	—	—	—	38

5 ft by 2 ft by 6 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^c	0.19	0.27	0.18	0.14	0.19	0.19	0.17	
2 < 3	0.22	0.20	0.16	0.14	—	—	—	44
3 to 5	0.16	0.14	0.14	0.14	—	—	—	44
10	0.15	0.14	0.14	0.14	—	—	—	36
15	0.20	0.18	0.18	0.14	—	—	—	36
20	0.26	0.23	0.24	0.14	—	—	—	36
25	0.33	0.29	0.29	0.14	—	—	—	36
30	0.39	0.34	0.35	0.14	—	—	—	36

5 ft by 3 ft by 6 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^c	0.19	0.31	0.21	0.14	0.19	0.19	0.17	
2 < 3	0.18	0.24	0.19	0.14	—	—	—	45
3 to 5	0.14	0.17	0.16	0.14	—	—	—	36
10	0.14	0.16	0.17	0.14	—	—	—	36
15	0.16	0.21	0.22	0.14	—	—	—	35
20	0.21	0.27	0.28	0.14	—	—	—	35
25	0.26	0.34	0.34	0.14	—	—	—	35
30	0.31	0.41	0.41	0.14	—	—	—	35

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

5 ft by 4 ft by 6 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^c	0.19	0.33	0.24	0.14	0.19	0.19	0.17	
2 < 3	0.16	0.27	0.22	0.14	—	—	—	45
3 to 5	0.14	0.19	0.18	0.14	—	—	—	45
10	0.14	0.18	0.18	0.14	—	—	—	36
15	0.14	0.23	0.24	0.14	—	—	—	35
20	0.17	0.30	0.31	0.14	—	—	—	35
25	0.21	0.37	0.38	0.14	—	—	—	35
30	0.25	0.44	0.45	0.14	—	—	—	35

5 ft by 5 ft by 6 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^c	0.19	0.35	0.26	0.14	0.19	0.19	0.17	
2 < 3	0.14	0.29	0.24	0.14	—	—	—	45
3 to 5	0.14	0.21	0.20	0.14	—	—	—	45
10	0.14	0.19	0.20	0.14	—	—	—	45
15	0.14	0.24	0.25	0.14	—	—	—	36
20	0.15	0.31	0.32	0.14	—	—	—	35
25	0.18	0.38	0.39	0.14	—	—	—	35
30	0.21	0.46	0.47	0.14	—	—	—	35

6 ft by 2 ft by 7 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^d	0.23	0.27	0.19	0.17	0.19	0.19	0.17	
2 < 3	0.25	0.21	0.17	0.17	—	—	—	43
3 to 5	0.20	0.17	0.17	0.17	—	—	—	43
10	0.20	0.17	0.17	0.17	—	—	—	39
15	0.26	0.20	0.20	0.17	—	—	—	39
20	0.34	0.26	0.26	0.17	—	—	—	39
25	0.43	0.32	0.32	0.17	—	—	—	39
30	0.52	0.38	0.39	0.17	—	—	—	39

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

6 ft by 3 ft by 7 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^d	0.20	0.31	0.22	0.17	0.19	0.19	0.17	
2 < 3	0.21	0.24	0.19	0.17	—	—	—	43
3 to 5	0.17	0.18	0.17	0.17	—	—	—	39
10	0.17	0.18	0.19	0.17	—	—	—	39
15	0.22	0.24	0.24	0.17	—	—	—	38
20	0.28	0.31	0.31	0.17	—	—	—	38
25	0.35	0.38	0.39	0.17	—	—	—	38
30	0.42	0.46	0.46	0.17	—	—	—	38

6 ft by 4 ft by 7 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^d	0.19	0.34	0.25	0.17	0.19	0.19	0.17	
2 < 3	0.19	0.27	0.21	0.17	—	—	—	43
3 to 5	0.17	0.21	0.19	0.17	—	—	—	39
10	0.17	0.20	0.21	0.17	—	—	—	39
15	0.18	0.27	0.27	0.17	—	—	—	38
20	0.24	0.34	0.35	0.17	—	—	—	38
25	0.29	0.43	0.42	0.17	—	—	—	38
30	0.35	0.51	0.52	0.17	—	—	—	38

6 ft by 5 ft by 7 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^d	0.19	0.37	0.28	0.17	0.19	0.19	0.17	
2 < 3	0.17	0.30	0.24	0.17	—	—	—	43
3 to 5	0.17	0.23	0.21	0.17	—	—	—	43
10	0.17	0.22	0.23	0.17	—	—	—	39
15	0.17	0.28	0.29	0.17	—	—	—	38
20	0.20	0.37	0.38	0.17	—	—	—	38
25	0.25	0.45	0.46	0.17	—	—	—	38
30	0.30	0.54	0.55	0.17	—	—	—	38

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

6 ft by 6 ft by 7 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2 ^d	0.19	0.38	0.30	0.17	0.19	0.19	0.17	
2 < 3	0.17	0.32	0.26	0.17	—	—	—	52
3 to 5	0.17	0.24	0.22	0.17	—	—	—	52
10	0.17	0.23	0.24	0.17	—	—	—	43
15	0.17	0.29	0.31	0.17	—	—	—	39
20	0.18	0.38	0.39	0.17	—	—	—	39
25	0.23	0.46	0.48	0.17	—	—	—	38
30	0.27	0.55	0.57	0.17	—	—	—	38

7 ft by 2 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.27	0.28	0.19	0.19	0.19	0.19	0.19	
2 < 3	0.31	0.21	0.20	0.19	—	—	—	58
3 to 5	0.23	0.19	0.19	0.19	—	—	—	47
10	0.25	0.19	0.19	0.19	—	—	—	47
15	0.33	0.22	0.22	0.19	—	—	—	43
20	0.43	0.28	0.29	0.19	—	—	—	43
25	0.54	0.35	0.35	0.19	—	—	—	43
30	0.65	0.42	0.42	0.19	—	—	—	43

7 ft by 3 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.23	0.31	0.22	0.19	0.19	0.19	0.19	
2 < 3	0.27	0.25	0.24	0.19	—	—	—	47
3 to 5	0.19	0.19	0.19	0.19	—	—	—	43
10	0.21	0.20	0.21	0.19	—	—	—	43
15	0.28	0.26	0.27	0.19	—	—	—	43
20	0.36	0.34	0.35	0.19	—	—	—	43
25	0.45	0.42	0.43	0.19	—	—	—	43
30	0.54	0.50	0.51	0.19	—	—	—	43

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

7 ft by 4 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.21	0.34	0.25	0.19	0.19	0.19	0.19	
2 < 3	0.23	0.28	0.28	0.19	—	—	—	43
3 to 5	0.19	0.22	0.19	0.19	—	—	—	43
10	0.19	0.23	0.23	0.19	—	—	—	43
15	0.24	0.30	0.30	0.19	—	—	—	41
20	0.31	0.38	0.39	0.19	—	—	—	41
25	0.38	0.47	0.48	0.19	—	—	—	41
30	0.46	0.57	0.57	0.19	—	—	—	41

7 ft by 5 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.19	0.36	0.27	0.19	0.19	0.19	0.19	
2 < 3	0.21	0.31	0.31	0.19	—	—	—	47
3 to 5	0.19	0.24	0.21	0.19	—	—	—	43
10	0.19	0.25	0.26	0.19	—	—	—	43
15	0.21	0.32	0.33	0.19	—	—	—	41
20	0.27	0.41	0.42	0.19	—	—	—	41
25	0.33	0.51	0.52	0.19	—	—	—	41
30	0.40	0.61	0.62	0.19	—	—	—	41

7 ft by 6 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.19	0.38	0.30	0.19	0.19	0.19	0.19	
2 < 3	0.19	0.33	0.34	0.19	—	—	—	59
3 to 5	0.19	0.25	0.23	0.19	—	—	—	47
10	0.19	0.26	0.27	0.19	—	—	—	43
15	0.19	0.34	0.35	0.19	—	—	—	41
20	0.24	0.43	0.45	0.19	—	—	—	41
25	0.29	0.53	0.55	0.19	—	—	—	41
30	0.35	0.64	0.65	0.19	—	—	—	41

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

7 ft by 7 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.19	0.40	0.33	0.19	0.19	0.19	0.19	
2 < 3	0.19	0.36	0.37	0.19	—	—	—	59
3 to 5	0.19	0.27	0.25	0.19	—	—	—	59
10	0.19	0.27	0.29	0.19	—	—	—	47
15	0.19	0.35	0.37	0.19	—	—	—	43
20	0.22	0.44	0.46	0.19	—	—	—	43
25	0.27	0.54	0.57	0.19	—	—	—	43
30	0.32	0.65	0.67	0.19	—	—	—	41

8 ft by 2 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.35	0.31	0.21	0.19	0.19	0.19	0.19	
2 < 3	0.40	0.25	0.23	0.19	—	—	—	64
3 to 5	0.32	0.20	0.20	0.19	—	—	—	55
10	0.34	0.21	0.22	0.19	—	—	—	50
15	0.45	0.28	0.28	0.19	—	—	—	50
20	0.59	0.36	0.37	0.19	—	—	—	50
25	0.74	0.45	0.45	0.19	—	—	—	50

8 ft by 3 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.31	0.35	0.25	0.19	0.19	0.19	0.19	
2 < 3	0.35	0.29	0.28	0.19	—	—	—	55
3 to 5	0.28	0.23	0.24	0.19	—	—	—	50
10	0.29	0.25	0.26	0.19	—	—	—	45
15	0.39	0.33	0.34	0.19	—	—	—	45
20	0.51	0.43	0.44	0.19	—	—	—	45
25	0.63	0.53	0.54	0.19	—	—	—	45

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

8 ft by 4 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.27	0.38	0.29	0.19	0.19	0.19	0.19	
2 < 3	0.31	0.34	0.32	0.19	—	—	—	50
3 to 5	0.25	0.27	0.27	0.19	—	—	—	50
10	0.26	0.28	0.29	0.19	—	—	—	45
15	0.34	0.37	0.38	0.19	—	—	—	41
20	0.44	0.48	0.49	0.19	—	—	—	41

8 ft by 5 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.24	0.40	0.32	0.19	0.19	0.19	0.19	
2 < 3	0.28	0.37	0.35	0.19	—	—	—	50
3 to 5	0.23	0.29	0.30	0.19	—	—	—	45
10	0.23	0.31	0.32	0.19	—	—	—	45
15	0.30	0.41	0.42	0.19	—	—	—	41
20	0.39	0.52	0.54	0.19	—	—	—	41

8 ft by 6 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.22	0.42	0.35	0.19	0.19	0.19	0.19	
2 < 3	0.25	0.40	0.38	0.19	—	—	—	50
3 to 5	0.21	0.32	0.33	0.19	—	—	—	50
10	0.22	0.33	0.34	0.19	—	—	—	45
15	0.28	0.43	0.45	0.19	—	—	—	41
20	0.36	0.55	0.57	0.19	—	—	—	41

8 ft by 7 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.20	0.44	0.37	0.19	0.19	0.19	0.19	
2 < 3	0.23	0.43	0.41	0.19	—	—	—	55
3 to 5	0.19	0.34	0.35	0.19	—	—	—	55
10	0.20	0.34	0.36	0.19	—	—	—	50
15	0.26	0.45	0.47	0.19	—	—	—	41
20	0.33	0.57	0.60	0.19	—	—	—	41

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.

Table 1—Design Reinforcement Requirements for Precast Concrete Box Sections under Earth, Dead, and HL-93 Live Load Conditions (*Continued*)

8 ft by 8 ft by 8 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.20	0.45	0.40	0.19	0.19	0.19	0.19	
2 < 3	0.21	0.45	0.44	0.19	—	—	—	65
3 to 5	0.19	0.36	0.38	0.19	—	—	—	65
10	0.19	0.35	0.38	0.19	—	—	—	55
15	0.24	0.46	0.49	0.19	—	—	—	45
20	0.31	0.59	0.62	0.19	—	—	—	45

9 ft by 2 ft by 9 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.38	0.30	0.22	0.22	0.22	0.22	0.22	
2 < 3	0.44	0.26	0.22	0.22	—	—	—	71
3 to 5	0.35	0.22	0.22	0.22	—	—	—	59
10	0.39	0.22	0.23	0.22	—	—	—	54
15	0.52	0.30	0.30	0.22	—	—	—	54
20	0.68	0.38	0.39	0.22	—	—	—	54
25	0.86	0.47	0.48	0.22	—	—	—	54

9 ft by 3 ft by 9 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.34	0.33	0.24	0.22	0.22	0.22	0.22	
2 < 3	0.39	0.30	0.27	0.22	—	—	—	59
3 to 5	0.31	0.24	0.23	0.22	—	—	—	54
10	0.34	0.27	0.27	0.22	—	—	—	49
15	0.45	0.35	0.36	0.22	—	—	—	49
20	0.59	0.46	0.46	0.22	—	—	—	49
25	0.74	0.56	0.57	0.22	—	—	—	49

9 ft by 4 ft by 9 in.								
Design Earth Cover (ft)	Circumferential Reinforcement Areas, in. ² /ft							M (in.)
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	
0 < 2	0.30	0.36	0.28	0.22	0.22	0.22	0.22	
2 < 3	0.35	0.34	0.31	0.22	—	—	—	54
3 to 5	0.28	0.27	0.27	0.22	—	—	—	50
10	0.31	0.30	0.31	0.22	—	—	—	49
15	0.40	0.40	0.41	0.22	—	—	—	49
20	0.52	0.51	0.52	0.22	—	—	—	44
25	0.65	0.64	0.65	0.22	—	—	—	44

^a Top Slab 7 in., Bottom Slab 6 in.

^b Top Slab 7.5 in., Bottom Slab 6 in.

^c Top Slab 8 in., Bottom Slab 7 in.

^d Top Slab 8 in.

Continued on next page.