



Standard Specification for Corrugated Aluminum Box Culverts¹

This standard is issued under the fixed designation B 864/B 864M; 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 (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope *

1.1 This specification covers material, geometric, and wall section properties of aluminum box culverts manufactured from corrugated plate or sheet, with attached rib stiffeners, for field assembly. Appropriate fasteners and optional materials, such as aluminum invert plates and headwalls, are also described. Applications for aluminum box culverts include conduits for gravity flow drainage of surface water, such as culverts and storm drains, as well as for small bridges and grade separation structures such as pedestrian or vehicular underpasses, and utility tunnels.

1.2 This specification does not include requirements for foundations, backfill, or the relationship between earth cover or live loads and strength requirements. These important design considerations are described in the AASHTO Standard Specifications for Highway Bridges.

1.3 This specification does not include requirements for the hydraulic design of these structures. Hydraulic design, placement of footings or inverts, and end treatments to resist scour are described in FHWA HDS No. 5.

1.4 Appendix X1 lists nominal dimensions of box culvert sizes commonly available. Also listed are cross-sectional area and hydraulic design parameters for these sizes.

1.5 Appendix X2 lists manufacturer's suggested design properties for the rib stiffener types, spacing classes, and material thicknesses described in this specification.

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

2. Referenced Documents

2.1 ASTM Standards:

A 36/A 36M Specification for Carbon Structural Steel²

A 123/A 123M Specification for Zinc (Hot-Dip Galva-

nized) Coatings on Iron and Steel Products³

A 153/A 153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware³

A 307 Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength⁴

A 563 Specification for Carbon and Alloy Steel Nuts⁴

A 563M Specification for Carbon and Alloy Steel Nuts [Metric]³

B 221/B 221M Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes⁵

B 746/B 746M Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches⁵

B 790/B 790M Practice for Structural Design of Corrugated Aluminum Pipe, Pipe-Arches, and Arches for Culverts, Storm Sewers, and Other Buried Conduits⁵

2.2 AASHTO Standard:

Standard Specifications for Highway Bridges⁶

2.3 FHWA Standard:

HDS No. 5, Hydraulic Design of Highway Culverts, Report No. FHWA-IP-85-15⁷

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *box culvert*—a generally rectangular conduit having a cross section symmetric about a vertical axis, with a long radius crown segment, short radius haunch segments, and straight side segments, with rib stiffeners (see Fig. 1).

3.1.2 *crown*—the long radius top arc segment of a box culvert cross section (see Fig. 1).

3.1.3 *haunch*—the short radius segments at the upper corners of a box culvert cross section, making the transition between the long radius crown segment and the straight side segments (see Fig. 1).

3.1.4 *rib stiffeners*—spaced extruded aluminum structural members, curved to the shape of the transverse cross section of box culverts and attached by field-bolting to the corrugated plate shell (see Fig. 1).

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² *Annual Book of ASTM Standards*, Vol 01.04.

³ *Annual Book of ASTM Standards*, Vol 01.06.

⁴ *Annual Book of ASTM Standards*, Vol 15.08.

⁵ *Annual Book of ASTM Standards*, Vol 02.02.

⁶ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 225, Washington, DC.

⁷ Available from the National Technical Information Service, Springfield, VA 22161.

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

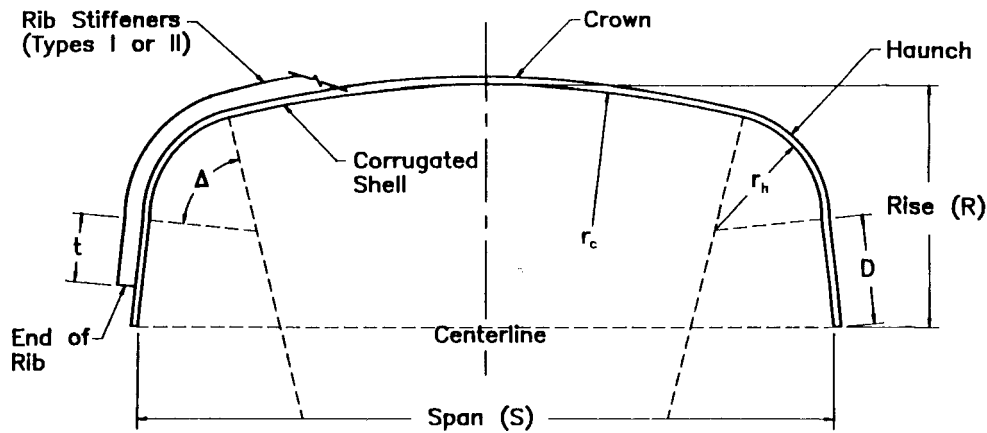


FIG. 1 Box Culvert Geometry

3.1.5 *rise*—the clear inside vertical dimension from the bottom of the straight side segments of a box culvert to the crown, measured at the axis of symmetry (see Fig. 1).

3.1.6 *shell*—the continuous, structural enclosure of the box culvert consisting of modular, field-assembled, and bolted corrugated aluminum plate members forming the crown, haunch, and side segments (see Fig. 1).

3.1.7 *span*—the clear inside horizontal dimension of a box culvert, measured at the bottom of the straight side segments (see Fig. 1).

4. Classification

4.1 Aluminum box culverts consist of a 9 by 2½ in. [229 by 64 mm] corrugated aluminum plate shell in combination with extruded aluminum stiffening ribs. The plate thickness, stiffener type, and spacing class at the crown and haunch of the box

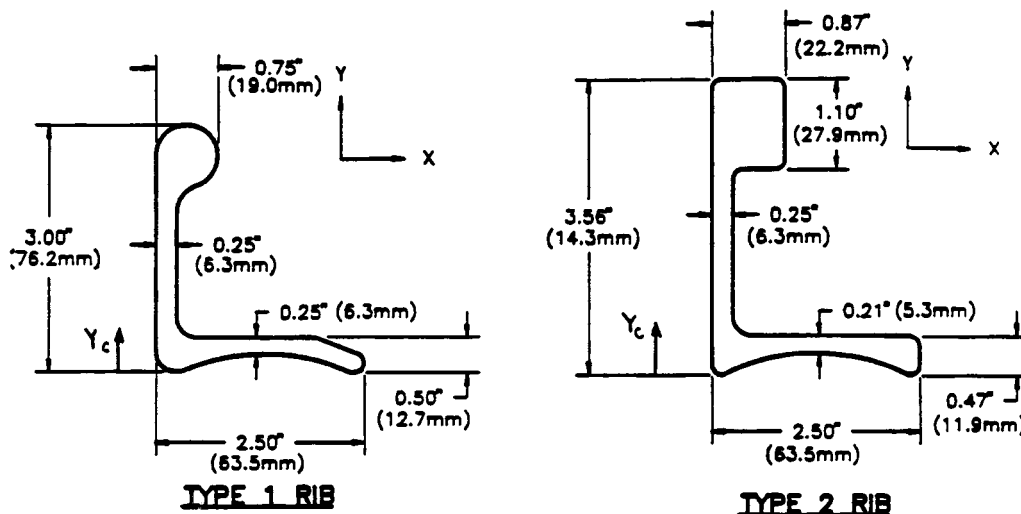
culvert may differ, provided they satisfy the ordering information and the design properties (see 5.1 and 6.1). The plate thickness and stiffener type and spacing class may be varied along the length of the box culvert in accordance with cover and loading requirements, as agreed upon between the purchaser and the fabricator.

4.2 Rib Stiffener Type and Spacing Class:

4.2.1 Rib stiffeners consist of either Type 1 or Type 2 at the option of the fabricator. Geometry, section, and mechanical properties must conform to the requirements of Fig. 2. Rib stiffener spacing classes shall be as defined in 4.2.2-4.2.5 and illustrated in Fig. 3.

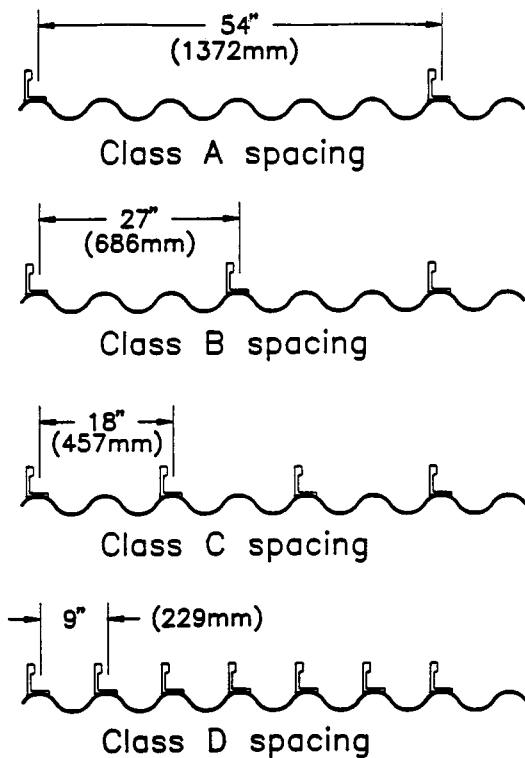
4.2.2 *Class A Spacing*, consisting of either Type 1 or Type 2 external rib stiffeners spaced at 54 in. [1372 mm] center-to-center.

4.2.3 *Class B Spacing*, consisting of either Type 1 or Type 2



	Type 1	Type 2
Alloy	6061-T6	6061-T6
Yield Strength	35 ksi [241.3 MPa]	35 ksi [241.3 MPa]
Tensile Strength	38 ksi [262.0 MPa]	38 ksi [262.0 MPa]
Area	1.71 in. ² [1103 mm ²]	2.27 in. ² [1465 mm ²]
Center of Area	Y _c = 1.02 in. [26.0 mm]	Y _c = 1.76 in. [44.8 mm]
Plastic Modulus	1.70 in. ³ [27 858 mm ³]	2.68 in. ³ [43 917 mm ³]
Plastic Moment	M _p = 4.97 ^k -ft [6.72 kN-m]	M _p = 7.81 ^k -ft [10.60 kN-m]

FIG. 2 Extruded Aluminum Rib Stiffeners Geometry and Nominal Properties for Design



Ribs are either Type 1 or Type 2.

FIG. 3 Rib Stiffener Spacing Classes

external rib stiffeners spaced at 27 in. [686 mm] center-to-center.

4.2.4 *Class C Spacing*, consisting of either Type 1 or Type 2 external rib stiffeners spaced at 18 in. [457 mm] center-to-center.

4.2.5 *Class D Spacing*, consisting of either Type 1 or Type 2 external rib stiffeners spaced at 9 in. [229 mm] center-to-center.

5. Ordering Information

5.1 Orders for products specified herein shall include the following information required as necessary to adequately describe the desired product characteristics:

- 5.1.1 Name of product (corrugated aluminum box culvert),
- 5.1.2 ASTM designation and year of issue, as B XXX-____ for inch-pound units or B XXXM-____ for SI units,
- 5.1.3 Number of structures,
- 5.1.4 Nominal dimensions of each structure including the rise, span, length (measured along the bottom centerline), and cross sectional area required,

NOTE 1—The nominal length increment is 2.25 ft [0.68 m]. Special lengths can be provided.

5.1.5 Minimum and maximum cover height over structure top centerline (measured from the inside crest of the corrugated plate to the finished surface of the traveled way),

NOTE 2—The minimum and maximum cover height is assumed to apply to the entire length of the structure unless the purchaser specifies otherwise. The design specifications limit cover height to a range of between 1.4 ft and 5.0 ft [0.43 m and 1.52 m]. Small deviations in the height of cover can make a significant difference in the design. It is

recommended that the purchaser specify minimum and maximum cover heights to the nearest 0.1 ft [30 mm].

5.1.6 Dead load unit weight, if different than 120 lb/ft³ [1920 kg/m³],

5.1.7 Structure live load vehicle configuration, if different than AASHTO HS 20-44 (see AASHTO Standard Specifications for Highway Bridges),

5.1.8 Corrugated footing pads or full invert plates, if required. For box culverts not supported on concrete footings, allowable foundation bearing capacity, if different than 2 tons/ft² [192 kPa],

NOTE 3—Design procedures for corrugated footing pads or full invert plates are beyond the scope of this specification. However, general considerations for design of structural plate arch footings are given in Practice B 790/B 790M. Also, specific design criteria for similar applications are available in the AASHTO Standard Specifications for Highway Bridges.

5.1.9 End treatment (bevel, skew, grade or slope corrections, corrugated aluminum headwalls, cut-off walls, or other special provision), if required,

NOTE 4—End conditions involving beveled or skewed cut ends may require a structural support wall or collar. The design procedures for these end treatments as well as for vertical headwalls are beyond the scope of this specification.

5.1.10 Other special requirements such as stubs, tap-ins, saddles, elbows, etc., if required, and

5.1.11 Material certification, if required (see 13.1).

NOTE 5—Typical ordering information may be described as: (1) One corrugated aluminum box culvert, in accordance with ASTM B XXX-____, 7 ft, 3 in. rise by 20 ft, 6 in. span by 45 ft long, having a 1.4 ft minimum cover and a 3.0 ft maximum cover, with full invert plates; or (2) Two corrugated aluminum box culverts, in accordance with ASTM B XXXM-____, each being 1.96 m rise by 4.67 m span by 18.3 m long, each having 0.43 m minimum and maximum covers, assuming a dead load unit weight of 2162 kg/m³, having full invert plates and having ends slope adjusted for 2 % grade, including certification.

6. Design Properties

6.1 The required plastic moment capacities shall be determined for the crown and haunch segments of the box culvert in accordance with the ordering information and AASHTO Standard Specifications for Highway Bridges. The AASHTO specification is applicable for the range of geometric limits given in Fig. 1 and Table 1.

7. Materials

7.1 The corrugated plate material utilized for the shell shall be fabricated from aluminum sheet or plate conforming to the

TABLE 1 Geometric Limits of Box Culverts

Elements ^A	Minimum	Maximum
Span (<i>S</i>)	8.75 ft [2.67 m]	25.42 ft [7.75 m]
Rise (<i>R</i>)	2.50 ft [0.76 m]	10.50 ft [3.20 m]
Radius of crown (<i>r_c</i>)	...	24.79 ft [7.56 m]
Radius of haunch (<i>r_h</i>)	2.50 ft [0.76 m]	...
Haunch angle (Δ)	50°	70°
Length of leg (<i>D</i>)	0.50 ft [0.15 m]	5.2 ft [1.59 m]
Length of rib on leg (<i>t</i>)	^B	...

^A See Fig. 1 for illustration of geometric elements.

^B Minimum 19 in. [483 mm] or length of leg (*D*) minus 3 in. [76 mm], whichever is less.

chemical, mechanical, thickness and shape requirements of Specification B 746/B 746M. Section properties for the corrugated plate are provided in Practice B 790/B 790M.

7.2 Rib stiffeners shall be extruded shapes conforming to the chemical and mechanical requirements of Specification B 221/B 221M for 6061-T6. Their dimensions and the required, nominal section properties developed are shown in Fig. 2.

7.3 Corrugated aluminum footing and invert members, when specified, shall conform to the same material requirements as 7.1. Thickness shall be as required by the design (see Note 3) and shall not be less than 0.100 in. [2.5 mm].

7.4 Corrugated aluminum headwalls, when specified, shall conform to the same material requirements as 7.1. Aluminum walers, tie-back rods, deadman anchors, and other aluminum structural members shall conform to the mechanical and chemical requirements of 7.2. Any steel tie-back rods, deadman anchors, or other steel structural member shall meet the requirements of Specification A 36/A 36M. Where they are installed in contact with aluminum members steel members shall be hot-dip galvanized after fabrication in accordance with the coating requirements of Specification A 123/A 123M. The thickness, shape, and dimensions of headwall and incidental members shall be as required by the design (see Note 4).

7.5 Aluminum cut-off walls, when specified, shall conform to the same material requirements as 7.1 and provide a nominal thickness of 0.10 in. [2.5 mm].

7.6 Bolts and nuts required to join corrugated plates together, or to join corrugated plates to the stiffeners or other structural members, shall conform to the requirements of Specification B 746/B 746M. Bolts and nuts for joining structural and other items that are not corrugated shall conform to the requirements of Specification B 746/B 746M or alternatively meet or exceed the requirements of Specification A 307, Grade A and Specifications A 563 and A 563M. Steel bolts and nuts shall be hot-dip galvanized in accordance with Specification A 153/A 153M, Class C.

8. Fabrication

8.1 The corrugated aluminum shell of the box culvert shall conform to the geometric dimensional limits specified in Table 1 and shall be subject to the manufacturing tolerances in 9.1-9.3.

8.2 Corrugated aluminum shell plates shall be fabricated in accordance with Specification B 746/B 746M.

8.3 Extruded aluminum rib stiffeners shall consist of annular rings conforming to the shape and dimensions of the structural plate shell. The bolt holes shall be punched so that all members having like dimensions and curvature are interchangeable. Sufficient bolt holes shall be provided in the corrugated shell to match the arrangement, number, and spacing of bolt holes in the stiffeners. The layout of the stiffeners relative to the corrugated shell shall be in accordance with 4.2 for the stiffener type and spacing class required by the design.

8.4 Rib stiffeners that are designed to be continuous around the periphery of the crown and haunch, but that are not fabricated in one piece, shall be provided with splice connections at the intermediate ends. The design of the splice shall be

adequate to develop the bending and axial loads carried by the rib stiffener at the location of the splice.

8.5 Rib stiffeners shall be provided with adequate bolted connectors to resist the beam shear that develops between the stiffener and the shell due to the moment requirements described in 6.1.

8.6 Corrugated footing and invert plates shall be fabricated in accordance with Specification B 746/B 746M.

8.7 Special members for headwalls, cut-off walls, etc. and special plates forming skewed ends, beveled ends, or curved alignment, when required, shall be accurately cut to fit the requirements of the ordering information. Cut edges of members shall not contain excessive notches, gouges, or burrs, and shall present a workmanlike finish.

9. Dimensions and Permissible Variations

9.1 Furnished box culvert dimensions shall not vary from the ordered sizes by more than the permissible amounts given in Table 2, except as noted in 9.2 and 9.3.

9.2 When agreed upon between the purchaser and the fabricator, the span dimension furnished may exceed the limits given in Table 2. However, the cross-sectional area furnished shall not be less than that ordered. Also, the actual span shall be used in lieu of the ordered span for structural design (see 1.2 and 6.1).

9.3 When agreed upon between the purchaser and the fabricator, the variation in the rise dimension furnished may exceed Table 2. However, the resulting shape and height of cover shall meet the structural and hydraulic design requirements for box culverts (see 1.2, 1.3 and 6.1).

10. Workmanship

10.1 Plates, rib stiffeners, accessories, and fasteners shall be of uniform quality consistent with good manufacturing, fabrication, and inspection practices.

11. Sampling and Testing

11.1 Sampling and testing of corrugated plate and miscellaneous flat plate materials for chemical composition and mechanical properties shall be in accordance with Specification B 746/B 746M.

11.2 Sampling and testing of rib stiffeners and miscellaneous aluminum structural shapes for chemical composition and mechanical properties shall be in accordance with Specification B 221/B 221M.

11.3 Sampling and testing of structural steel members for chemical composition and mechanical properties shall be in accordance with Specification A 36/A 36M. Testing for galvanizing coating weight shall be in accordance with Specification A 123/A 123M.

TABLE 2 Tolerances on Dimensions

Rise ^A	Span ^A	Length	Area ^B
+ 2 in. [50 mm] or 1 % of span, whichever is greater	±2 %	±1.5 ft [±0.46 m]	-2 %
-2 % of span

^A In no case shall permitted variations in rise and span result in a combination of cover height and loading requirements that fall outside the limits specified by the design (see 6.1).

^B Positive tolerance on area is not applicable.

12. Rejection and Rehearing

12.1 Material that fails to conform to the minimum requirements of this specification may be rejected. Rejection should be reported to the fabricator promptly and in writing. In case of dissatisfaction with the results of the test, the fabricator may make claim for a rehearing.

13. Material Certification

13.1 When specified in the purchase order or contract, the purchaser shall be furnished a material certification that samples representing each lot have been either tested or inspected as directed in this specification and that the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

14. Product Marking

14.1 Each corrugated plate shall be identified in accordance with the requirements of Specification B 746/B 746M.

15. Assembly Drawings

15.1 The purchaser shall be furnished with assembly drawings showing the layout and location of all corrugated plates, stiffener ribs, and other structural members supplied in accordance with the ordering information. Legible identification shall be placed on each special member to designate its proper position in the finished structure and shall be referenced on the assembly drawings.

16. Keywords

16.1 bridge; box culvert; corrugated aluminum structural plate; culvert; grade separation; low cover structure; low profile structure; storm sewer

APPENDIXES

(Nonmandatory Information)

X1. DIMENSION AND HYDRAULIC INFORMATION

TABLE X1.1 Dimension and Hydraulic Information

Structure Number	Span, ft-in. [m]	Rise, ft-in. [m]	Area ^A , ft ² [m ²]	R ^B , ft [m]	WP ^C , ft [m]	AR ^{2/3D}	AD ^{1/2E}
1	8 ft-9 in. [2.67]	2 ft-6 in. [0.76]	18.4 [1.71]	0.92 [0.28]	20.11 [6.13]	17.40	29.10
2	9 ft-2 in. [2.79]	3 ft-3 in. [0.99]	25.4 [2.36]	1.15 [0.35]	22.14 [6.75]	27.88	45.79
3	9 ft-7 in. [2.92]	4 ft-1 in. [1.24]	32.6 [3.03]	1.35 [0.41]	24.17 [7.37]	39.82	65.88
4	10 ft-0 in. [3.05]	4 ft-10 in. [1.47]	40.2 [3.73]	1.54 [0.47]	26.20 [7.99]	53.61	88.38
5	10 ft-6 in. [3.20]	5 ft-7 in. [1.70]	48.1 [4.47]	1.71 [0.52]	28.22 [8.60]	68.78	113.66
6	10 ft-11 in. [3.33]	6 ft-4 in. [1.93]	56.4 [5.24]	1.86 [0.57]	30.25 [9.22]	85.30	141.94
7	11 ft-4 in. [3.45]	7 ft-2 in. [2.18]	65.0 [6.04]	2.01 [0.61]	32.28 [9.84]	103.52	174.01
8	10 ft-2 in. [3.10]	2 ft-8 in. [0.81]	23.0 [2.14]	1.00 [0.30]	23.14 [7.05]	23.00	37.56
9	10 ft-7 in. [3.23]	3 ft-5 in. [1.04]	31.1 [2.89]	1.24 [0.38]	25.11 [7.65]	35.90	57.49
10	10 ft-11 in. [3.33]	4 ft-3 in. [1.30]	39.5 [3.67]	1.46 [0.45]	27.09 [8.26]	50.84	81.43
11	11 ft-4 in. [3.45]	5 ft-0 in. [1.52]	48.2 [4.48]	1.66 [0.51]	29.07 [8.86]	67.57	107.76
12	11 ft-8 in. [3.56]	5 ft-9 in. [1.75]	57.2 [5.31]	1.84 [0.56]	31.05 [9.46]	85.89	137.16
13	12 ft-1 in. [3.68]	6 ft-7 in. [2.01]	66.4 [6.17]	2.01 [0.61]	33.03 [10.07]	105.75	170.37
14	12 ft-5 in. [3.78]	7 ft-4 in. [2.24]	76.0 [7.06]	2.17 [0.66]	35.01 [10.67]	127.39	205.81
15	11 ft-7 in. [3.53]	2 ft-10 in. [0.86]	28.1 [2.61]	1.08 [0.33]	26.15 [7.97]	29.58	47.30
16	11 ft-11 in. [3.63]	3 ft-7 in. [1.09]	37.4 [3.47]	1.33 [0.41]	28.08 [8.56]	45.23	70.80
17	12 ft-3 in. [3.73]	4 ft-5 in. [1.35]	46.9 [4.36]	1.56 [0.48]	30.01 [9.15]	63.08	98.56
18	12 ft-7 in. [3.84]	5 ft-2 in. [1.57]	56.6 [5.26]	1.77 [0.54]	31.94 [9.74]	82.82	128.65
19	12 ft-11 in. [3.94]	6 ft-0 in. [1.83]	66.6 [6.19]	1.97 [0.60]	33.87 [10.32]	104.66	163.14
20	13 ft-3 in. [4.04]	6 ft-9 in. [2.06]	76.9 [7.14]	2.15 [0.66]	35.80 [10.91]	128.10	199.79
21	13 ft-0 in. [3.96]	3 ft-0 in. [0.91]	33.8 [3.14]	1.16 [0.35]	29.16 [8.89]	37.32	58.54
22	13 ft-4 in. [4.06]	3 ft-10 in. [1.17]	44.2 [4.11]	1.42 [0.43]	31.04 [9.46]	55.84	86.54
23	13 ft-7 in. [4.14]	4 ft-7 in. [1.40]	54.8 [5.09]	1.66 [0.51]	32.91 [10.03]	76.83	117.32
24	13 ft-10 in. [4.22]	5 ft-5 in. [1.65]	65.6 [6.09]	1.89 [0.58]	34.79 [10.60]	100.28	152.68
25	14 ft-1 in. [4.29]	6 ft-2 in. [1.88]	76.6 [7.12]	2.09 [0.64]	36.67 [11.18]	125.22	190.22
26	14 ft-5 in. [4.39]	3 ft-3 in. [0.99]	40.0 [3.72]	1.24 [0.38]	32.15 [9.80]	46.17	72.11
27	14 ft-8 in. [4.47]	4 ft-1 in. [1.24]	51.5 [4.78]	1.52 [0.46]	33.98 [10.36]	68.08	104.07
28	14 ft-10 in. [4.52]	4 ft-10 in. [1.47]	63.2 [5.87]	1.77 [0.54]	35.80 [10.91]	92.48	138.94
29	15 ft-1 in. [4.60]	5 ft-8 in. [1.73]	75.1 [6.98]	2.00 [0.61]	37.63 [11.47]	119.21	178.77
30	15 ft-4 in. [4.67]	6 ft-5 in. [1.96]	87.2 [8.10]	2.21 [0.67]	39.46 [12.03]	147.95	220.89
31	15 ft-6 in. [4.72]	7 ft-3 in. [2.21]	99.4 [9.23]	2.41 [0.73]	41.28 [12.58]	178.68	267.64
32	15 ft-9 in. [4.80]	8 ft-0 in. [2.44]	111.8 [10.39]	2.59 [0.79]	43.11 [13.14]	210.85	316.22
33	15 ft-10 in. [4.83]	3 ft-6 in. [1.07]	46.8 [4.35]	1.33 [0.41]	35.13 [10.71]	56.60	87.55
34	16 ft-0 in. [4.88]	4 ft-3 in. [1.30]	59.5 [5.53]	1.61 [0.49]	36.90 [11.25]	81.73	122.66
35	16 ft-2 in. [4.93]	5 ft-1 in. [1.55]	72.3 [6.72]	1.87 [0.57]	38.68 [11.79]	109.74	163.01

TABLE X1.1 *Continued*

Structure Number	Span, ft-in. [m]	Rise, ft-in. [m]	Area ^A , ft ² [m ²]	R ^B , ft [m]	WPC ^C , ft [m]	AR ^{2/3D}	AD ^{1/2E}
36	16 ft-4 in. [4.98]	5 ft-11 in. [1.80]	85.2 [7.92]	2.11 [0.64]	40.45 [12.33]	140.16	207.24
37	16 ft-6 in. [5.03]	6 ft-8 in. [2.03]	98.3 [9.13]	2.33 [0.71]	42.23 [12.87]	172.77	253.81
38	16 ft-8 in. [5.08]	7 ft-6 in. [2.29]	111.5 [10.36]	2.53 [0.77]	44.00 [13.41]	207.02	305.36
39	16 ft-10 in. [5.13]	8 ft-3 in. [2.51]	124.8 [11.59]	2.73 [0.83]	45.78 [13.95]	243.78	358.46
40	17 ft-9 in. [5.41]	3 ft-10 in. [1.17]	54.4 [5.05]	1.41 [0.43]	38.71 [11.80]	68.40	106.51
41	18 ft-2 in. [5.54]	4 ft-7 in. [1.40]	68.3 [6.35]	1.68 [0.51]	40.72 [12.41]	96.52	146.22
42	18 ft-7 in. [5.66]	5 ft-4 in. [1.63]	82.5 [7.66]	1.93 [0.59]	42.74 [13.03]	127.89	190.53
43	19 ft-0 in. [5.79]	6 ft-1 in. [1.85]	97.1 [9.02]	2.17 [0.66]	44.75 [13.64]	162.75	239.49
44	19 ft-5 in. [5.92]	6 ft-11 in. [2.11]	111.9 [10.40]	2.39 [0.73]	46.77 [14.26]	200.03	294.29
45	19 ft-10 in. [6.05]	7 ft-8 in. [2.34]	127.1 [11.81]	2.61 [0.80]	48.79 [14.87]	240.94	351.92
46	20 ft-3 in. [6.17]	8 ft-5 in. [2.57]	142.6 [13.25]	2.81 [0.86]	50.80 [15.48]	283.96	413.70
47	19 ft-1 in. [5.82]	4 ft-2 in. [1.27]	63.3 [5.88]	1.52 [0.46]	41.60 [12.68]	83.68	129.21
48	19 ft-5 in. [5.92]	4 ft-11 in. [1.50]	78.3 [7.27]	1.80 [0.55]	43.56 [13.26]	115.86	173.62
49	19 ft-9 in. [6.02]	5 ft-8 in. [1.73]	93.6 [8.70]	2.06 [0.63]	45.52 [13.87]	151.54	222.81
50	20 ft-1 in. [6.12]	6 ft-8 in. [1.98]	109.2 [10.15]	2.30 [0.70]	47.48 [14.47]	190.27	278.41
51	20 ft-6 in. [6.25]	7 ft-3 in. [2.21]	125.0 [11.61]	2.53 [0.77]	49.44 [15.07]	232.09	336.57
52	20 ft-10 in. [6.35]	8 ft-1 in. [2.46]	141.2 [13.12]	2.75 [0.84]	51.39 [15.66]	277.16	401.45
53	21 ft-2 in. [6.45]	8 ft-10 in. [2.69]	157.6 [14.64]	2.95 [0.90]	53.35 [16.26]	324.17	468.40
54	20 ft-4 in. [6.20]	4 ft-6 in. [1.37]	73.1 [6.79]	1.64 [0.50]	44.48 [13.56]	101.66	155.07
55	20 ft-7 in. [6.27]	5 ft-3 in. [1.60]	89.2 [8.29]	1.92 [0.59]	46.38 [14.14]	137.79	204.38
56	20 ft-11 in. [6.38]	6 ft-1 in. [1.85]	105.5 [9.80]	2.19 [0.67]	48.28 [14.72]	177.92	260.21
57	21 ft-3 in. [6.48]	6 ft-10 in. [2.08]	122.1 [11.34]	2.43 [0.74]	50.18 [15.29]	220.69	319.18
58	21 ft-6 in. [6.55]	7 ft-8 in. [2.34]	139.0 [12.91]	2.67 [0.81]	52.08 [15.87]	267.52	384.87
59	21 ft-10 in. [6.65]	8 ft-5 in. [2.57]	156.0 [14.49]	2.89 [0.88]	53.98 [16.45]	316.51	452.58
60	22 ft-1 in. [6.73]	9 ft-3 in. [2.82]	173.3 [16.10]	3.10 [0.94]	55.88 [17.03]	368.45	527.07
61	21 ft-7 in. [6.58]	4 ft-11 in. [1.50]	83.8 [7.79]	1.77 [0.54]	47.32 [14.42]	122.62	185.81
62	21 ft-10 in. [6.65]	5 ft-8 in. [1.73]	101.0 [9.38]	2.05 [0.62]	49.16 [14.98]	162.99	240.43
63	22 ft-1 in. [6.73]	6 ft-6 in. [1.98]	118.4 [11.00]	2.32 [0.71]	51.00 [15.54]	207.50	301.86
64	22 ft-3 in. [6.78]	7 ft-3 in. [2.21]	135.9 [12.63]	2.57 [0.78]	52.84 [16.11]	254.98	365.92
65	22 ft-6 in. [6.86]	8 ft-1 in. [2.46]	153.7 [14.28]	2.81 [0.86]	54.69 [16.67]	308.06	436.99
66	22 ft-9 in. [6.93]	8 ft-10 in. [2.69]	171.6 [15.94]	3.04 [0.93]	53.53 [16.32]	360.11	510.01
67	23 ft-0 in. [7.01]	9 ft-8 in. [2.95]	189.8 [17.63]	3.25 [0.99]	58.37 [17.79]	416.44	590.11
68	22 ft-9 in. [6.93]	5 ft-4 in. [1.63]	95.5 [8.87]	1.91 [0.58]	50.14 [15.28]	147.01	220.55
69	23 ft-0 in. [7.01]	6 ft-1 in. [1.85]	113.7 [10.56]	2.19 [0.67]	51.92 [15.83]	191.74	280.43
70	23 ft-2 in. [7.06]	6 ft-11 in. [2.11]	132.1 [12.27]	2.46 [0.75]	53.70 [16.37]	240.73	347.42
71	23 ft-4 in. [7.11]	7 ft-8 in. [2.34]	150.6 [13.99]	2.71 [0.83]	55.48 [16.91]	292.73	416.99
72	23 ft-6 in. [7.16]	8 ft-6 in. [2.59]	169.3 [15.73]	2.96 [0.90]	57.27 [17.46]	349.02	493.59
73	23 ft-8 in. [7.21]	9 ft-3 in. [2.82]	188.1 [17.48]	3.18 [0.97]	59.05 [18.00]	406.76	572.08
74	23 ft-10 in. [7.26]	10 ft-1 in. [3.07]	207.0 [19.23]	3.40 [1.04]	60.83 [18.54]	468.05	657.31
75	24 ft-0 in. [7.32]	5 ft-9 in. [1.75]	108.2 [10.05]	2.05 [0.62]	52.92 [16.13]	174.61	259.45
76	24 ft-1 in. [7.34]	6 ft-6 in. [1.98]	127.5 [11.85]	2.33 [0.71]	54.64 [16.65]	224.09	325.06
77	24 ft-3 in. [7.39]	7 ft-4 in. [2.24]	146.8 [13.64]	2.60 [0.79]	56.37 [17.18]	277.57	397.54
78	24 ft-4 in. [7.42]	8 ft-2 in. [2.49]	166.2 [15.44]	2.86 [0.87]	58.09 [17.71]	334.87	474.96
79	24 ft-5 in. [7.44]	8 ft-11 in. [2.72]	185.7 [17.25]	3.10 [0.94]	59.81 [18.23]	394.81	554.51
80	24 ft-7 in. [7.49]	9 ft-9 in. [2.97]	205.3 [19.07]	3.34 [1.02]	61.54 [18.76]	458.73	641.05
81	24 ft-8 in. [7.52]	10 ft-6 in. [3.20]	225.0 [20.90]	3.56 [1.09]	63.26 [19.28]	524.58	729.08
82	25 ft-2 in. [7.67]	6 ft-2 in. [1.88]	122.0 [11.33]	2.19 [0.67]	55.67 [16.97]	205.74	302.96
83	25 ft-2 in. [7.67]	7 ft-0 in. [2.13]	142.2 [13.21]	2.48 [0.76]	57.33 [17.47]	260.54	376.23
84	25 ft-3 in. [7.70]	7 ft-9 in. [2.36]	162.4 [15.09]	2.75 [0.84]	59.00 [17.98]	318.77	452.10
85	25 ft-4 in. [7.72]	8 ft-7 in. [2.62]	182.6 [16.96]	3.01 [0.92]	60.66 [18.49]	380.67	534.97
86	25 ft-4 in. [7.72]	9 ft-5 in. [2.87]	202.9 [18.85]	3.26 [0.99]	62.33 [19.00]	446.09	622.63
87	25 ft-5 in. [7.75]	10 ft-2 in. [3.10]	223.3 [20.75]	3.49 [1.06]	63.99 [19.50]	513.77	712.00

^A Inside area of box culvert cross section.

^B Hydraulic radius of box culvert section.

^C Wetted perimeter of box culvert cross section.

^D Uniform flow section factor.

^E Inlet control section factor.

X2. MANUFACTURER'S SUGGESTED DESIGN PROPERTIES

X2.1 The plastic moment capacities tabulated in Table X2.1 are based on test results adjusted for minimum mechanical properties.

TABLE X2.1 Plastic Moment Capacity in k-ft/ft [kN-m/m]

		Plate and Rib Composite Section Properties					
Rib Type	Spacing Class	Metal Thickness, in. [mm]					
		0.125 [3.18]	0.150 [3.81]	0.175 [4.45]	0.200 [5.08]	0.225 [5.72]	0.250 [6.35]
		Plastic Moment Capacity					
Type 1	A	4.62 [20.55]	5.46 [24.28]	6.04 [26.86]	6.61 [29.40]	7.17 [31.89]	7.74 [34.42]
Type 1	B	6.18 [27.49]	7.25 [32.25]	7.94 [35.31]	8.60 [38.25]	9.25 [41.14]	9.87 [43.90]
Type 1	C	7.41 [32.96]	8.66 [38.52]	9.48 [42.16]	10.26 [45.63]	11.00 [48.93]	11.71 [50.75]
Type 1	D	10.63 [47.28]	12.13 [53.95]	13.08 [58.18]	14.05 [62.48]	15.03 [66.85]	16.02 [71.26]
Type 2	A	5.87 [26.11]	6.82 [30.33]	7.43 [33.05]	8.04 [35.76]	8.63 [38.30]	9.21 [40.96]
Type 2	B	8.32 [37.00]	9.59 [42.65]	10.39 [46.21]	11.14 [49.55]	11.85 [52.71]	12.55 [55.82]
Type 2	C	10.42 [46.35]	11.90 [52.93]	12.84 [57.11]	13.72 [61.02]	14.57 [64.81]	15.39 [68.45]
Type 2	D	16.45 [73.17]	18.46 [82.11]	19.41 [86.39]	20.38 [90.65]	21.37 [95.05]	22.37 [99.50]

SUMMARY OF CHANGES

Committee B07 has identified the location of selected changes to this standard since the last issue (B 864/B 864M-95) that may impact the use of this standard.

- (1) Paragraph 1.5 was added to point out that suggested design properties are included in the appendix.
- (2) ASTM standards in the Referenced Documents were updated to show their dual status.
- (3) Paragraph 6.1 now references Fig. 1 as part of the geometry limits of an aluminum box culvert.
- (4) Deleted paragraph 6.2 and Table 2 to remove design properties from the specification text.
- (5) Suggested design properties included in Appendix X2.

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