SUPER-SPAN™ and SUPER-PLATE®

Over 4000 SUPER-SPANS in Place

Since 1967, more than 4,000 structures have been built on five continents. That makes SUPER-SPAN the most widely accepted, long-span, corrugated steel design in the world.

SUPER-SPAN structures with individual spans up to 50 feet are serving as bridges, railroad overpasses, stream enclosures, vehicular tunnels, culverts, and conveyor conduits. Installations have involved almost every job condition possible, including severe weather and unusual construction time constraints.

National specification

SUPER-SPAN's popularity has resulted in a national specification written for long-span, corrugated metal structures by the American Association of State Highway and Transportation Officials. A.A.S.H.T.O. Standard Specifications (Section 12.7) for Highway Bridges provide for the selection of acceptable combinations of plate thickness, minimum cover requirements, plate radius and other design factors. Material is covered by A.A.S.H.T.O. M 167 AND ASTM A 761. Installation is covered by A.A.S.H.T.O. standard specification for highway bridges (Sec. 12) and ASTM A 761.

Acceptance

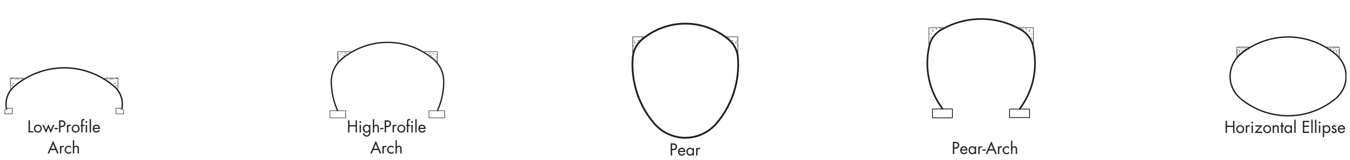
Many state and federal agencies recognize the excellent performance and economy of SUPER-SPAN corrugated structures. In a 1979 memorandum, the chief of FHWA's Bridge Division noted that in the previous 15 years, several hundred CONTECH SUPER-SPAN Culverts had been erected in the United States and Canada and their performance had been excellent.

In a 1983 report to the Secretary of Transportation, the General Accounting Office stated, *"Some innovations, such as using certain long-span culverts rather than building conventional bridges, have substantially lowered bridge costs."*

Aluminum Long-Span structures (SUPER-PLATE)

SUPER-PLATE structures add both longitudinal stiffeners (thrust beams) and circumferential stiffeners (reinforcing ribs) to conventional Aluminum Structural Plate to achieve larger sizes. Clear spans in excess of 30 feet and clear areas over 435 square feet are achievable with SUPER-PLATE. Available shapes include low-profile and high-profile arch and horizontal ellipse. Consult a CONTECH representative for additional information.

High-profile arch SUPER-SPAN (43'-3" span, 27' rise) in Hamilton, Ohio to span a wetland and to provide a wildlife crossing.



Standard Shapes

General design and installation characteristics

As conventional round structures increase in diameter beyond 16-18 feet, they become more difficult to install. It becomes increasingly difficult to both control the shape and to achieve good backfill support. CONTECH's SUPER-SPAN and SUPER-PLATE help overcome these problems through the use of both special shapes and concrete thrust beams.

SUPER-SPAN/SUPER-PLATE solves the problem

The horizontal ellipse, low-profile and high-profile arch shapes are wide-span, reduced-rise structures. They provide large open areas with less rise than comparable circular shapes. Sidewalls are compact with a modest radius to provide a more rigid pipe wall to compact against. At the same time, the large radius top arc of these structures is flatter and, therefore, has less tendency to peak as it supports the sides (see Figure 9).

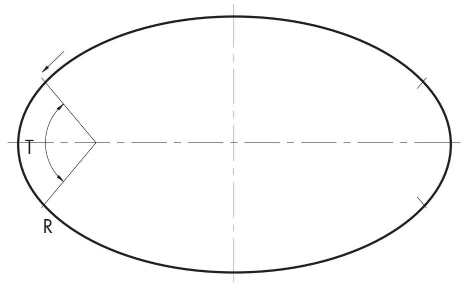


Figure 9

By contrast, pear and pear-arch shapes provide relatively high-rise structures. These shapes orient their sides at the derivable angle to the soil pressures (see Figure 10). Their smaller radius crowns are typically heavy gauge to provide the necessary restraint at the top.

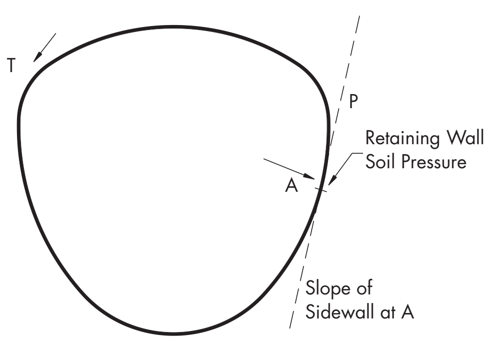
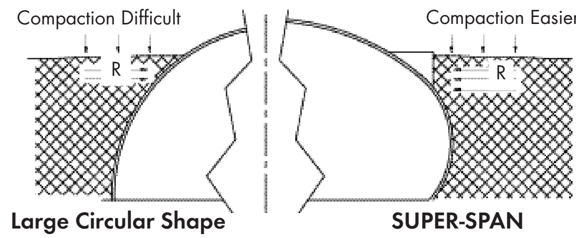


Figure 10

The thrust beam is the key element to SUPER-SPAN and SUPER-PLATE success. Besides providing perfect backfill in the important area above the spring line, it acts as a floating footing for the critical large radius top arch of the structure. It fixes the end of the arch, stiffening it and reducing deflection as backfill goes over the top.

Thrust Beam Function



With the shape on the left, it is difficult to obtain adequate compaction of the backfill at the critical 3/4 rise point.

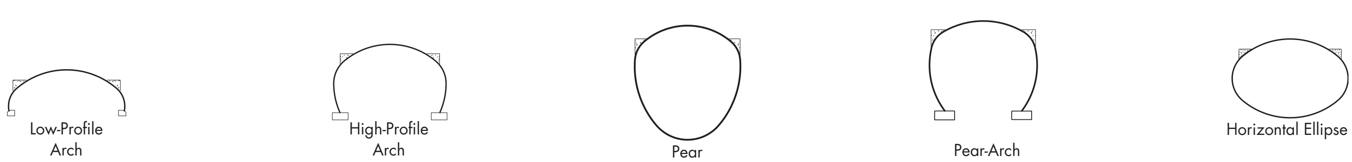
Compare it to the SUPER-SPAN on the right. Excellent compaction* and a high restraining force (R) is readily obtained against the vertical surface of the thrust beam. Force (R) acts on the vertical surface to prevent significant horizontal movement on the pipe wall at the 3/4 rise point under dead and live loads.

*See Backfilling and Backfill material on Design Details on page 81.

The thrust beam also provides a solid vertical surface that is easy to backfill against to obtain excellent compaction*. After installation, the beam effectively controls possible horizontal spreading of the top arch.

SUPER-SPAN and SUPER-PLATE structures, by means of their shape and thrust beams (which reduce the central angle of the effective top arch to 80 degrees) have added stability against deflection and snap-through buckling. They can be economically designed and installed within recognized AASHTO/AISI critical stresses and seam strength limits.

Horizontal reinforcement bars are tied to CONTECH bent and threaded rods to provide reinforcement for the concrete thrust beam



Standard Shapes

Structural design

Table 53
Minimum Thickness — Mininum Cover Table, Ft. H-20, HS-20, H-25, HS-25 Live Load

Top Radius R_T, Ft.	Wall Thickness, In. 0.111″ (12)	0.138″ (10)	0.168″ or 0.188″ (8 or 7)	0.218″ (5)	0.249″ (3)	0.280″ (1)
15′	2.5′	2.5′	2.5′	2.0′	2.0′	2.0′
15′-17′		3.0′	3.0′	2.5′	2.0′	2.0′
17′-20′			3.0′	2.5′	2.5′	2.5′
20′-23′				3.0′	3.0′	3.0′
23′-25′					4.0′	4.0′

Notes
1. Designs listed are for steel 6″ x 2″ corrugation only. For aluminum 9″ x $2^1/_2$″ corrugation design, please contact your local CONTECH representative.
2. Heights of cover for highway live loads given are to top of concrete pavement or bottom of flexible pavement.
3. Minimum covers for E 80 live loads are approximately twice those for HS 20. However, E 80 minimums must be established for individual applications.
4. Minimum covers for construction loads and similar heavy wheel loads must be established for individual applications.
5. The table assumes a granular backfill over the crown of the structure to the full minimum cover depth (height) compacted to not less than 90 percent AASHTO T180 density.
6. Call a CONTECH representative for Pear shape gauges.

A SUPER-SPAN or SUPER-PLATE structure is essentially an engineering combination of steel and soil. Maximum fill heights are calculated on the basis of A.A.S.H.T.O./AISI design methods using top radius to calculate ring compression (thrust=pressure x R_T) with allowable wall stress of 16,500 psi. In the design method, AISI requires a seam strength safety factor of two, while A.A.S.H.T.O. requires a seam strength safety factor of three.

In accordance with A.A.S.H.T.O., buckling and flexibility factors are not calculated. These factors are covered by the minimum thickness/minimum cover table on this page and special geometry limitations spelled out by A.A.S.H.T.O.

Shallow fill

Minimum designs are shown in Table 53. Ordinarily, shallow cover structures will be at the minimum (shown in the tables) thickness required for installation and to prevent against buckling. Wall stresses can be checked in deep cover applications by adding the soil load to the appropriate live load.

When adding the total live load over the structure, it is necessary to distribute it over an appropriate area of the structure which varies with the fill height.

Special designs

Structure sizes shown in Tables 55 through 61 are standard shapes. Intermediate or larger sizes are available. These special sizes also are designed in accordance with the A.A.S.H.T.O. design method.

Minimum covers shown in Table 53 are based on standard construction. Somewhat lower covers are possible with special measures such as using concrete relieving slabs. Special designs are also available for fill heights exceeding the normal limitations of standard structures. Your CONTECH representative can provide information on special requirements.

Foundation

The foundation under the structure and sidefill zones must be evaluated by the design engineer to ensure adequate bearing capacity. Differential settlement between the structure and sidefill must be minimal.

Hydraulic design

The most commonly used SUPER-SPAN and SUPER-PLATE hydraulic shapes are the horizontal ellipse, the low-profile arch, and the high-profile arch. Hydraulic data for these shapes are presented in tabular and graphical form in the current edition of the Handbook of Steel Drainage and Highway Construction Products. Standard procedures are presented in the Hydraulics chapter of the handbook to determine the headwater depth required for a given flow through these structures under both inlet and outlet control conditions.

In addition, the hydraulic design series of publications from FHWA offers guidance regarding hydraulic capacity of these structures.

Installation precautions

During the installation and prior to the construction of permanent erosion control and end-treatment protection, special precautions may be necessary. The structure must be protected from unbalanced loads and from any structural loads or hydraulic forces that might bend or distort the unsupported ends of the structure. Erosion wash out of previously placed soil support must be prevented to ensure that the structure maintains its load capacity.

CONTECH SUPER-SPAN structures have proven both practical and economical to construct in a wide range of applications and conditions. Nevertheless, there are basic rules of installation that must be obeyed to ensure acceptable performance.

Comprehensive installation and inspection standards are furnished with every SUPER-SPAN purchase. These documents should be studied thoroughly by the contractor and engineer. The following material highlights the key elements involved in the proper construction of a CONTECH SUPER-SPAN.

Excavation, foundation and bedding

There must be adequate distance between the SUPER-SPAN and questionable native soils. Bedding must be preshaped for structures with inverts. A loose soil cushion should be provided for the bottom plates. Base channels for arches must be square to the centerline on arch structures.

Erection

Plates can be placed either one at a time or in preassembled units of two or more plates in a ring.

All bolts in a newly hung plate or assembly should be tightened before adding the next unit above it. This should be done only with the plates in proper relation to each other for correct curvature and alignment in the structure. It may be necessary to use cables, props, or jigs to keep the plates in position during tightening.

The structure cross-section must be checked regularly during assembly. Its shape must be symmetrical, with the plates forming smooth, continuous curves. Longitudinal seams should be tight and plate ends should be parallel to each other.

Backfilling

SUPER-SPANs are flexible structures, therefore care is required during the placement and compaction of backfill. An effective system to monitor the structure during the backfilling process must be established.

Select an approved structure backfill material for the zone around the SUPER-SPAN. Establish soil density curves and determine proper frequencies and procedures for testing. The equipment used to place and compact fill around and over the structure should be selected based on the quality of the backfill and the shape of the SUPER-SPAN. Such plans should be verified in the initial backfilling stages.

Use only backfilling methods and equipment that obtain specified density without excessive movement or deformation of the structure.

Backfill material

CONTECH's specification for backfill material contains the following as listed in the A.A.S.H.T.O. Bridge Specification:

1. Granular type soils shall be used as structure backfill (the envelope next to the metal structure). Well-graded sand and gravel that is sharp, rough, and angular is preferred.
   Approved stabilized soil shall be used only under direct supervision of a competent, experienced soils engineer. Plastic or cohesive soils should not be used.
2. The structure backfill material shall conform to one of the following soil classifications from A.A.S.H.T.O. Specification M145, Table 2; for height of fill less than 12 feet, A-1, A-2-4 and A-2-5; for height of fill of 12 feet and more and all pear or pear-arch structures, A-1. Structure backfill shall be placed and compacted to not less than 90 percent density, per A.A.S.H.T.O. T 180.
3. The extent of the select structural backfill outside the maximum span is dependent on the quality of the adjacent embankment, loading and shape of the structure. It may be necessary to excavate native soil at the sides to provide an adequate width needed for compaction. For ordinary installations with a good quality, well-compacted embankment or in situ soil adjacent to the structure backfill, a minimum width of structural backfill six feet beyond the structure is usually required. The engineer must evaluate the in situ conditions to ensure adequate bearing capacity. The structure backfill shall extend to the minimum cover elevation (Table 53—page 80) above the structure.

Monitoring Backfill

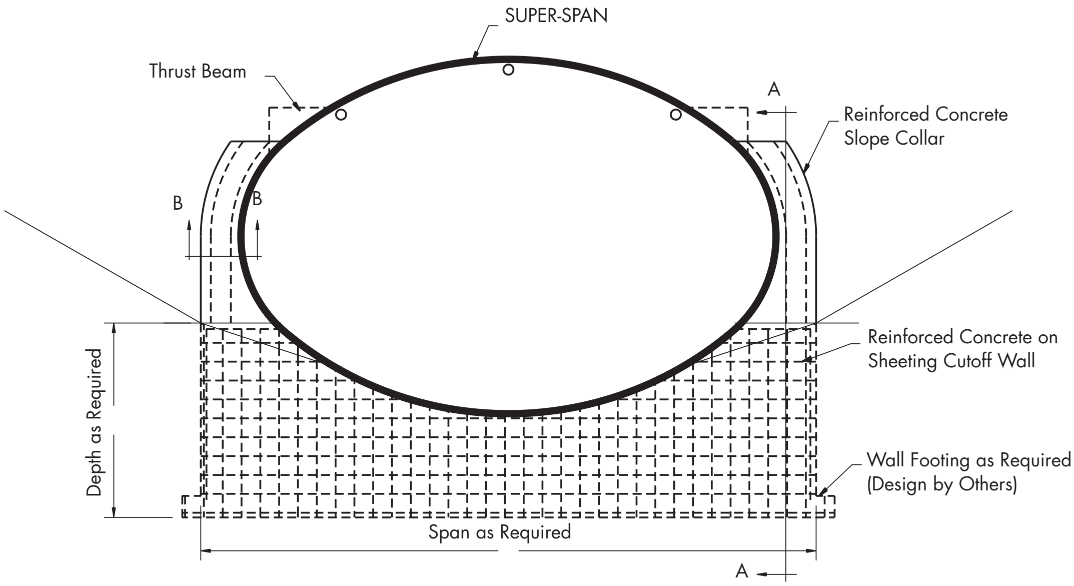
Regular monitoring is required during backfilling to assure a structure with a proper shape and that compaction levels are achieved. A CONTECH technician will confirm the structure's shape before backfilling, then monitor the shape and verify compaction readings until the backfill reaches the minimum cover level.

Special requirements

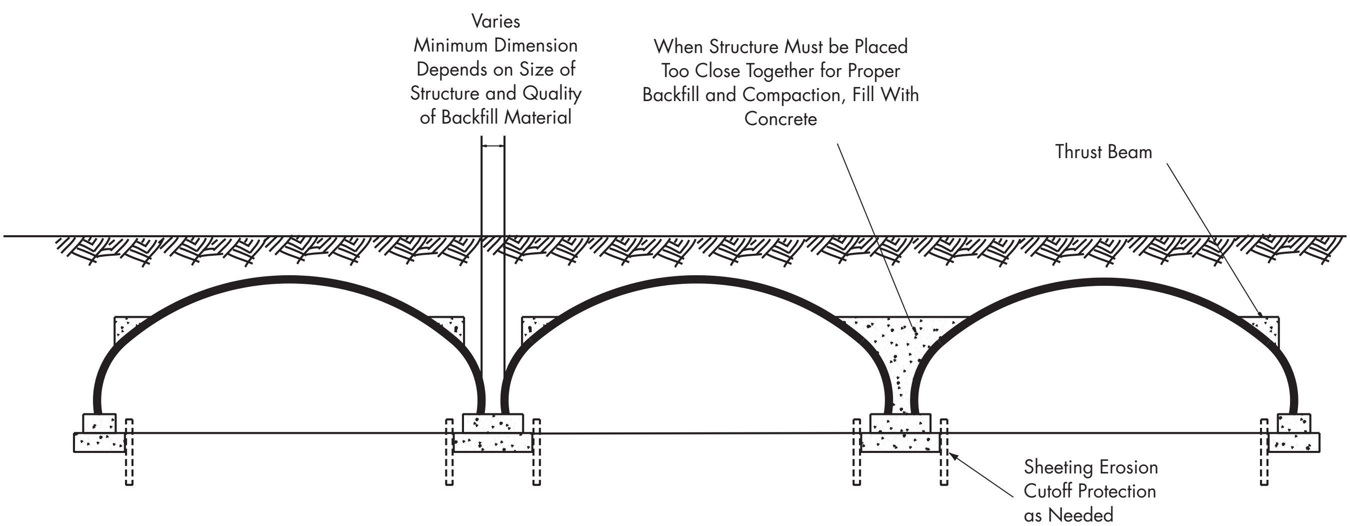
Very large or high structures sometimes call for additional special provisions for shape control during backfilling.

The minimum stiffness requirements for some structures shown in Table 53 on Page 80 may need to be augmented by increased design stiffness or mandatory top loading. Top loading requires the placement of a modest blanket of soil on the crown when backfill is approximately at the springline height.

Conceptual drawings[1]



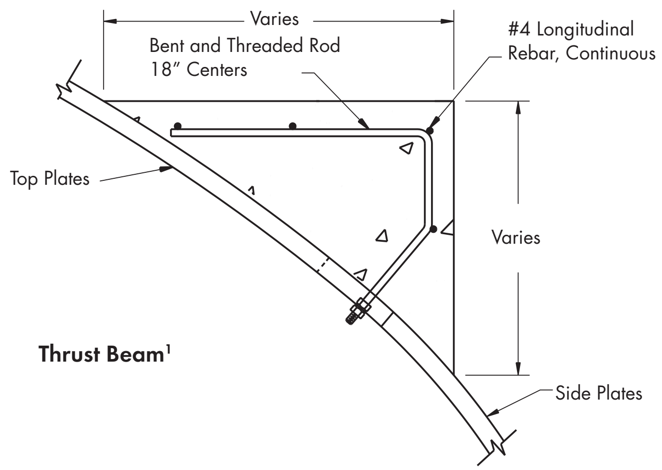
End Elevation Typical Step-Beveled End with Cutoff Wall and Slope Collar



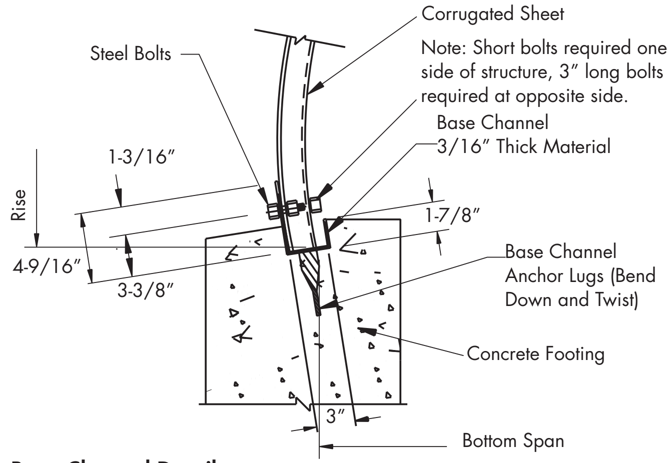
Typical Multiple Span Low Profile Arches

Note:
1. Many of the details shown are conceptual. The designer should work with the CONTECH representative on each particular application.

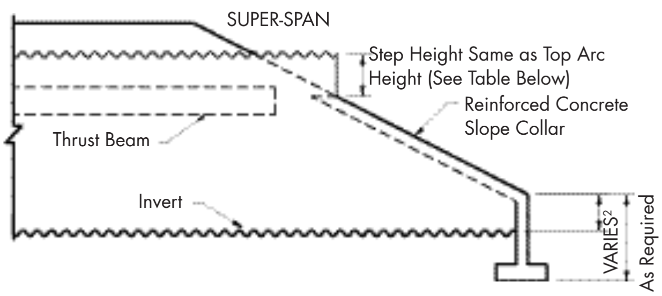
Conceptual drawings[1]



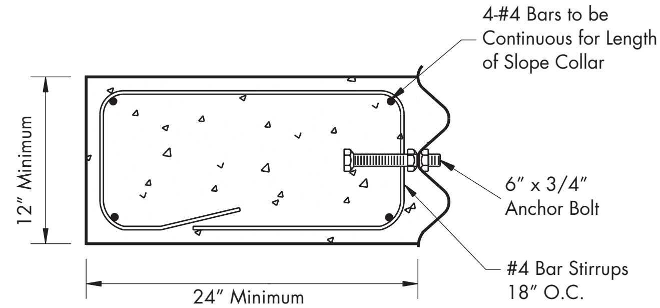
Thrust Beam[1]



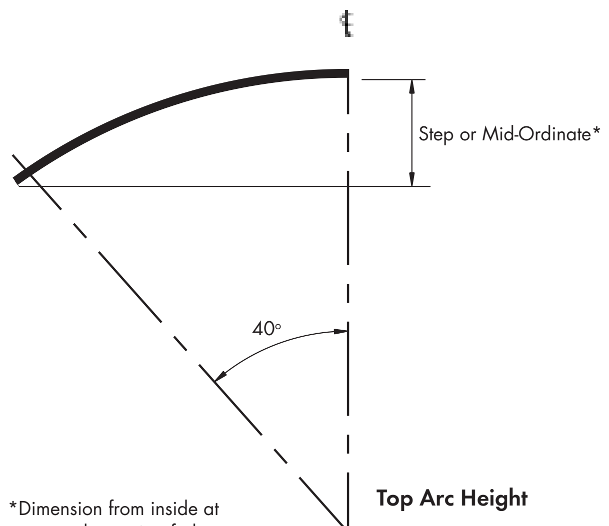
Base Channel Detail



Section A-A



Section B-B
Typical Slope Collar[1]



Top Arc Height

*Dimension from inside at crown to lower tip of plate as shown

Notes

1. Many of the details are conceptual. The designer should work with the CONTECH representative on each particular application.
2. Top and bottom steps are the same for ellipse shapes.

Table 54. Typical Top Step Dimensions

Top or Bottom Arc. in Pi	Step or Mid-Ordinate
60	2′-10″
63	2′-11″
66	3′-1″
69	3′-3″
72	3′-4″
75	3′-6″
78	3′-7″
81	3′-9″
84	3′-11″
87	4′-0″
90	4′-2″
93	4′-3″
96	4′-5″
99	4′-7″
102	4′-8″
105	4′-10″
108	4′-11″
111	5′-1″
114	5′-3″
117	5′-4″
120	5′-6″
123	5′-8″
126	5′-9″
129	5′-11″
132	6′-0″

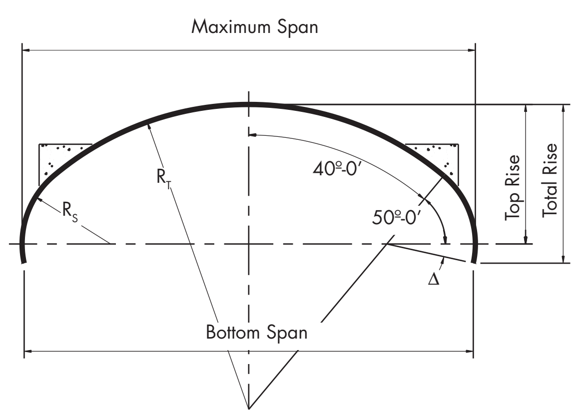
(applies only to structures with 80° top arc)

Galvanized Steel 6″ x 2″ Corrugation

Table 55. TYPICAL LOW PROFILE ARCH SHAPES
(All Dimensions to Inside Crests)

Structure Number	Maximum Span	Bottom Span	Total Rise	Top Rise	Top Radius R_T	Side Radius R_S	Angle Below Horizontal Δ	Approx. Area (Sq. Ft.)	Shape Factor R_T/R_S
69A15	19′-5″	19′-2″	6′-9″	5′-10″	13′-1″	3′-7″	15º-36′	105	3.60
69A18	20′-1″	19′-10″	7′-6″	6′-6″	13′-1″	4′-6″	12º-28′	120	2.91
75A18	21′-6″	21′-4″	7′-9″	6′-9″	14′-3″	4′-6″	12º-28′	133	3.13
78A18	22′-3″	22′-1″	7′-11″	6′-11″	14′-10″	4′-6″	12º-28′	140	3.25
81A18	23′-0″	22′-9″	8′-1″	7′-1″	15′-5″	4′-6″	12º-28′	147	3.38
84A18	23′-9″	23′-6″	8′-2″	7′-2″	16′-0″	4′-6″	12º-28′	154	3.50
87A18	24′-6″	24′-3″	8′-3″	7′-4″	16′-6″	4′-6″	12º-28′	161	3.63
90A18	25′-2″	25′-0″	8′-5″	7′-5″	17′-1″	4′-6″	12º-28′	168	3.75
93A18	25′-11″	25′-9″	8′-7″	7′-7″	17′-8″	4′-6″	12º-28′	176	3.88
93A24	27′-3″	27′-1″	10′-0″	9′-0″	17′-8″	6′-4″	8º-55′	217	2.77
99A21	28′-1″	27′-11″	9′-6″	8′-7″	18′10″	5′-5″	10º-24′	212	3.48
99A24	28′-9″	28′-7″	10′-3″	9′-3″	18′-10″	6′-4″	8º-55′	234	2.95
102A21	28′-10″	28′-8″	9′-8″	8′-8″	19′-5″	5′-5″	10º-24′	220	3.54
108A21	30′-3″	30′-1″	9′-11″	8′-11″	20′-7″	5′-5″	10º-24′	237	3.76
108A24	30′-11″	30′-9″	10′-8″	9′-8″	20′-7″	6′-4″	8º-55′	261	3.22
108A30	31′-7″	31′-2″	12′-1″	10′-4″	20′-7″	7′-3″	14º-03′	309	2.82
111A21	31′-0″	30′10″	10′-1″	9′-1″	21′-1″	5′-5″	10º-24′	246	3.85
111A30	32′-4″	31′-11″	12′-3″	10′-6″	21′-1″	7′-3″	14º-03′	319	2.89
114A21	31′-9″	31′-7″	10′-2″	9′-3″	21′-8″	5′-5″	10º-24′	255	3.96
114A30	33′-1″	32′-7″	12′-5″	10′-8″	21′-8″	7′-3″	14º-03′	330	2.97
117A24	33′-2″	33′-0″	11′-1″	10′-1″	22′-3″	6′-4″	8º-55′	289	3.49
117A33	34′-5″	34′-1″	13′-3″	11′-6″	22′-3″	8′-2″	12º-29′	367	2.71
123A24	34′-7″	34′-6″	11′-4″	10′-4″	23′-5″	6′-4″	8º-55′	308	3.67
123A42	37′-11″	37′-7″	15′-7″	13′-10″	23′-5″	10′-11″	9º-22′	477	2.14
126A24	35′-4″	35′-2″	11′-5″	10′-6″	24′-0″	6′-4″	8º-55′	318	3.76
126A42	38′-8″	38′-4″	15′-9″	14′-0″	24′-0″	10′-11″	9º-22′	490	2.28
129A30	37′-10″	37′-9″	12′-11″	12′-5″	24′-7″	8′-9″	3º-10′	383	2.81
129A36	39′-4″	39′-4″	14′-4″	14′-1″	24′-7″	10′-10″	1º-25′	441	2.27
*138A30	*39′-8″	39′-7″	13′-5″	12′-6″	26′-3″	8′-3″	6º-22′	417	3.18
*138A39	*42′-3″	42′-3″	15′-5″	15′-3″	26′-3″	11′-11″	0º-36′	510	2.20
*144A51	*45′-0″	44′-9″	18′-8″	16′-11″	27′-5″	13′-8″	7º-30′	675	2.00

Note: Other sizes are available for special designs.
* Structures require ring beams on the crown plates per A.A.S.H.T.O. Section 12.



End View – Low Profile Arch

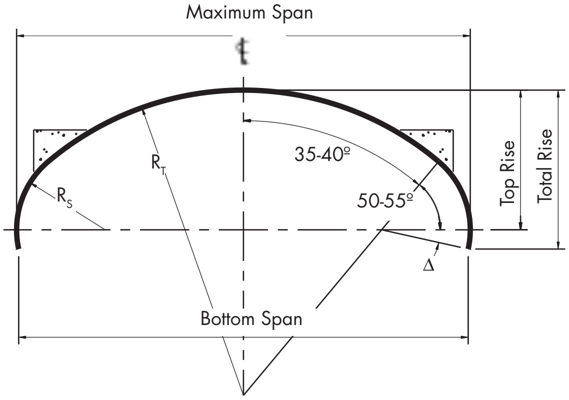
Galvanized Steel 6" x 2" Corrugation

Table 56. SPECIAL LOW-RISE SHAPES[1]
(All Dimensions to Inside Crests)

Structure Number	Maximum Span	Bottom Span	Total Rise	Top Rise	Top Radius R_T	Side Radius R_S	Angle Below Horizontal	Approx. Area (Sq. Ft.)	Shape Factor R_T/R_S
69A15-NS	20'-8"	20'-8"	6'-3"	6'-1.5"	14'-10"	4'-2"	1º-56'	101	3.56
78A15-NS	22'-8"	22'-8"	6'-8"	6'-3.5"	16'-8"	3'-11"	5º-43'	119	4.26
84A15-NS	24'-5"	24'-5"	6'-11"	6'-9"	18'-0"	4'-2"	2º-05'	130	4.32
87A15-S	24'-6"	24'-6"	7'-6"	7'-4.5"	16'-6"	4'-7"	1º-32'	142	3.61
93A15-S	26'-0"	26'-0"	7'-9"	7'-7.5"	17'-8"	4'-7"	1º-32'	155	3.86
99A15-S	27'-6"	27'-6"	8'-0"	7'-11"	18'-10"	4'-7"	1º-32'	169	4.11
108A15-S	29'-9"	29'-9"	8'-5"	8'-4"	20'-7"	4'-8"	0º-38'	191	4.40
105A21-NS	30'-9"	30'-9"	9'-1"	8'-7"	22'-9"	5'-5"	5º-32'	220	4.20
111A18-S	31'-1"	31'-1"	9'-3"	9'-1.5"	21'-1"	5'-6"	1º-17'	221	3.84
117A18-S	32'-7"	32'-7"	9'-7"	9'-5"	22'-3"	5'-6"	1º-17'	238	4.05
123A18-S	34'-0"	34'-0"	9'-10"	9'-8"	23'-5"	5'-6"	1º-17'	255	4.26
129A18-S	35'-7"	35'-7"	10'-1"	10'-0"	24'-7"	5'-7"	0º-32'	273	4.40
129A21S	36'-2"	36'-2"	10'-9"	10'-8"	24'-7"	6'-5"	1º-07'	299	3.83

[1]Due to their high shape factor, cover heights are generally limited to 8' or less. Backfill material typically must meet A.A.S.H.T.O. M145 requirements for A-1 materials or consist of cementatious grout, CLSM, or cement stabilized sand. Other backfill materials may be acceptable, depending upon the structure selected and the actual cover height.

Note: Other sizes are available for special designs.



End View – Special Low Profile Arch

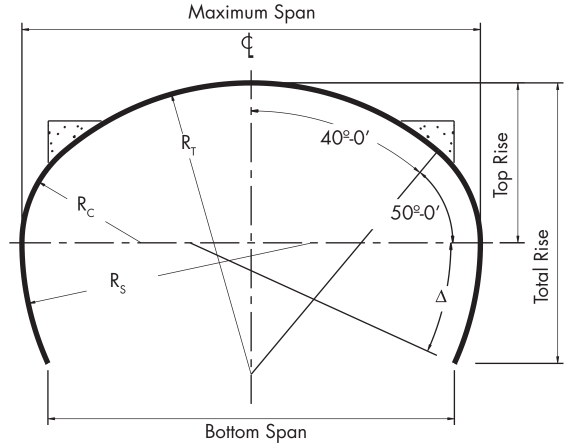
SUPER-SPAN/SUPER-PLATE

Galvanized Steel 6" x 2" Corrugation **SUPER-SPAN**

Table 57. TYPICAL HIGH PROFILE ARCH SHAPES
(All Dimensions to Inside Crests)

Structure Number	Maximum Span	Bottom Span	Total Rise	Top Rise	Top Radius R_T	Upper Side Radius R_C	Lower Side Radius R_S	Angle Below Horizontal Δ	Approx. Area (Sq. Ft.)	Shape Factor R_T/R_C
69A15-9	20′-1″	19′-7″	9′-1″	6′-6″	13′-1″	4′-6″	13′-1″	11º-18′	152	2.91
69A18-18	20′8″	18′-10″	12′-1″	7′-3″	13′-1″	5′-5″	13′-1″	21º-44′	214	2.40
75A15-18	21′-6″	19′-10″	11′-8″	6′-9″	14′-3″	4′-6″	14′-3″	20º-0′	215	3.13
75A21-24	22′-10″	19′10″	14′-6″	8′-2″	14′-3″	6′-4″	14′-3″	26º-24′	284	2.24
78A15-18	22′-3″	20′-7″	11′-10″	6′-11″	14′-10″	4′-6″	14′-10″	19º-13′	224	3.25
78A18-15	22′-11″	21′-9″	11′-9″	7′-8″	14′-10″	5′-5″	14′-10″	16º-09′	228	2.73
78A18-24	22′-11″	20′-1″	14′-0″	7′-7″	14′-10″	5′-5″	14′-10″	25º-23′	275	2.71
81A15-18	23′-0″	21′-5″	11′-11″	7′-1″	15′-5″	4′-6″	15′-5″	18º-31′	234	3.38
81A18-15	23′-8″	22′-6″	11′-10″	7′-9″	15′-5″	5′-5″	15′-5″	15º-33′	238	2.84
81A21-24	24′-4″	21′-7″	14′-10″	8′-5″	15′-5″	6′-4″	15′-5″	24º-26′	309	2.41
84A15-18	23′-9″	22′-2″	12′-1″	7′-2″	16′-0″	4′-6″	16′-0″	17º-51′	244	3.50
84A18-15	24′-5″	23′-4″	12′-0″	7′-11″	16′-0″	5′-5″	16′-0″	14º-57′	248	2.95
87A15-24	24′-6″	21′-11″	13′-9″	7′-4″	16′-6″	4′-6″	16′-6″	22º-45′	288	3.63
87A21-15	25′-9″	24′-9″	12′-10″	8′-9″	16′-6″	6′-4″	16′-6″	14º-29′	280	2.61
87A21-24	25′-9″	23′-2″	15′-1″	8′-9″	16′-6″	6′-4″	16′-6″	22º-45′	334	2.59
90A15-21	25′-2″	23′-3″	13′-1″	7′-5″	17′-1″	4′-6″	17′-1″	19º-20′	283	3.75
90A21-15	26′-6″	25′-6″	13′-0″	8′-10″	17′-1″	6′-4″	17′-1″	13º-59′	290	2.70
90A21-24	26′-6″	24′-0″	15′-3″	8′-10″	17′-1″	6′-4″	17′-1″	22º-0′	347	2.68
93A15-21	25′-11″	24′-1″	13′-3″	7′-7″	17′-8″	4′-6″	17′-8″	18º-42′	294	3.88
93A21-15	27′-3″	26′-3″	13′-2″	9′-0″	17′-8″	6′-4″	17′-8″	13º-32′	301	2.79
93A21-24	27′-3″	24′-10″	15′-5″	9′-0″	17′-8″	6′-4″	17′-8″	21º-17′	360	2.77
99A15-21	27′-5″	25′-8″	13′-6″	7′-10″	18′-10″	4′-6″	18′-10″	17º-34′	317	4.13
99A21-15	28′-9″	27′-10″	13′-5″	9′-3″	18′-10″	6′-4″	18′-10″	12º-43′	323	2.97
99A24-24	29′-5″	27′-1″	16′-5″	9′-11″	18′-10″	7′-3″	18′-10″	20º-0′	412	2.58

Note: Other sizes are available for special designs.



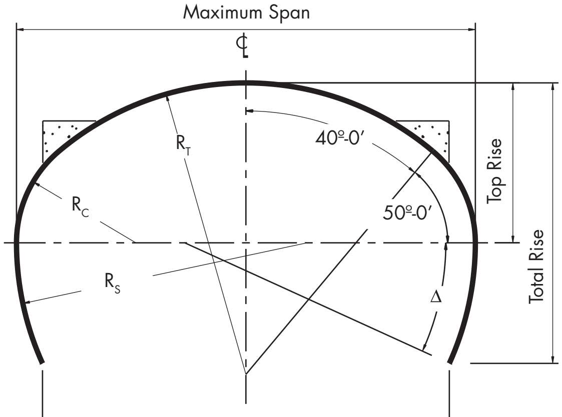
End View – High Profile Arch

Table 58. TYPICAL HIGH PROFILE ARCH SHAPES (All Dimensions to Inside Crests)

Structure Number	Maximum Span	Bottom Span	Total Rise	Top Rise	Top Radius R_T	Upper Side Radius R_C	Lower Side Radius R_S	Angle Below Horizontal Δ	Approx. Area (Sq. Ft.)	Shape Factor R_T/R_C
102A15-24	28′-2″	25′-11″	14′-5″	8′-0″	19′-5″	4′-6″	19′-5″	19º-24′	348	4.25
102A24-15	30′-1″	29′-3″	14′-3″	10′-1″	19′-5″	7′-3″	19′-5″	12º-21′	360	2.68
102A24-30	30′-1″	26′-9″	18′-0″	10′-1″	19′-5″	7′-3″	19′-5″	24º-07′	466	2.66
108A18-24	30′-3″	28′-2″	15′-5″	8′-11″	20′-7″	5′-5″	20′-7″	18º-20′	399	3.75
108A24-18	31′-7″	30′-5″	15′-3″	10′-4″	20′-7″	7′-3″	20′-7″	13º-51′	408	2.83
108A24-30	31′-7″	28′-5″	18′-4″	10′-4″	20′-7″	7′-3″	20′-7″	22º-46′	496	2.82
111A18-24	31′-0″	29′-0″	15′-7″	9′-1″	21′-1″	5′-5″	21′-1″	17º-50′	412	3.85
111A21-30	31′-8″	28′-7″	17′-9″	9′-10″	21′-1″	6′-4″	21′-1″	22º-09′	483	3.31
111A24-18	32′-4″	31′-2″	15′-5″	10′-6″	21′-1″	7′-3″	21′-1″	13º-31′	420	2.91
†111A24-36	32′-4″	27′-11″	19′-11″	10′-6″	21′-1″	7′-3″	21′-1″	26º-29′	553	2.89
114A18-30	31′-9″	28′-8″	17′-2″	9′-3″	21′-8″	5′-5″	21′-8″	21º-34′	469	3.96
114A30-18	34′-4″	33′-3″	17′-0″	12′-0″	21′-8″	9′-1″	21′-8″	13º-09′	490	2.39
†114A24-36	33′-1″	28′-9″	20′-1″	10′-8″	21′-8″	7′-3″	21′-8″	25º-47′	570	2.97
117A18-30	32′-6″	29′-6″	17′-4″	9′-4″	22′-3″	5′-5″	22′-3″	21º-01′	484	4.06
117A30-18	35′-1″	34′-0″	17′-1″	12′-2″	22′-3″	9′-1″	22′-3″	12º-49′	504	2.45
†117A24-36	33′-10″	29′-7″	20′-3″	10′-9″	22′-3″	7′-3″	22′-3″	25º-07′	587	3.05
123A18-30	34′-0″	31′-2″	17′-8″	9′-8″	23′-5″	5′-5″	23′-5″	20º-0′	513	4.27
123A30-18	36′-7″	35′-6″	17′-4″	12′-5″	23′-5″	9′-1″	23′-5″	12º-11′	533	2.58
†123A21-36	34′-7″	30′-7″	19′-10″	10′-4″	23′-5″	6′-4″	23′-5″	23º-54′	590	3.67
126A18-30	34′-8″	31′-11″	17′-9″	9′-9″	24′-0″	5′-5″	24′-0″	19º-31′	528	4.38
126A30-18	37′-4″	36′-3″	17′-6″	12′-7″	24′-0″	9′-1″	24′-0″	11º-54′	547	2.64
†126A21-36	35′-4″	31′-5″	20′-0″	10′-6″	24′-0″	6′-4″	24′-0″	23º-20′	607	3.76

† Very large or high structures sometimes call for additional special provisions for shape control during backfill.

Note: Other sizes are available for special designs.



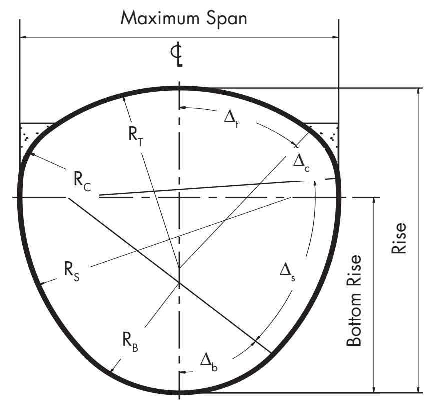
End View – High Profile Arch

Galvanized Steel 6″ x 2″ Corrugation **SUPER-SPAN**

Table 59. TYPICAL PEAR SHAPES
(All Dimensions to Inside Crests)

Structure Number	Maximum Span	Total Rise	Bottom Rise	Top Radius R_T	Δ_t	Corner Radius R_C	Δ_c	Side Radius R_S	Δ_s	Bottom Radius R_B	Δ_b	Approx. Area (Sq. Ft.)
75P15-72-45	23′-8″	25′-5″	14′-10″	14′-10″	38º-25′	6′-1″	37º-10′	16′-6″	66º-24′	9′-0″	38º-1′	477
66P21-66-60	24′-0″	25′-10″	15′-1″	16′-2″	31º-2′	7′-0″	45º-18′	17′-4″	57º-50′	9′-11″	45º-50′	497
81P21-60-63	25′-2″	26′-1″	16′-1″	15′-10″	38º-53′	6′-11″	45º-50′	18′-9″	48º-39′	10′-3″	46º-38′	517
81P15-75-54	24′-10″	27′-8″	16′-9″	15′-11″	38º-41′	5′-9″	39º-17′	19′-9″	57º-46′	9′-3″	44º-16′	544
*84P15-90-36	26′-7″	28′-4″	18′-1″	20′-11″	30º-34′	4′-9″	47º-25′	20′-2″	67º-47′	7′-11″	34º-14′	593
90P18-78-48	27′-6″	27′-8″	18′-0″	19′-11″	34º-22′	5′-6″	49º-16′	20′-3″	58º-31′	9′-7″	37º-51′	596
81P24-66-75	28′-1″	27′-9″	16′-9″	20′-5″	30º-11′	7′-3″	50º-0′	18′-10″	53º-16′	12′-3″	46º-33′	624
96P21-72-72	28′-6″	30′-8″	19′-8″	18′-2″	40º-11′	7′-0″	45º-18′	24′-3″	45º-13′	11′-1″	49º-18′	689
96P24-69-75	30′-0″	29′-8″	20′-1″	21′-10″	33º-28′	6′-7″	55º-0′	24′-2″	43º-29′	11′-10″	48º-3′	698
**102P21-72-78	29′-11″	31′-3″	20′-0″	19′-3″	40º-18′	7′-0″	45º-18′	24′-4″	45º-04′	12′-0″	49º-20′	738

*Meets A.R.E.M.A. clearances for bridges and turntables.
**Meets A.R.E.M.A. clearances for single track tunnel.
Note: Other sizes are available for special designs.



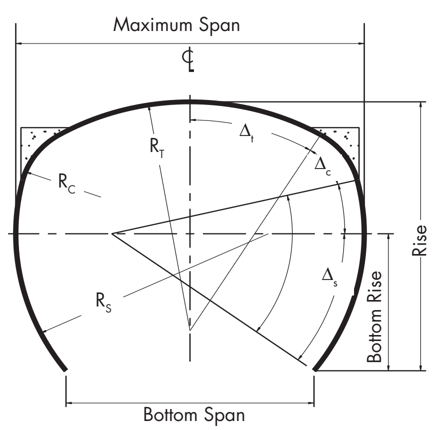
End View – Pear

Galvanized Steel 6″ x 2″ Corrugation **SUPER-SPAN**

Table 60. TYPICAL PEAR-ARCH SHAPES
(All Dimensions to Inside Crests)

Structure Number	Maximum Span	Bottom Span	Total Rise	Top Rise	Top Radius R_T	Δ_t	Corner Radius R_C	Δ_c	Side Radius R_S	Δ_s	Approx. Area (Sq. Ft.)
75PA15-66	23′-11″	16′-2″	23′-4″	11′-10″	14′-10″	38º-25′	6′-1″	37º-10′	20′-0″	50º-47′	480
78PA21-66	26′-4″	18′-5″	24′-9″	11′-11″	15′-5″	38º-27′	8′-6″	37º-23′	20′-0″	50º-47′	559
*81PA18-75	27′-3″	17′-9″	25′-6″	13′-8″	20′-0″	30º-49′	6′-0″	45º-13′	22′-0″	52º-24′	603
87PA21-69	29′-7″	21′-6″	24′-11″	12′-8″	22′-0″	30º-6′	6′-9″	46º-57′	22′-0″	48º-15′	645
**90PA21-72	30′-4″	21′-7″	25′-10″	13′-2″	22′-0″	31º-8′	7′-0″	45º-18′	22′-0″	50º-20′	683

*Meets A.R.E.M.A. clearances for bridges and turntables.
**Meets A.R.E.M.A. clearances for single track tunnel.
Note: Other sizes are available for special designs.



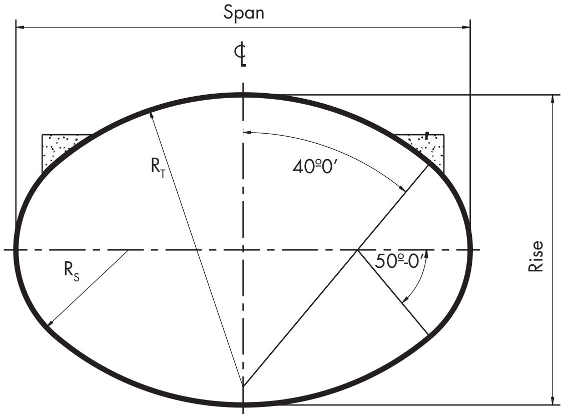
End View – Pear Arch

Table 61. TYPICAL HORIZONTAL ELLIPSE SHAPES (All Dimensions to Inside Crests)

Structure Number	Maximum Span	Total Rise	Top Radius R_T	Side Radius R_S	Approx. Area (Sq. Ft.)	Shape Factor R_T/R_S
66E30	19′-4″	12′-9″	12′-6″	4′-6″	191	2.78
69E30	20′-1″	13′-0″	13′-1″	4′-6″	202	2.90
72E24	20′-2″	11′-11″	13′-8″	3′-7″	183	3.81
75E24	20′-10″	12′-2″	14′-3″	3′-7″	194	3.97
69E39	21′-0″	15′-2″	13′-1″	5′-11″	248	2.21
78E27	21′-11″	13′-1″	14′-10″	4′-1″	221	3.63
75E39	22′-6″	15′-8″	14′-3″	5′-11″	274	2.40
81E30	23′-0″	14′-1″	15′-5″	4′-6″	249	3.42
78E39	23′-3″	15′-11″	14′-10″	5′-11″	288	2.50
81E42	24′-4″	16′-11″	15′-5″	6′-4″	320	2.43
87E30	24′-6″	14′-8″	16′-6″	4′-6″	274	3.66
90E30	25′-2″	14′-11″	17′-1″	4′-6″	287	3.79
87E39	25′-5″	16′-9″	16′-6″	5′-11″	330	2.79
87E45	26′-1″	18′-2″	16′-6″	6′-10″	369	2.42
93E33	26′-3″	15′-10″	17′-8″	5′-0″	320	3.53
96E33	27′-0″	16′-2″	18′-3″	5′-0″	334	3.65
90E48	27′-2″	19′-1″	17′-1″	7′-3″	405	2.35
93E48	27′-11″	19′-5″	17′-8″	7′-3″	421	2.43
99E36	28′-1″	17′-1″	18′-10″	5′-5″	369	3.47
102E36	28′-10″	17′-5″	19′-5″	5′-5″	384	3.58
99E48	29′-5″	19′-11″	18′-10″	7′-3″	455	2.59
102E48	30′-1″	20′-2″	19′-5″	7′-3″	472	2.67
108E36	30′-3″	17′-11″	20′-7″	5′-5″	415	3.75
105E51	31′-2″	21′-2″	20′-0″	7′-9″	513	2.58
111E39	31′-4″	18′-11″	21′-1″	5′-11″	454	3.56
114E39	32′-1″	19′-2″	21′-8″	5′-11″	471	3.66
108E54	32′-3″	22′-2″	20′-7″	8′-2″	555	2.52
111E54	33′-0″	22′-5″	21′-1″	8′-2″	574	2.58
117E42	33′-2″	20′-1″	22′-3″	6′-4″	512	3.51
114E57	34′-1″	23′-4″	21′-8″	8′-8″	619	2.50
123E42	34′-7″	20′-8″	23′-5″	6′-4″	548	3.69
123E45	34′-11″	21′-4″	23′-5″	6′-10″	574	3.42
†117E60	35′-1″	24′-4″	22′-3″	9′-1″	665	2.44
126E48	36′-0″	22′-4″	24′-0″	7′-3″	619	3.31
†132E45	37′-2″	22′-2″	25′-2″	6′-10″	631	3.68

† Very large or high structures sometimes call for additional special provisions for shape control during backfill.

Note: Other sizes are available for special designs.



End View – Horizontal Ellipse

SUPER-SPAN

Specification Galvanized Steel Long Span Structures — 6” x 2” Corrugation

General Description

The long span steel structural plate structure, conforming to the dimensions shown on the plans and specifications, shall be installed at the location designated. The design and installation shall conform to A.A.S.H.T.O. Standard Specifications for Highway Bridges, Division I, “Soil-Corrugated Metal Structure Interaction Systems”, Section 12.7, “Long Span Structural Plate Structures”, and Division II, Section 26, “Metal Culverts” and Division II, Section 8, “Concrete Structures.”

Materials

The galvanized steel structural plate shall have 6” x 2” corrugations and shall be of the gauge as shown on the plans. The plates shall be manufactured in conformance with A.A.S.H.T.O. Specification M 167. Bolts and nuts shall meet the provisions of ASTM A 449, Type 1 and ASTM A 563, Grade C, respectively. The steel anchor bolts shall conform to ASTM A-307, Grade A.

Longitudinal Structural Stiffeners (Thrust Beams)

Longitudinal stiffeners shall be located at the radius transition at the ends of the top arc. The thrust beams shall consist of reinforced concrete conforming to Division II, Section 8, Class B of the A.A.S.H.T.O. Standard Specifications for Highway Bridges having a minimum compression strength of 2400 psi. Reinforcing steel shall conform to ASTM A 615, Grade 40, having a minimum yield strength of 40,000 psi. Thrust beams shall be formed and poured conforming to the plan dimensions when the backfill reaches the bottom elevation of the thrust beams.

Design

The long span structure shall be designed in accordance with the latest A.A.S.H.T.O. design criteria and shall be required to incorporate the use of continuous longitudinal structural stiffeners (concrete thrust beams).

Structure Erection

The structure shall be erected in strict accordance with the manufacturer’s instructions and to the design shape shown on the plans. Plates shall be assembled according to plate assembly drawings supplied by the manufacturer.

Structural Backfill

Material

A granular type of material shall be used around and over the structure. This select structural backfill material shall conform to one of the following classifications of soil from A.A.S.H.T.O. Specification M-145, as modified in the following table for A-1, A-2-4 or A-2-5.

AASHTO M-145 - Table 62

GROUP CLASSIFICATION	A-1 A-1-a	A-1 A-1-b	A-2(Modified) A-2-4	A-2(Modified) A-2-5
Sieve Analysis, Percent Passing:				
No.10 (2.00 mm)	50 Max.	——	——	——
No. 40 (0.425 mm)	30 Max.	50 Max.	——	——
No. 100 (0.150 mm)	——	——	50 Max.	50 Max.
No. 200 (0.075 mm)	15 Max.	25 Max.	20 Max.	20 Max.
Characteristics of Fraction Passing No. 40 (0.425 mm)				
Liquid Limit	—		40 Max.	41 Min.
Plasticity Index	6 Max.		10 Max.	10 Max.
Usual Types of Significant Constituent Materials	Stone Fragments Gravel and Sand		Silty or Clayey Gravel and Sand	

* Modified to be more select than M-145.

Additional Requirements

1. Materials must be dense graded (open graded or gap graded materials are not allowed).
2. Fine beach sands, windblown sands, and stream deposited sands all of which exhibit fine, rounded particles and typically are classified by A.A.S.H.T.O. M-145 as A-3 materials are not allowed.
3. On site mixing or blending to achieve specified gradation is not allowed.

Maximum particle size shall not exceed 3 inches. For the A-2 materials, moisture content must be between -3% and +2% optimum as defined by A.A.S.H.T.O. T-180. All soil classifications are limited to the following height of cover limits and structure shape applications:

- A-1-a material is suitable for all long span shapes, sizes and fill heights.
- A-1-b material is suitable only for use with high profile arch and pear shape structures to a 12′ maximum fill height and for use with elliptical and low profile arch structures to a 20′ maximum fill height.
- A-2-4 and A-2-5 materials are restricted to maximum heights of cover of 12′. These materials are not allowed for use with pear, pear arch or high profile arches with more than 30 Pi in the side arc.

Other backfill materials which provide equivalent structural properties, long term, in the environmental conditions expected (saturation, freeze-thaw, etc.) may be used. Such materials shall be approved only after thorough investigation and testing by a soils engineer familiar with the requirements for structural backfill of long span structures.

Backfill Envelope Limits

The backfill envelope limits are as detailed on the plans.

Backfill Placement

Before backfilling, the erected structure shall meet the tolerance and symmetry requirements of A.A.S.H.T.O. and the manufacturer.

Approved backfill material shall be placed in horizontal, uniform layers not exceeding 8" in thickness, before compaction, and shall be brought up uniformly on both sides of the structure. Each layer of backfill shall be compacted to a relative density of not less than 90%, modified proctor per A.A.S.H.T.O. Test Method No. T-180. Field density tests of compacted backfill will be made at regular intervals during backfill.

Long span structures, due to their size and shape, are sensitive to the types and weights of equipment used to place and compact the select backfill material. This is especially critical in the areas immediately adjacent to and above the structure. Therefore, equipment types will be restricted in those critical zones. Compaction equipment or methods that produce horizontal or vertical earth pressures which cause excessive distortion or damage to structures shall not be used. Contractors should plan to have a D4 (approximately 20,000 lbs.) or similar weight tracked dozer to place and grade backfill immediately alongside and above the structure until minimum cover level is reached. Lightweight vibratory plate or roller type compaction equipment must be used to compact the backfill in these zones. Use of heavier equipment and/or rubber tired equipment such as scrapers, graders, and front end loaders will likely be prohibited inside the select fill envelope zone until appropriate minimum cover height has been obtained.

Shape Control Monitoring

CONTECH shall provide a Shape Control Technician who is a qualified representative of a professional soils engineering firm, or other qualified organization, to ensure a properly shaped structure. The Shape Control Technician shall take initial measurements of the erected structure before backfilling, observe all backfill materials and their placement, and record compaction densities. The Technician shall record all density readings and ensure they meet the requirements of the plans and specifications. However, in no case shall the relative densities be less than 90% per A.A.S.H.T.O. T-180. The Shape Control Technician shall monitor the structure shape during the placement of structural backfill to the minimum cover height over the structure. **No structural backfill shall be placed without the Shape Control Technician on site.**

The Shape Control Technician shall:

- Monitor the structure's shape throughout the backfilling operation and report shape change rates to the contractor.
- Contact the CONTECH representative immediately if there are problems in meeting the established tolerances.
- Have full authority to stop backfill work if necessary.

Preconstruction Conference

Prior to construction, a meeting will be held to review the construction procedures. A qualified representative of the manufacturer of the structure will be present to discuss methods and responsibility for shape monitoring and control, backfill material selection, testing and placement, and compaction methods and testing. A representative of the Engineer, Prime Contractor, and any involved sub-contractors must be present.

Alternate Structures

The Contractor may furnish an alternate structure to the long span shown on the plans and these specifications but the following conditions must be met:

1. The structure must be designed using the A.A.S.H.T.O. Long Span criteria and these plans and specifications. Steel structural plate shall conform to the requirements of A.A.S.H.T.O. M167. Aluminum alloy structural plate shall conform to the requirements of A.A.S.H.T.O. M219.
2. The corrugated metal plate thickness specified is considered the minimum acceptable for the structure(s) on this project based on structural and durability requirements. Any other structure, regardless of "special features", must be of the same thickness or greater.
3. "Special Features", such as hot rolled structural steel ribs, shall be hot-dip galvanized after fabrication per ASTM A 123. Ribs shall be placed across the top 180°, i.e., to the springline of all structures. Maximum rib spacing shall be two (2) feet. Ribs shall be placed over the same length of structure that the thrust beams would apply. No allowance for composite action between the rib and plate will be allowed. The combined moment of inertia of both plate and rib must satisfy the normal flexibility factor as shown in A.A.S.H.T.O. Division I, Section 12.6.1.4. The span in the formula for the flexibility factor shall be replaced by twice the top arc radius.
4. Alternate structures meeting the above criteria will only be considered for use if pre-approved in writing by the Engineer prior to the bid date. To qualify for pre-approval, an alternate submittal package must be submitted to the Engineer a minimum of 15 days prior to the bid date.
5. The material supplier shall be a qualified manufacturer of steel structural plate and long span structures with a minimum of 50 successful installations. The foundation, structural backfill and end treatment shall be as required herein and detailed on the plans.

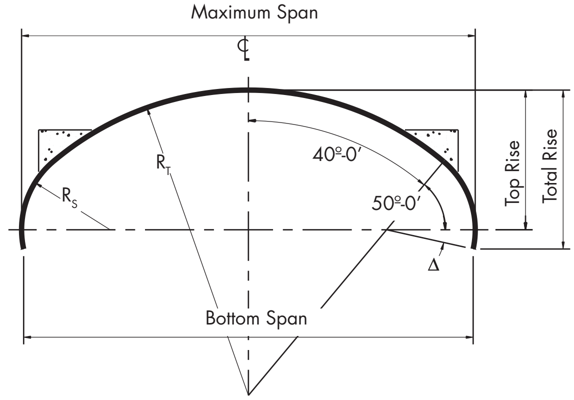
Aluminum 9" x 2-1/2" Corrugation **SUPER-PLATE**

Table 63. TYPICAL LOW PROFILE ARCH SHAPES[1]
(All Dimensions to Inside Crests)

Structure Number	Maximum Span	Bottom Span	Total Rise	Top Rise	Top Radius R_T	Side Radius R_S	Angle Below Horizontal Δ	Approx. Area (Sq. Ft.)	Shape Factor R_T/R_S
23A5	19′-5″	19′-2″	6′-9″	5′-10″	13′-1″	3′-7″	15º-23′	105	3.66
23A6	20′-1″	19′-10″	7′-6″	6′-6″	13′-1″	4′-6″	12º-21′	120	2.91
25A6	21′-7″	21′-4″	7′-9″	6′-9″	14′-3″	4′-6″	12º-21′	133	3.17
26A6	22′-3″	22′-1″	7′-11″	6′-11″	14′-10″	4′-6″	12º-21′	140	3.30
27A6	23′-0″	22′-10″	8′-0″	7′-1″	15′-5″	4′-6″	12º-21′	147	3.42
28A6	23′-9″	23′-7″	8′-2″	7′-2″	16′-0″	4′-6″	12º-21′	154	3.55
29A6	24′-6″	24′-3″	8′-3″	7′-4″	16′-7″	4′-6″	12º-21′	161	3.68
30A6	25′-3″	25′-0″	8′-5″	7′-5″	17′-2″	4′-6″	12º-21′	168	3.81
31A6	26′-0″	25′-9″	8′-7″	7′-7″	17′-8″	4′-6″	12º-21′	176	3.93
31A8	27′-3″	27′-2″	10′-0″	9′-0″	17′-8″	6′-4″	8º-52′	217	2.80
33A7	28′-1″	27′-11″	9′-6″	8′-7″	18′10″	5′-5″	10º-19′	212	3.48
33A8	28′-9″	28′-7″	10′-3″	9′-3″	18′-10″	6′-4″	8º-52′	234	2.98
34A7	28′-10″	28′-8″	9′-8″	8′-8″	19′-5″	5′-5″	10º-19′	220	3.59
36A7	30′-4″	30′-2″	9′-11″	9′-0″	20′-7″	5′-5″	10º-19′	237	3.80
36A8	31′-0″	30′-10″	10′-8″	9′-8″	20′-7″	6′-4″	8º-52′	261	3.25
36A10	31′-8″	31′-2″	12′-2″	10′-4″	20′-7″	7′-3″	14º-02′	309	2.84
37A7	31′-1″	30′11″	10′-1″	9′-1″	21′-2″	5′-5″	10º-19′	246	3.90
37A10	32′-4″	31′-11″	12′-3″	10′-6″	21′-2″	7′-3″	14º-02′	320	2.92
38A7	31′-10″	31′-7″	10′-2″	9′-3″	21′-9″	5′-5″	10º-19′	255	4.01
38A10	33′-1″	32′-8″	12′-5″	10′-8″	21′-9″	7′-3″	14º-02′	330	3.00
39A8	33′-2″	33′-0″	11′-1″	10′-1″	22′-4″	6′-4″	8º-52′	289	3.52
39A11	34′-6″	34′-1″	13′-3″	11′-6″	22′-4″	8′-2″	12º-29′	368	2.73
41A8	34′-8″	34′-6″	11′-4″	10′-4″	23′-5″	6′-4″	8º-52′	308	3.70
41A14	37′-11″	37′-8″	15′-8″	13′-10″	23′-5″	10′-11″	9º-24′	478	2.15
42A8	35′-5″	35′-3″	11′-5″	10′-6″	24′-0″	6′-4″	8º-52′	318	3.79
42A14	38′-8″	38′-5″	15′-9″	14′-0″	24′-0″	10′-11″	9º-24′	491	2.20

Note: Other sizes are available for special designs.

[1] The design table on page 80 of the catalog is for steel 6″ x 2″ corrugation only, for aluminum 9″ x 2-1/2″ corrugation design, please call your local CONTECH representative. Reinforcing ribs may be required. Rib length will be determined.



End View – Low Profile Arch

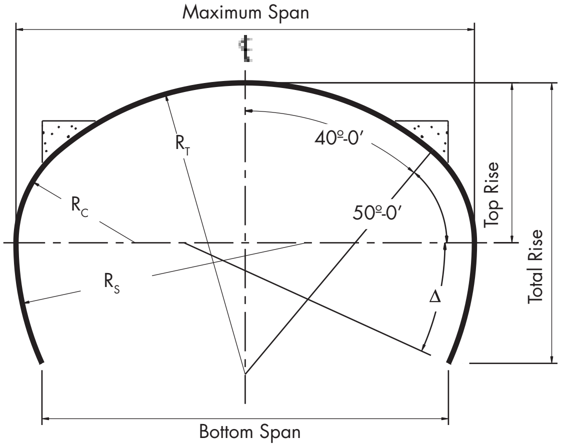
Table 64. TYPICAL HIGH PROFILE ARCH SHAPES[1]
(All Dimensions to Inside Crests)

Structure Number	Maximum Span	Bottom Span	Total Rise	Top Rise	Top Radius R_T	Upper Side Radius R_C	Lower Side Radius R_S	Angle Below Horizontal Δ	Approx. Area (Sq. Ft.)	Shape Factor R_T/R_C
23A5-3	20′-1″	19′-7″	9′-1″	6′-6″	13′-1″	4′-6″	13′-1″	11º-18′	152	2.91
23A6-6	20′9″	18′-10″	12′-1″	7′-3″	13′-1″	5′-5″	13′-1″	21º-44′	214	2.42
25A5-6	21′-6″	19′-10″	11′-8″	6′-9″	14′-3″	4′-6″	14′-3″	20º-0′	215	3.17
25A7-8	22′-10″	19′10″	14′-6″	8′-2″	14′-3″	6′-4″	14′-3″	26º-23′	285	2.25
26A5-6	22′-3″	20′-7″	11′-10″	6′-11″	14′-10″	4′-6″	14′-10″	19º-13′	225	3.30
26A6-8	22′-11″	20′-1″	14′-0″	7′-7″	14′-10″	5′-5″	14′-10″	25º–22′	275	2.74
27A5-6	23′-0″	21′-5″	11′-11″	7′-1″	15′-5″	4′-6″	15′-5″	18º-31′	235	3.43
27A7-8	24′-4″	21′-7″	14′-10″	8′-5″	15′-5″	6′-4″	15′-5″	24º-27′	309	2.43
28A5-6	23′-9″	22′-3″	12′-1″	7′-2″	16′-0″	4′-6″	16′-0″	17º-51′	245	3.56
29A5-8	24′-6″	21′-11″	13′-9″	7′-4″	16′-7″	4′-6″	16′-7″	22º-45′	289	3.69
29A7-8	25′-10″	23′-3″	15′-1″	8′-9″	16′-7″	6′-4″	16′-7″	22º-45′	335	2.62
30A5-7	25′-3″	23′-4″	13′-1″	7′-5″	17′-2″	4′-6″	17′-2″	19º-20′	283	3.81
30A7-8	26′-7″	24′-1″	15′-3″	8′-10″	17′-2″	6′-4″	17′-2″	22º-0′	347	2.71
31A5-7	26′-0″	24′-1″	13′-3″	7′-7″	17′-8″	4′-6″	17′-8″	18º-43′	294	3.94
31A7-8	27′-3″	24′-10″	15′-5″	9′-0″	17′-8″	6′-4″	17′-8″	21º-17′	360	2.80
33A5-7	27′-5″	25′-8″	13′-7″	7′-10″	18′-10″	4′-6″	18′-10″	17º-35′	317	4.20
33A8-8	29′-5″	27′-2″	16′-5″	10′-0″	18′-10″	7′-3″	18′-10″	20º-0′	412	2.60
34A5-8	28′-2″	25′-11″	14′-5″	8′-0″	19′-5″	4′-6″	19′-5″	19º-25′	348	4.33
34A8-10	30′-2″	26′-9″	18′-0″	10′-1″	19′-5″	7′-3″	19′-5″	24º-07′	466	2.68
36A6-8	30′-4″	28′-3″	15′-5″	9′-0″	20′-7″	5′-5″	20′-7″	18º-20′	400	3.80
36A8-10	31′-8″	28′-5″	18′-4″	10′-4″	20′-7″	7′-3″	20′-7″	22º-47′	497	2.84
37A6-8	31′-1″	29′-0″	15′-7″	9′-1″	21′-2″	5′-5″	21′-2″	17º-50′	413	3.91
37A7-10	31′-9″	28′-7″	17′-9″	9′-10″	21′-2″	6′-4″	21′-2″	22º-10′	484	3.34
†37A8-12	32′-4″	27′-11″	19′-11″	10′-6″	21′-2″	7′-3″	21′-2″	26º-29′	555	2.92
38A6-10	31′-10″	28′-9″	17′-3″	9′-3″	21′-9″	5′-5″	21′-9″	21º-35′	470	4.02
†38A8-12	33′-1″	28′-9″	20′-1″	10′-8″	21′-9″	7′-3″	21′-9″	25º-47′	572	3.00
39A6-10	32′-6″	29′-7″	17′-4″	9′-4″	22′-4″	5′-5″	22′-4″	21º-02′	485	4.12
†39A8-12	33′-10″	29′-8″	20′-3″	10′-9″	22′-4″	7′-3″	22′-4″	25º-08′	589	3.08
41A6-10	34′-0″	31′-2″	17′-8″	9′-8″	23′-5″	5′-5″	23′-5″	20º-0′	514	4.33
†41A7-12	34′-8″	30′-8″	19′-10″	10′-4″	23′-5″	6′-4″	23′-5″	23º-54′	591	3.70
42A6-10	34′-9″	32′-0″	17′-9″	9′-9″	24′-0″	5′-5″	24′-0″	19º-32′	529	4.44
†42A7-12	35′-5″	31′-6″	20′-0″	10′-6″	24′-0″	6′-4″	24′-0″	23º-20′	608	3.80

† Very large or high structures sometimes call for additional special provisions for shape control during backfill.

Note: Other sizes are available for special designs.

[1] The design table on page 80 of the catalog is for steel 6″ x 2″ corrugation only. For aluminum 9″ x 2-1/2″ corrugation design, please call your local CONTECH representative. Reinforcing ribs may be required. Rib length will be determined.



End View – High Profile Arch

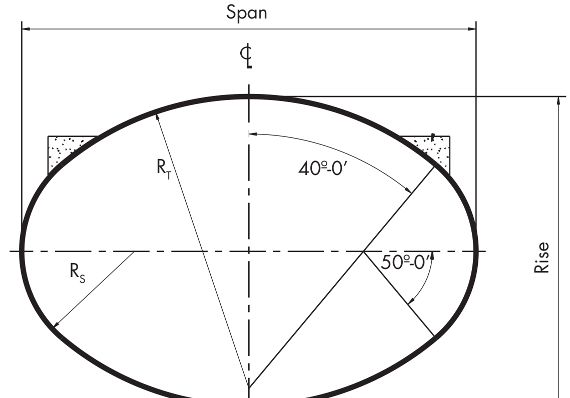
Aluminum 9" x 2-1/2" Corrugation **SUPER-PLATE**

Table 65. TYPICAL HORIZONTAL ELLIPSE SHAPES[1]
(All Dimensions to Inside Crests)

Structure Number	Maximum Span	Rise	Top Radius R_T	Side Radius R_S	Approx. Area	Shape Factor R_T/R_S
22E10	19'-4"	12'-9"	12'-6"	4'-6"	191	2.79
23E10	20'-1"	13'-0"	13'-1"	4'-6"	202	2.92
24E8	20'-2"	11'-11"	13'-8"	3'-7"	183	3.83
25E8	20'-11"	12'-2"	14'-3"	3'-7"	194	3.99
23E13	21'-1"	15'-2"	13'-1"	5'-10"	248	2.23
26E9	21'-11"	13'-1"	14'-10"	4'-0"	221	3.68
25E13	22'-6"	15'-8"	14'-3"	5'-10"	275	2.43
27E10	23'-0"	14'-1"	15'-5"	4'-6"	249	3.43
26E13	23'-3"	15'-11"	14'-10"	5'-10"	288	2.53
27E14	24'-4"	16'-11"	15'-5"	6'-4"	320	2.43
29E10	24'-6"	14'-8"	16'-7"	4'-6"	275	3.69
30E10	25'-3"	14'-11"	17'-2"	4'-6"	288	3.81
29E13	25'-6"	16'-9"	16'-7"	5'-10"	330	2.82
29E15	26'-2"	18'-2"	16'-7"	6'-9"	369	2.44
31E11	26'-4"	15'-10"	17'-8"	4'-11"	320	3.58
32E11	27'-0"	16'-2"	18'-3"	4'-11"	334	3.69
30E16	27'-2"	19'-1"	17'-2"	7'-3"	405	2.35
31E16	27'-11"	19'-5"	17'-8"	7'-3"	422	2.44
33E12	28'-1"	17'-1"	18'-10"	5'-5"	369	3.48
34E12	28'-10"	17'-5"	19'-5"	5'-5"	385	3.59
33E16	29'-5"	19'-11"	18'-10"	7'-3"	455	2.60
34E16	30'-2"	20'-2"	19'-5"	7'-3"	473	2.68
36E12	30'-4"	17'-11"	20'-7"	5'-5"	416	3.80
35E17	31'-3"	21'-2"	20'-0"	7'-9"	513	2.59
37E13	31'-5"	18'-11"	21'-2"	5'-10"	455	3.60
38E13	32'-1"	19'-2"	21'-9"	5'-10"	472	3.70
36E18	32'-3"	22'-2"	20'-7"	8'-2"	556	2.52
37E18	33'-0"	22'-5"	21'-2"	8'-2"	575	2.59
38E14	32'-5"	19'-10"	21'-9"	6'-4"	495	3.43
38E19	34'-1"	23'-5"	21'-9"	8'-8"	620	2.52
41E14	34'-8"	20'-8"	23'-5"	6'-4"	549	3.70
41E15	35'-0"	21'-4"	23'-5"	6'-9"	575	3.45
†39E20	35'-2"	24'-4"	22'-4"	9'-1"	667	2.45
42E16	36'-1"	22'-4"	24'-0"	7'-3"	620	3.31
†44E15	37'-3"	22'-2"	25'-2"	6'-9"	632	3.71

† Very large or high structures sometimes call for additional special provisions for shape control during backfill.
Note: Other sizes are available for special designs.

[1] The design table on page 80 of the catalog is for steel 6" x 2" corrugation only. For aluminum 9" x 2-1/2" corrugation design, please call your local CONTECH representative. Reinforcing ribs may be required. Rib length will be determined.



End View – Horizontal Ellipse

SUPER-PLATE®

Specification Aluminum Long Span Structures — 9" x 2-1/2" Corrugation

General Description

The long span aluminum structural plate structure, conforming to the dimensions shown on the plans and specifications, shall be installed at the location designated. The design and installation shall conform to A.A.S.H.T.O. Standard Specifications for Highway Bridges, Division I, "Soil-Corrugated Metal Structure Interaction Systems", Section 12.7, "Long Span Structural Plate Structures", and Division II, Section 26, "Metal Culverts" and Division II, Section 8, "Concrete Structures".

Materials

The aluminum structural plate shall have 9" x 2-1/2" corrugations and shall be of the gauge as shown on the plans. The plates shall be manufactured in conformance with A.A.S.H.T.O. Specification M 219 and ASTM B 209. Bolts and nuts shall meet the provisions of ASTM A 307, Grade A and ASTM A 563, Grade A, respectively, and shall be galvanized in accordance with the requirements of ASTM A 153, Class C or B 695, Class 50. Steel anchor bolts shall conform to ASTM A 307, Grade A.

Required stiffening ribs for the crown portion shall be extruded bulb angles produced from 6061-T6 alloy providing a minimum 35 ksi yield strength.

Long Span Special Features

Aluminum Long Span Structures will transverse stiffening ribs as well as longitudinal stiffeners.

Transverse Stiffeners

Transverse stiffeners will be bolted to the crown portion of the structure on 1 N (9.625") maximum circumferential centers. Their size and longitudinal spacing must adequately stiffen the top portion of the crown over a minimum 55 degree arc.

Longitudinal Structural Stiffeners (Thrust Beams)

Longitudinal stiffeners shall be located at the radius transition at the ends of the top arc. The thrust beams shall consist of reinforced concrete conforming to Division II, Section 8, Class B of the A.A.S.H.T.O. Standard Specifications for Highway Bridges having a minimum compression strength of 2400 psi. Reinforcing steel shall conform to ASTM A 615, Grade 40, having a minimum yield strength of 40,000 psi. Black reinforcing steel shall in no instance come in contact with the Aluminum Structural Plate. Thrust beams shall be formed and poured conforming to the plan dimensions when the backfill reaches the bottom elevation of the thrust beams.

Design

The long span structure shall be designed in accordance with the latest A.A.S.H.T.O. design criteria and shall be required to incorporate the use of continuous longitudinal structural stiffeners (concrete thrust beams). The material supplier shall be a qualified manufacturer of steel structural plate and long span structures with a minimum of 50 successful installations. The foundation, structural backfill, and end treatment shall be as required herein and detailed on the plans.

Structure Erection

The structure shall be erected in strict accordance with the manufacturer's instructions and to the design shape shown on the plans. Plates shall be assembled according to plate assembly drawings supplied by the manufacturer.

Structural Backfill

Material

A granular type of material shall be used around and over the structure. This select structural backfill material shall conform to one of the following classifications of soil from A.A.S.H.T.O. Specification M-145, as modified in the following table for A-1, A-2-4 or A-2-5.

AASHTO M-145 - Table 66

GROUP CLASSIFICATION	A-1 A-1-a	 A-1-b	A-2(Modified) A-2-4	 A-2-5
Sieve Analysis, Percent Passing:				
No.10 (2.00 mm)	50 Max.	——	——	——
No. 40 (0.425 mm)	30 Max.	50 Max.	——	——
No. 100 (0.150 mm)	——	——	50 Max.	50 Max.
No. 200 (0.075 mm)	15 Max.	25 Max.	20 Max.	20 Max.
Characteristics of Fraction Passing No. 40 (0.425 mm)				
Liquid Limit	—		40 Max.	41 Min.
Plasticity Index	6 Max.		10 Max.	10 Max.
Usual Types of Significant Constituent Materials	Stone Fragments Gravel and Sand		Silty or Clayey Gravel and Sand	

* Modified to be more select than M-145.

Additional Requirements

1. Materials must be dense graded (open graded or gap graded materials are not allowed).
2. Fine beach sands, windblown sands, and stream deposited sands, all of which exhibit fine, rounded particles and typically are classified by A.A.S.H.T.O. M-145 as A-3 materials, are not allowed.

3. On site mixing or blending to achieve specified gradation is not allowed.

Maximum particle size shall not exceed 3 inches. For the A-2 materials, moisture content must be between -3% and +2% optimum as defined by A.A.S.H.T.O. specification T-180. All soil classifications are limited to the following height of cover limits and structure shape applications:

- A-1-a material is suitable for all long span shapes, sizes and fill heights.
- A-1-b material is suitable only for use with high profile arch structures to a 12′ maximum fill height and for use with elliptical and low profile arch structures to a 20′ maximum fill height.
- A-2-4 and A-2-5 materials are restricted to maximum heights of cover of 12′.

Other backfill materials, which provide equivalent structural properties, long-term, in the environmental conditions expected (saturation, freeze-thaw, etc.), may be used. Such materials shall be approved only after thorough investigation and testing by a soils engineer familiar with the requirements for structural backfill of long span structures.

Backfill Envelope Limits

The backfill envelope limits are as detailed on the plans.

Backfill Placement

Before backfilling, the erected structure shall meet the tolerance and symmetry requirements of A.A.S.H.T.O. and the manufacturer.

Approved backfill material shall be placed in horizontal, uniform layers not exceeding 8″ in thickness, before compaction, and shall be brought up uniformly on both sides of the structure. Each layer of backfill shall be compacted to a relative density of not less than 90%, modified proctor per A.A.S.H.T.O. Test Method specification T-180. Field density tests of compacted backfill will be made at regular intervals during backfill.

Long span structures, due to their size and shape, are sensitive to the types and weights of equipment used to place and compact the select backfill material. This is especially critical in the areas immediately adjacent to and above the structure. Therefore, equipment types will be restricted in those critical zones. Compaction equipment or methods that produce horizontal or vertical earth pressures which cause excessive distortion or damage to structures shall not be used.

Contractors should plan to have a D4 (approximately 20,000 lbs.) or similar weight tracked dozer to place and grade backfill immediately alongside and above the structure until minimum cover level is reached. Lightweight vibratory plate or roller type compaction equipment must be used to compact the backfill in these zones. Use of heavier equipment and/or rubber tired equipment such as scrapers, graders, and front end loaders will likely be prohibited inside the select fill envelope zone until appropriate minimum cover height has been obtained.

Shape Control Monitoring

The material supplier or the manufacturer shall provide a Shape Control Technician who is a qualified representative of a professional soils engineering firm, or other qualified organization, to ensure properly shaped structure. The Shape Control Technician shall take initial measurements of the erected structure before backfilling, observe all backfill materials and their placement, and record compaction densities. The Technician shall record all density readings and ensure they meet the requirements of the plans and specifications. However, in no case shall the relative densities be less than 90% per A.A.S.H.T.O. T-180. The Shape Control Technician shall monitor the structure shape during the placement of structural backfill to the minimum cover height over the structure. **No structural backfill shall be placed without the Shape Control Technician on site.**

The Shape Control Technician shall:

- Monitor the structure's shape throughout the backfilling operation and report shape change rates to the contractor.
- Contact the material supplier or the manufacturer immediately if there are problems in meeting the established tolerances.
- Have full authority to stop backfill work if necessary.

Preconstruction Conference

Prior to construction, a meeting will be held to review the construction procedures. A qualified representative of the manufacturer of the structure will be present to discuss methods and responsibility for shape monitoring and control, backfill material selection, testing and placement, and compaction methods and testing. A representative of the Engineer, Prime Contractor and any involved sub-contractors must be present.

Alternate Structures

The Contractor may furnish an alternate structure to the long span shown on the plans and these specifications but the following conditions must be met:

1. The structure must be designed using the A.A.S.H.T.O. Long Span criteria and these plans and specifications. Steel structural plate shall conform to the requirements of A.A.S.H.T.O. specification M167. Aluminum alloy structural plate shall conform to the requirements of A.A.S.H.T.O. M219.
2. The corrugated metal plate thickness specified is considered the minimum acceptable for the structure(s) on this project based on structural and durability requirements. Any other structure, regardless of "special features", must be of the same thickness or greater.
3. When longitudinal reinforcements are not used, the "Special Features", such as aluminum structural ribs, shall be aluminum alloy 6061-T6. Ribs shall be placed over the same length of structure that the thrust beams would apply.
4. Alternate structures meeting the above criteria will only be considered for use if pre-approved in writing by the Engineer prior to the bid date. To qualify for pre-approval, an alternate submittal package must be submitted to the Engineer a minimum of 15 days prior to the bid date.