American Association of
State Highway and
Transportation Officials

Jack Lettiere, Jr., President
Commissioner
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Executive Director

ERRATA

Dear Customer:

Due to errors found after the publication had been completed, AASHTO has reprinted the pages listed below and made the following errata changes to the *AASHTO LRFD Bridge Construction Specifications*, 2nd Edition:

Replacement Pages	Affected Article	Errata Change
p. 4-15/4-16	4.4.6	Remove extraneous bullet points from commentary column. (This is an editorial correction to clarify that there is no commentary for this article.)
p. 6-11/p. 6-12	6.5.5.3	Display last row of Table 6.5.5.3-1.
p. 26-11/p. 26-12	26.5.4.1	Display entire Figure 26.5.4.1-1.
p. 27-5/p. 27-6	27.5.2.2	Display entire Figure 27.5.2.2-2.
p. 27-11/p. 27-12	27.5.3	Display entire Figure 27.5.3-1.
p. 31-7/p. 31-8	31.4.1	Display entire right column of Table 31.4.1-1.
p. 31-11/p. 31-12	31.4.11.2	Correct symbols in Eq. 31.4.11.2-1.
	31.4.11.3	Correct symbols in Eq. 31.4.11.3-1.
	31.4.11.4	Correct symbols in Eq. 31.4.11.4-1.
p. 31-15/p. 31-16	31.5.5	Remove extraneous article number from commentary column. (This is an editorial correction to clarify that there is no commentary for this article.)
p. A-21/p. A-22	Appendix	Correct symbols in SI version of Eq. 31.4.11.2-1.

Please substitute the original pages of text with the enclosed pages. We apologize for any inconvenience this may have caused.

AASHTO Publications Staff
January 2005

where:

S_f = settlement at failure, in.

D = pile diameter or width, in.

S = elastic deformation of total unsupported pile length, in.

The top elevation of the test pile shall be determined immediately after driving and again just before load testing to check for heave. Any pile that heaves more than 0.25 in. (6 mm) shall be redriven or jacked to the original elevation prior to testing. Unless otherwise specified in the contract documents, a minimum three-day waiting period shall be observed between the driving of any anchor piles or the load test pile and the commencement of the load test.

4.4.5 Splicing of Piles

4.4.5.1 Steel Piles

Full-length piles shall be used where practicable. If splicing is permitted, the method of splicing shall be as specified in the contract documents or as approved by the Engineer. The arc method of welding shall be preferred when splicing steel piles. Welding shall only be performed by certified welders.

4.4.5.2 Concrete Piles

Concrete piles shall not be spliced, other than to produce short extensions as permitted herein, unless specified in the contract documents or in writing by the Engineer.

Short extensions or “build-ups” may be added to the tops of reinforced concrete piles to correct for unanticipated events. After the driving is completed, the concrete at the end of the pile shall be cut away, leaving the reinforcing steel exposed for a length of 40 diameters. The final cut of the concrete shall be perpendicular to the axis of the pile. Reinforcement similar to that used in the pile shall be securely fastened to the projecting steel and the necessary form work shall be placed, care being taken to prevent leakage along the pile. The concrete shall be of not less than the quality used in the pile. Just prior to placing concrete, the top of the pile shall be thoroughly flushed with water, allowed to dry, then covered with a thin coating of neat cement, mortar, or other suitable bonding material. The forms shall remain in place not less than seven days and shall then be carefully removed and the entire exposed surface of the pile finished as previously specified.

4.4.5.3 Timber Piles

Timber piles shall not be spliced unless specified in the contract documents or in writing by the Engineer.

4.4.6 Defective Piles

The procedure incident to the driving of piles shall not subject them to excessive and undue abuse producing crushing and spalling of the concrete, injurious splitting, splintering and brooming of the wood, or excessive deformation of the steel. Manipulation of piles to force them into proper position, considered by the Engineer to be excessive, will not be permitted. Any pile damaged by reason of internal defects, by improper driving, driven out of its proper location, or driven below the butt elevation fixed by the contract documents or by the Engineer shall be corrected at the Contractor's expense by one of the following methods approved by the Engineer for the pile in question:

- The pile shall be withdrawn and replaced by a new and, if necessary, longer pile.
- A second pile shall be driven adjacent to the defective or low pile.
- The pile shall be spliced or built up as otherwise provided herein or a sufficient portion of the footing extended to properly embed the pile.

All piles pushed up by the driving of adjacent piles or by any other cause shall be driven down again.

All such remedial materials and work shall be furnished at the Contractor's expense.

4.4.7 Pile Cut-Off

4.4.7.1 General

All piles shall be cut off to a true plane at the elevations required and anchored to the structure, as shown in the contract documents.

All cut-off lengths of piling shall remain the property of the Contractor and shall be properly disposed of.

4.4.7.2 Timber Piles

Timber piles which support timber caps or grillage shall be sawn to conform to the plane of the bottom of the superimposed structure. The length of pile above the elevation of cut-off shall be sufficient to permit the complete removal of all material injured by driving but piles driven to very nearly the cut-off elevation shall be carefully added or otherwise freed from all broomed, splintered, or otherwise injured material.

C4.4.7.2

where:

AL = Alignment load

DL = Design load for ground anchor

* = Graph required, as specified herein

The maximum test load in a performance test shall be held for 10 min. The jack shall be repumped as necessary in order to maintain a constant load. The loadhold period shall start as soon as the maximum test load is applied, and the ground anchor movement shall be measured and recorded at 1 min, 2, 3, 4, 5, 6, and 10 min. If the ground anchor movements between 1 min and 10 min exceeds 0.04 in. (1.0 mm), the maximum test load shall be held for an additional 50 min. If the load-hold is extended, the ground anchor movement shall be recorded at 15 min, 20, 25, 30, 45, and 60 min.

A graph shall be constructed showing a plot of ground anchor movement versus load for each load increment marked with an asterisk (*) in Table 6.5.5.2-1 and a plot of the residual ground anchor movement of the tendon at each alignment load versus the highest previously applied load. Graph format shall be approved by the Engineer prior to use.

The alignment load is a small load, normally less than ten percent of the design load, applied to the ground anchor in order to keep the testing equipment in position during testing.

6.5.5.3 Proof Test

Those anchors not subjected to a performance test shall be tested as specified herein.

The proof test shall be performed by incrementally loading the ground anchor in accordance with the following schedule unless a different maximum test load and schedule are indicated in the contract documents. The load shall be raised from one increment to another immediately after recording the ground anchor movement. The ground anchor movement shall be measured and recorded to the nearest 0.001 in. (0.025 mm) with respect to an independent fixed reference point at the alignment load and at each increment of load. The load shall be monitored with a pressure gage. At load increments other than the maximum test load, the load shall be held just long enough to obtain the movement reading.

Table 6.5.5.3-1 Proof Test Schedule.

Load	Load
AL	1.00*DL*
0.25*DL*	1.20*DL*
0.50*DL*	1.33*DL* (max. test load)
0.75*DL*	Reduce to lock-off load

C6.5.5.3

If a different maximum test load is to be required, a schedule similar to the one given in this article should be described in the contract documents.

where:

AL = Alignment load

DL = Design load for ground anchor

The maximum test load in a proof test shall be held for 10 min. The jack shall be repumped as necessary in order to maintain a constant load. The load-hold period shall start as soon as the maximum test load is applied, and the ground anchor movement shall be measured and recorded at 1 min, 2, 3, 4, 5, 6, and 10 min. If the ground anchor movement between 1 min and 10 min exceeds 0.04 in. (1.0 mm), the maximum test load shall be held for an additional 50 min. If the load-hold is extended, the ground anchor movement shall be recorded at 15 min, 20, 30, 45, and 60 min. A graph shall be constructed showing a plot of ground anchor movement versus load for each load increment in the proof test. Graph format shall be approved by the Engineer prior to use.

6.5.5.4 Creep Test

Creep tests shall be performed if specified in the contract documents. The Engineer shall select the ground anchors to be creep tested.

The creep test shall be made by incrementally loading and unloading the ground anchor in accordance with the performance test schedule used. At the end of each loading cycle, the load shall be held constant for the observation period indicated in the creep test schedule below unless a different maximum test load is indicated in the contract documents. The times for reading and recording the ground anchor movement during each observation period shall be 1 min, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270, and 300 min as appropriate. Each load-hold period shall start as soon as the test load is applied. In a creep test, the pressure gage and reference pressure gage shall be used to measure the applied load, and the load cell shall be used to monitor small changes of load during a constant load-hold period. The jack shall be repumped as necessary in order to maintain a constant load.

Table 6.5.5.4-1 Creep Test Schedule.

AL	Observation Period, min
0.25*DL*	10
0.50*DL*	30
0.75*DL*	30
1.00*DL*	45
1.20*DL*	60
1.33*DL*	300

C6.5.5.4

If creep tests are required, at least two ground anchors should be creep-tested. If a different maximum test load is to be required, a schedule similar to this one should be described in the contract documents.

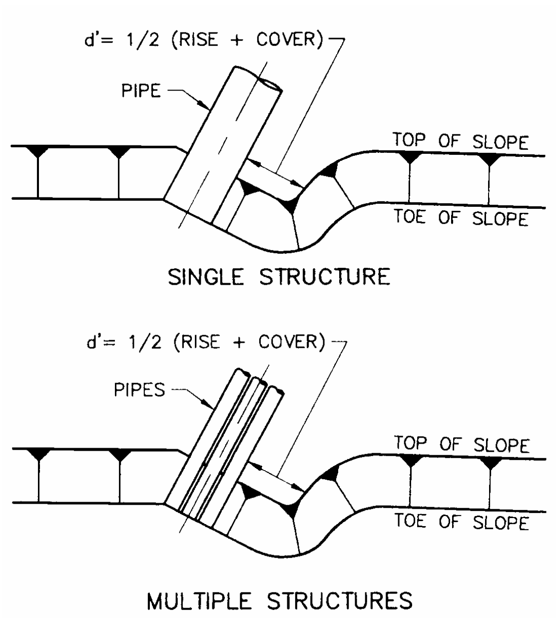


Figure 26.5.4.1-1 End Treatment of Skewed Flexible Culvert.

26.5.4.2 Arches

Arches may require special shape control during the placement and compaction of structure backfill.

Prior to construction, the Manufacturer shall attend a preconstruction conference to advise the Contractor(s) and Engineer of the more critical functions to be performed during backfilling and to present the intended quality control steps to be used to control loads, shape and movements.

C26.5.4.2

Pin connections at the footing restrict uniform shape change. Arches may peak excessively or experience curvature flattening in their upper quadrants during backfilling. Using lighter compaction equipment, more easily compacted structure backfill or top loading by placing a small load of structure backfill on the crown will aid installation.

26.5.4.3 Long-Span Structures

Prior to construction, the Manufacturer shall attend a preconstruction conference to advise the Contractor(s) and Engineer of the more critical functions to be performed during backfilling and to present the intended quality control steps to be used to control loads, shape and movements.

Equipment and construction procedures used to backfill long-span structural plate structures shall be such that excessive structure distortion will not occur. Structure shape shall be checked regularly during backfilling to verify acceptability of the construction methods used. Magnitude of allowable shape changes will be specified by the Manufacturer (Fabricator of long-span structures). The Manufacturer shall provide a qualified shape-control Inspector to aid the Engineer during the placement of all structure backfill to the minimum cover level over the structure. The shape-control Inspector shall advise the Construction Engineer on the acceptability of all backfill material and methods and the proper monitoring of the shape. Structure backfill material shall be placed in horizontal uniform layers not exceeding an 8.0-in.

C26.5.4.3

Backfill requirements for long-span structural-plate structures are similar to those for smaller structures. Their size and flexibility require special control of backfill and continuous monitoring of structure shape.

(200-mm) loose lift thickness and shall be brought up uniformly on both sides of the structure. Each layer shall be compacted to a density not less than 90 percent modified density per AASHTO T 180. The structure backfill shall be constructed to the minimum lines and grades shown in the contract documents, keeping it at or below the level of adjacent soil or embankment. The following exceptions to the required structure backfill density shall be permitted:

- the area under the invert,
- the 12.0-in. to 18.0-in. (300-mm to 450-mm) width of soil immediately adjacent to the large radius side plates of high-profile arches and inverted-pear shapes, and
- the lower portion of the first horizontal lift of overfill carried ahead of and under the small, tracked vehicle initially crossing the structure.

26.5.4.4 Box Culverts

A preconstruction conference on backfilling shall be required only when specified in the contract document or required by the Engineer. Shape control considerations should be similar to those needed for a metal culvert.

Structure backfill material shall be placed in uniform, horizontal layers not exceeding an 8-in. (200-mm) maximum loose lift thickness and compacted to a density not less than 90 percent modified density per AASHTO T 180. The structure backfill shall be constructed to the minimum lines and grades shown in the contract documents, keeping it at or below the level of the adjacent soil or embankment.

C26.5.4.4

Metal box culverts are not long-span structures because they are relatively stiff, semi-rigid frames.

26.5.5 Bracing

When required, temporary bracing shall be installed and shall remain in place as long as necessary to protect workers and to maintain structure shape during erection.

For long-span structures which require temporary bracing or cabling to maintain the structure in shape, the supports shall not be removed until the structure backfill is placed to an elevation to provide the necessary support. In no case shall internal braces be left in place when backfilling reaches the top quadrant of the pipe or the top radius arc portion of a long-span structure.

26.5.6 Arch Substructures and Headwalls

Substructures and headwalls shall be designed in accordance with the applicable requirements of *AASHTO LRFD Bridge Design Specifications*, 2004.

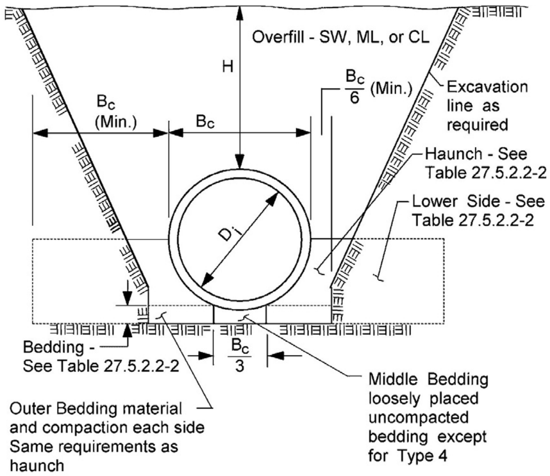
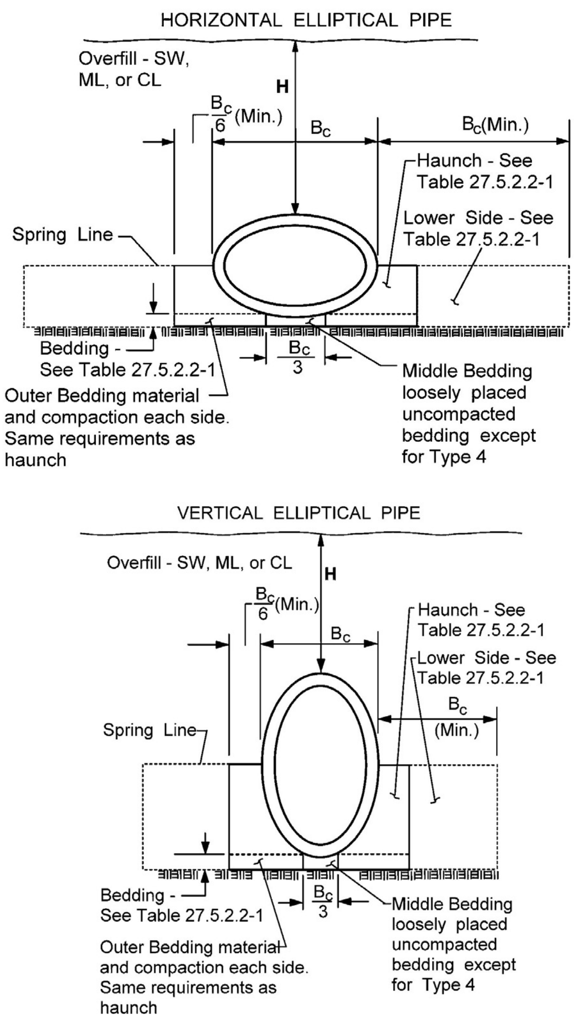


Figure 27.5.2.2-2 Standard Trench Installation—Round Pipe.



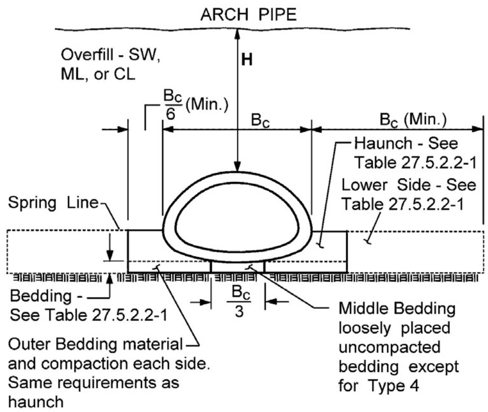
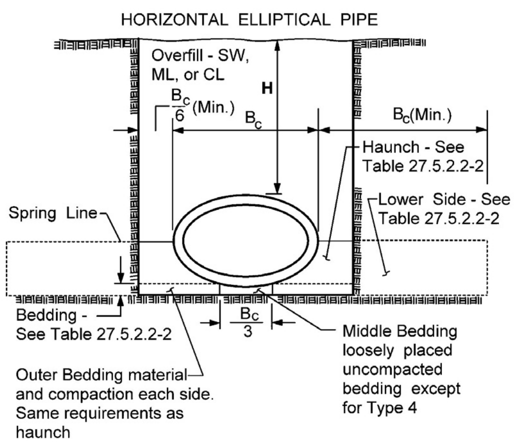
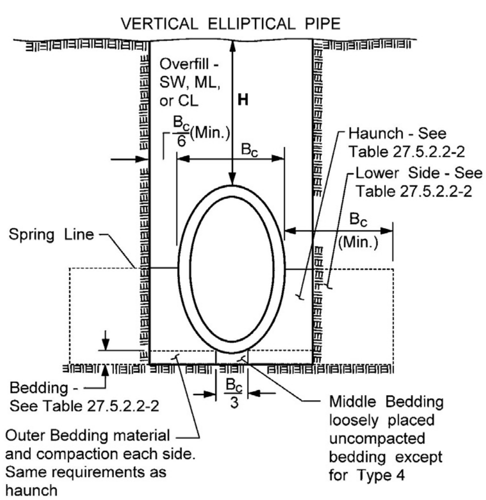
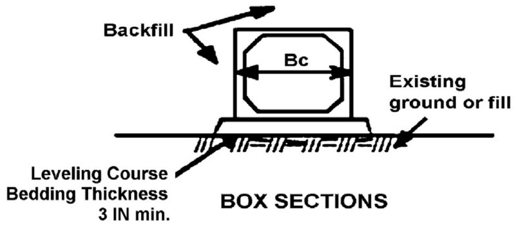


Figure 27.5.2.2-3 Embankment Beddings—Miscellaneous Shapes.







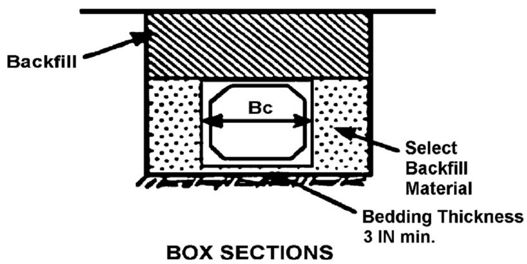


Figure 27.5.2.3-1 Bedding and Backfill Requirements.

27.5.3 Placing Culvert Sections

Unless otherwise authorized by the Engineer, the laying of culvert sections on the prepared bedding shall be started at the outlet and with the bell end pointing upstream and the spigot or tongue end pointing downstream and shall proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades. Where pipe with bells is installed, bell holes shall be excavated in the bedding to such dimensions that the entire length of the barrel of the pipe will be supported by the bedding when properly installed as shown in Figure 27.5.3-1. Proper facilities shall be provided for hoisting and lowering the sections of culvert into the trench without disturbing the prepared bedding and the sides of the trench. The ends of the section shall be carefully cleaned before the section is jointed. The section shall be fitted and matched so that when laid in the bed it shall form a smooth, uniform conduit. When elliptical pipe with circular reinforcing or circular pipe with elliptical reinforcing is used, the pipe shall be laid in the trench in such position that the markings “Top” or “Bottom,” shall not be more than five degrees from the vertical plane through the longitudinal axis of the pipe. Adjustments in grade by exerting force on the culvert with excavating equipment or by lifting and dropping the culvert shall be prohibited. If the installed culvert section is not on grade after joining, the section shall be completely unjoined, the grade corrected and the section rejoined.

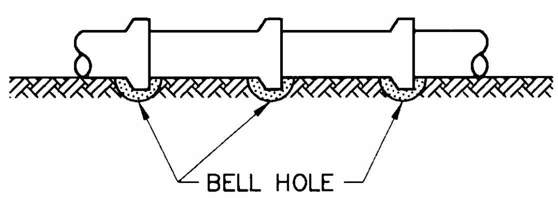


Figure 27.5.3-1 Excavation of Bell Holes for Uniform Support.

Multiple installations of reinforced concrete culverts shall be laid with the center lines of individual barrels parallel at the spacing shown in the contract documents. Pipe and box sections used in parallel installations require positive lateral bearing between the sides of adjacent pipe or box sections. Compacted earth fill, granular backfill, or grouting between the units are considered means of providing positive bearing.

27.5.4 Haunch, Lower Side, and Backfill or Overfill

27.5.4.1 Precast Reinforced Concrete Circular Arch and Elliptical Pipe

Haunch material, low side material, and overfill material shall be installed to the limits shown on Figures 27.5.2.2-1 through 27.5.2.2-4.

27.5.4.2 Precast Reinforced Concrete Box Sections

Backfill material shall be installed to the limits shown in Figure 27.5.2.3-1 for the embankment or trench condition.

C27.5.4.2

Although usually constructed with vertical walls, installation of precast box culverts in trenches with sloping sidewalls has not been a problem.

27.5.4.3 Placing of Haunch, Lower Side, and Backfill or Overfill

Fill material shall be placed in layers with a maximum loose thickness of 8.0 in. (200 mm) and compacted to obtain the required density. The fill material shall be placed and compacted with care under the haunches of the culvert and shall be raised evenly and simultaneously on both sides of the culvert. For the lower haunch areas of Type 1, 2, and 3 Standard Installations, soils requiring 90 percent or greater standard proctor densities shall be placed in layers with a maximum thickness of 8.0 in. (200 mm) and compacted to obtain the required density. The width of trench shall be kept to the minimum required for installation of the culvert. Ponding or jetting will be only by the permission of the Engineer.

C27.5.4.3

Generally, compaction of fill material to the required density is dependent on the thickness of the layer of fill being compacted, soil type, soil moisture content, type of compaction equipment, and amount of compactive force and length of time the force is applied.

31.4 FABRICATION

31.4.1 Identification of Aluminum Alloys During Fabrication

The Contractor shall issue cutting instructions and mark individual pieces so as to be able to identify the material used for each piece. Metal stamping marks, scribe lines, and center punch marks shall not be used where they will remain on fabricated material.

The Contractor may furnish material that can be identified by lot and mill test report from stock.

During fabrication prior to assembly, each piece shall clearly show its material specification. Writing the material specification number on the piece or by using the identification color codes shown in Table 31.4.1-1 shall be taken as compliance with this provision.

Table 31.4.1-1 Identification Color Codes.

Alloy	Color
5083	Red and Gray
5086	Red and Orange
6061	Blue
6063	Yellow and Green

Aluminum alloys not listed in Table 31.4.1-1 shall be marked with colors listed in *Aluminum Standards and Data*.

Any piece which will be subject to fabrication that might obscure its identification prior to assembly shall have a substantial tag affixed showing the material specification number.

Upon request by the Engineer, the Contractor shall furnish an affidavit certifying that the identification of pieces has been maintained in accordance with this specification.

C31.4.1

Aluminum Standards and Data gives color codes for additional alloys and other information on identification marking used by aluminum producers in Section 4.

31.4.2 Storage of Materials

Material shall be stored out of contact with the ground, free from dirt, grease, and foreign matter and out of contact with dissimilar materials such as uncoated steel.

31.4.3 Plates

31.4.3.1 Direction of Rolling

Unless otherwise specified in the contract documents, plates for main members and splice plates for flanges and main tension members, i.e., not secondary members, shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses.

31.4.3.2 Plate Edges

Plates more than 0.5 in. (12 mm) thick carrying calculated stress shall not be sheared. All edges that have been cut by the arc process shall be planed to remove edge cracks. Oxygen cutting shall not be used. Re-entrant corners shall be filleted to a radius of 0.75 in. (20 mm) or more.

31.4.3.3 Bent Plates

31.4.3.3.1 General

Bend lines in unwelded, load-carrying, rolled aluminum plates shall be perpendicular to the direction of rolling.

Before bending, the corners of the plates shall be rounded to a radius of 0.0625 in. (1.5 mm) throughout the portion of the plate over which the bending is to occur.

31.4.3.3.2 Cold Bending

Cold bending shall not produce cracking. For 90-degree bends, bend radii measured to the concave face of the metal shall not be less than those listed in Table 31.4.3.3.2-1.

C31.4.3.3.2

Recommended bend radii for 90-degree cold bends for other alloys may be found in Table 7.6 of *Aluminum Standards and Data, 2003 (Metric SI)*.

Table 31.4.3.3.2-1 Minimum Bend Radii (in.) for 90-Degree Bends.

Alloy	Plate Thickness, in.			
	0.1875	0.25	0.375	0.5
5083-H321	0.28	0.35	0.79	1.77
5086-H116	0.28	0.47	0.98	1.42
5456-H116	0.38	0.59	1.18	1.65
6061-T6	0.55	0.83	1.77	2.36

31.4.4 Fit of Stiffeners

End bearing stiffeners for girders and stiffeners intended as supports for concentrated loads shall bear fully on the flanges to which they transmit load or from which they receive load. Intermediate stiffeners not intended to support concentrated loads shall have a tight fit against the compression flange, unless specified otherwise.

C31.4.4

Full bearing may be obtained by milling, grinding, or in the case of compression regions of flanges, by welding.

31.4.5 Abutting Joints

Abutting ends of compression members of trusses and columns shall be milled or saw-cut to give a square joint and uniform bearing. At other joints, the distance between adjacent members shall not exceed 0.375 in. (10 mm).

31.4.11 Aluminum Bridge Decks

31.4.11.1 General

Dimensional tolerances specified below for aluminum bridge deck panels shall be applied to each completed, but unloaded panel. The deviation from detailed flatness, straightness, or curvature at any point shall be the perpendicular distance from that point to a template edge which has the detailed straightness or curvature and which is in contact with the panel at two other points. The template edge may have any length not exceeding the lesser of the greatest dimension of the panel and 1.5 times the least dimension of the panel; it may be placed anywhere on the panel. The distance between adjacent points of contact of the template edge with the panel shall be used in the formulas to establish the tolerances for the panel whenever this distance is less than the applicable dimension of the panel specified for the formula.

31.4.11.2 Flatness of Panels

The deviation, δ, from detailed flatness or curvature of a panel shall not exceed:

$$\delta \leq \frac{D}{144\sqrt{T}} \leq 0.1875 \text{ in.} \qquad (31.4.11.2\text{-}1)$$

where:

D = the least dimension along the boundary of the panel, in.

T = the minimum thickness of the top flange of the panel, in.

31.4.11.3 Straightness of Longitudinal Stiffeners Subject to Calculated Compressive Stress

The deviation, δ, from detailed straightness or curvature in any direction perpendicular to the length of a longitudinal stiffener subject to calculated compressive stress shall not exceed:

$$\delta \leq \frac{L}{480} \qquad (31.4.11.3\text{-}1)$$

where:

L = the length of the stiffener over which the deviation in detailed straightness or curvature is measured, in. (mm)

31.4.11.4 Straightness of Transverse Web Stiffeners and Stiffeners Not Subject to Calculated Compressive Stress

The deviation, δ, from detailed straightness or curvature in any direction perpendicular to the length of a transverse stiffener or a stiffener not subject to calculated compressive stress shall not exceed:

$$\delta \leq \frac{L}{240} \tag{31.4.11.4-1}$$

where:

L = the length of the stiffener over which the deviation in detailed straightness or curvature is measured, in. (mm)

31.4.12 Full-Size Tests

When full-size tests of fabricated structural members are required in the contract documents, the Contractor shall provide suitable facilities, material, supervision, and labor necessary for making and recording the required tests. The members tested shall be paid for in accordance with Article 31.7.2, "Basis of Payment."

31.4.13 Marking and Shipping

Each member shall be painted or marked with an erection mark for identification and an erection diagram showing these marks shall be furnished to the Engineer. Metal stamping shall not be used to mark aluminum parts.

The Contractor shall furnish to the Engineer as many copies of material orders, shipping statements, and erection diagrams as the Engineer may direct. The weight (mass) of the individual members shall be shown on the statements. Members having a weight (mass) of more than 6.5 kips (3000 kg) shall have the weight (mass) marked on them. Structural members shall be loaded on trucks or cars in such a manner that they may be transported and unloaded at their destination without being damaged.

Bolts, nuts, and washers from each rotational-capacity lot shall be shipped in the same container. If there is only one production lot number for each size of nut and washer, the nuts and washers may be shipped in separate containers. The gross weight (mass) of any container shall not exceed 0.3 kips (140 kg). A list showing the quantity and description of materials shall be plainly marked on the outside of each container.

31.5.3.2 Field Bolted Connections

Major compression members with milled ends shall be assembled in full bearing and then shall have their subsized holes reamed to the specified size while the members are assembled.

31.5.3.3 Check Assemblies for Numerically-Controlled Fabrication

Unless otherwise stated in the contract documents, when the Contractor elects to use numerically controlled hole fabrication, a check assembly shall be provided for each major structural type of each project. Except as noted herein, the check assembly shall consist of at least three contiguous shop sections. In a truss, the check assembly shall consist of all members in at least three contiguous panels, but not less than the number of panels associated with three contiguous chord lengths, i.e., length between field splices.

Check assemblies shall be assembled in accordance with the sequence shown on the erection drawings. If the check assembly fails to demonstrate that the required accuracy is being obtained, further check assemblies may be required by the Engineer at no additional cost to the Owner.

Each check assembly and its camber, alignment, accuracy of holes, and fit of milled joints shall be approved by the Engineer before reaming is commenced or before the check assembly is dismantled.

31.5.3.4 Field-Welded Connections

For field-welded connections, the fit of members, including the proper space between abutting members, shall be prepared or verified with the segment preassembled in accordance with Article 31.5.3.1.

31.5.4 Match-Marking

Connecting parts preassembled in the shop to assure proper fit in the field shall be match-marked, and a diagram showing such marks shall be furnished to the Engineer.

31.5.5 Welding

Brackets, clips, shipping devices, or other material not required by the contract documents shall not be welded or tacked to any member unless specified in the contract documents and approved by the Engineer.

31.6 ERECTION

31.6.1 General

The Contractor shall provide all tools, machinery, and equipment necessary to erect the structure.

31.6.2 Handling and Storing Materials

Material to be stored at the job site shall be placed on skids above the ground and kept clean and well drained. Girders and beams shall be placed upright and shored. If the Contractor's scope of work is for erection only, the Contractor shall check the material received against the shipping lists and report promptly in writing any shortage or damage. After material is received by the Contractor, the Contractor shall be responsible for any damage to or loss of material.

C31.6.2

Where moisture is trapped between adjacent surfaces of closely packed aluminum, white or gray stains, referred to as water stains, may result. Alloys having a high magnesium content are affected to a greater degree, but all aluminum alloys can be affected. Water staining is a superficial condition and does not affect the strength of the material, nor will it progress once the conditions that caused it are removed. It can be avoided by keeping the material dry.

31.6.3 Bearings and Anchorages

Bridge bearings shall be furnished and installed in conformance with Section 18, “Bearing Devices.”

If the aluminum superstructure is to be placed on a substructure that was built under a separate contract, the Contractor shall verify that the substructure has been constructed in the right location and to the correct lines and elevations before ordering materials.

31.6.4 Erection Procedure

31.6.4.1 Conformance to Erection Drawings

The erection procedure shall conform to the erection drawings submitted in accordance with Article 31.2.2, “Erection Drawings.” Any modifications to or deviations from this erection procedure shall require revised drawings and verification of stresses and geometry.

31.6.4.2 Erection Stresses

Any erection stresses induced in the structure as a result of erection which differs from the contract documents shall be accounted for by the Contractor. Erection design calculations for such changed methods shall be prepared at the Contractor's expense and submitted to the Engineer. The calculations shall indicate any change in stresses or change in behavior for the temporary and final structures. Additional material required to keep both the temporary and final force effects within the limits used in design shall be provided at the Contractor's expense.

The Contractor shall be responsible for providing temporary bracing or stiffening devices to limit stresses in individual members or segments of the structure during erection.

SECTION 30

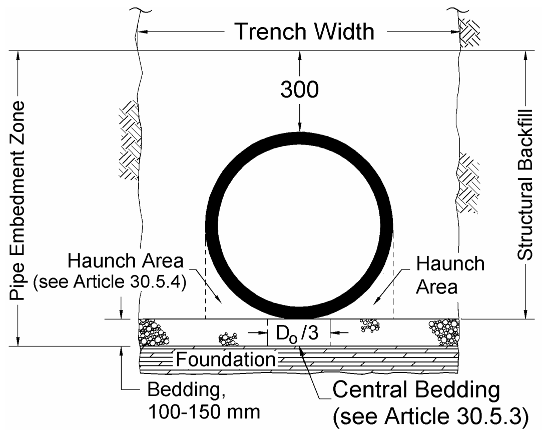


Figure 30.5.1-1 Trench Details.

Table 30.5.5-1 Minimum Cover for Construction Loads.

	Minimum Cover, mm, for Indicated Axle Loads, kN			
Nominal Pipe Diameter, mm	80–220	220–330	330–490	490–670
600–915	600	750	900	900
1050–1220	900	900	1050	1200
1350–1525	900	900	1050	1200

SECTION 31

Table 31.4.3.3.2-1 Minimum Bend Radii, mm, for 90-Degree Bends.

Alloy	Plate Thickness, mm			
	5	6	10	12
5083-H321	7	9	20	30
5086-H116	7	12	25	36
5456-H116	10	15	30	42
6061-T6	14	21	45	60

$$\delta \leq \frac{D}{28\sqrt{T}} \leq 5 \text{ mm} \qquad (31.4.11.2\text{-}1)$$

where:

D = the least dimension along the boundary of the panel, mm

T = the minimum thickness of the top flange of the panel, mm

Table 31.7.1-1 Mass Densities of Aluminum Alloys.

Alloy	Mass Density, kg/m^3
5083	2660
5086	2660
5456	2660
6061	2710
6063	2690