AASHTO

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ERRATA for
AASHTO LRFD Bridge Construction Specifications, 4th Edition (LRFDCONS-4)

November 2021

Dear Customer:

Recently, we were made aware of some technical revisions that need to be applied to the *AASHTO LRFD Bridge Construction Specifications,* 4th Edition. This file contains both previous errata from March 2018 as well as newer corrections. Changes are listed first, followed by all necessary replacement pages. Please scroll down to see the full erratum.

As this publication has two errata and an interim, changes should be applied in the following order:

- 2018 Errata
- 2020 Interim
- 2021 Errata

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Please replace the existing pages with the corrected pages to ensure that your edition is both accurate and current.

AASHTO staff sincerely apologizes for any inconvenience to our readers.

Summary of Errata for LRFDCONS-4, March 2018

Page	*Existing Text*	*Corrected Text*
11-27	*11.5.5.4.1—General* … Rotation, as used in Table 11.5.5.4.1-2, shall be taken as rotation of the nut relative to the bolt, regardless of the element (nut or bolt) being turned. The tolerances is minus 30, plus 60°. The values, given in Table 11.5.5.4.1-2, shall be	*11.5.5.4.1—General* … Rotation, as used in Table 11.5.5.4.1-2, shall be taken as rotation of the nut relative to the bolt, regardless of the element (nut or bolt) being turned. The tolerances is minus 30, plus 60°. The values, given in Table 11.5.5.4.1-2, shall be <u>applicable only to connections in which all material within grip of the bolt is steel.</u> <u>For situations in which the bolt length measured from the underside of the head to the end of the bolt exceeds 12 diameters, the required rotation shall be determined by actual tests in a suitable tension device simulating the actual conditions.</u> <u>The bolt length used shall be such that the end of the bolt is flush with or extends beyond the outer face of the nut when properly installed.</u>

Second Errata for LRFDCONS-4, November 2021

Page	*Existing Text*	*Corrected Text*
10-5		**10.3.2.1**—Added the following paragraph to the end of the section: Dynamic tests, in accordance with Article 10.3.2.2, shall be required on bonded tendons where the anchorage is located or used in such manner that repeated load applications can be expected on the anchorage; otherwise dynamic tests shall be required only if specified in the contract documents.
26-8	**26.4.3**—When required by structural design, reinforcing ribs shall be attached to the structural plate corrugation crown prior to backfilling, using a bolt spacing of not more than 12.0 in. Legible identifying letters or numbers shall be placed on each rib to designate its proper position in the finished structure.	**26.4.3**—When required by structural design, reinforcing ribs shall be attached to the structural plate corrugation ~~crown~~ crest at the necessary locations around the circumference of the structure prior to backfilling, using a bolt spacing of not more than 12.0 in. or 16.0 in. for deep corrugated structural plate structures. Legible identifying letters or numbers shall be placed on each rib to designate its proper position in the finished structure.
26-8		**C26.4.3**—Added the following: It is acceptable to measure bolt spacing either at the centroid or crest of the structural plate corrugation. Where reinforcing ribs are only used as an installation tool during backfill, they may be clamped or bolted as necessary to provide shape control.

Page	*Existing Text*	*Corrected Text*
26-14		Added new Article: **26.5.4.5—Deep Corrugated Structural Plate Structures** Prior to construction, the Manufacturer shall conduct 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 deep corrugated structural plate structures shall be such that excessive structure distortion will not occur. A Manufacturer's representative shall be on site during initial sidefill placement and compaction, and shall review data on the shape when backfill reaches the minimum cover level over the top of the structure as set forth in the *AASHTO LRFD Bridge Design Specifications*. Structure backfill material shall be placed in horizontal uniform layers not exceeding an 8.0 in. loose lift thickness and shall be brought up uniformly on both sides of the structure. Each layer shall be compacted per the contract documents, but not less than 90 percent maximum density per AASHTO T 180 (modified Proctor test). The structure backfill shall be constructed to the lines and grades shown on the contract documents, keeping it at or below the level of adjacent soil.

strength rather than the guaranteed ultimate tensile strength. The reason for this is to make sure the hardware used for gripping does not reduce the capacity of the tendons more than 5 percent. This can only be measured in reference to the actual strength of the particular prestressing steel used in the test. The recommendation of using 95 percent of the actual ultimate tensile strength for the anchorage efficiency test was made in NCHRP Report 356.

The dynamic strand-wedge performance test for unbonded tendons is specified in Article 10.3.2.2.

10.3.2.1—Bonded Systems

Bond transfer lengths between anchorages and the zone where full prestressing force is required under service and ultimate loads shall normally be sufficient to develop the minimum specified ultimate strength of the prestressing steel. When anchorages or couplers are located at critical sections under ultimate load, the ultimate strength required of the bonded tendons shall not exceed the ultimate capacity of the tendon assembly, including the anchorage or coupler, tested in an unbonded state.

Housings shall be designed so that complete grouting of all of the coupler components will be accomplished during grouting of tendons.

Dynamic tests, in accordance with Article 10.3.2.2, shall be required on bonded tendons where the anchorage is located or used in such manner that repeated load applications can be expected on the anchorage; otherwise dynamic tests shall be required only if specified in the contract documents.

10.3.2.2—Unbonded Systems

For unbonded tendons, two dynamic tests shall be performed on a representative anchorage and coupler specimen and the tendon shall withstand, without failure, 500,000 cycles from 60 percent to 66 percent of its minimum specified ultimate strength, and 50 cycles from 40 percent to 80 percent of its minimum specified ultimate strength. Each cycle shall be taken as the change from the lower stress level to the upper stress level and back to the lower. Different specimens may be used for each of the two tests. Systems utilizing multiple strands, wires, or bars may be tested utilizing a test tendon of smaller capacity than the full-size tendon.

Anchorages for unbonded tendons shall not cause a reduction in the total elongation under ultimate load of the tendon to less than two percent measured in a minimum gage length of 10.0 ft.

All the coupling components shall be completely protected with a coating material prior to final encasement in concrete.

10.3.2.3—Special Anchorage Device Acceptance Test

10.3.2.3.1—Test Block Requirements

The test block shall be a rectangular prism. It shall contain those anchorage components which will also be embedded in the structure's concrete. Their arrangement shall comply with the practical application and the suppliers' specifications. The test block shall contain an empty duct of size appropriate for the maximum tendon size which can be accommodated by the anchorage device.

C10.3.2.3.1

Figure C10.3.2.3.1-1 shows a local zone specimen with the local zone confining reinforcement in the upper portion of the specimen and the optional supplementary reinforcement of Article 10.3.2.3.4, “Skin Reinforcement,” over the full-length of the specimen. However, an anchorage device supplier could also choose to eliminate such reinforcement in either or both portions of the block.

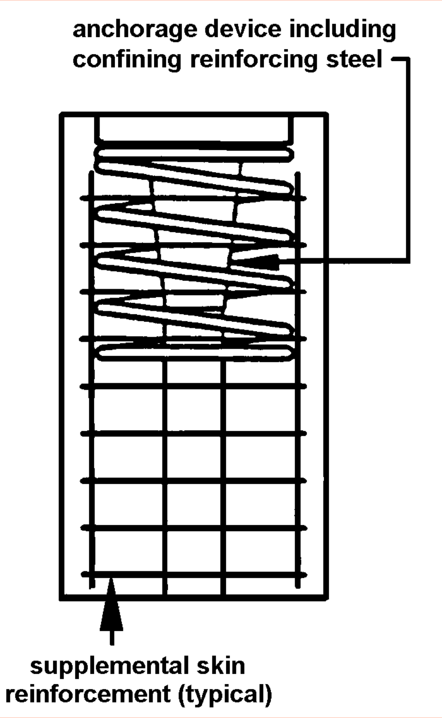

Figure C10.3.2.3.1-1—Special Anchorage Device Acceptance Test Specimen

10.3.2.3.2—Test Block Dimensions

The dimensions of the test block perpendicular to the tendon in each direction shall be the smaller of the minimum edge distance or the minimum spacing specified by the anchorage device supplier, with the stipulation that the cover over any confining reinforcing steel or supplementary skin reinforcement be appropriate for the particular application and environment. The length of the block along the axis of the tendon shall be at least two times the larger of the cross-section dimensions.

C10.3.2.3.2

Table 11.5.5.4.1-1—Minimum Required ASTM F3125 Bolt Tension, kips

Bolt Size	Grade A325 or F1852	Grade A490 or F2280
0.5	12	15
0.625	19	24
0.75	28	35
0.875	39	49
1.0	51	64
1.125	64	80
1.25	81	102
1.375	97	121
1.5	118	148

The minimum bolt tension values given in Table 11.5.5.4.1-1 are equal to 70 percent of the minimum tensile strength of the bolts.

Table 11.5.5.4.1-2—Nut Rotation from the Snug Condition

	Geometry of Outer Faces of Bolted Parts		
Bolt length measured from underside of head to end of bolt	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20. Bevel washer not used.	Both faces sloped not more than 1:20 from normal to bolt axis. Bevel washers not used.
Up to and including four diameters	$^1/_3$ turn	$^1/_2$ turn	$^2/_3$ turn
Over four diameters, but not exceeding eight diameters	$^1/_2$ turn	$^2/_3$ turn	$^5/_6$ turn
Over eight diameters, but not exceeding 12 diameters	$^2/_3$ turn	$^5/_6$ turn	1 turn

Rotation, as used in Table 11.5.5.4.1-2, shall be taken as rotation of the nut relative to the bolt, regardless of the element (nut or bolt) being turned. The tolerances is minus 30, plus 60°.

The values, given in Table 11.5.5.4.1-2, shall be applicable only to connections in which all material within grip of the bolt is steel.

For situations in which the bolt length measured from the underside of the head to the end of the bolt exceeds 12 diameters, the required rotation shall be determined by actual tests in a suitable tension device simulating the actual conditions.

The bolt length used shall be such that the end of the bolt is flush with or extends beyond the outer face of the nut when properly installed.

Tolerances are generous and are both plus and minus as the bolt tension in the inelastic range is not very sensitive to rotation.

No research work has been performed by the Research Council on Structural Connections (RCSC) to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters.

The requirement in the last paragraph of this Article related to the minimum bolt length is taken from Section 2.3.2 of RCSC (2014). Contract documents sometimes include a stick-through length requirement or minimum protrusion of the bolt point beyond the nut. However, because the threaded length for any given bolt diameter is constant regardless of the bolt length, an excessive stick-through length requirement, which may require a longer bolt, increases the risk of jamming the nut on the thread run-out. Because a stick-through length requirement does not enhance the performance of the bolt and can reduce the rotational ductility of the fastener, a minimum stick-through requirement should not be specified. Note that there is no specified maximum limitation on bolt stick-through. However, in order to provide the rotational ductility of the fastener required for proper tensioning of high-strength bolts, sufficient threads in the grip must be available. Three full threads located within the grip of the bolt is sufficient to provide the required ductility. The use of an additional flat washer under the bolt head is a common solution to provide the additional threads within the grip or when there is a risk of jamming the nut on the thread run-out. For standard holes, up to two washers may be used under either or both the head and the nut to accommodate variations in bolt and thread length.

11.5.5.4.2—Rotational-Capacity Tests

Rotational-capacity testing by the Manufacturer shall be required for all fastener assemblies with ASTM F3125 Grade A325 or A490 bolts. Rotational-capacity testing shall not be required for twist-off bolts (ASTM F3125 Grade F1852 or F2280). DTIs or captive DTI/nuts shall not be included in rotational-capacity testing assemblies. Assemblies specified as galvanized shall be tested after galvanizing. Washers shall be required as part of the test even though they may not be required as part of the installation procedure. Rotational-capacity testing shall be performed in accordance with ASTM F3125 Annex A2.

C11.5.5.4.2

An assembly lot is defined as a combination of fastener components of different types which are configured as they are to be installed in the steel. An example would be a bolt, nut, and washer. Each component in an assembly lot will have come from a production lot of similar components. Any change in component lots warrants additional testing of the assembly lots into which the component lots are integrated.

Rotational-capacity testing is not appropriate for twist-off bolts (ASTM F3125 Grade F1852 or F2280), or for DTIs and captive DTI/nuts, because these installation processes do not rely upon the ductility of the fastener. DTIs and captive DTI/nuts do not have to be included in rotational-capacity testing assemblies as this test is designed only to test the capacity of the nut and bolt.

The required starting tension in the ASTM F3125 rotational-capacity test is 10 percent of the required minimum installation tension, and is assumed to bring the connection to a snug condition.

The required nut rotations from the snug condition in the rotational-capacity test are approximately twice the required rotations specified in Table 11.5.5.4.1-2, adjusted to provide roughly equal ductility demand across different bolt sizes.

SECTION 26: METAL CULVERTS

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Table 26.4.2.4-1—Categories of Pipe Joints

	Soil Condition				
	Nonerodible		Erodible		
	Joint Type		Joint Type		
Joint Property	Standard	Special	Standard	Special	Downdrain
Shear Resistance	2%	5%	2%	5%	2%
Moment Resistance	5%	15%	5%	15%	15%
Tensile Resistance 0–42.0 in. dia.	0	5.0 kips	—	5.0 kips	5.0 kips
Tensile Resistance (48.0 in.–84.0 in.), dia.	—	10.0 kips	—	10.0 kips	10.0 kips
Joint Overlap, minimum	10.5 in.	NA	10.5 in.	NA	NA
Soil tightness	NA	NA	0.3 or 0.2	0.3 or 0.2	0.3 or 0.2
Watertightness	See Article C26.4.2.4				

26.4.2.5—Steel-reinforced Thermoplastic Culvert Joints

Joints for steel-reinforced thermoplastic pipe shall comply with the details shown in the contract drawings and on the approved working drawings. Each joint shall be sealed to prevent infiltration of soil (soiltight), fines (silttight), or water (watertight) as required by the contract documents. Field tests may be required by the Engineer whenever there is a question regarding compliance with the contract requirements.

Joints shall be installed so that the connection of pipe sections will form a continuous surface free from irregularities in the flow line.

C26.4.2.5

Joint types include bands, bell-and-spigot pipe ends, double-bell couplings, and fusion welded joints. Joints may or may not require gaskets. Other joint types may be used provided that documentation is submitted to demonstrate that the joint meets the project requirements.

Joints are often provided as soiltight or watertight. Definitions of soiltight and silttight are vague. Examples can be found elsewhere in this Section. Watertight joints are normally specified to meet ASTM D3212. Pressure capability of joints shall be based on project requirements. Commonly available pressure capabilities are 2, 5, and 10 psi.

26.4.3—Assembly of Long-span Structures

Unless held in shape by cables, struts, or backfill, longitudinal seams should be tightened when the plates are hung. Care shall be taken to align plates to ensure properly fitted seams prior to bolt tightening. The variation in structure dimensions before backfill shall comply with the following provisions:

- For horizontal elliptic shapes having a ratio of top to side radii of three or less, the span and rise shall not deviate from the specified dimensions by more than two percent.
- For arch shapes having a ratio of top to side radii of three or more, the rise shall not deviate from the specified dimensions by more than one percent of the span.
- For all other long-span structures, the span and rise shall not deviate from the specified dimensions by more than two percent, nor more than 5.0 in., whichever is less.

C26.4.3

Long-span structures may require deviation from the normal practice of loose bolt assembly.

The process of erection specified herein may require temporary shoring.

When required by structural design, reinforcing ribs shall be attached to the structural plate corrugation ~~crown~~ crest at the necessary locations around the circumference of the structure prior to backfilling, using a bolt spacing of not more than 12.0 in. or 16.0 in. for deep corrugated structural plate structures. Legible identifying letters or numbers shall be placed on each rib to designate its proper position in the finished structure.

It is acceptable to measure bolt spacing either at the centroid or crest of the structural plate corrugation.

When required for control of structure shape during installation, reinforcing ribs shall be spaced and attached to the corrugated plates at the discretion of the manufacturer with the approval of the Engineer.

Where reinforcing ribs are only used as an installation tool during backfill, they may be clamped or bolted as necessary to provide shape control.

26.5—INSTALLATION

26.5.1—General

For trench conditions, the trench shall be excavated to the width, depth, and grade shown in the contract documents.

Proper preparation of foundation, placement of foundation material where required, and placement of bedding material shall precede the installation of all culvert pipe. This work shall include necessary leveling of the native trench bottom or the top of the foundation material as well as placement and compaction of required bedding material to a uniform grade so that the entire length of pipe will be supported on a uniform base. The backfill material shall be placed and compacted around the pipe in a manner to meet the requirements specified.

Materials used for foundation improvements, bedding and structure backfill must have gradations compatible with adjacent soils to avoid migration. Where material gradations cannot be properly controlled, adjacent materials must be separated with a suitable geotextile.

All pipes shall be protected by sufficient cover before permitting heavy construction equipment to pass over them during construction.

All pipe laying, joining, and backfilling shall be in accordance with the strictest of the following requirements: the Manufacturer's instructions, the contract documents, or these Specifications.

26.5.2—Foundation

The foundation under the pipe and structure backfill shall be investigated for its adequacy to support the loads. A foundation shall be provided, such that the structure backfill does not settle more than the pipe to avoid downdrag loads on the pipe.

The foundation must provide uniform support for the pipe invert. Boulders, rock or soft spots in the foundation shall be excavated to a suitable depth and backfilled with material compacted sufficiently to provide uniform bearing as shown in Figure 26.5.2-1.

C26.5.2

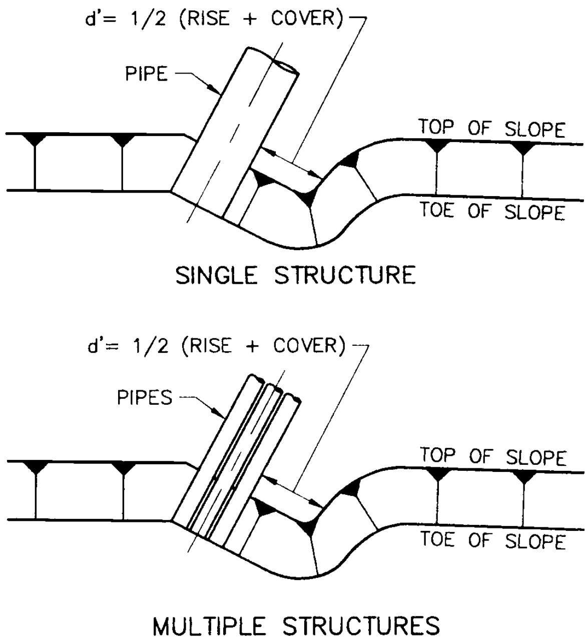

Figure 26.5.4.1-1—End Treatment of Skewed Flexible Culvert

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.

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.

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. 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. 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. 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.

26.5.4.5—Deep Corrugated Structural Plate Structures

Prior to construction, the Manufacturer shall conduct 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 deep corrugated structural plate structures shall be such that excessive structure distortion will not occur. A Manufacturer's representative shall be on site during initial sidefill placement and compaction, and shall review data on the shape when backfill reaches the minimum cover level over the top of the structure as set forth in the *AASHTO LRFD Bridge Design Specifications*. Structure backfill material shall be placed in horizontal uniform layers not exceeding an 8.0 in. loose lift thickness and shall be brought up uniformly on both sides of the structure. Each layer shall be compacted per the contract documents, but not less than 90 percent maximum density per AASHTO T 180 (modified Proctor test). The structure backfill shall be constructed to the lines and grades shown on the contract documents, keeping it at or below the level of adjacent soil.

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

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