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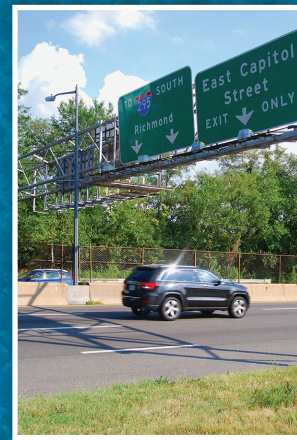
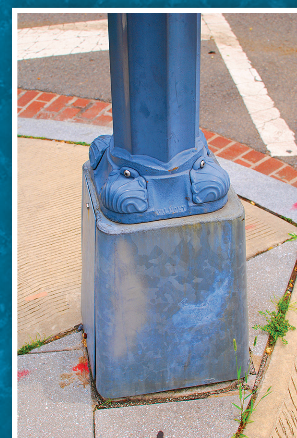


2015 Interim Revisions to

Standard Specifications for

Structural Supports for Highway Signs, Luminaires, and Traffic Signals



Sixth Edition 2013

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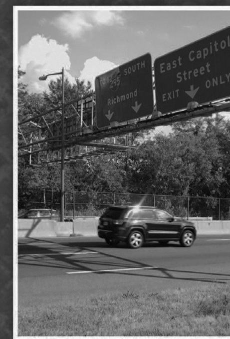

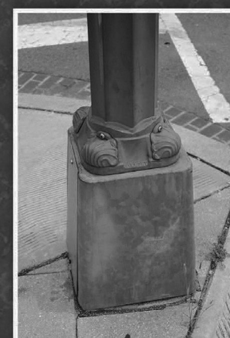

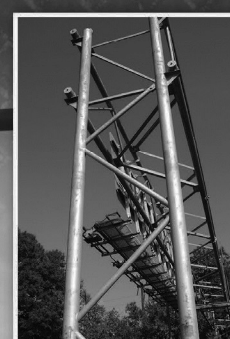

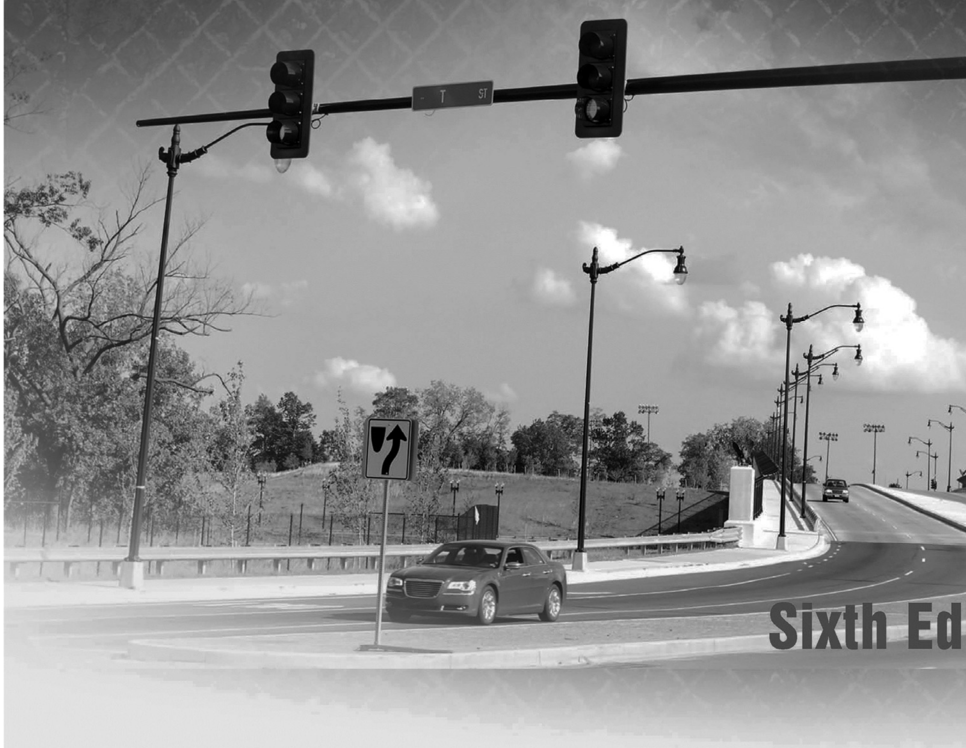

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INSTRUCTIONS AND INFORMATION

General

AASHTO has issued proposed interim revisions to *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, Sixth Edition (2013). This packet contains the revised pages. They are not designed to replace the corresponding pages in the book but rather to be kept with the book for fast reference.

Affected Articles

Underlined text indicates revisions that were approved in 2014 by the AASHTO Highways Subcommittee on Bridges and Structures. ~~Strikethrough text~~ indicates any deletions that were likewise approved by the Subcommittee. A list of affected articles is included below.

All interim pages are printed on pink paper to make the changes stand out when inserted in the second edition binder. They also have a page header displaying the section number affected and the interim publication year. Please note that these pages may also contain nontechnical (i.e., editorial) changes made by AASHTO publications staff; any changes of this type will not be marked in any way so as not to distract the reader from the technical changes.

Please note that in response to user concerns, page breaks are now being added within sections between noncontiguous articles. This change makes it an option to insert the changes closer to the affected articles.

2015 Changed Articles

SECTION 5: STEEL DESIGN

5.14.6.1
5.14.6.2
C5.15.2
5.15.5
C5.15.5

SECTION 11: FATIGUE DESIGN

11.7.2
11.9.3.1

SECTION 5: STEEL DESIGN

5.14.6—Holes and Cutouts

5.14.6.1—Unreinforced Holes and Cutouts

Revise the following paragraph as follows:

The width of unreinforced holes and cutouts in the cross-sectional plane of the tube shall not be greater than 40 percent of the tube diameter at that section for structures that are designed according to Section 11. The corners of the opening shall be rounded to a radius of 30 to 50 percent of the width of the opening. Alternative hole and cutout configurations may be approved by the Owner based on sound engineering practices. The minimum clear distance between the transverse plate and the opening shall not be less than the diameter of the tube.

Location of cutouts and appurtenances shall be approved by the Owner based on sound engineering practices.

5.14.6.2—Reinforced Holes and Cutouts

Revise the following paragraph as follows:

The width of reinforced holes and cutouts in the cross-sectional plane of the tube shall not be greater than 40 percent of the tube diameter at that section <u>for structures that are designed according to Section 11.</u> The corners of the opening shall be rounded to a radius of 30 to 50 percent of the width of the opening. Alternative hole and cutout configurations may be approved by the Owner based on sound engineering practices. The minimum clear distance between the transverse plate and the opening shall not be less than the diameter of the tube.

Location of cutouts and appurtenances shall be approved by the Owner based on sound engineering practices.

C5.15.2

Revise the following paragraph as follows:

A 60 percent weld penetration implies that the depth that the fused cross section (not counting reinforcement) extends into the joint from the weld face is 60 percent of the material thickness. Where electric resistance welding (ERW) is used, welding takes place simultaneously throughout the thickness of the tube wall. In this case, 60 percent fusion is needed to comply with the requirement.

Full-penetration seam groove welds on the female section of telescopic field splices are difficult to achieve in small tube diameters (330 mm (13 in.) or less), because of inadequate access from the inside of the tube for back gouging and welding. In lieu of full-penetration groove welds in this area, external longitudinal reinforcement bars that are at least as thick as the thickness of the tube to which they are being welded have been used as an acceptable method to ensure seam integrity. This alternate weld connection may be used if approved by the Owner. See Figure C5.15.2-1.

5.15.5—Weld Inspection

Revise the following paragraph as follows:

All welds shall be visually inspected (VT).

In addition to visual inspection, all full-penetration groove welds shall be inspected by magnetic particle testing (MT) or ultrasonic testing (UT), based on the thinnest mating material:

Thickness < 6 mm (0.25 in.)	MT
Thickness ≥ 6 mm (0.25 in.)	UT

<u>Full-penetration, laminated, tube-to-transverse-plate welds shall be inspected by magnetic particle testing (MT), after the welding of each individual ply.</u>

As an alternative, the Owner may require that full-penetration groove welds be inspected by radiographic testing (RT) or by destructive methods acceptable to the Owner. The full length of all full-penetration groove welds on all members of all structures shall be inspected, except for welds to arms less than or equal to 152 mm (6 in.) in diameter over their entire length.

Full-penetration groove welds associated with tube-to-transverse-plate connection details having a constant amplitude fatigue threshold (CAFT) of 69 MPa (10 ksi) or less shall be ultrasonically inspected for toe cracks after galvanizing. This inspection is in addition to the volumetric inspection required after fabrication.

In addition to visual inspection, partial-penetration groove welds and fillet welds shall be inspected by magnetic particle testing (MT) or by destructive methods acceptable to the Owner. A required length of all partial-penetration groove welds and fillet welds shall be inspected on a random 25 percent of all structures as shown in Table 5.15.5-1, except for welds to arms less than or equal to 152 mm (6 in.) in diameter over their entire length. The structures to be inspected shall be selected by the Owner, if requested. If there are fewer than four structures, at least one structure shall be randomly selected.

C5.15.5

Revise the following paragraph as follows:

Ultrasonic inspection is normally prequalified for material thicknesses of 8 mm (0.3125 in.) or greater, but has been shown to be effective for thicknesses down to and including 6 mm (0.25 in.). Additional prequalification of inspection is required within this thinner thickness range per AWS D1.1 Annex S "UT Examination of Welds by Alternative Techniques." AWS D1.1 Annex S is not part of AWS D1.1, but is included by AWS for informational purposes. The UT techniques described in AWS D1.1 Annex S are proven methods that have been used in the shipbuilding and offshore oil/gas industries for many years. <u>Reliable ultrasonic inspections of laminated tube-to-transverse-plate welds are not obtainable due to the transition of the wall thickness layers.</u>

Radiography is generally an expensive method of nondestructive testing requiring special safety precautions, influencing manufacturing productivity, and extending lead times.

Inspection requirements are not mandatory for welds to arms less than or equal to 152 mm (6 in.) in diameter over their entire length unless specified by the Owner.

Cracking after galvanizing at the toe of the weld connecting the tube to the transverse plate has been observed. These initial cracks reduce the fatigue performance of the connection. Ultrasonic testing of the connections using a small angle beam transducer can be used to detect the shallow toe cracks. Research has shown they can be successfully repaired in the shop.

With each welding repair, the micro-structure of the heated steel may change, potentially decreasing its strength and fatigue resistance.

SECTION 11: FATIGUE DESIGN

11.7.2—High-Mast Lighting Towers

Revise the following paragraph as follows:

High-mast lighting towers shall be designed for fatigue to resist the combined wind effect using the equivalent static pressure range of

$$P_{CW} = P_{FLS} C_d \tag{11.7.2-1}$$

where P_{FLS} is the fatigue-limit-state static pressure range presented in Table 11.7.2-1. HMLTs are defined as being 55 ft or taller structures. Luminaires less than 55 ft tall do not need to be designed for fatigue.

For the structural element considered, C_d is the appropriate drag coefficient specified in Section 3, "Loads," and shall be based on the yearly mean wind velocity, V_{mean}. The combined wind-effect pressure range shall be applied in the horizontal direction to the exposed area of all high-mast lighting tower components. Designs for combined wind shall consider the application of wind from any direction.

The yearly mean wind velocity used in determining P_{FLS} shall be as given in Figure 11.7.2-1. For all islands adjacent to the Alaska mainland and west coast Alaska mainland, use Range C (>4.9 m/s or 11 mph). For Alaska inlands, use Range B (4–4.9 m/s or 9–11 mph). For all Hawaii islands, use Range B (4–4.9 m/s or 9–11 mph).

Designers are cautioned of the effects of topography when considering location-specific mean wind velocity in their design. These effects can cause considerable variation in wind speed. For locations with more detailed wind records, the yearly mean wind velocity may be modified at the discretion of the Owner.

11.9.3.1—Stress Concentration Factors

Revise the following equation as follows:

For finite life design of tubular connections, fatigue stress concentration factors in Table 11.9.3.1-1 shall be calculated as per equations given in Table 11.9.3.1-3.

For infinite life design of tubular connections, the fatigue stress concentration factor in Table 11.9.3.1-1 shall be calculated as:

SI Units

$$K_I = \left[\left(1.76 + \frac{t_T}{13.9}\right) - 4.76 \times 0.22^{K_F}\right] \times K_F \qquad (11.9.3.1\text{-}1)$$

U.S. Customary Units

$$K_I = \left[\left(1.76 + 1.83 t_T\right) - 4.76 \times 0.22^{K_F}\right] \times K_F$$

where K_F is calculated from Table 11.9.3.1-3 for the respective details.

The parameters used in the expressions for stress concentration factors are:

C_{BC} = $\dfrac{D_{BC}}{D_T}$

C_{OP} = $\dfrac{D_{OP}}{D_T}$

D_{BC} = diameter of circle through the fasteners in the transverse plate; for connections with multiple bolt circles, use the outer most bolt circle (mm, in.)

D_{OP} = diameter of concentric opening in the transverse plate (mm, in.)

D_T = external diameter of a round tube or outer flat-to-flat distance of a multisided tube at top of transverse plate (mm, in.)

h_{ST} = height of longitudinal attachment (stiffener) (mm, in.)

N_{ST} = number of longitudinal attachments (stiffener)

t_{ST} = thickness of longitudinal attachment (stiffener) plate (mm, in.)

t_T = thickness of tube (mm, in.)

t_{TP} = thickness of transverse plate (mm, in.)

Table 11.9.3.1-3—Fatigue Stress Concentration Factors, K_F

Revise the following table as follows:

Section Type	Detail	Location	Fatigue Stress Concentration Factor for Finite Life, K_F	
Round	Fillet-welded tube-to-transverse-plate connections	Fillet-weld toe on tube wall	SI Units $K_F = 2.2 + 25(7t_T + 24) \times (D_T^{1.2} - 500) \times (C_{BC}^{0.03} - 1) \times t_{TP}^{-2.5}$ Valid for: 5 mm ≤ t_T ≤ 13 mm 203 mm ≤ D_T ≤ 1270 mm 38 mm ≤ t_{TP} ≤ 102 mm 1.25 ≤ C_{BC} ≤ 2.5 U.S. Customary Units $K_F = 2.2 + 4.6(15t_T + 2) \times (D_T^{1.2} - 10) \times (C_{BC}^{0.03} - 1) \times t_{TP}^{-2.5}$ Valid for: 0.179 in. ≤ t_T ≤ 0.5 in. 8 in. ≤ D_T ≤ 50 in. 1.5 in. ≤ t_{TP} ≤ 4 in. 1.25 ≤ C_{BC} ≤ 2.5	(11-120)
	Groove-welded tube-to-transverse-plate connections	Groove-weld toe on tube wall	SI Units $K_F = 1.35 + 33(7t_T + 12) \times (D_T - 130) \times \left(\frac{C_{BC}^{0.02} - 1}{4C_{OP}^{-0.7} - 3}\right) \times t_{TP}^{-2}$ Valid for: 5 mm ≤ t_T ≤ 16 mm 203 mm ≤ D_T ≤ 1270 mm 38 mm ≤ t_{TP} ≤ 102 mm 1.25 ≤ C_{BC} ≤ 2.5; 0.3 ≤ C_{OP} ≤ 0.9	(11-11)

Section Type	Detail	Location	Fatigue Stress Concentration Factor for Finite Life, K_F	
			U.S. Customary Units $K_F = 1.35 + 16(15t_T + 1) \times (D_T - 5) \times \left(\frac{C_{BC}{}^{0.02} - 1}{4C_{OP}{}^{-0.7} - 3}\right) \times t_{TP}{}^{-2}$ Valid for: $0.179 \text{ in.} \le t_T \le 0.625 \text{ in.}$ $8 \text{ in.} \le D_T \le 50 \text{ in.}$ $1.5 \text{ in.} \le t_{TP} \le 4 \text{ in.}$ $1.25 \le C_{BC} \le 2.5$ $0.3 \le C_{OP} \le 0.9$	
Round	Fillet-welded tube-to-transverse-plate connections stiffened by longitudinal attachments	Weld toe on tube wall at the end of attachment	SI Units $K_F = \frac{1}{1000}\left(79\frac{t_{ST}{}^{0.4}}{t_T{}^{0.7}} + 9\right) \times \left(\frac{D_T{}^{0.8}}{N_{ST}{}^{1.2}} + 30\right)$ Valid for: $6 \text{ mm} \le t_{ST} \le 19 \text{ mm}$ $8 \le N_{ST}$ ~~≤ 12~~ $6 \text{ mm} \le t_T \le 16 \text{ mm}$ $610 \text{ mm} \le D_T \le 1270 \text{ mm}$ U.S. Customary Units $K_F = \left(\frac{t_{ST}{}^{0.4}}{t_T{}^{0.7}} + 0.3\right) \times \left(0.4\frac{D_T{}^{0.8}}{N_{ST}{}^{1.2}} + 0.9\right)$ Valid for: $0.25 \text{ in.} \le t_{ST} \le 0.75 \text{ in.}$ $8 \le N_{ST}$ ~~≤ 12~~ $0.25 \text{ in.} \le t_T \le 0.625 \text{ in.}$ $24 \text{ in.} \le D_T \le 50 \text{ in.}$	(11-12)
	Fillet-welded tube-to-transverse-plate connections stiffened by longitudinal attachments	Fillet-weld toe on tube wall	SI Units $K_F = \left[\left(80\frac{D_T{}^{0.15}}{N_{ST}{}^{1.5}} + 1\right) \times \left(\frac{3.3}{h_{ST} + 178}\right) \times \left(\frac{33}{t_{ST}{}^{0.5}} - 1\right) \times K_F \text{ as per Eq.11-10}\right]$ Valid for: $305 \text{ mm} \le h_{ST} \le 1067 \text{ mm}$ $6 \text{ mm} \le t_{ST} \le 19 \text{ mm}$ $8 \le N_{ST}$ ~~≤ 12~~ $610 \text{ mm} \le D_T \le 1270 \text{ mm}$	(11-13)

Section Type	Detail	Location	Fatigue Stress Concentration Factor for Finite Life, K_F	
			U.S. Customary Units $K_F = \left[\left(130\frac{D_T^{0.15}}{N_{ST}^{1.5}}+1\right)\times\left(\frac{0.13}{h_{ST}+7}\right)\times\left(\frac{6.5}{t_{ST}^{0.5}}-1\right) \times K_F \text{ as per Eq. 11-10}\right]$ Valid for: 12 in. $\leq h_{ST} \leq$ 42 in. 0.25 in. $\leq t_{ST} \leq$ 0.75 in. 8 $\leq N_{ST}$ ~~$\leq$ 12~~ 24 in. $\leq D_T \leq$ 50 in.	
Multisided	As above	As above	Multiply respective K_F above (except for Eq. 11-12) by: SI Units $\left[1+\frac{1}{25}\left(D_T - r_b\right)\times N_S^{-2}\right]$ Valid for: 203 mm $\leq D_T \leq$ 1270 mm 25 mm $\leq r_b \leq$ 102 mm 8 $\leq N_S \leq$ 16 U.S. Customary Units $\left[1+\left(D_T - r_b\right)\times N_S^{-2}\right]$ Valid for: 8 in. $\leq D_T \leq$ 50 in. 1 in. $\leq r_b \leq$ 4 in. 8 $\leq N_S \leq$ 16	(11-14)