AASHTO T-14
2018 Agenda Items
Proposed Revisions to LRFD BDS Section 6

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### T-14 Agenda Item No. 21
Section 6, Table 6.6.1.2.3-1 and Article 6.17

<table>
<thead>
<tr>
<th>Description</th>
<th>Category</th>
<th>Constant A (ksi³)</th>
<th>Threshold (ΔF)_TH ksi</th>
<th>Potential Crack Initiation Point</th>
<th>Illustrative Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SECTION 1 – PLAIN MATERIAL AWAY FROM ANY WELDING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1.1 Base metal, except non-coated weathering steel, with rolled or cleaned surfaces, or base metal with flame-cut edges with a surface roughness value of 1,000 μ-in. or less, but without re-entrant corners.</strong></td>
<td>A</td>
<td>250 x 10⁸</td>
<td>24</td>
<td>Away from all welds or structural connections</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>1.2 Non-coated weathering steel base metal with rolled or cleaned surfaces designed and detailed in accordance with FHWA (1989), or noncoated weathering steel base metal with flame-cut edges with a surface roughness value of 1,000 μ-in. or less, but without re-entrant corners.</strong></td>
<td>B</td>
<td>120 x 10⁸</td>
<td>16</td>
<td>Away from all welds or structural connections</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>1.3 Base metal of members with re-entrant corners at copes, cuts, block-outs or other geometrical discontinuities made to the requirements of AASHTO/AWS D1.5, except weld access holes.</strong></td>
<td>C</td>
<td>44 x 10⁸</td>
<td>10</td>
<td>At any external edge</td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
</tbody>
</table>
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Section 6, Table 6.6.1.2.3-1 and Article 6.17

<table>
<thead>
<tr>
<th>Condition</th>
<th>Base Metal</th>
<th>Cross Section</th>
<th>Net Section</th>
<th>Base Metal at the Re-entrant Corner of the Weld Access Hole</th>
<th>Base Metal at the Net Section Originating at the Side of the Hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>C</td>
<td>44 x 10^6</td>
<td>10</td>
<td>In the base metal at the re-entrant corner of the weld access hole</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>D</td>
<td>22 x 10^6</td>
<td>7</td>
<td>In the net section originating at the side of the hole</td>
<td></td>
</tr>
</tbody>
</table>

- **Base metal of rolled cross sections with weld access holes made to the requirements of AASHTO/AWS D1.5, Article 3.2.4.**
- **Base metal at the net section of open holes in members made to the requirements of AASHTO/AWS D1.5 (Brown et al. 2007), except as specified in Condition 1.6.** All stresses shall be computed on the net section. (Note: see Condition 2.1 for holes with pretensioned high-strength bolts installed in standard-size holes.)
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Section 6, Table 6.6.1.2.3-1 and Article 6.17

1.6 Base metal at the net section of manholes or hand holes made to the requirements of AASHTO/AWS D1.5, in which the width of the hole is at least 0.30 times the width of the plate \((A \geq 0.30W)\) (Bonachera Martin and Connor, 2017). The geometry of the hole shall be:

| a. | circular; or |
| b. | square with corners filleted at a radius at least 0.10 times the width of the plate \((R \geq 0.10W)\); or |
| c. | oval \((B > A)\), elongated parallel to the primary stress range; or |

| C | \(44 \times 10^8\) | 10 |

In the net section originating at the side of the hole

![Diagram of different hole geometries](image-url)
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<table>
<thead>
<tr>
<th>d</th>
<th>rectangular ($B &gt; A$), elongated parallel to the primary stress range, with corners filleted at a radius at least 0.10 times the width of the plate ($R \geq 0.10W$).</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>$44 \times 10^8$</td>
</tr>
</tbody>
</table>

All holes shall be centered on the plate under consideration, and all stresses shall be computed on the net section.

(Note: Condition 1.5 shall apply for all holes in cross-sections in which other smaller open holes or holes with nonpretensioned fasteners are located anywhere within the net section of the larger hole, and minimum edge distance requirements specified in Article 6.13.2.6.6 are satisfied for the smaller holes.)
T-14 Agenda Item No. 22
Section 6, Article C6.6.2.1 and 6.6.2.2

• Description of Proposed Revisions:

• Item #1:
  ➢ Article C6.6.2.1 (6th paragraph) - clarify the designations for the steel grades in AASHTO M270M/M270 (ASTM A709/A709M) subject to Charpy V-notch testing requirements as follows:

The Charpy V-notch impact energy requirements, specified in AASHTO M 270M/M 270 (ASTM A709/A709M) and shown in Table C6.6.2.1-1, vary depending on the grade of steel, and the applicable minimum service temperature. FCMs are subject to more stringent Charpy V-notch impact energy requirements than nonfracture-critical components. Steel grades for nonfracture-critical tension members or components subject to Charpy V-notch testing should be designated with the suffix T in AASHTO M 270M/M 270 (ASTM A709/A709M), and steel grades for fracture-critical tension members or components subject to Charpy V-notch testing should be designated with the suffix F.
• Item #2:
  - Article 6.6.2.2 (2nd paragraph) - clarify the language related to the identification and designation of System Redundant Members (SRMs) as follows:

Where a refined analysis has shown that a simulated fracture of a primary member or a portion thereof for which the redundancy is not known by engineering judgment, does not result in a portion of or the entire bridge to collapse, that member or portion thereof A primary member or portion thereof subject to tension, for which the redundancy is not known by engineering judgment but which is demonstrated to have redundancy in the presence of a simulated fracture in that member through the use of a refined analysis, shall still be designated as a System Redundant Member (SRM) in the contract documents. The contract documents shall further indicate that SRMs are to be fabricated according to the provisions of Clause 12 specified in the AASHTO/AWS D1.5M/D1.5 Bridge Welding Code. These special members or portions thereof shall be identified as System Redundant Members (SRMs) in the contract documents. The criteria, assumptions, and other pertinent information related to the refined analysis used to demonstrate the redundancy shall be retained and included in the inspection records or permanent bridge file.
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Section 6, Article C6.6.2.1 and 6.6.2.2

• Item #3:

  Article C6.6.2.2 (end) – language added to clarify the reasons for the exclusion of bearing sole plates from the FCM requirements as follows:

  The exclusion of bearing sole plates from FCM designation is because they are located in regions of low or zero tensile stress at the ends of spans or in regions of compression at interior supports of continuous spans. Preheating to fracture critical temperatures may also be harmful to some bearing materials. Bearings and sole plates are also designated as secondary members in Table 6.6.2.1-1, exempt from FCM designation.
T-14 Agenda Item No. 23
Section 6, Article 6.13.2.5

- Item #1:
  - Revise Article 6.13.2.5 as follows:

6.13.2.5—Size of Bolts

Bolts shall not be less than 0.625 in. in diameter. Bolts 0.625 in. in diameter shall not be used in primary members, except in 2.5-in. legs of angles and in flanges of sections whose dimensions require 0.625-in. fasteners to satisfy other detailing provisions herein. Use of structural shapes that do not allow the use of 0.625-in. fasteners shall be limited to handrails.

Angles whose size is not determined by a calculated demand may use:

- 0.625-in. diameter bolts in 2.0-in. legs,
- 0.75-in. diameter bolts in 2.5-in. legs,
- 0.875-in. diameter bolts in 3.0-in. legs, and
- 1.0-in. diameter bolts in 3.5-in. legs.

The diameter of bolts in angles of primary members shall not exceed one-fourth the width of the leg in which they are placed.
Item #1:

- Revise Article C6.7.8 as follows:

Article 11.4.3.3 of the AASHTO LRFD Bridge Construction Specifications limits the minimum bend radius for all grades and thicknesses of steel conforming to Structural Steel for Bridges, AASHTO M 270M/M 270 (ASTM A709/A709M) used in fracture-critical or nonfracture-critical applications, and where the bend lines are oriented perpendicular to the direction of final rolling of the plate, to $5.0t$ where $t$ is the thickness of the plate. The radius is measured to the concave face of the plate. Where the bend lines are oriented parallel to the final rolling direction, the minimum bend radius is increased to $7.5t$. Web splice plates, fillers, gusset plates not serving as chord splices, connection plates, and web stiffeners are not included in the rolling direction requirements. For cross-frame or diaphragm connection plates up to 0.75 in., the minimum bending radii may be taken as $1.5t$. These limits are to ensure that the bending of the plate has not significantly lowered the toughness and ductility of the plate. Smaller radius bends may be used with the approval of the Engineer.
T-14 Agenda Item No. 24
Section 6, Various Articles

• Item #2:
  ➢ Revise the 8th paragraph of Article 6.13.6.1.3c as follows:

    Webs shall be spliced symmetrically by plates on each side. The splice plates shall extend as near as practical for the full depth between flanges without impinging on bolt assembly clearances or fillet areas on rolled beams. For bolted web splices with thickness differences of 0.0625 in. or less, filler plates should not be provided.
Item #3:

- Revise the 3rd paragraph of Article 6.13.6.1.4 as follows:

  Fillers 0.25 in. or more in thickness shall consist of not more than two plates, unless approved by the Engineer. The actual total filler thickness may exceed the total filler thickness shown in the contract documents by up to a maximum of 0.25 in.

- Add the following paragraph after the 3rd paragraph of Article C6.13.6.1.4:

  A tolerance of up to 0.25 in. on the total filler thickness is permitted should fabrication or rolling tolerances require the use of an additional filler not shown in the contract documents in order to adequately mate the fillers with the outer surface of the flange on the other side of the splice. A reduction in the specified filler thickness is permitted without restriction. Test results (Frank and Yura, 1981; Dusicka and Lewis, 2010) have shown that a 0.25-in-thick filler does not significantly reduce the resistance of the connection.
T-14/T-4/T-18 Agenda Item No. 25
Section 11, Articles C11.9.1 and 11.9.2

• Item #1:
  ➢ Revise the 2nd paragraph of Article C11.9.1 as follows:

  Based on research performed at Lehigh University, the fatigue strength of welded connections can be improved by post-weld Ultrasonic Impact Treatment (S. Roy, et al., 2005; S. Roy, and J.W. Fisher, 2005).
  
  Research performed at Lehigh University has shown that the fatigue strength of welded connections can be improved by post-weld 27 kHz Ultrasonic Impact Treatment (Roy et al., 2005; Roy and Fisher, 2005). Subsequent research performed at Purdue University has shown that post-weld 20 kHz Ultrasonic Impact Treatment has equivalent effectiveness (Hui et al., 2018). In general, the objective of UIT is to plastically deform the material at the weld toes and introduce residual compressive stresses substantially greater than the largest anticipated tensile stresses to a depth of no less than 0.02 in. (0.5 mm).
Revise the 4th paragraph of Article C11.9.1 as follows:

To successfully accomplish the treatment, the following sample procedure should be included in the special provisions of the contract documents, unless otherwise recommended by the UIT equipment Manufacturer: The following is a sample procedure for a particular 27 kHz Ultrasonic Impact Treatment system. Due to the proprietary nature of UIT, operating parameters may vary depending on equipment manufacturer. Whether a 20 kHz or 27 kHz system is selected, the treatment should be carried out following the equipment manufacturer’s recommended practices.

Note: removed all occurrences of “shall” and “must” in the description of the sample procedure.

Item #2:

Revise the 4th paragraph of Article 11.9.2 as follows:

Prior to UIT, the weld toe to receive UIT shall be visually inspected and magnetic particle-tested for conformance to the quality standards specified in the contract documents. The instrument shall be calibrated against the maximum flaw size allowed. Surface cracks Discontinuities greater than 1/32 in. (0.79 mm) shall be repaired satisfactorily prior to initiating the work.
# T-14 Editorial Items

<table>
<thead>
<tr>
<th>Location of Change</th>
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<th>Proposed Text</th>
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<tr>
<td>Article 6.13.2.7, 1st paragraph</td>
<td>The nominal shear resistance of a high-strength bolt (ASTM F3125) or an ASTM A307 bolt (Grade A or B) at the strength limit state in joints whose length between extreme fasteners measured parallel to the line of action of the force is less than 38.0 in. shall be taken as:</td>
<td>The nominal shear resistance of a high-strength bolt (ASTM F3125) or an ASTM A307 bolt (Grade A or B) at the strength limit state in joints whose length between extreme fasteners measured parallel to the line of action of the force is less than or equal to 38.0 in. shall be taken as:</td>
</tr>
<tr>
<td>Appendix A6, title</td>
<td>APPENDIX A6–FLEXURAL RESISTANCE OF STRAIGHT COMPOSITE I-SECTIONS IN NEGATIVE FLEXURE AND STRAIGHT NONCOMPOSITE I-SECTIONS WITH COMPACT OR NONCOMPACT WEBS</td>
<td>APPENDIX A6–FLEXURAL RESISTANCE OF STRAIGHT COMPOSITE I-SECTIONS IN NEGATIVE FLEXURE AND STRAIGHT NONCOMPOSITE I-SECTIONS WITH COMPACT OR NONCOMPACT WEBS IN STRAIGHT BRIDGES</td>
</tr>
<tr>
<td>Article D6.3.1, 1st paragraph</td>
<td>For composite sections in positive flexure, the depth of the web in compression in the elastic range, (D_c), shall be the depth over which the algebraic sum of the stresses in the steel, long-term composite and short-term composite sections from the dead and live loads, plus impact, is compressive.</td>
<td>For composite sections in positive flexure, the depth of the web in compression in the elastic range, (D_c), shall be the depth over which the algebraic sum of the factored stresses in the steel, long-term composite and short-term composite sections from the dead and live loads, plus impact, is compressive.</td>
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</tr>
</thead>
<tbody>
<tr>
<td>Eq. D6.3.1-1, “where” list</td>
<td>$f_c = \text{sum of the compression-flange stresses caused by the different loads, i.e., } DC1$, the permanent load acting on the noncomposite section; $DC2$, the permanent load acting on the long-term composite section; $DW$, the wearing surface load; and $LL+IM$; acting on their respective sections (ksi). $f_c$ shall be taken as negative when the stress is in compression. Flange lateral bending shall be disregarded in this calculation.</td>
<td>$f_c = \text{sum of the factored compression-flange stresses caused by the different loads, i.e., } DC1$, the permanent load acting on the noncomposite section; $DC2$, the permanent load acting on the long-term composite section; $DW$, the wearing surface load; and $LL+IM$; acting on their respective sections (ksi). $f_c$ shall be taken as negative when the stress is in compression. Flange lateral bending shall be disregarded in this calculation.</td>
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<td>$f_t = \text{the sum of the tension-flange stresses caused by the different loads (ksi). Flange lateral bending shall be disregarded in this calculation.}$</td>
<td>$f_t = \text{the sum of the factored tension-flange stresses caused by the different loads (ksi). Flange lateral bending shall be disregarded in this calculation.}$</td>
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