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steel interchange

*Note: Unless specifically noted, all AISC publications mentioned in the questions and/or answers reference the current edition and can be found at **www.aisc.org/specifications**.*

Flanges with Concentrated Forces

Section J10 of the *Specification for Structural Steel Buildings* (ANSI/AISC 360) states: "This section applies to single- and double-concentrated forces applied normal to the flange(s) of wide-flange sections and similar built-up shapes." Does this mean that the provisions of the section cannot be applied to sections other than wide-flange sections?

No. The statement is intended to indicate that the provisions were written to address concentrated forces applied to wide-flange sections. Most of the research has also involved only rolled wide-flange sections. However, the provisions can be adapted to address other conditions with some judgment.

For example, Section K: Additional Requirements for HSS and Box-Section Connections (K2) states: "The available strength of connections to rectangular HSS with concentrated loads shall be determined based on the applicable limit states from Chapter J."

In fact, the Commentary to Section J10 has been revised in the 2016 *Specification* to provide more guidance when checking sections other than wide-flange shapes. An example of this would be the use of Section J10 to check concentrated forces on HSS walls, which was previously addressed in Chapter K. The Commentary for Section J10 states: "The provisions in J10 have been developed for use with wide-flange sections and similar built-up shapes. With some judgment, they can also be applied to other shapes. The Commentary related to the individual subsections provides further detail relative to testing and assumptions." You will ultimately need to rely on your engineering judgment.

Flange local bending (J10.1) is based on a yield line analysis, which assumes a flange on each side of the web. It might make sense to assume only half the yield lines can be developed at a channel flange. Web local yielding (J10.2) assumes a distribution of 2.5:1 through the flange thickness and the fillet (k-distance). Since there is only a fillet on one side of the web at a channel, it might make sense to discount the strength accordingly. The stability checks, web local crippling (J10.3), web sidesway buckling (J10.4) and web compression buckling (J10.5) are more complex. You may want to look at the original research (listed at the end of the Commentary) and/or use a conservative model (possibly neglecting restraint from the flange) for these checks. The Commentary provides references for all of these checks, except web compression buckling equation, which is derived by Chen and Newlin; see "Column Web Strength in Steel Beam-to-Column Connections" from the 1971 ASCE Annual and National Environmental Engineering Meeting. There are plans to add a reference to this equation to the Commentary of the 2022 *Specification*.

Jonathan Tavarez

Stress Concentrations

I do not see any provisions in the *Specification* that account for the effects of stress concentrations. How are stress concentrations addressed?

The *Specification* does not address stress concentration through explicit provisions. Instead, it addresses the potential effects of stress concentrations indirectly through its requirements on welds, weld access holes, bolted connections and various other sharp discontinuities. The Commentary for Section A3.1a states: "Good workmanship and good design details incorporating joint geometry that avoids severe stress concentrations are generally the most effective means of providing fracture-resistant construction." Satisfaction of the *Specification* requirements should ensure the avoidance of severe stress concentrations. You can find a discussion on the effects of the specification requirements on stress concentrations in the Commentary for Sections J1.5, J1.6 and J10.1 and Appendix 3.

AISC Engineering FAQ 4.4.1 addresses stress concentrations and the impacts of notch toughness. (The AISC Engineering FAQs can be found at **www.aisc.org/faqs**.)

The details in Appendix 3 (Fatigue) also indirectly account for the effect of stress concentrations. NSBA's *A Fatigue Primer for Structural Engineers* provides further information and can be downloaded at **www.aisc.org/fatigueprimer**.

Jonathan Tavarez

Use of Oversized Holes in Bolted Flange-Plate Moment Connections

I am a fabricator working on a project with a large number of bolted flange-plate moment connections. The engineer of record (EOR) is not allowing the use of oversized holes and has specifically noted that they are not permitted during the shop drawing review. I feel that the oversized holes are necessary to accommodate the flange tilt tolerances on the column. Since the connection design has been delegated, I feel that the decision to use oversized holes in these connections is mine alone. Can I use oversized holes if the connections are designed as slip-critical?

No, not without approval from the EOR.

It is common to use oversized holes in the flange plates of a moment connection to accommodate column flange tilt. Some statements in AISC publications that confirm this are as follows:

- Page 12-4 of the 15th Edition *Manual* states, in a section on Flange-Plated FR Moment Connections: "Misalignment on short connections, as illustrated in Figure 12-3, can be accommodated by providing oversized holes in the plates."

- Section 7.5.4 in *Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications* (ANSI/AISC 358) states that for a prequalified bolted flange plate moment connection: "Standard holes shall be used in beam flanges. Holes in flange plates shall be standard or oversized holes." The user note in this same section states: "Although standard holes are permitted in the flange plate, their use will likely result in field modifications to accommodate erection tolerances."
- Appendix D in AISC Design Guide 13: *Wide-Flange Column Stiffening at Moment Connections* (**www.aisc.org/dg**) states: "Oversized holes should be used in the flange plates to allow for mill tolerances in the column and beam. These connections with oversized holes must be designed as slip-critical."
- The May 2004 *Modern Steel* article "30 Good Rules for Connection Design" states: "At flange-plated moment connections or brace connections with slip-critical bolts, oversized bolt holes are often preferred over standard bolt holes. Although standard holes give a greater bolt capacity, oversized holes permit more erection tolerance and reduce field problems. Typically, oversized holes are used in the detail material and standard holes in the main member."
- The December 2009 *Modern Steel* Steel Interchange, in the "Bolt Hole Alternatives for Fit-Up" question, states: "It is not uncommon to use oversized holes designed as slip-critical connections for certain applications such as vertical bracing and bolted flange plate moment connections. It is rare to see oversized holes used in beam connections." (Both articles are available at **www.modernsteel.com** in the Archives section.)

Though common, the use of oversized holes may not be appropriate in every situation, and ultimately the EOR is responsible for deciding what is acceptable for the project.

In addition, Section J3.2 of the *Specification* states: "Standard holes or short-slotted holes transverse to the direction of the load shall be provided in accordance with the provisions of this *Specification*, unless oversized holes, short-slotted holes parallel to the load, or long-slotted holes are approved by the EOR." You can use oversized holes parallel to the load when approved by the EOR.

Another consideration is what you have agreed to per the contract documents. We cannot arbitrate, but we can provide information that I believe may be relevant to your issue. Some relevant sections in the *Code of Standard Practice for Buildings and Bridges* (ANSI/AISC 303) are as follows:

- The Commentary to Section 3.1 states: "Contract documents vary greatly in complexity and completeness. Nonetheless, the fabricator and the erector must be able to rely upon the accuracy and completeness of the contract documents. This allows the fabricator and the erector to provide the owner with bids that are adequate and complete." The Commentary also states: "Some examples of critical information may include, when applicable: Restrictions on connection types."
- Section 3.1.1 of the *Code* states: "When Option 2 or 3 is specified, the owner's designated representative for design shall provide the following connection design criteria in the structural design documents and specifications: (a) Any restrictions on the types of connections that are permitted."
- Section 4.2.3 of the *Code* states: "When the fabricator submits a request to change connection details that are described in the contract documents, the fabricator shall notify the owner's designated representatives for design and construction in writing in advance of the submission of the approval documents. The owner's designated representative for design shall review and approve or reject the request in a timely manner."

If you believe that the contract documents permitted the use of oversized holes, but now the EOR is prohibiting the use of oversized holes, this may represent a change to the contract, a situation that is addressed in Section 9.3 of the *Code*.

Carlo Lini, PE

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