Steel Interchange

Steel Interchange is an open forum for *Modern Steel Construction* readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine.

The opinions expressed in *Steel Interchange* do not necessarily represent an official position of the American Institute of Steel Construction, Inc. and have not been reviewed. It is recognized that the design of structures is within the scope and expertise of a competent licensed structural engineer, architect or other licensed professional for the application of principles to a particular structure.

If you have a question or problem that your fellow readers might help you to solve, please forward it to us. At the same time, feel free to respond to any of the questions that you have read here. Contact *Steel Interchange* at:

Steel Interchange
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Question from February 2000:

Part 9 of the AISC LRFD *Manual of Steel Construction*, 2nd edition, Volume II – Connections, contains tables for single plate shear connections. These tables are dependent on the flexibility/rigidity of the supporting structural element. Part 9 defines a rigid support as a supporting member possessing relatively high rotational stiffness, such as a beam-to-column flange connection. A flexible support is defined as a member possessing relatively low rotational stiffness such as a one-sided beam-to-girder connection.

These definitions are also discussed in the *Hollow Structural Sections Connections Manual*. Would the following single plate shear connections be defined as rigid or flexible?

1. **Beam-to-face of structural tube.**
2. **Beam-to-web of wide flange shape.**

Is there any published information that provides guidelines for classifying supporting members as either rigid or flexible?

John V. Novelli, P.E.
Novelli Engineering
Shaftsbury, VT

In response to Mr. Novelli's question on rigidity of supports, for single plate shear connections I offer the following thoughts:

The explanation of rigidity as stated in the AISC *LRFD Manual*, 2nd ed., may appear nebulous to some but was purposely presented that way so as not to restrict the range of judgment required by the design professional.

There are two aspects of support rigidity–the rigidity (stiffness) of the entire supporting member and the rigidity of the immediate area where the connection is to be made. Both affect the rotation-resisting ability of the joint.

The questioner asks about the degree of rigidity of the face of an HSS. A lot depends on the width and thickness (b/t ratio) of the HSS face, the length of the shear plate and its location, whether near the center of the face or near the radiused corner. Some guidance in this regard is given on page 4-97 of the *HSS Connections Manual*, but ultimately it's a judgment call by the design professional.

The questioner also asks about a single plate shear connection to a wide-flange web. Do not use this connection method without building and extending the connection out past the column flange tips. The erector cannot pin the connection, nor ream the holes if necessary, nor pretension the bolts using a "gun." Conventional shear plates are not intended for use in wide-flange column webs.

David T. Ricker, P.E.
Javelina Explorations
Payson, AZ

Another response:

My approach has always been to use the more conservative value unless I've had to use the other case to make the connection work (i.e., if the lesser value would work, I didn't have to wrangle with deciding whether the support was rigid or flexible).

Otherwise, I'd look at the connection and see where the rotation was likely to come from. If the support were the likely source, I'd call the support condition flexible. If the connection were the likely source, I'd call the support condition rigid. Some details fall in between and you have to use your best judgment.

Charles J. Carter, S.E., P.E.
American Institute of Steel Construction
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Via email:

Is there a reference or any published guidelines that would assist the Engineer in deciding whether expansion joints are needed in a building structure and if so where they should be located?

Joe Underwood
Karl R. Rohrer Associates, Inc.
Akron, OH

The most commonly cited reference on expansion joints is a 1974 report from the Federal Construction Council Standing Committee on Structural Engineering titled *Technical Report No. 65: Expansion Joints In Buildings*. Copies are available for a fee from the Federal Facilities Council at 202/334-3374.

Keith A. Grubb, S.E., P.E.
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Chicago, IL

Via email:

I just received a fax from one of our fabricating customers that says that we must now provide what they call "safety holes" for beams framing into column webs. I'll try to see if I can adequately describe it.

For example, the column web would have six rows of holes. The clip angle on one side of the column web would have five rows of holes and would bolt on the upper five holes of the column web. The clip angle on the other side of the column web would also have five rows of holes, but would bolt to the lower five holes in the column web. Four rows of bolts (middle four) would be in double shear and two rows (top and bottom) would be in single shear. I'm assuming this is for safety during the erection. Great idea! Is this now being required and specified by AISC? Will this affect the design and loading requirements?

Randy Sedlacek

There is no AISC requirement that the "safety hole" approach to erection safety must be used at a double connection because there are many other acceptable ways to make the situation safe. I think everyone agrees that the safe erectability of a double connection (e.g., common bolts shared through the web of a column or girder over the top of a column) should be considered, particularly when there is a fall-away hazard.

I think the term "safety connection" was coined in Canada to describe the detail you mentioned: extending one of the back-to-back connections down an extra set of bolts to allow the first beam to be connected while the crane goes to get the next beam. That way, the ironworker doesn't have to hang the beam on a drift pin, a dangerous scenario.

A few other approaches include the use of one-sided connections like shear tabs and single angles (whenever possible or permitted), the use of erection seats on one side (or on both if you don't know the sequence of erection), the use of vertically or horizontally offset connections, and many other good approaches.

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In February's column, Mr. David E. Ayers, P.E., posed several questions about the use of X-bolts (where the bolt threads are intended to be excluded from the shear planes). The following is in response to his question about verifying the thread location.

All ASTM A325 and A490 high-strength bolts except for A325 T (fully-threaded) bolts, have a defined thread length based on their diameter. The thread lengths are summarized in Table 8-2, Dimensions of High-Strength Fasteners, in volume II of the *LRFD Manual of Steel Construction*, 2nd ed.

If the end of the bolt is visible, it is possible to calculate the location of the end of the threads and thus determine if an X-bolt is installed properly.

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