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. If you have a question or problem that your fellow readers might help you to solve, please forward it to *Modern Steel Construction*. At the same time, feel free to respond to any of the questions that you have read here. Please send them to:

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Modern Steel Construction
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Chicago, IL 60601-2001

Answers and/or questions should be typewritten and double-spaced. Submittals that have been prepared by word-processing are appreciated on computer diskette (either as a Word file or in ASCII format).

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.

Information on ordering AISC publications mentioned in this article can be obtained by calling AISC at 800/644-2400.

* * * * **Questions and answers can now be e-mailed to: rokach@aiscmail.com** * * * *

The following responses from previous Steel Interchange columns have been received:

(From November 1998)

Does the term "machine bolt" refer to the type of material (A307, A325) of the bolt or does it pertain to the thread geometry?

Would it be accurate to call out a ¾" diameter A325 bolt as a machine bolt on a structural drawing?

The term "machine bolt" refers to one of a general class of bolts often used in steel construction. Other names often applied are common bolts, ordinary bolts, and rough bolts. They may be forged or turned. Heads and nuts may be square or hex and vary in size and thickness. Material will vary but cannot be considered to be high-strength in the same context we associate with high-strength bolts. Other aspects of geometry may vary. Some of these bolts meet A307 requirements but none meet A325 standards. It is totally inaccurate to refer to an A325 bolt as a "machine bolt" on a structural drawing or anywhere else.

David T. Ricker
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(From November 1996)

How are stresses and strains calculated in curved I-beam monorails? Curved beam problems can be solved when the load is pointed to the center of the curve or away from the center. However, what is a practical solution for an I-beam with a curve for the trolley?

When dealing with curved wide flange or standard shape monorails, one can find information on stresses and deflections from references such as:

- *AISC Steel Design Guide #9: Torsional Analysis of Structural Steel Members*
- *Roark's Formulas for Stress & Strain*, by Warren C. Young (McGraw Hill, 6th Edition)
- *Design of Welded Structures*, by Omer Blodgett.

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(From February 1996)

One of the primary concerns in flexural design is the use of lateral bracing to control lateral-torsional buckling. What constitutes lateral bracing? Does the bracing member need to be a particular stiffness compared to the member being braced? Does it need to be a particular stiffness compared to the member being braced? Does it need to brace the compression flange, or will it serve its purpose if it braces the web? If the load is applied uniformly by a plate resting across the top flange of the beam, does the plate laterally brace the beam? What if the plate is welded to the beam?

1. What constitutes lateral bracing? For beams, a brace "must prevent the relative displacement of the top and bottom flanges, i.e., twist on the section" (Stability Bracing Specification Provisions and Commentary, to be published in the next LRFD Specification). A structural member can be considered a brace if it has sufficient strength and stiffness to restrain the compression flange from displacing or prevent the top and bottom flange from twisting (i.e. relative displacement).

2. Does the bracing member need to be a particular stiffness compared to the member being braced?
Yes, the brace must have adequate stiffness to provide sufficient restraint.

3. Does it need to be a particular stiffness compared to the member being braced?
Yes, the stiffness required is a function of the

amount of force in the flange which needs to be braced.In addition to the Stability Bracing Specification Provisions to be published in the next LRFD Specification, a good reference is *Bracing for Stability* by Joseph A. Yura and Todd A. Helwig, which was sponsored by AISC and the Structural Stability Research Council.

4. Does it need to brace the compression flange or will it serve its purpose if it braces the web?
The brace does not necessarily need to brace the compression flange as long as it prevents relative displacement between the top and bottom flanges (i.e., twist). Please note that "lateral" bracing systems which are attached near the beam centroid are ineffective.

5. If the load is applied by a plate resting across the top flange of a beam, does the plate laterally brace the beam? What if the plate were welded to the beam?
A plate resting on a beam may provide restraint through friction; however, this would not be a reliable or easily quantifiable restraining force. If the plate were welded to the beam, it would act compositely with the beam and increase its section properties in the weak direction thereby increasing the allowable length of flange that can be unbraced.

James Rongoe
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(From March 1994)

Under the ASD design specification, how is the maximum unbraced length (L_c) of a structural tee beam to be determined if the tee stem is in compression? How is the allowable flexural stress to be calculated if the unbraced length exceeds this limit?

In Section 9.12 (Lateral Buckling of Channels, Zees, Monosymmetric I-Shaped Sections, and Tees) of *Steel Structures: Design and Behavior*, 4th Edition, by C.G. Salmon and J.E. Johnson, the authors provide a discussion and also an example under the Tee Section.

For example, in 9.12.2, the moment strength of a structural tee section (a WT7x19) is investigated when the flange is in compression (case 1) and wit the stem in compression (case 2). The example also shows how the strength of the structural tee is affected by lateral bracing.

This procedure, while based on the LRFD Specification, is also applicable for structural tee sections designed by the ASD Specification.

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(From September 1998)

Is there a repair code for steel beams?

American Railway Engineering Association (AREA) *Manual for Railway Engineering* (1996) Chapter 15 "Steel Structures" Part 7 "Existing Bridges" Section 7.2 "Repair, Strengthening and Retrofitting" provides requirements for plate girders or rolled beam repairs.

Another useful publication is *ASCE Standard 11-90, Guideline for Structural Condition Assessment of Existing Buildings*.

Also, in the next (1999) LRFD Specification, a new Chapter N, "Evaluation of Existing Structures," will be added.

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NEW QUESTION

"Mill to bear" is a term often used in contract drawings and specifications. What precisely is the definition of "mill to bear", especially as it relates to *AASHTO Standard Specification for Highway Bridges* (16th Edition) and AWS D1.1 (1996)?

While our drawings do not call the parts "stiffeners", the closest we can come to the above question is paragraph 5.23.10 in D1.1. Because our contract does not reference AISC, Section M4.4 of the LRFD Specification (2nd Edition) is not being recognized by our customer.

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