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 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:

Steel Interchange
Modern Steel Construction
1 East Wacker Dr.
Suite 3100
Chicago, IL 60601

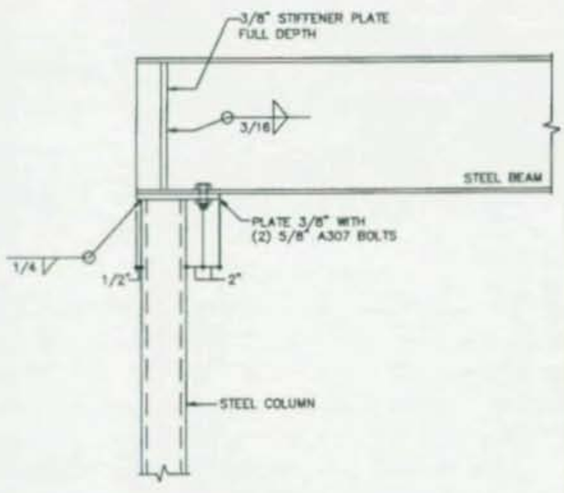
Answers and/or questions should be typewritten and double spaced. Submittals that have been prepared by word-processing are appreciated on computer diskette (either as a Wordperfect file or in ASCII format).

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 312/670-2400 ext. 433.

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

When designing a horizontal beam resting on columns with an unbraced compression top flange, may full-height web stiffeners at the bearing ends provide bracing to the compression flange without any intersecting beams? (See Detail)



COLUMN TO BEAM CONNECTION

The purpose of bracing the compression flange of a beam in bending is that this flange acts as a column and so is predisposed to buckle. The beam's web prevents buckling in the flange's weak direction; so it buckles sideways —about its strong axis (the beam's weak axis). (This is called "lateral torsional buckling" because the beam will twist as it buckles in this manner.) To prevent this, the compression flange must be braced.

However, the flange at the end of a simply supported beam is not in compression and doesn't need to be braced for this purpose. The web stiffener could help prevent web buckling if shear were high, but based on the very light connection detail shown, it's obvious that this is not a consideration.

Normally, the bracing utilized for situations where it is necessary is another compression member (i.e. a brace, not a stiffener) that is capable of resisting a small fraction of the flange compression force in the lateral direction. The actual design of such bracing is beyond the scope of this letter, but is described in books on structural steel design.

Mark W. Cunningham
Worcester, MA

Is it permissible to weld nuts to bolts to prevent them from backing off? Are any special welding procedures required? Is the bolt/nut strength affected?

There are countless thousands of examples where all kinds of bolts and/or nuts have been successfully welded to each other and/or to the connected parts: to preventing the nut from backing off; for holding the bolt in place during erection; for holding the fastener when there is no access to the far side of the assembled member; or, for sealing the fastener to make it air or water tight.

However, it is not recommended that welding be added to supplement the strength of a threaded fastener, for instance, where bolt threads are required, but fail, to engage the full threading of the nut.

Column anchor bolts, not subject to significant uplift, have been successfully welded to column base plates via heavy washers to prevent shifting of the base, but this is a special case requiring engineering judgement. A column anchor bolt can be extended utilizing a properly executed groove weld.

David T. Ricker
Payson, AZ

Consider eccentricity and what has to be done to accommodate it in various connections.

The determination of eccentricity and its importance require value judgements on the part of the designer. Even the most ordinary connection details

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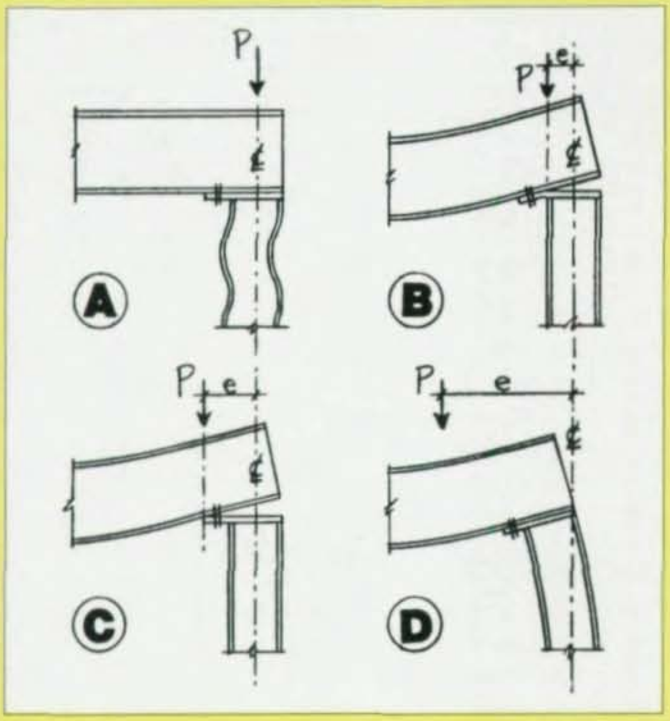

provide a system complex enough for illustrative purposes. In the hypothetical detail shown, the eccentricity is a function of the designed relative stiffness of the various components.

In Figure A, the load is applied near the column centerline when the beam stiffness is high and the column stiffness is low. The column cap plate stiffness is inconsequential.

In Figure B, the load is applied out near the column face when the beam stiffness is low, the column stiffness is high and the cap plate stiffness is low, causing yielding of the cap plate at the column face.

In Figure C, the load is applied further out, near the outer edge of the cap plate when the beam stiffness is low and the column and cap plate stiffnesses are high. The bolt stiffness is assumed to be low for the sake of the discussion.

In Figure D, the load is applied theoretically further out still, potentially beyond the connection itself when the beam and column stiffness are low. In this case, the eccentricity is the bending moment transferred to the column divided by the load magnitude. The cap plate stiffness is inconsequential.

More variations on this theme are possible in this detail but unnecessary to the discussion. Other apparently ordinary details can be subjected to this type of examination. Often, however, they are not. This examination is usually reserved for those classic details in which eccentricity of load application is an obvious and routine part of the detail design. It is nevertheless the responsibility of the designer to determine when this is necessary.

The AISC Specification provides guidelines for classifying connection details according to the degree with which eccentricity is involved. The reader is referred to the Types of Construction section in the General Provisions of the Specification in both the ninth edition of the Allowable Stress Design Manual and the first edition of the Load and Resistance Factor Design Manual. A comparison of the two is interesting. In the ASD Specification, connections are classified as either rigid, semi-rigid, or simple. In the LRFD Specification, connections are classified as fully restrained or partially restrained, with simple connections being a special case of partial restraint. The evolution of the terminology is also interesting, with emphasis moving away from the classification of simple vs. fixed to a desire to identify the degree of partial restraint involved.

As more precise determinations of partial restraint become common place in the design office, it will increasingly be the responsibility of the designer to make value judgements about how eccentricity of load application is involved, when it is to be considered to be critical and to design the connection components accordingly.

David B. Morris, P.E.
St. Paul MN

New Question

Listed below is a question we would like the readers to answer or discuss. If you have an answer or suggestion please send it to the Steel Interchange Editor, Modern Steel Construction, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

Questions and responses will be printed in future editions of Steel Interchange. Also, if you have a question or problem that readers might help solve, send these to the Steel Interchange Editor.

There is a dearth of information related to the preparation of a pin hole in a lifting lug. We would like an opinion and sources of information that would answer the following question:

If a pin hole in a lifting lug is flame-cut, should the net section be reduced to compute the capacity of the lug?

Thank you very much for making available to the profession a wide variety of opinions in this matter.

Richard W. Frazee, P.E.
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Maryland Heights, MO