

STEEL INTERCHANGE

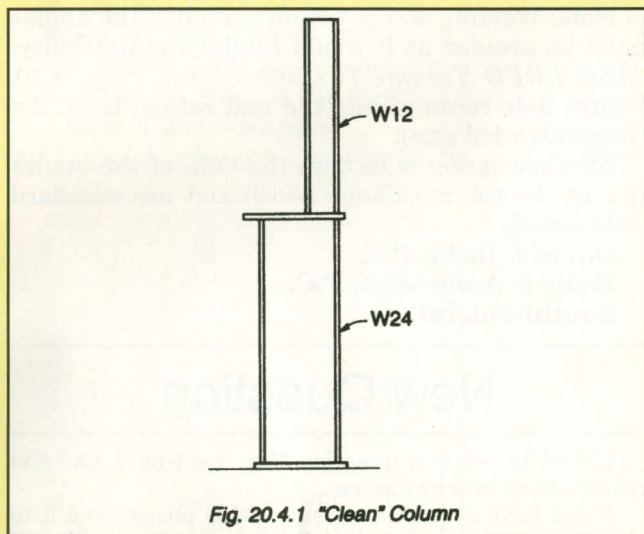
Steel Interchange is an open forum for *Modern Steel Construction* readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine. If you have a question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

Steel Interchange
Modern Steel Construction
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001

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

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

Question: How does one design a stepped column?



Answer: Appropriate references for this question can be found in many classical steel design textbooks. The book *Steel Structures Design and Behavior* by Salmon and Johnson includes many references for stepped columns. The *Mill Building Design Manual* is also another good source of information on stepped columns.

Mike Al Omari, P.E.
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Question: What is the procedure for designing a hole for piping in a simply supported steel beam? Are there special details?

Answer: There are several publications which provide adequate information for designing beams with web openings.

An excellent reference would be the AISC Steel

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 principals to a particular structure.

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

Design Guide Number 2, *Steel and Composite Beams with Web Openings*. David Darwin authored this design guide and provides a thorough discussion and the necessary equations for designing beams with web openings. Examples 1 and 2 of this publication cover the question asked. A detail of each design is also given.

The *Structural Engineer (S.E.) License Review Manual, Volume 3*, 4th Edition published by PEDP (Professional Engineering Development Publications, Inc.) provides two design examples of (1) a beam with a web opening (see pages 7-109 to 7-115) and (2) a beam with a large penetration (see pages 8-16 to 8-21). A detail of each design is also given.

If a check is desired to see if a beam is overstressed having a small opening placed in the web see the appendix page A-5 which is Section Modulus and Bending Stress in Unsymmetrical Sections in the *AISC Manual of Steel Construction, Volume 2 Connections*.

Timothy M. Young
Cumberland, VA

Question: When rolled wide flange sections are used as lintels to support masonry wall openings, should the allowable stress be reduced in accordance with Formulae F1-6 and F1-7 from the AISC Specification for the following cases:

1. Masonry is placed on the top flange. Sides are open. Masonry is unreinforced except for horizontal joint reinforcing?
2. Same condition as above except masonry is placed on each side of the web between the flanges?

Answer: The question really asks how much top flange lateral bracing is provided by the masonry.

While the masonry undoubtedly does provide some lateral support, the degree to which it does is so highly indeterminate that we in our practice assume that it provides no support.

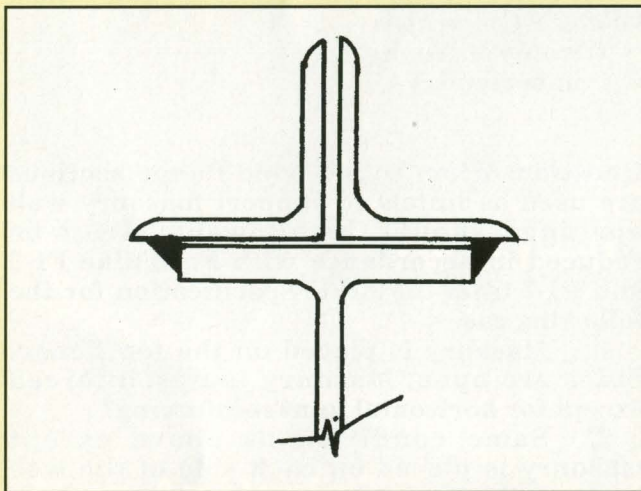
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There is one consideration much more important than stress in designing beams supporting masonry, and that is deflection. Section 5.6.1 of "Building Code Requirements for Masonry Structures", ACI 530-95/ASCE 5-95/TMS 402-95, specifies a limit on the deflection of beams and lintels supporting masonry elements of $1/600$, not to exceed 0.3". This is a relaxation of earlier industry recommendations which limited deflection to $1/900$, not to exceed 0.3 inches.) The purpose of this restriction is to limit cracking of the masonry due to deflection of the supporting member.

It is our office practice in designing rolled wide flange sections supporting masonry to calculate the required moment of inertia based on the deflection limitation (we often use the more restrictive $1/900$), and to select a member which meets this requirement and whose depth is modular with the masonry, i.e. 8" or 16", sometimes as deep as 24". With this approach we usually find that the stress due to bending is less than the maximum allowable stress given by formulae F1-6 and F1-7.

William Bretnall
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Question: How is a welded double angle connection designed when the double angles are connected to the flange of the column and welded on the back side of the double angles? See figure. This may be necessary when the column flange is short.



Answer: The standard connection as discussed in AISC *LRFD Volume II Connections* requires flexibility within the joint to allow the necessary end rotation. The design of this detail should follow AISC *LRFD Volume II* Table 9.3 or 9.4 with the appropriate end return.

The end return as defined in *LRFD Specification* Section J2.2b Paragraph, "Side or End Fillet Welds", states side or end fillet welds terminating at end or sides, respectively, of parts or members shall, wherever practicable, be returned continuously around the corners for a distance not less than 2 times the nominal size of the weld. This provision shall apply to side and top fillet welds connecting brackets, beam seats and similar connections, on the plane about which bending moments are computed. For framing angles and simple end plate connections which depend upon flexibility of the outstanding legs for connection flexibility, end returns shall not exceed four times the nominal size of the weld. Fillet welds which occur on opposite sides of a common place shall be interrupted at the corner common to both welds. End returns shall be indicated on the design and detail drawings.

Note: Welding across the entire top of the angles must be avoided as it would inhibit the flexibility. AISC *LRFD Volume II Connections* Page 9-11 Figure 9-4c recommends the end return to be $2w$ (w equals weld size).

Another option is to trim the OSL of the angles to suit the column flange width and use standard weld detail.

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New Question

Listed below is a question that 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 can also be sent via e-mail to newman@aismail.com.

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.

Question: Consider a stiffener welded to a flat plate. The stiffener and some amount of participating plate are considered to be an effective section. If the calculated shear at the stiffener to plate connection can be carried by an intermittent weld, is there a practical limit on weld spacing beyond which the stiffener and plate no longer act as a single member?

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