*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**

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.

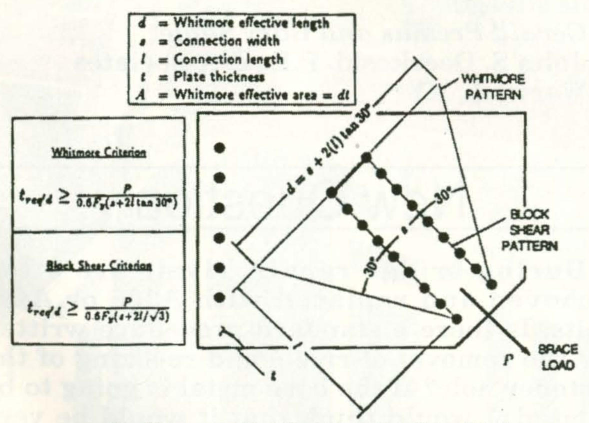
**** **Questions and answers can now be e-mailed to: rokach@aiscmail.com** ****

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

*(This answer ads to the previous answer in the April 1998 issue)*

**In many design examples in the 2nd Edition LRFD Manual of Steel Construction, yielding and buckling in a gusset plate or similar fitting are checked on a Whitmore section. What is a Whitmore section?**

Sometimes the Whitmore section "spills" over the boundaries of the connected elements as shown in the attached figure. If a "block shear" concept (see "Analytical Models for Steel Connections" by Ralph M. Richard, Behavior of Metal Structures, *Proceedings of the W.H. Munse Symposium*, ASCE, pp. 128-155, 1983) is used as shown rather than




The Whitmore and Block Shear Gusset Plate Design Criteria

the Whitmore section, this apparent dilemma is then circumvented with identical computed load results.

***Ralph M. Richard, Ph.D., P.E.***
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*(From April 1998)*

**Section I1. of the 9th edition of the AISC ASD *Manual of Steel Construction* defines the requirements for the determination of composite members. The specification details two situations:**

1. **When a beam is totally encased, relying on friction for composite action; and**
2. **When a beam is not totally encased, utilizing shear connectors for composite action.**

**What about other conditions? My situation is typical to many older industrial buildings. The beam is question is made up of a rolled steel section with concrete haunches and slab on one or both sides. This section does not meet code requirements for composite action because it does not have 2" of reinforced concrete soffit below the bottom flange, nor does it have shear connectors along the top flange. The beam does have reinforcing bars (#4 @ 12" EW) on both sides of the web that are welded to the flange and web.**

**My questions are as follows:**

1. **Is there any recorded research or publication available on the determination of composite action for members of this configuration?**
2. **How is the stiffness of the section affected?**
3. **Can the composite section be used in the determination of the natural frequency of floor framing?**
4. **Is there anyone I can contact to discuss my situation?**

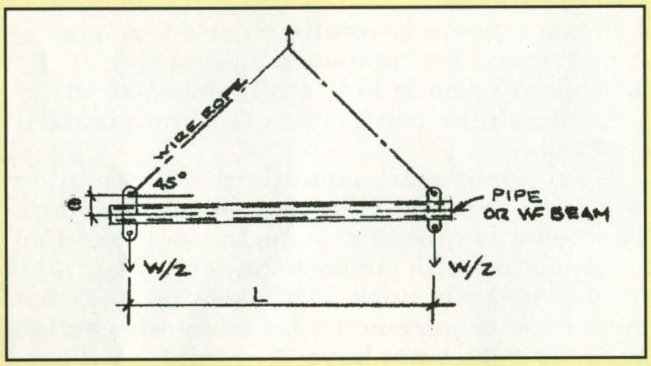
The definition of a composite section simply states that as long as horizontal shear transfer between different types of materials exists, then the cross sectional properties may be calculated using composite action. In this particular situation, the shear transfer occurs through the connection at the reinforcing steel. If the welded reinforcing steel is type ASTM A706, and the welded connection at the web of the beam is adequate to resist the shear as depicted in the AISC LRFD 2nd edition *Manual of Steel Construction* Section I5 (Section I4 in *ASD*

*9th edition)*, then the section may be considered composite. If the above requirements are satisfied, it can be concluded that the calculated stiffness may also be used in computing the natural frequency for this composite assembly.

***Kyriacos Panayiotou, P.E.***
**Micron Technology, Inc.**
**Boise, ID**

(From September 1997)

**A typical lifting beam or strongback in the materials handling, crane and rigging industry takes the form of either a horizontal or wide flange beam, with padeyes top and bottom at both ends. The lifting wire rope bridle with two legs at about 45 degree angle attaches to the top padeyes and the supported weight attaches to the bottom padeyes (see sketch).**




**The wire rope bridle induces both compression and bending moment in the lifting beam. Again, there is no lateral support.**

**What analysis would be used to solve for the safe lifting capacity of this form of lifting beam?**

The question points to the problem of establishing an allowable stress, which may be used to judge the efficiency of the design and adequacy of the selected member sizes once the design load stress distribution is known. The lifting beam is thus two problems: the first and easier problem is to determine the state of stress for the design loading; the second is to establish the allowable stress.

Feasible methods of stress analysis of the lifting beam are apparent. As was noted in the question, the lifting beam is subject to both moment and axial compression. The member may be readily analyzed as a beam-column using simple strength of materials methods. In exceptional cases, the analyst may elect to address more rigorously, using elastic theory or the finite element method, the stress distribution in the vicinity of the lifting lugs. The analysis of lifting lugs is discussed with specific regard to lifting beams by David T. Ricker in "Design and Construction of Lifting Beams," *Engineering Journal*, Fourth Quarter 1991.

A solution to the problem of allowable stress, however, is not so apparent. The American National Standards Institute, in the standard titled "Below The Hook Lifting Devices," requires a 3:1 safety factor based on yield for structural and mechanical lifting devices (ANSI/ASME B30.20). This working stress requirement is sufficient only to establish a performance criterion. In an addenda, ANSI/ASME B30.20C-1989 interpretation 20-2, ANSI makes clear that B30.20 is intended to provide the designer with a criterion of performance and that it is the designer's responsibility to achieve it within the framework of applicable design codes.

ANSI offers no guidance on how to incorporate the criterion of B30.20 with standard code formulae for allowable stress that are typically nonlinear and either not explicit functions of factor of safety or for which the factor of safety is embedded in a coefficient. in Chapter F of the the *LRFD Manual of Steel Construction*, AISC presents the designer with various formulae of this type for "beams and other flexural members." Should the designer's work be governed by AASHTO, allowable axial and bending stress formulae with explicit factor of safety terms are provided in the *Manual for Condition Evaluation of Bridges* and the factor of safety may be readily adjusted to 3:1 as required by ANSI.

The allowable stress for fabricated steel lug plates is discussed in the aforementioned article by Ricker. The allowable capacities of prefabricated components, e.g. hooks, shackles, and wire rope, are established as required by OSHA in 29 CFR part 1926.251 with a factor of safety of 5 on ultimate strength.

***Gerald Premus and Gary Sable***
**John S. Deerkoski, P.E., & Associates**
**Warwick, NY**

## New Question

**During bridge repair, rivets are often removed and replaced with A325 or A490 bolts. Is there a standard procedure written for the removal of rivets and re-sizing of the fastener hole? If the base metal is going to be re-used, I would think that it would be very important not to damage or overheat the base metal around the fastener hole. This base metal could be a multiple build-up of two, three or four plys. Should these rivets be removed with a machine or cutting torch? Rivets are pressed in when newly installed, should they be pressed out? What preparations should be taken to remove and rework a riveted connection?**

***Larry Lefoy***
**St. Louis, MO**