IF YOU'VE EVER ASKED YOURSELF "WHY?" about something related to structural steel design or construction, *Modern Steel Construction*'s monthly Steel Interchange column is for you! Send your questions or comments to solutions@aisc.org.

It is with great sadness we report that David T. Ricker died on February 22, 2008 in Payson, Ariz. Dave was a longtime member of the AISC Committee on Manuals and Textbooks and a frequent contributor of articles, papers, and answers to questions about steel design and construction, including in this feature, Steel Interchange. He authored several professional articles that are still provided with great frequency in response to questions received by AISC. To honor the memory of this friend of the steel industry, Dave is the focus of this month's Steel Interchange.

Dave graduated from the Norwich Free Academy in Norwich, Conn. and earned a Bachelor of Science degree in civil engineering from the University of Connecticut, where he also was a member of the Tau Beta Pi Engineering Honor Society. After serving in the Army during the Korean War, he was employed at the American Bridge Division of U.S. Steel Corp. in Elmira, N.Y. Later, he moved to the Berlin Steel Construction Company in Kensington, Conn., where after 27 years, he retired as the vice president of engineering.

As a licensed professional engineer, Dave was an active member serving on numerous committees for both AISC and the American Society of Civil Engineers (ASCE). He was a very influential member of the AISC manual committee and the ASCE committee on design of steel building structures. Dave received AISC's Lifetime Achievement Award for excellence in his field and was also honored by the University of Connecticut School of Engineering with a distinguished alumni award.

To read more about Dave's career and accomplishments, please visit **www.modernsteel.com/connectionman**.

Dave Ricker and his wife, Jacquelyn, at their home in 1999.

The following are just a few of the many answers that Dave provided to Steel Interchange questions over the years.

Welding to Existing Members

It is a general rule that welding on an existing structural member is not permitted unless provisions are made to unload the member first (for example, if the member is being reinforced) and that the weld must not degrade the properties of the material. Is there a written reference that discusses this from both a code perspective and a practical approach?

There is no general rule requiring existing members to be unloaded prior to field welding. Despite the desirability of such a rule, in the real world it is rare that an existing beam can be shed of both of its live and dead load, and rarer still for a column. However, there are proven procedures for field welding to existing load carrying members. One reference is "Field Welding to Existing Structures" in AISC's *Engineering Journal*, First Quarter, 1988. This reference also lists several other articles on the topic.

Lifting Beams

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 a 45° angle attaches to the top padeyes, and the supported weight attaches to the bottom padeyes.

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?

Procedures for both analysis and design of lifting beams are given in an article titled "Design and Construction of Lifting Beams," in the Fourth Quarter, 1991 issue of *Engineering Journal*. A more efficient section for resisting both bending and compression is generally a hollow structural section (HSS) rather than the pipe or wide-flange section.

Double-Angle Connections

How is a welded double-angle connection designed when the [wider] double angles are connected to the [narrower] flange of the column and welded on the back side of the double angles? This may be necessary when the column flange is short.

The design of double-angle connections using "back-side" welds is no different than when using conventionally placed welds. In fact, "back-side" flare bevel welds are quite common in HSS (hollow structural section) construction. The AISC connection tables can be used, as these take into account weld eccentricities on the angle legs connected to the column. But, do not attempt to make top returns on the vertical welds, as this may result in notches in the column flange edges.

If one needs to avoid a back-side weld, one can use angles with shorter legs, such as a 3½ in. by 2½ in., and use the normal weld placement. If this won't work, another connection such as a shear plate could be used.

steel interchange

Crane Rail Tolerances

How does the AISC *Code of Standard Practice* address the possible tolerance for vertical and horizontal alignment of a crane rail in a mill-type building?

The AISC *Code of Standard Practice* does not specifically address crane rail erection tolerance. However, AISE (now AIST) Technical Report No. 13 gives the following crane rail tolerances: The center-to-center distance of crane rails is not to exceed ¼ in. from the theoretical dimension. The horizontal misalignment of crane rails is not to exceed ¼ in. per 50 linear ft of runway with a maximum of ½ in. total deviation from the theoretical location. Crane rails should be centered on the crane girders whenever possible, but in no case should the eccentricity be greater than three-fourths the thickness of the girder web. Vertical misalignment of crane rails measured at the center lines of the columns shall not exceed ¼ in. per 50 linear ft of runway, with a maximum total deviation of ½ in. from the theoretical location.

Further information on crane runways can be found in AISC *Steel Design Guide* 7, *Industrial Buildings* and in the Fourth Quarter, 1982 issue of *Engineering Journal*, "Tips for Avoiding Crane Runway Problems."

Rivet Removal

During bridge repair, rivets are often removed and replaced with ASTM A325 or A490 bolts. Is there a standard procedure written for the removal of rivets and resizing of the fastener hole? If the base metal is going to be reused, 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 preparation should be taken to remove and rework a riveted connection?

The rivet question was actually four questions and can be summarized as follows:

1. Is there a written procedure for rivet removal and hole rehabilitation? No.
2. Should rivets be removed by mechanical means or by torch? Both methods are commonly and successfully used. Mechanically extracted rivets will usually cause less damage to the base metal. This may be a factor in bridge rehabilitation, where constant vibrations will accelerate fatigue failure. Most building structures experience static loading. Burning off rivet heads and "coring" the shanks are common methods of removing rivets. If done carefully, no damage to the base metal results.
3. Should rivets be pressed out? Yes, there is no other way. If the original rivet was installed in a hole where the plies were not perfectly aligned, the hot rivet assumed the shape of the crank shaft. These are difficult to remove and coring the shank will ease the task.
4. What preparation should be taken to remove and rework a riveted connection? When removing the rivet head, either by chisel or torch, care must be taken not to gouge the base metal beneath the head to the extent that it would prevent proper seating of the subsequently installed high-strength bolt. Misalignment of plies can be treated with a reamer.

To summarize: Whether to use a mechanical means or a torch to extract rivets depends mainly on the use to which the structure is subjected. This should be addressed in the project documents. Burned holes have been the subject of much unsubstantiated concern in recent years despite evidence to the contrary. For more information, see "Effect of Hole-Making on the Strength of Double Lap Joints" by Thomas Schlafly and Nestor Iwankiw in the AISC *Engineering Journal*, Third Quarter, 1982.

Note: *Engineering Journal* articles mentioned in these questions are available to AISC members and *e*Pubs subscribers at no charge at **www.aisc.org/epubs**. They may also be purchased through the AISC bookstore at **www.aisc.org/bookstore**.

The complete collection of Steel Interchange questions and answers is available online. Find questions and answers related to just about any topic by using our full-text search capability. Visit Steel Interchange online at **www.modernsteel.com**.

Kurt Gustafson is the director of technical assistance and Amanuel Gebremeskel is a senior engineer in AISC's Steel Solutions Center. Charlie Carter is AISC's chief structural engineer, and Lou Geschwindner is AISC's vice president of engineering and research.

Steel Solutions Center

One East Wacker Dr., Suite 700
Chicago, IL 60601
tel: 866.ASK.AISC • fax: 312.803.4709
solutions@aisc.org