

If you've ever asked yourself "Why?" about something related to structural steel design or construction, *Modern Steel's* monthly Steel Interchange is for you! Send your questions or comments to [solutions@aisc.org](mailto:solutions@aisc.org).

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### Clevises

Due to architectural considerations, I am using high-strength rods to support loads. I am being told that there is no available clevis-rod combination that meets the strength requirements per AISC *Manual* Table 15-4. I am further being told that clevis-rod combinations not included in Table 15-4 are not produced. Note that I have contacted a clevis manufacturer and have been told that they produce their products to AISC requirements.

**What are the AISC requirements for clevises? Is it true that clevises not listed in Table 15-4 cannot be obtained and do not comply with AISC requirements?**

My answer may surprise and possibly frustrate you. There are no AISC requirements governing clevises. Despite what you have been told it is likely that someone produces hardware that will suit your needs.

It is important to distinguish between the *Manual* and the *Specification*. The *Manual* does not provide requirements. It provides information and guidance, so the information provided in the *Manual* cannot be viewed as a requirement. Table 15-4 is provided as a convenience for our users. As stated in the table, the information must be confirmed with the manufacturer. AISC derives the information from the manufacturers. It is not generated by AISC.

However, the responses that you have received do not really surprise me. This information, though it has varied a little over time, has appeared in the *Manual* for a very long time. Though the information in the *Manual* is intended to reflect what is being done in the industry, it must be recognized that it also influences what is done in the industry. Engineers have confidence that they can get the hardware that is shown in the table, so they tend to specify this hardware instead of something else. Manufacturers respond to the volume of requests by producing the hardware shown in the table instead of some other configuration. What has been common practice continues as common practice and may appear to be an external requirement rather than the effect of market forces.

However, there is nothing in the AISC *Manual* that prevents a manufacturer from producing other configurations—or that should discourage engineers from specifying other appropriate hardware that is available. Ultimately, the engineer must evaluate the adequacy of the hardware for a given application.

Larry S. Muir, P.E.

### Calculating Beam Weight

**When calculating weights of beams for payment, is it correct to multiply the weight per foot by the length and not deduct for things like copes, cuts and bolt holes?**

Yes. Item (a) in Section 9.2.2 in the AISC *Code of Standard Practice* applies, and the weight is calculated as the nominal weight per foot times the detailed overall length. Item (e) in Section 9.2.2 further applies: "Deductions shall not be made for material that is removed for cuts, copes, clips, blocks, drilling, punching, boring, slot milling, planing or weld joint preparation."

Charles J. Carter, S.E., P.E., Ph.D.

### Calculating Plate Weight

**How do we calculate the weight for payment for a gusset plate that is nonrectangular?**

You are somewhere between Items (b) and (c) in Section 9.2.2 in the *Code*. Item (b) states: "The weights of plates and bars shall be calculated using the detailed overall rectangular dimensions." Item (c) states: "When parts can be economically cut in multiples from material of larger dimensions, the weight shall be calculated on the basis of the theoretical rectangular dimensions of the material from which the parts are cut." Your pentagonal shape will come from a rectangular plate, and perhaps multiple pentagons will come from the same plate if they can nest. Either case gets you back to the rectangular dimensions times the thickness times 490 pcf.

Charles J. Carter, S.E., P.E., Ph.D.

### Filled Composite Columns

**Are shear connectors required for all filled composite columns?**

No. AISC Design Examples (v. 14.1) I.3, I.4, I.5, I.6 and I.7 ([www.aisc.org/examples](http://www.aisc.org/examples)) all address filled composite member designs. The following statement is made in Example I.3: "Shear connection involves the use of steel headed stud or channel anchors placed within the HSS section to transfer the required longitudinal shear force. The use of the shear connection mechanism for force transfer in filled HSS is usually limited to large HSS sections and built-up box shapes, and is not practical for the composite member in question. Consultation with the fabricator regarding their specific capabilities is recommended to determine the feasibility of shear connection for HSS and box members. Should shear connection be a feasible load transfer mechanism, AISC *Specification* Section I6.3b

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in conjunction with the steel anchors in composite component provisions of Section I8.3 apply.”

Section I6.3 addresses force transfer mechanisms and provides three options for filled composite members: direct bearing, shear connection and direct bond interaction—all options that do not involve the use of shear studs.

A 2011 NASCC: The Steel Conference presentation by Will Jacobs, N23: New Composite Design Provisions in the 2010 AISC *Specification* ([www.aisc.org/2011nasconline](http://www.aisc.org/2011nasconline)), may be helpful.

*Carlo Lini, P.E.*

## Field-Cut Holes

**Several 3-in.-diameter holes need to be cut into steel beams that are already erected. Is it acceptable to thermally cut these holes?**

Yes. You might ask whether there is a more appropriate method for field cutting these holes. Generally speaking, that answer is no.

Issues with field cutting tend to relate to the accuracy of the cut. The use of a mechanical guide can improve the accuracy of the cut. AISC *Specification* Section M2.2 addresses thermal cutting of steel and defers you to AWS D1.1 clauses 5.15.1.2, 5.15.4.3, and 5.15.4.4 for acceptance criteria. This information can be supplemented by AISC Engineering FAQ 2.2.6, which provides some guidance on acceptable roughness limitations for thermally cut edges, and FAQ 2.2.7, which provides some guidance on how to repair edges that do not meet those limitations. The FAQs can be found at [www.aisc.org/faq](http://www.aisc.org/faq).

To ensure you and your contractor have the same expectations regarding the field-cut openings, I would suggest you incorporate the relevant recommendations from the above references plus whatever other guidelines you feel are appropriate for your situation in your response to the contractor on how to proceed with the field cutting of the holes.

Beyond this, it becomes an engineering judgment question in which the engineer of record must decide whether the existing beam that is to be penetrated requires reinforcement due to the penetrations (in which case, I refer you to AISC Design Guide 2: *Design of Steel and Composite Beams with Web Openings*, available at [www.aisc.org/dg](http://www.aisc.org/dg)). When deciding whether or not the beams require reinforcing, some consideration should be given to the fact that the holes will likely not be perfect circles and may be slightly oversized, especially if there are notches or grooves resulting from the field cut that need to be ground down or repaired. The ability of the contractor to make an accurate cut in the field may be influenced by ease of access to the member to be cut, including the presence of other items (ducts, pipes, ceiling tiles, etc.). I would suggest you discuss with your contractor how much tolerance they require on the field-cut holes based on your given circumstances so that you

can incorporate these into your evaluation of the penetrated beam. Alternatively, you could specify a tolerance which, if exceeded, would require additional work.

*Susan Burmeister, P.E.*

## Bracing Connections to Column Webs

**A peer reviewer has said that our design for a special concentrically braced frame (SCBF) does not conform to the AISC Seismic Provisions because the bracing connections frame to column webs. The reviewer has correctly pointed out that all examples in the AISC Seismic Design Manual are shown to the column flange. However, I cannot find any related restrictions in the Provisions. Are connections to column webs permitted for SCBF?**

Yes. Connections to column webs are permitted. The peer reviewer's position is a surprisingly common and persistent misconception. One reason the examples address connections to column flanges is that this permits more design considerations to be demonstrated. When connecting to the column flange, eccentricities must be accounted for that result in normal forces at the beam-to-column and gusset-to-column connections. When connecting to the web, only shears need be transferred at these connections, thus simplifying the design.

Examples to column webs are included in AISC Design Guide 29: Vertical Bracing Connections—Analysis and Design ([www.aisc.org/dg](http://www.aisc.org/dg)). Again, the fact that none of these examples is designed to meet the Seismic Provisions is not intended to convey a prohibition on column web connections. The Design Guide, though nearly 400 pages long, cannot address every conceivable configuration that might be encountered in practice, and neither can the manuals.

*Larry S. Muir, P.E.*

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Steel Interchange is a forum 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.

The opinions expressed in Steel Interchange do not necessarily represent an official position of the American Institute of Steel Construction 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.

If you have a question or problem that your fellow readers might help you solve, please forward it to us. At the same time, feel free to respond to any of the questions that you have read here. Contact Steel Interchange via AISC's Steel Solutions Center:

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