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!

Slot Dimensions

How are slotted holes applied—to the centers of the round portions of the holes (the dimensions given in the AISC *Specification*) or to the edges of the slot (out to out)?

Question sent to AISC's Steel Solutions Center

A slot is designated in the format of width × length with both dimensions being the out-to-out measurements to the edges of the slot. A short slot for a ¾" diameter bolt is designated as 13/16 × 1, and the out-to-out dimension of the slot length to the edges of the hole is 1".

Kurt Gustafson, S.E., P.E.
American Institute of Steel Construction

Slotted Hole Length

All steel books I have read list lengths of slotted holes as either short or long. How about the lengths in between? The shop where I previously worked used 13/16" × 1 1/16" slot punches. Would this still be considered a short-slotted hole?

I have always asked, "When does the length change from short to long?" No engineer whom I have asked has been able to provide an answer. How about slots longer than 13/16" × 1 7/8"? I would assume that it would be treated as a long slot. Is that right?

Question sent to AISC's Steel Solutions Center

Nominal hole dimensions for standard, oversized, short-slotted and long-slotted holes are given in Table J3.3 of the 2005 AISC *Specification for Structural Steel Buildings*, and in Table 3.1 of the 2004 *RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts*. There is no intermediate classification for slot lengths between that of the short and long designations. If a slot exceeds the length stipulated for a short slot, but is less than or equal to the long-slot length listed, this is considered a long-slot. If the slot length exceeds that of the long-slot for the given bolt diameter, this is not an installation in accordance with the AISC or RCSC specifications.

Kurt Gustafson, S.E., P.E.
American Institute of Steel Construction

Flame-Cut Bolt Holes/Residual Stress

Are there any provisions for flame-cutting holes into steel members regarding residual stresses?

Question sent to AISC's Steel Solutions Center

Limited testing by Iwankiw and Schlafly demonstrated that for static loading, connection strength and performance was not affected by flame-cutting bolt holes. Refer to AISC FAQ 5.1.3 at **www.aisc.org/faq** for additional information. Note that the 2005 AISC specification, Section M2.5, permits thermally cut holes subject to a surface roughness profile limitation. A copy of the 2005 specification is available as a free download at **www.aisc.org/2005spec**.

Sergio Zoruba, Ph.D., P.E.
American Institute of Steel Construction

Modulus of Ridgity for HSS

I am trying to find the torsion in an HSS 12×12. I am having difficulty finding a value for the modulus of ridgity. I checked your manual and I couldn't find a value. Is this information available? The steel is governed under ASTM A500 grade B.

Question sent to AISC's Steel Solutions Center

The shear modulus of elasticity (typically designated as G) is a function of Young's Modulus, E, and Poisson's ratio, ν, of steel, and is generally taken as 11,200 ksi for structural steel. Since all common structural steels have Elastic Modulus of 29,000 to 30,000 ksi, and $\nu = 0.3$ is also a constant, the shear modulus would not differ for ASTM A500 steel from that of other structural steels such as ASTM A992, A572, or A36.

By the way, G is defined at 11,200 ksi in the steel manuals: page 6-31of the 9th edition ASD manual, page 16.1-xvii of the 3rd edition LRFD manual, and page 16.1-xxxii of the 13th edition manual.

Kurt Gustafson, S.E., P.E.
American Institute of Steel Construction

Charpy V-Notch Test Results

My customer requires me to supply Charpy test results on raw material steel. Where can I get this information? The information is not available on the mill tests.

Question sent to AISC's Steel Solutions Center

A Charpy V-notch toughness test can be requested when placing an order with a mill. If it is requested, the information will appear on the mill report; otherwise, it will not typically be listed on the mill report.

For example, for ASTM A992 steel (all wide-flange shapes are produced to A992) one can specify Supplement S5 to the ASTM A992 Standard to require the steel producer to test the material for CVN toughness. In addition, Supplement S30 can be specified for alternative core locations to determine CVN toughness.

When purchasing smaller quantities of steel, say, from a service center, one may need to conduct a CVN test after the fact. Many testing labs have the capability to do this dynamic test. Please note that the test results typically apply to the same heat number. Therefore, if you have materials with many heat numbers, you will need a lot of tests.

Sergio Zoruba, Ph.D., P.E.
American Institute of Steel Construction

steel interchange

Short Anchor Rods

I have a column (gravity loads only) where the projected length of the anchor rod is too short. At best, the top of the nut is level with the top of the bolt. However, on some, the nut is 1/8" above the top of the rod. Is there a way to determine the capacity with a partially threaded nut?

Question sent to AISC's Steel Solutions Center

There are no code or specification provisions of which I am aware that cover the subject of partially engaged nuts on anchor rods. This becomes an engineering judgment on the part of the EOR. There was an excellent article in the May 2004 issue of *Modern Steel Construction* titled "An Ounce of Prevention" by Jim Fisher and Larry Kloiber, which gives their opinion of using straight line interpolation of the threads engaged in determining the anchor capacity. The article also gives other hints about anchor placement and repairs. You can download a copy of this article from the back issues section **www.modernsteel.com**.

Kurt Gustafson, S.E., P.E.
American Institute of Steel Construction

Bent Anchor Rods

What is the correct method for repairing a bent 1" diameter A36 anchor rod? The anchor rod is one of a set of four for a W10 column in the final structure. The bend is approximately 60 degrees and is located in the threaded region of the bolt, with no apparent cracking or kinks at the bend. Heating and bending has been brought up, but not decided on. Is this an adequate solution? If so, what codes or guidelines are available that discuss temperature, bending procedure, etc.

Question sent to AISC's Steel Solutions Center

The AISC specification does not cover subjects of anchor rod installation, acceptability, or repair procedures. The acceptability of bent anchor rods is largely a matter of engineering judgment involving evaluation of the purpose of the anchors in the final structure. Typically, anchors that are expected to carry significant load may be judged on a different scale than those that are required only for erection stability. The extent of the bend may also impact the decision. However, the purpose of the rod may again play a role in the decision. For information about bending you may want to look at the ASTM F1554 standard (which today is the preferred anchor rod material—the F1554 Grade 36 is essentially the same material as A36 except for the designation). The ASTM F1554 standard includes provisions for both cold-bending and hot-bending of the rods, with guidelines as to bending and temperature limitations and cooling procedures.

Kurt Gustafson, S.E., P.E.
American Institute of Steel Construction

Welding HSS

When welding flat surfaces to rectangular HSS, a flare-bevel situation is created. The effective throat size is defined by Table J2.2 as 5/16 of the radius. I found a little information on this radius in the appendix of the HSS specification, but is there a comprehensive table somewhere? It seems like the inner and outer radii should be included in Table 1-11 with the rest of the dimensions.

Question sent to AISC's Steel Solutions Center

Table J2.2 is similar to the information in AWS D1.1 for convenience. The radii will vary from supplier to supplier, so it is impractical to make a table with such values. The radius of any outside corner of the HSS is taken as either $1.5t_{des}$ or $2t_{des}$ depending on the design purpose as indicated on page 1-5 of the 13th Edition *Steel Construction Manual*.

Sergio Zoruba, Ph.D., P.E.
American Institute of Steel Construction

Steel Interchange is a 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.

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.

If you have a question or problem that your fellow readers might help you to 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:

Steel SolutionsCenter
One East Wacker Dr., Suite 700
Chicago, IL 60601
tel: 866.ASK.AISC • fax: 312.670.9032
solutions@aisc.org