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.

C_b for HSS Beams?

Are C_b values permitted in the design of HSS beams? Are C_b values greater than 2.3 permitted, in any case, in ASD? Is there an instance where C_b = 4.7 for an unbraced square HSS cantilever with a concentrated load at the end is justifiable?

The amplification of beam strength by C_b cannot result in a value that is larger than the full yield strength of the member ($F_y Z$) – that is, C_b can only be applied to the lateral-torsional buckling portions of the beam curve up to the value of full yield of the section. This is demonstrated graphically on page 3-4 of the 13th edition AISC *Manual*. Since HSS beams are not subjected to lateral-torsional bucking and are always controlled by the yield or local buckling strength of the member, C_b does not apply.

Speaking more generally, the upper limit on C_b is 3.0, as given by formula F1-1 of the 2005 *Specification*. So yes, a value greater than 2.3 is permitted. However, there is no case where C_b = 4.7 can be used.

Chris Hewitt, S.E.

ASTM F1554 vs. ASTM A449 Anchor Rods

I am trying to better understand when to specify F1554 vs. A449 for anchor rods. Table 2-5 in the *Manual* does not indicate a preferred material specification for high-strength anchor rod. Is there a reason for this? Is there a preferred material for anchor rods?

ASTM F1554 and ASTM A449 refer to specific material types that meet specific ASTM Standards. Both of these material types are permitted for use as anchor rods under the auspices of the AISC *Specification*. Table 2-5 in the 13th edition *Manual* shows ASTM F1554 grade 36 as the usual grade for the general case. If you are specifically going to use a high-strength anchor rod, ASTM F1554 is the preferred type, since this is a standard specifically developed for anchor rods.

The ASTM F1554 anchor rods are available in three grades of 36, 55, and 105 ksi minimum yield stress material, and are available in specified lengths, with threading lengths as specified. ASTM A449 is a general material standard that is applicable to other applications of bolts, screws, and studs as well as for anchor rods. ASTM A449 does not have stipulated minimum yield strength; however, the material exhibits tensile strengths similar to some of the ASTM F1554 grades. Since the nominal tensile stress listed in Table J3.2 is determined based on the F_u of the material, the EOR is able to assess the tensile capacity of the ASTM A449 rods.

Kurt Gustafson, S.E., P.E.

Reuse of ASTM A325 Bolts

ASTM A325 bolts have been specified to connect lifting lugs to column cap plates. After the columns are loaded onto trucks, the lifting lugs need to be removed due to shipping height restrictions. Can these bolts be reused at the job site to lift the columns again, if the bolts are just snug-tight previously?

Bolts can be reused if they have not been pretensioned. ASTM A325 bolts that are not galvanized can be reused even if they have been pretensioned. ASTM A490 bolts and galvanized A325 bolts cannot be reused once they have been pretensioned.

The Commentary to Section 2.3.3 of the RCSC *Bolt Specification*, which can be downloaded for free from **www.boltcouncil.org**, states:

Pretensioned installation involves the inelastic elongation of the portion of the threaded length between the nut and the thread run-out. ASTM A490 bolts and galvanized ASTM A325 bolts possess sufficient ductility to undergo one pretensioned installation, but are not consistently ductile enough to undergo a second pretensioned installation. Black ASTM A325 bolts, however, possess sufficient ductility to undergo more than one pretensioned installation as suggested in the Guide, which can also be downloaded from **www.boltcouncil.org** *(Kulak et al., 1987). As a simple rule of thumb, a black ASTM A325 bolt is suitable for reuse if the nut can be run up the threads by hand.*

Larry S. Muir, P.E

Brace Stiffness

I have been questioned about calculations for a stability bracing member per AISC 360-05 Appendix 6, Equations A-6-7 and A-6-8. I can calculate the required brace stiffness, but how do I calculate the actual brace stiffness provided?

The required brace stiffness from Equation A-6-8 in the AISC *Specification* represents the required axial stiffness of the brace. The actual brace stiffness provided can be calculated using the relationship $\Delta = PL/AE$.

Kurt Gustafson, S.E., P.E.

Fire Rating of Concrete-Filled HSS

Where can I locate fire rating information for concrete-filled HSS?

There is a method of determining the fire rating of concrete-filled HSS columns shown on page 28 of AISC *Design Guide 19*, which is available for free download by AISC members at **www.aisc.org/epubs**. This discussion is based on research conducted at the National Research Council of Canada and presented in ASCE/SFPE 29-99.

Amanuel Gebremeskel, P.E.

Welding or Bolting?

Does welding steel decrease the strength as opposed to bolting? What are the benefits/pros to bolting versus welding?

Welding does not reduce the strength of steel.

The choice between welding and bolting is often driven by economics and shop and field preferences. It is common to try to limit welding to the shop and provide bolted connections in the field. However, even these preferences can vary by application, contractor preferences, and regional conditions. Ask the fabricator on your project what details will be best for the project. They will probably be more than happy to help.

Larry S. Muir, P.E.

steel interchange

Design Guide 11—Walking Speeds

I could not find information in AISC *Design Guide 11* whether to assume "fast," "moderate," or "slow" walking speed criterion when designing for sensitive equipment. The remainder of the criteria for sensitive equipment vibration calculations seems rather straightforward. My problem is that I can easily achieve good results for walking speeds of 75 steps per minute (moderate) or less, but it's nearly impossible to achieve this for fast walking speeds of 100 steps per minute. The examples indicate that fast walking speeds are generally conservative, but I could use additional direction. The moderate criterion for 75 steps per minute seems reasonable to me, but I have no reference. Do you know of any additional sources of information that provide guidance as to where fast, moderate, and slow walking speeds should be used?

The following response was offered by Dr. Thomas Murray, lead author of AISC *Design Guide 11*:

To my knowledge there is no hard-and-fast guidance for when the various walking speeds are to be used. I recommend the following:

- For laboratories with one or two technicians, use slow walking.
- For laboratories with three and more technicians, use moderate walking.
- For laboratories adjacent to corridors using the same framing, and with high traffic, use fast walking.

Design Guide 11 recommends 100 steps per minute for fast walking, and as you said, that results in very stiff floor requirements. Many designers use 85 steps per minute for fast walking situations, which results in more reasonable requirements.

Thomas M. Murray, Ph.D., P.E.
Emeritus Professor of Structural Steel Design
Department of Civil Engineering
Virginia Tech

Column Leveling Plate

For column bases, what is the relationship between the base plate size and leveling plate size?

Use of leveling/setting plates is one method of column erection that can be selected at the option of the erector. There are no specific requirements listed in the AISC *Specification* as to when this method (or another) is to be used or as to the size of the plates required. When the method is used, setting plates are usually about ¼ in. thick and slightly larger than the base plate, and they are grouted in place in advance of column erection. A plate this thin has a tendency to warp when fabricated and thus, this method is typically limited to a maximum plate dimension of about 24 in. Individual preferences on this limit—and the column erection method in general—will vary. See AISC *Design Guide 10* at www.aisc.org/epubs for a discussion of the various column erection methods that are commonly used.

Kurt Gustafson, S.E., P.E.

Round HSS or Pipe?

What is the difference between round HSS and pipe shapes?

Round HSS most typically are manufactured in the U.S. to the ASTM A500 Standard. Pipes covered under the AISC *Specification* are manufactured to the ASTM A53 Grade B Standard. The materials have different minimum specified yield strengths but similar dimensional characteristics in the cross-sections that match between these different products. F_y = 42 ksi for ASTM A500 Grade B Round HSS, whereas F_y = 35 ksi for ASTM A53 Grade B Pipe. For further information about differences and similarities, see "Are You Properly Specifying Materials?" in the January 2009 issue of MSC (available online at www.modernsteel.com).

Kurt Gustafson, S.E., P.E.

Extended Single-Plate Shear Connection

I have a question pertaining to Example IIA-19 (Extended Single-Plate Connection—Beam-to-Column Web) from the Design Examples CD that is issued with the 13th edition AISC *Steel Construction Manual*. Why is e = 10.5 in. used for calculating shear strength of the bolt group, while a = 9 in. is used to calculate the required strength of the plate? Should we use a = 10.5 in. in this case?

The design example is correct. An eccentricity measured from the face of the support to the center of the bolt group is used to check the bolts, but an eccentricity measured from the face of the support to the first line of bolts is used to check bending on the plate. This is done to account for the fact that some of the load has been transferred out of the plate through the bolts at that first line of bolts.

Larry S. Muir, P.E.

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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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