STEEL INTERCHANGE

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 clearly presented. E-mail submittals and/or e-mail attachments are welcome.

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To order an AISC publication mentioned in this article, call AISC Publications at 800/644-2400.

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

Question from May 1999:

Are there any references on the maintenance of weathering steel wall panels or structural members? Can weathering steel be painted?

An excellent reference for weathering steel is at the Bethlehem Burns Harbor web site:

www.bethsteel.com/divisions/burns/bhweathstl.html

Weathering steel can be painted and the above web site has some specific suggestions.

Harold Sprague, P.E.
The Neenan Company
Fort Collins, CO

Question from June 1999:

Anchor rods (A307 or A36 material) occasionally get knocked and bent prior to the installation of the structural steel columns. Are there any guidelines or provisions for bending the anchor rods back into position? Are there limits to the degree of bending that can be straightened?

Michael D. Gregory, P.E.
Teton Structural Engineers
Idaho Falls, ID

It sounds as if your anchor rods had an encounter with a D8 Cat and lost! Consideration must be given to the degree of bend, the radius of the bend, and the diameter of the anchor rod. A sharp 90 degree cold bend in a 1-1/2 in. diameter rod is likely to produce molecular distortion and small cracks. Straightening, even with heat, would likely result in reduced strength in such a case. On the other hand, a gradual cold bend of 20 degrees in a 1 in. diameter rod would probably not be a problem. Similar bends are routinely made in fabricating shops.

Anchor rods with slight bends or rods which are cast into concrete in a tilted position can usually be straightened without heating using a pipe "hickey." Contract documents usually stipulate that contemplated repairs to defective or damaged column anchorage be reviewed by the structural engineer of record or other competent person. AISC Design Guide No. 1, *Column Base Plates*, contains broad information on column base design and construction.

David T. Ricker, P.E.
Javelina Explorations
Payson, AZ

Another response:

Anchor rods are frequently impacted and bent on highway structures in the State of Illinois. If the degree of bending is substantial, a significant amount of cumulative fatigue damage can be sustained by the anchor. Bending it backwards causes further fatigue damage. The larger the anchor rod, the smaller the angle of bending that is tolerable.

Also, the material composition of the anchor rod is important. For example, an ASTM A36 anchor rod can generally sustain greater slow-strain-rate plastic deformation at 70 degrees F than an ASTM F1554 105 ksi anchor, although its impact energy or fracture toughness may be significantly different. This is particularly important for anchor rods used in seismic areas or those subject to fluctuating loads. The general rules I have used in forensic analysis is that any bend which caused tearing at the thread roots or more than 2 to 5% local plastic deformation probably sustains a nascent or precursor fatigue crack.

To remedy the problem, the bent area is cut off, and reconnected with coupling nuts of equivalent section and strength. Use of thread-locking compounds and torquing requirements are preferred if any vibrations may be encountered, which is typically the case for sign/signal structures and bridges.

Christopher Hahin, P.E.
Illinois Department of Transportation
Springfield, IL

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Question from June 1999:

Is there a publication or research paper which discusses the design of column base plate shear lugs made out of the standard W sections? In particular, should such shear lugs be designed for overall section bending and shear only due to the bearing pressure exerted against the concrete face, or should the effect of local flange or web bending be considered? Shear lugs are assumed to be confined in shear pockets by a non-shrink grout.

Mark Trojanowski, P.Eng.
Hatch
Mississauga, Ontario, Canada

Why consider using a wide flange section for a shear lug unless is is to use scraps from the scrap bin? Think of the poor guy who has to cast the "H" shaped grooves in the top of the foundation and later has to pump or poke the grout into and around the positioned shear lug without allowing any skips or air pockets. There are better devices. AISC Design Guide No. 1, *Column Base Plates*, contains basic information on column base design and construction. The use of heavy plate shear lugs in a crossing pattern should ease the questioner's concerns with wide flange section bending and local flange and web distortion resulting from shear forces.

David T. Ricker, P.E.
Javelina Explorations
Payson, AZ

I note that the AISC specification for composite members requires composite floor shear studs to extend up to 1.5 in. above the top of the deck.

How can a strength value be assigned to a stud that is short of this? While safe, it seems too conservative to say that the stud has no strength. LRFD Equation I3-1 considers stud length relative to deck height but is, as I understand it, designed to consider primarily the effects of narrow ribs. I will appreciate any discussion.

Alfred Hendrickson, P.E.
Whitten & Borges, PC
Billings, MT

The simplest, most direct way in which the question can be addressed is to conduct a series of push-out tests on the particular configuration (deck type, stud length, etc.) in question. In lieu of this test data, an arbitrary reduction in the strength of the stud must be made. I have no data to support a particular number.

The strength reduction equation is used to account for the stud placed in steel deck, without regard to the issue of narrow or wide rib deck. Certainly the reduction is greater for "narrow" rib deck than it is for "wide" rib deck, however the equation is intended to be applicable to both.

As a side note, there will be a great deal of information coming forward in the next few months pertaining to the general behavior and design of welded shear studs placed in steel deck. This information is the result of a significant number of push-out tests, beam tests and analytical study. However, the issue of studs less than 1.5 in. above the top of the deck was not considered. This value was maintained throughout the test program as a design minimum.

W. Samuel Easterling, Ph.D., P.E.
Virginia Tech
Blacksburg, VA

New Question

Under what circumstances would one use a cross sectional area other than gross area, of a threaded connector in tension? Or, when would one use the "tensile stress area" or "minimum root area" provided in the tables for Screw Threads, as contained in the AISC Manuals? How are these issues related to material properties or specification? Consider, as an example, a threaded rod in a tension splice.

Phil Pierce, P.E.
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