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# steel interchange

## Steel-on-Concrete Slip Coefficient

**In section 3.5.1 of the first edition of AISC Design Guide 1: *Base Plate and Anchor Rod Design*, the static friction coefficient for steel-on-concrete was taken as 0.7. I would like to know the origin of this value. What current guidance does AISC provide relative to this value?**

The authors of the design guide point to the 1986 AISC LRFD *Specification* as the source of the 0.7 value for steel placed against concrete or grout. The 1986 *Specification* states:

The coefficient of friction μ shall be 0.90 for concrete placed against as-rolled steel with contact plane a full plate thickness below the concrete surface; 0.70 for concrete or grout placed against as-rolled steel with contact plane coincidental with the concrete surface; 0.55 for grouted conditions with the contact plane between grout and as-rolled steel above the concrete surface.

It provides no reference for these values.

Both the design guide and the *Specification* are now silent on the matter. I will therefore provide some references that relate to this topic:

- Burdette, Edwin G., Teresa C. Perry, and Raymond R. Funk, "Load Relaxation Tests of Anchors in Concrete," Presented at ACI Convention in Atlanta, GA, January 21, 1982, published in ACI, Special Publication SP-103.
- E. Chesson, Jr., N. L. Faustino, and W. H. Munse, "High-Strength Bolts Subjected to Tension and Shear," *Journal of the Structural Division*, ASCE, Vol. 91, ST5, October 1965.
- Klingner, R.E., Mendonca, J.A., and Malik, J.B., "Effect of Reinforcing Details on the Shear Resistance of Anchor Bolts under Reversed Cyclic Loading," *ACI Journal*, Proceedings, Vol. 79, No.1, Jan.-Feb. 1982.
- McMackin, P.J., Slutter, R.G., and Fisher, J.W., "Headed Steel Anchors under Combined Loading," AISC *Engineering Journal*, Second Quarter, April 1973. (Visit **www.aisc.org/ej**.)
- Kulak, G.L., J.W. Fisher and J.H.A. Struik, 1987, *Guide to Design Criteria for Bolted and Riveted Joints*, Second Edition, John Wiley & Sons, New York, NY.
- Shoup, T. E. and Singleton, R. C., "Headed Concrete Anchors," *Proceedings of the American Concrete Institute*, Vol. 60, 1963.
- AIJ. (2006), Recommendation for Design of Connection in Steel Structures, AIJ, Tokyo, Japan. Washio, K., Takimoto, G., Hisatsune, J., Suzuki, T. (1969). Research of fix effect for steel column base part.2- Slip between steel plate and mortar. Summaries of Technical Papers of Annual Meeting Architectural Institute of Japan, Structure 44, 1177-1178.

These references may allow you to select a coefficient from testing and other data that matches the detail you are considering.

*Carlo Lini*

## Dogs and Wedges

**A splice is required between two round hollow structural sections (HSS). One of the HSS is round within tolerance, and the other has been flattened somewhat during handling. The contractor has stated that "dogs and wedges" will be used to correct the shape of the flattened HSS. What are "dogs and wedges?"**

You should to speak to the contractor to find out exactly what they intend. However, it is likely they intend to employ cold working to return the HSS to its original shape.

The term "dog" generally refers to something that acts like the jaws of a dog clamping something into place. The term is common in both ironworking and woodworking. In this case, the dog is an anchor of some sort intended to direct force towards the HSS. I suspect what they will do is place the dogging element over the HSS and then drive the wedge in to flatten the pipe back into a circle. This process will involve plastically deforming the pipe. This is fairly similar to what was done to make the shape round in the first place, although the original equipment used is much more refined.

I believe the term dog and wedge can be traced back to ship building where the dog and wedge were used to curve flat wooden planks, and later steel plates, into the sleek profile of a ship's hull.

*Larry S. Muir, P.E.*

## Doublers and Stiffeners

**I know that doublers can be provided to reinforce columns to resist panel zone shear, per Section J10.6 of the AISC *Specification*, and stiffeners can be provided to reinforce columns to resist the effects of concentrated loads. Can the reverse be true? Can doublers be used to resist the effects of concentrated loads, and can stiffeners be used to resist panel zone shear?**

Yes is the answer to these questions. In many instances, the AISC *Specification* explicitly allows either doublers or stiffeners to be used:

- Relative to web local yielding, Section J10.2 states: "When required, a pair of transverse stiffeners or a doubler plate shall be provided."
- Relative to web local crippling, Section J10.3 states: "When required, a pair of transverse stiffeners or a doubler plate shall be provided.

- Relative to web side-sway buckling, Section J10.4 states: "When the required strength of the web exceeds the available strength, local lateral bracing shall be provided at the tension flange or either a pair of transverse stiffeners or a doubler plate shall be provided."
- Relative to web compression buckling, Section J10.5 states: "When required, a single transverse stiffener, a pair of transverse stiffeners or a doubler plate extending the full depth of the web shall be provided."
- Relative to panel zone shear, Section J10.6 states: "When required, doubler plate(s) or a pair of diagonal stiffeners shall be provided within the boundaries of the rigid connection whose webs lie in a common plane."

Thus, except for flange local bending, all of the limit states presented in Section J10 can be addressed with either stiffeners or doublers. It should be noted that in many instances the stiffener or doubler can serve double-duty, addressing both panel zone shear and concentrated loading.

Economical fabrication should be the goal in evaluating alternatives, and the most economical alternative is nearly always to increase the size of the member to eliminate the need for reinforcement. Note also that the option covered above for the use of diagonal stiffeners is historic and, in my experience, rarely used today.

*Larry S. Muir, P.E.*

## Welding Across the Flange

**I have heard that welding should not be performed across the flange of an I-shaped member. Is this correct?**

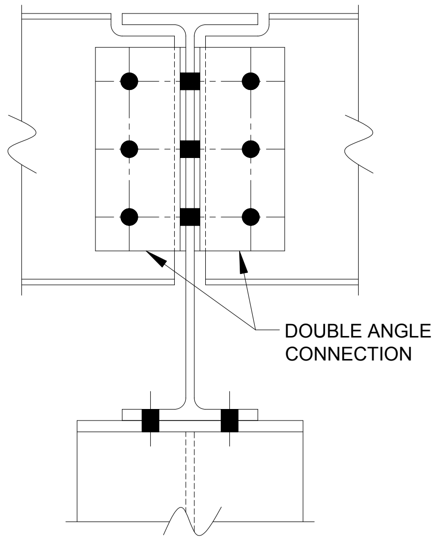
The 2010 AISC *Specification* (a free download available from **www.aisc.org/2010spec**) does not prohibit welding across the tension flange of a beam. Many engineers and detailers I have worked with in the past have been adamant that welds should not be placed across a beam tension flange. When asked, many different reasons for this old rule of thumb were given, but the only valid concern that I am aware of is related to welding across the flange of a *loaded* member. In this case, the heat from welding temporarily reduces the base metal strength, causing a less- or non-effective area near the weld. While this area can be significant in the plane perpendicular to weld travel, the effect is larger for the plane parallel to weld travel. This concept is discussed further in the AISC webinar "Design of Reinforcement for Steel Members, Part 2," which can be viewed at **http://www.aisc.org/content.aspx?id=32580**. As you'll see (and hear) in that lecture, it isn't as simple as the often-repeated advice.

*Bo Dowswell, P.E., Ph.D.*

## Quiz Correction

**The figure in the second question of February's Steel Quiz on OSHA regulations appears to be in error. Is it?**

There was indeed an error in the figure we provided for Question 2 in February's Steel Quiz. The question was about OSHA regulations for double connections, which are concerned with connections that meet through the web of a column or through the web of a girder over the top of a column. We showed a location away from the column, and the OSHA regulations do not include such a condition. They focus specifically on locations at columns where there is a column fall-away hazard. The corrected illustration is shown below. Also, the answer referenced OSHA Section 1926.756(a)(1); the correct reference is actually Section 1926.756(c)(1).

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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.



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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