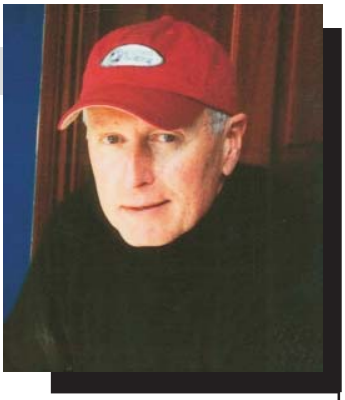
About the Author/WAYNE WALLACE



Wayne Wallace is the president of Applied Bolting Technology Products. The company provides bolting consulting services and manufactures direct tension indicating washers from its base in Rockingham, Vermont. Wallace is a member of the Research Council on Structural Connections, owner of several patents, and author of numerous papers on the practical aspects of quality assurance in structural bolting. He can be reached by phone at 800-552-1999, by fax at 802-460-3104, or e-mail at wwllace@sover.net.

Emailing Interactive 3-D Bolting Pictures Makes for Better Constructability

A 15,000 ton steel frame for a new coal-fired power plant, even without all the supplementary add-ons like Selective Catalytic Reduction Units (SCR's) and Heat Recovery Steam Generators (HRSG's), requires about 350,000 bolts (See Figure 1). Probably half would be in the 7/8" to 1" A325 size range, and the other half would be in the 1 1/8" to 1 ¼" A490 size range. At 10 bolts installed per man-hour, and at a man-hour cost of US$100.00, the bolting labor will cost $3,500,000. A 20 percent saving in this cost would amount to $700,000, or about $2.00/bolt!

Figure 1

So it's no wonder that constructors like Bechtel, Shaw, Washington Group, and Fluor are willing to consider constructability issues surrounding the bolting. Especially where the contract steelwork specifications state that earthquake conditions dictate the connection design and the QA procedures. In seismic structural design, the influence of such specifications as ASCE-7, FEMA 353, and AISC 341, mean the connections have to be slip-critical, with fully tensioned bolts of course. IBC/ICC 2003 section 1704.3.3 allows "periodic" inspection QA procedures when DTI's are used. The only alternatives to DTI's are turn-of-nut with matchmarking (very costly and slow), TC bolts (break-off tension tested at the point of installation and not available in all diameters, grades, and coatings), or shifting to "continuous" inspection which is not feasible. There are only about 400 to 500 qualified ICC-trained inspectors in the USA in total, and once on the jobsite they have to do the inspection of welding, concrete, everything, not just bolts. So periodic inspection it has to be on all the bolts, and the seismic design rules lead to LOTS of bolts in some cases (See Fig. 2).

Figure 2

Using Squirter DTI's makes the installation go faster, more efficiently, according to a number of bolting foremen, and doing one pre-installation test of the Squirter DTI's in a Skidmore on site with the ICC Special Inspector present gets him/her on board. Showing the bolting crew and the ICC inspector what the squirted silicone looks like after final tensioning goes a long long way to building up the inspector comfort factor. Showing the inspector that the squirted silicone can be held in place with a quick urethane spray helps also, so that the ICC inspector can be elsewhere on the site (or home for the weekend) even while bolting continues, and he can resume inspection many days later just by walking around and look-

ing from a distance at the silicone (See Fig. 3).

And Squirter DTI's also do a few other things that regular DTI's don't. If installed upside down, they don't squirt. If installed over oversized holes without the correct flat washer in place, they don't squirt. With Squirters, the ICC inspector can see at a glance that ALL the bolts were tensioned, without getting up close with a feeler gage.

Figure 3

Now, on three projects, constructors are taking bolting constructability one step further, and it looks to me like a trend. They are specifying that the bolts be sent to the site ASSEMBLED, with the Squirter washer AND the flat washers in place on the assembly, ARRANGED AND SIZED SO THAT THE BOLTS CAN BE INSTALLED INTO THE HOLE FROM EITHER SIDE, WITHOUT RE-ARRANGING THE FLAT WASHERS. AND WITH FLAT WASHERS SIZED SO THAT THE HOLES CAN BE STANDARD OR OVERSIZED OR EVEN SHORT SLOTS.

This was a new one on us when we saw it at first, but now we understand. It's difficult to get the flat washer and Squirter washer installation rules right down to the craft trade workers up on the steelwork. But when the bolts are brought to them assembled as described above, they don't have to decide what goes where, they just pull apart the assembly and put it into the hole, making sure there's a flat washer on each end. No decisions about what thickness flat washer goes over what hole, and if access from one side is a problem, just put the bolt into the hole from the other side. AND, in the odd case where the bolt is a little short, and this happens more often than is admitted, at least when the hole is a standard hole, a washer or two can be omitted and the bolt can be used.

Because there are quite a few variations in flat washer thickness and diameter to suit Squirter DTI's, we needed a way to electronically transmit clear diagrams of standard assemblies and these special "constructability assemblies" to detailers, constructors, and distributor suppliers. We settled on using a handy feature of a program called Solidworks (www.solidworks.com), which is the 3-D CAD program on which we draw all our parts, along with flat washers and bolts, as single components and then as assemblies. Solidworks includes a feature called "e-drawings" which are relatively small files that can be emailed to clients even without them actually owning the Solidworks program.

You can see all of these constructability assemblies on our website (http://appliedbolting.com/eDrawings.php), and a couple of examples are illustrated here (See Fig. 4a, 4b, and 4c), although on the client's computer these 3D bolt assemblies are interactive and can be moved around to see exactly what component goes where.

A picture's worth a thousand words — interactive 3-D pictures even more.

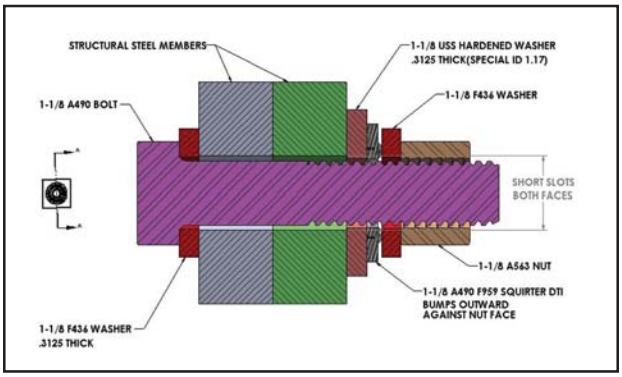


Figure 4a

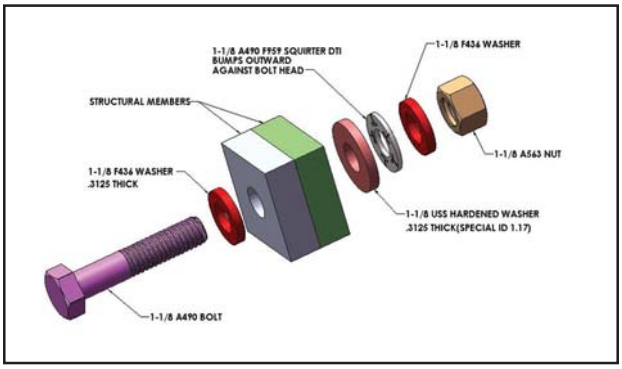


Figure 4b

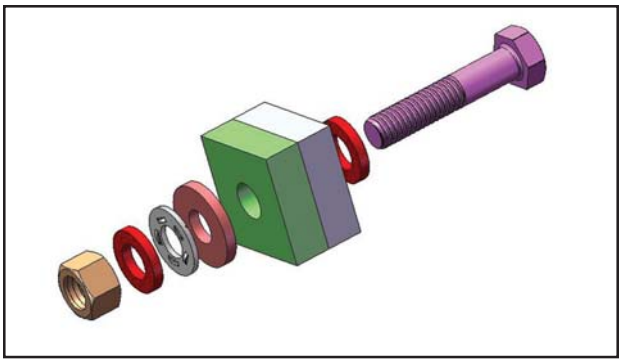


Figure 4c