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Holes for anchor rods

Question

09/01/2000



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The LRFD *Manual*, Vol. II, part 11, includes a discussion on holes for anchor rods and grouting in column base plates. Table 11-3 recommends base plate hole sizes to accommodate anchor rods. The discussion indicates that "An adequate washer should be provided for each anchor rod." Why are the recommended holes sizes so much larger than those in the ASD *Manual*, Part 4? What washer materials and thicknesses would be considered adequate?

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Answer(s)

10/01/2000

Hole sizes for steel-to-steel structural connections are not the same as hole sizes for steel-to-concrete anchorage applications. In the case of steel-to-steel connections, the parts are made in a shop under good quality control, so standard holes (bolt diameter plus 1/16"), oversized holes (bolt diameter plus 3/16"), and short and long-slotted holes can be used quite successfully. However, the field placement of anchorage devices has long been subject to more permissive tolerances (and often, inaccuracies that exceed those tolerances anyway and may require consideration by the structural Engineer of Record).

AISC published *Design Guide No. 1: Column Base Plates* back in the early 1990s. At that time, it was recognized that the quality of foundation work was getting worse and worse. To allow the erector (and designer) greater latitude when possible, the permissible hole sizes in base plates were increased. These same larger hole sizes were included in the 2nd ed. LRFD *Manual*. The values there are maximums, not a required size. Smaller holes can be used if desired. Plate washers are generally required with these holes because ASTM F436 washers can collapse into the larger-sized holes, even under erection loads.

The larger hole sizes are primarily intended for the majority of base plates that transfer only axial compression from the column into the foundation. The anchor rods don't usually do much after erection in that case.

For other applications, such as base plates with moment or uplift, the hole size is more of a concern for load transfer. It may be better in these cases to consider a detail that has been called a "boot," an anchor rod chair and a bolt box. Whatever its name, it's a detail with stiffeners that transfers tensile forces from the column flange to the anchor rods directly, not through the base plate. It is a more efficient and direct method to get the load out of the column. If you choose, anchor rods and thick washers over the base plate holes will work in many cases. You can find washer sizing guidance in AISC *Design Guide No. 10: Erection Bracing of Low-Rise Structural Steel Buildings*.

In applications involving shear at the column base, there are several ways to transfer the force. The frictional resistance due to the compressive load in the column is often adequate without further consideration. If not, the column base can be designed for shear using the shear-friction analogy. Alternatively, the anchor rods and plate washers can be detailed for shear transfer or a shear lug can be provide on the bottom of the base plate. When the shear to be resisted is significant, the shear-lug approach may be the most appropriate.

Column base design, erection and other considerations are also covered in a December 1993 *Steel Tips* article available in AISC's online resource library at [www.aisc.org/library.html](http://www.aisc.org/library.html).

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