FIGURE 3.15 This is where a hillside washer was before the Northridge earthquake. (*J. R. Miller & Associates.*)

FIGURE 3.16 A proprietary heavy-duty replacement for hillside washers.

3.3.6 Other Wall Bracing Details at the Bottom of Columns

Some manufacturers offer rod-to-frame connection details that do not involve hillside washers attached to the frame web. One alternative is to connect the bracing rods to the column flanges with bolted brackets. In Fig. 3.18*a,* the rod is connected to a straight column at its interior flange, a solution that avoids burning holes in the webs of flush-mounted girts normally associated with the straight columns. In Fig. 3.18*b,* the rod is bolted to the exterior flange of a tapered column. The rod is wholly contained within the column depth, to avoid interference with bypass girts often used with tapered columns. (See the discussion in Chap. 5 on the types of girts used in pre-engineered buildings.) Although these details sidestep the issue of direct attachment to an unreinforced web, they introduce torsion in the column near the base and in the anchor rods.

A radically different solution to the challenge of connecting bracing rods at the base is shown in Fig. 3.19. Here, the rod is attached not to the column at all, but to a separate foundation clip bolted directly to the foundation. The obvious advantages of this approach are counterbalanced by the need to provide additional anchor rods. Also, enlarged foundation piers or walls are needed at the clip locations, as further discussed in Chap. 12.

3.3.7 Wall Bracing Details at the Top of Frames

So far, we have described common rod-to-column connections at the bottom of the columns. Similar details are used for the top rod-to-column connections and at the attachments of the horizontal diaphragm bracing to the frame. With the obvious exception of the foundation clip, the available details parallel those used at the column base. The commonly offered choices are shown in Fig. 3.20: (*a*) direct attachment to the web of the knee; (*b*) connection to a straight column at the interior flange; and (*c*) bolting to the exterior flange of a tapered column.

The details of Fig. 3.20 invite the same comments made for their bottom-of-the-column versions, except that those arguments can be made even more forcefully here. Indeed, in Fig. 3.20*a* the thin column web must not only resist the forces applied by the two rods, but also has to transfer the load from the horizontal roof diaphragm to the vertical wall bracing. The author has seen this type of a

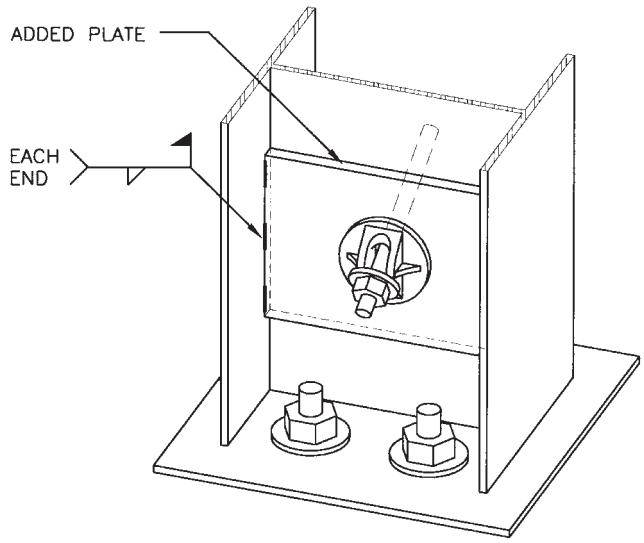

FIGURE 3.17 Added plate is used for web reinforcement.