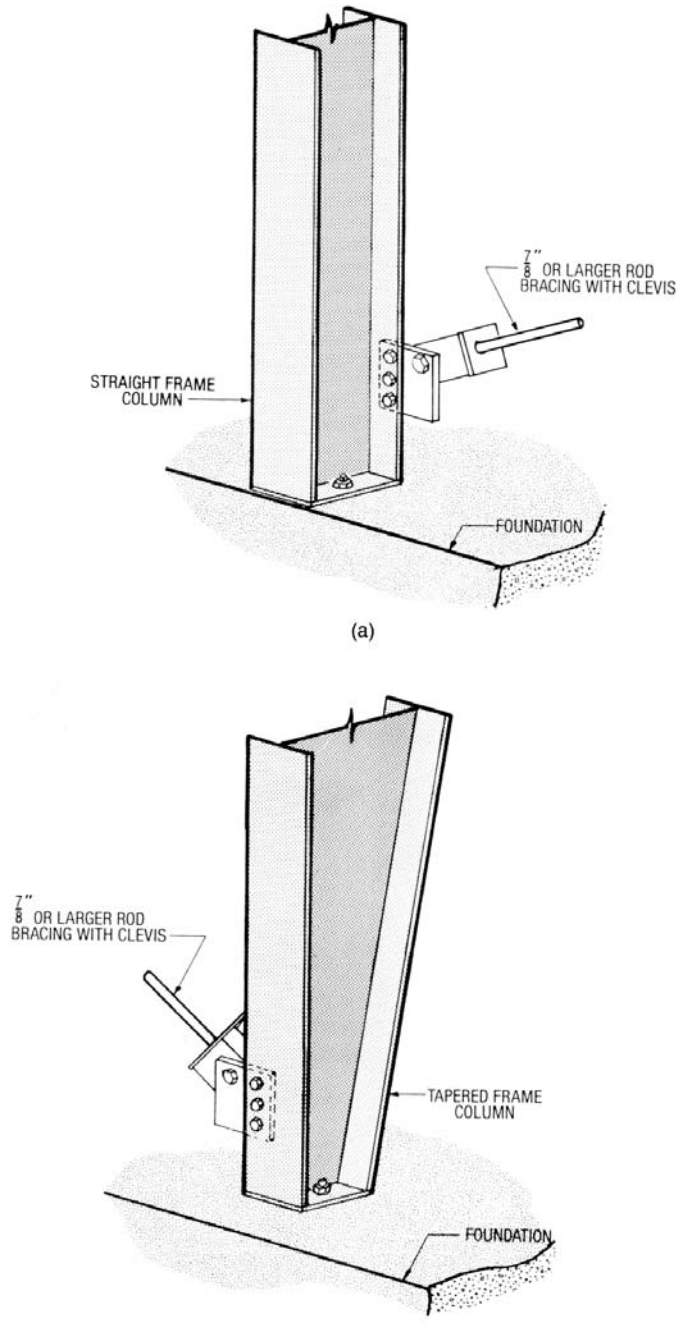

FIGURE 3.18 Details of wall bracing attachment to column flanges. (*a*) Attachment to straight column at the interior flange; (*b*) attachment to tapered column at the exterior flange. (*Star Building Systems.*)

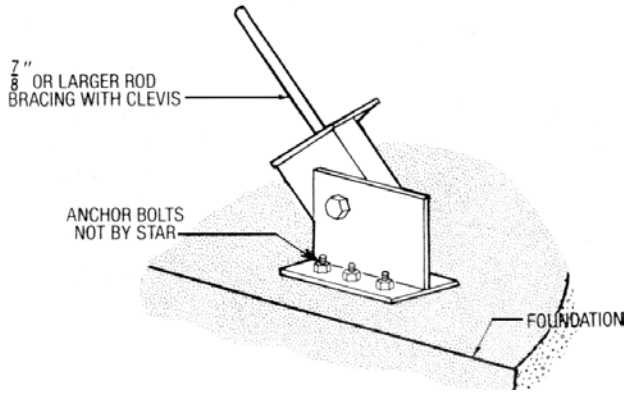

FIGURE 3.19 The use of foundation clips sidesteps the difficulties of attaching bracing rods to column. (*Star Building Systems.*)

connection fail under heavy load. In Fig. 3.21, which illustrates a failure of the horizontal roof diaphragm attachment to the rafter web, the rod in tension has pulled through the web, fractured it, and even locally bent the rafter.

In Figures 3.20*b* and 3.20*c,* torsion from the eccentricity of forces in the rods relative to the centers of the columns has to be resisted by the framing itself, since there are no anchor rods to help resist it.

One method of improving the simple connection of Fig. 3.20*a* is to introduce a combination of heavy-duty washers and reinforcing plates, as discussed above for the bottom connection with a hillside washer. An even better detail is illustrated in Fig. 3.22. Here, the horizontal and vertical bracing rods are connected to a bracket bolted to the web with a backup plate, so that the force transfer occurs within the sturdy bracket rather than within the frame web.

A final comment on the rod-to-column connection: It is important to keep the bracing rods taut, to avoid rattling and excessive sway of the building. However, it is difficult to tighten the rods solely by means of a nut behind the hillside washer, especially considering that tightening is done against a thin web plate. A more reliable detail is to provide a turnbuckle for tightening and to attach the rods to columns directly. One possible solution is shown in Fig. 3.23; it could be further improved by providing a web-stiffening plate or angle as discussed above.

3.3.8 Nontypical Wall Bracing Systems

In some cases, the standard rigid-frame-and-bracing scheme described above cannot be used and other solutions must be sought instead. For example, in a very tall building the proportions of a regular wall X-brace might exceed the limits of the standard connection details. In that case, a tiered brace may provide the solution. In the tiered brace, an intermediate compression member—a stiffened girt or a strut similar to those used in roof diaphragms—is introduced to keep the brace proportion reasonable (Fig. 3.24).

In another common scenario, one of the side walls is completely filled with overhead doors or windows, leaving no space for wall bracing. There are three possible design solutions for this situation.

The first is to provide bracing only at one side wall and at both end walls in combination with a relatively rigid roof diaphragm that can effectively distribute torsional loading between the three sides. This solution and the conditions that must be met for it to be feasible are shown in Fig. 3.25. This scheme is better suited to smaller buildings.