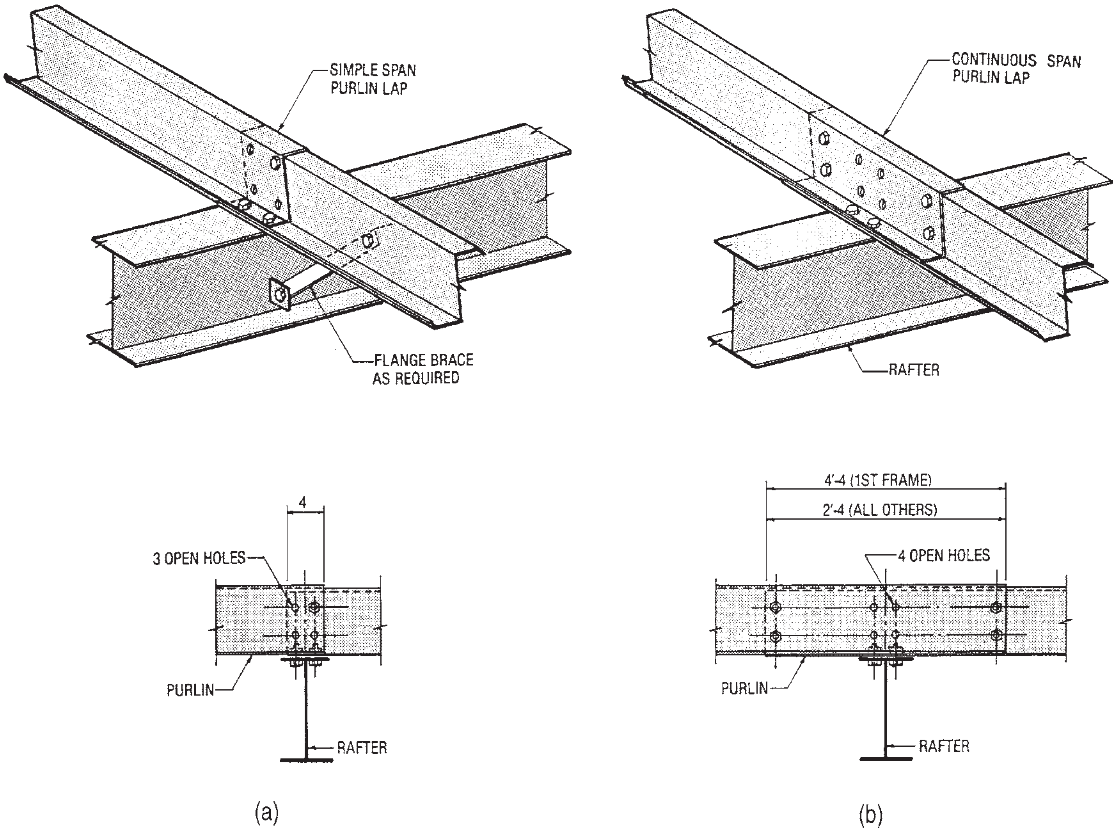

FIGURE 5.9 Examples of (*a*) simple-span and (*b*) continuous-span purlin laps. (*Star Building Systems.*)

A purlin can be attached to rafters in various ways, depending on the magnitude of crippling stress in the purlin's web. A simple bolting through the member flanges is acceptable if the web crippling stress is not critical; otherwise support clips acting as web stiffeners are needed.

Continuous framing, while offering significant material savings, requires careful consideration. The effects of potential problems caused by temperature changes and differential settlement have already been discussed. Further, continuous purlins are subjected to variable bending moments at different spans, even from uniform loads: the most critical bending stresses in a continuous beam occur at the end spans. It follows that the end-bay purlins must have stronger sections than the interior ones. Alternatively, some manufacturers prefer to utilize the same purlins throughout the building and provide additional splice lengths for the end-bay purlins. Either approach is fine; a potential red flag might be raised only if the shop drawings indicate the same purlin sections and lap distances at all locations, although it could simply mean that some cost efficiency has been forgone and all the purlins are kept to the size controlled by the end spans.

Yet another economical solution is to make the exterior (end) spans shorter than the interior ones. For example, if the interior spans are 25 ft, the end spans could be 23 or 24 ft. The opposite design, in which the end spans are longer than the interior, should be avoided, although there are circumstances where this is necessary. Then, additional simple-span purlins may be added in the end bays between the continuous purlin lines. In Fig. 5.10, *two* additional simple-span purlins had to be placed in this manner to support the loading at the unusually long end spans.

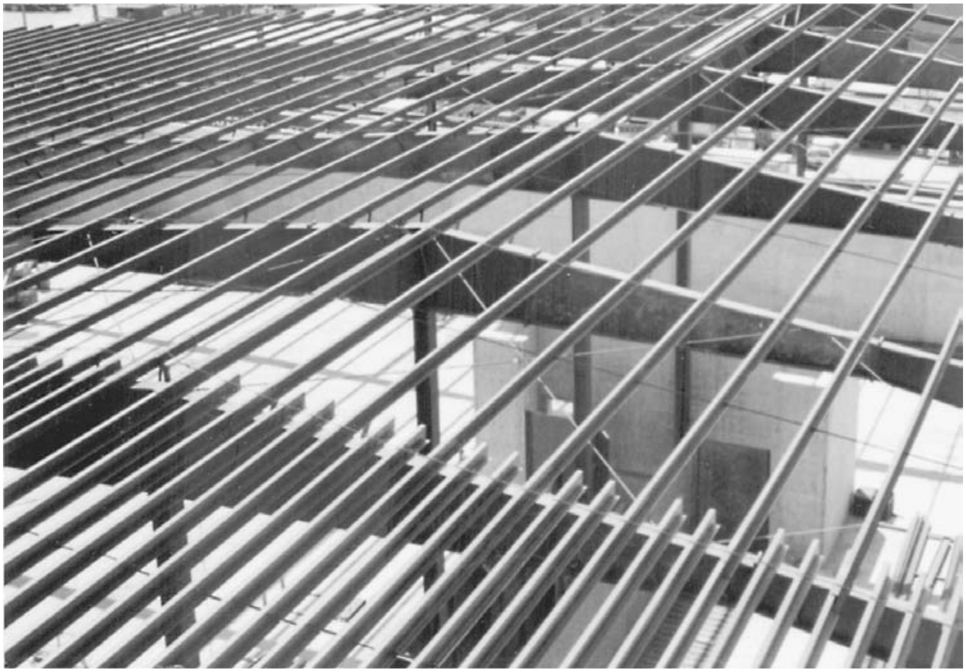

FIGURE 5.10 Two additional simple-span purlins are placed between continuous purlins in the end bays of this building.

5.3.3 General Methods of Purlin Design

Not too long ago, continuous C and Z purlins were designed by longhand—*very long* hand—calculations. Today, the increasing complexity of their design necessitates the use of computers. The larger manufacturers often use proprietary design software; their smaller competitors and independent designers typically use off-the-shelf computer programs. Some of these programs are listed on the CCFSS's website referenced in Chap. 2.

The design input for both the computer and hand calculations includes the detailed information on the purlin size and dimensions, loading, design strength of steel, the length and number of spans, the roof slope, the length of splices, the width of support beam flanges, and the manner of lateral bracing. To conserve space and to avoid enshrining any design formulas, which tend to change from one AISI Specification edition to the next, we refer the reader to a comprehensive design example for a four-span continuous purlin found in the AISI Cold-Formed Steel Design Manual.[2] The analysis procedure roughly follows that of any continuous beam, with some peculiarities noted below. The continuity is provided by the properly designed bolted connections.

5.3.4 Prismatic versus Nonprismatic Analysis

Unlike the continuous structural steel framing with compact welded or bolted connections, continuous cold-formed purlins use overlapping members through-bolted over the supports (see Fig. 5.9). As a result, the purlin stiffness at the support locations is twice the stiffness elsewhere. How does this added stiffness affect the purlin design?

There are two opposite approaches to this dilemma: the first one takes into account the increased purlin stiffness, the second does not. The first approach, which considers the actual (doubled) purlin section at the supports, is called nonprismatic or full-stiffness analysis model. The second approach