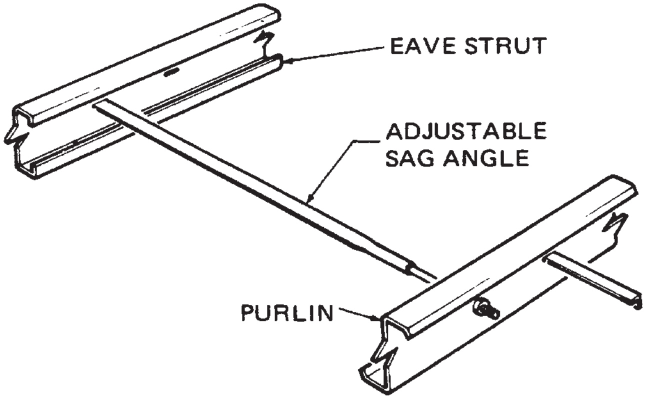


**FIGURE 5.26** Adjustable sag angle between the eave strut and the first purlin. (*Butler Manufacturing Co.*)

### 5.4.5 The Immovable Eave Strut

The eave struts are often assumed to provide a point of anchorage for lateral purlin bracing—an immovable point in the horizontal direction. How valid is this assumption?

The lateral stiffness of the eave strut section, taken alone, is comparable to or less than that of a typical Z purlin. For example, the moment of inertia in the weak direction ($I_y$) of an 8-in 14-ga Z purlin with 3.375-in flanges produced by LGSI (see Appendix B, Table B.6) is 3.076 $in^4$ and of an 8-in 14-ga Z purlin with 2.5-in flanges, 1.289 $in^4$ (Appendix B, Table B.7). In comparison, the $I_y$ of an 8-in 14-ga double-slope eave strut section by LGSI is 2.475 $in^4$ (Appendix B, Table B.8), so that its lateral rigidity falls between the two Z purlins.

True, the eave strut is attached to the wall siding, but how much lateral resistance can be afforded by a section of metal siding cantilevered 6–7 ft from the girt below? The closer the nearest girt is to the eave strut, the more horizontal resistance it provides, up to a point where the girt is right at the eave. Even then the stiffness of a single wall girt cannot possibly be sufficient for lateral bracing of the whole roof assembly: the girt has nowhere near the strength and stiffness needed to resist the accumulated purlin bracing forces without significant horizontal deflections. Overall, it makes more sense to assume that the eave strut will move with the rest of the roof sheathing and purlins rather than act as a true lateral support for them.

Does the eave strut provide *torsional* support for the adjacent purlins? It depends on the construction details. Most of the torsional resistance possessed by the eave strut is derived from the wall siding connection to its web. Depending on how this connection is made, the degree of the eave strut's torsional capacity could vary from substantial to minimal. When the siding is attached with closely spaced fasteners to the mid-depth of the web of a channel-like eave strut section, a resisting force couple between the fasteners and the strut flanges can develop significant initial torsional restraint. The initial restraint might gradually diminish if the prying action caused by the repeated purlin movements loosens the screws. Naturally, if the eave strut is not attached to the wall at all, its ability to resist torsion is negligible.

### 5.4.6 Diagonal Purlin Braces

Another purlin bracing system utilizes steel angles placed in a diagonal fashion between the top flange of one purlin and the bottom flange of the next (Fig. 5.28). Here, each purlin forms a part of a rigid triangle consisting of the purlin web, diagonal brace, and roofing. The principle works only

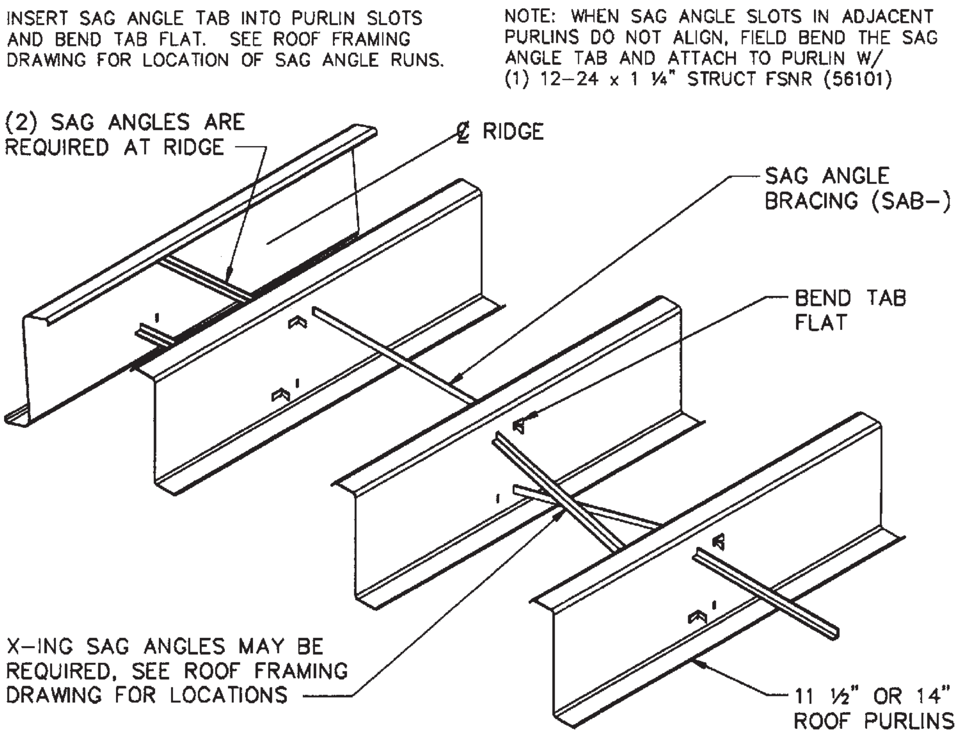


**FIGURE 5.27** Typical detail of crisscrossed sag angles. (*VP Buildings.*)

when the roofing is positively attached to the purlins and can take compressive forces. For this reason, diagonal bracing system can generally be used only in buildings with through-fastened roofs, not with standing-seam roofs with sliding clips.

The angle braces can be placed into prepunched holes in purlin webs, as in parallel bracing, or (less commonly) be connected to purlins by screws or bolts. The diagonal angles are typically attached to the eave strut, either directly (Fig. 5.28*a*) or by crisscrossing the purlin braces (Fig. 5.28*b*). The anchorage detail at the eave used by some manufacturers is shown in Fig. 5.29.

Our previous discussion about the lack of lateral resistance provided by the eave strut and its torsional capacity applies here as well, and the detail with crisscrossing purlin braces at the eaves (Fig. 5.28*b*) should be more effective than the detail in Fig. 5.28*a*. When the eave strut's torsional resistance is insignificant, it is easy to see how all the interior purlins in Fig. 5.28*a* can rotate clockwise under gravity load, and the eave strut counterclockwise (because of the pull exerted by the brace).

As with parallel purlin bracing, the diagonal brace system relies on sturdy ridge channels or angles to resist the accumulated bracing forces from both slopes of the roof (Fig. 5.30).

### 5.4.7 Diagonal Straps in the Plane of the Roofing

In addition to the systems discussed above, purlins can be laterally braced by diagonal steel straps located above or below the purlins. Unlike the parallel-to-slope strap bracing that extends from eave to eave, these straps run at an angle to the purlins and are anchored to the top flanges of the primary frame rafters. The attachments to purlins and rafters are made by bolting or welding. The diagonal straps can be used in combination with other types of purlin bracing (Fig. 5.31).