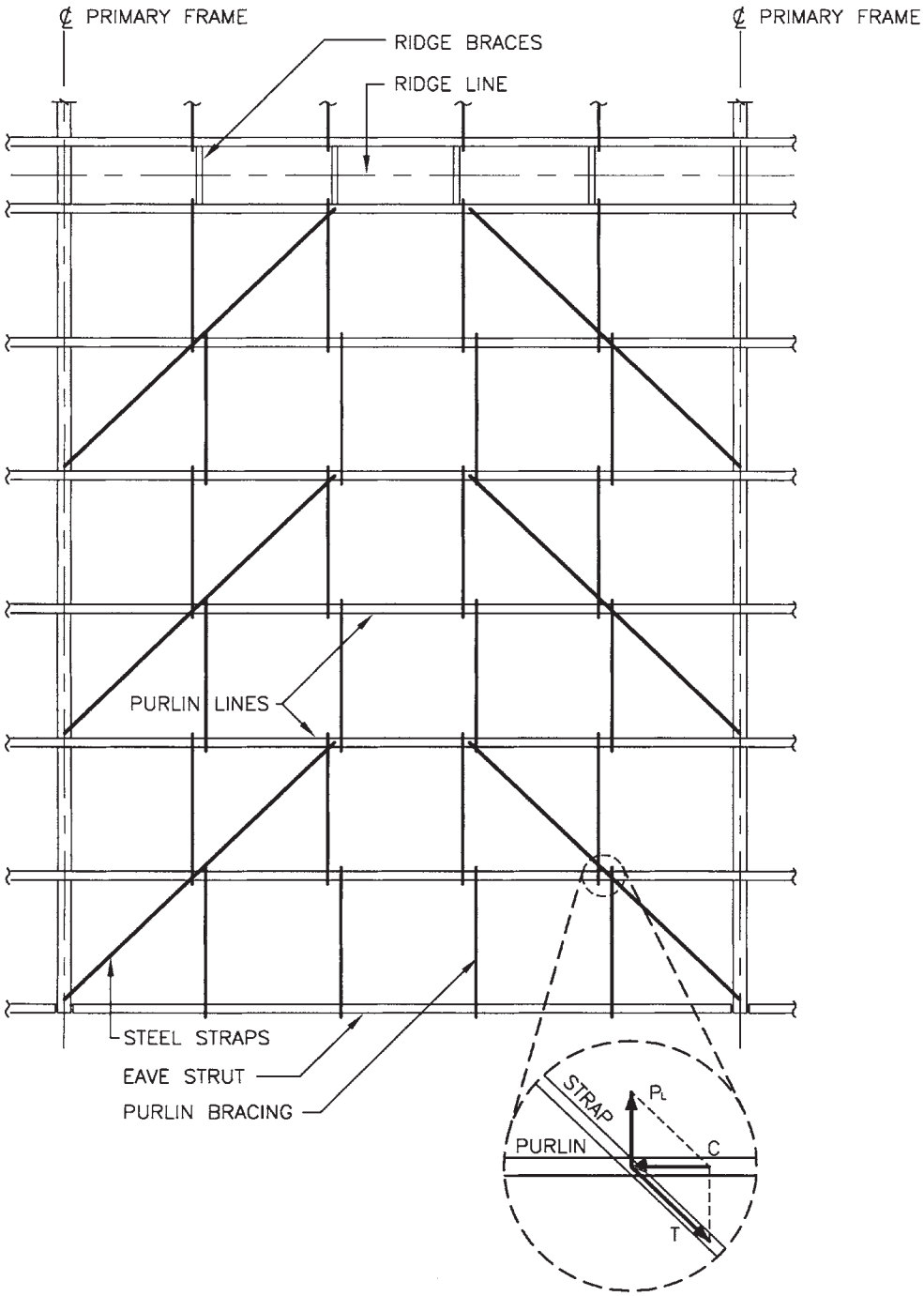

FIGURE 5.31 Purlin bracing by diagonal steel straps located above top flange of the purlins.

As shown in the inset, the force P_L—the parallel-to-slope force component that tries to overturn the purlin by moving its top flange toward the ridge—is resisted by a combination of tension in the strap, *T,* and compression in the purlin, *C*. When combined as vectors, *T* and *C* equal P_L.

The number of straps per bay depends on the desired spacing of purlin braces. The arrangement of Fig. 5.31 provides purlin bracing at one-quarter points of the purlin span. Note that each diagonal strap laterally braces two purlins and is designed for the tension force equal to twice P_L. Depending on the load direction, either interior or exterior member flange can be in compression, and lateral bracing may be needed for both flanges. The closer the spacing of the braces, the smaller the unbraced length of the section in the weak direction.

5.4.8 Recommended Purlin Bracing System

In theory, all commonly used purlin-bracing systems discussed above can be effective if properly designed and anchored. In practice, the available design details and construction practices make most of them less than ideal in meeting the three required parameters listed in Sec. 5.4.1. To repeat, these are

1. To provide lateral flange bracing
2. To restrain the member from rotation and to relieve torsion
3. To restrain the whole assembly of purlins and roofing from lateral translation

It is important to remember that *both* member flanges must be laterally stabilized. As the AISI Specification,[1,4] Section D3.2.2, puts it:

> When braces are provided, they shall be attached in such a manner [as] to effectively restrain the section against lateral deflection of both flanges at the ends and at any intermediate brace points.

Now consider what happens if only a single line of parallel sag angles is provided near the top of the purlin flange located under standing-seam roofing with sliding connections, an all-too-common design (Fig. 5.25). Even if properly anchored, this single line of bracing is typically placed too low to prevent purlin rotation under load (Fig. 5.32*a*) and is therefore of little use in restraining the section against rotation. The AISI Specification,[4] Section D3.2.1, recognizes the importance of placing purlin bracing as close as possible to the flange being restrained. Still, in some manufacturers' details, the bracing is located 3 in below the top flange—much closer to the neutral axis (mid-depth) of the purlin than to its top flange that is ostensibly being braced. This design does little to restrain the section against rotation or against lateral deflection of both flanges.

In contrast, properly anchored diagonal braces provide better purlin stability even when placed some distance away from the flanges (Fig. 5.32*b*). However, we have already noted that the diagonal bracing system should be used only in buildings with through-fastened metal roofs. Those roofs are specified less and less commonly because of the superior performance of standing-seam roofing with sliding connections. In standing-seam roofs, diagonal bracing can be supplemented by the lines of parallel bracing angles running near the top flange.

It is important to realize that purlin bracing is typically required even when through-fastened roofing is used. As already stated, the roofing may be able to provide lateral, but not torsional, purlin bracing. Also, the roofing diaphragm alone might not be strong enough to prevent the whole assembly of roofing and purlins from lateral translation under load as a unit.

Our recommended purlin bracing system comprises bolted channel blocking (Fig. 5.17) placed at close intervals. (The recommended spacing is discussed in the next section.) The channels are superior in bracing both flanges of purlins against translation and rotation, and their bolts provide significantly larger connection capacity than screws or bent tabs. It is essential to use sturdy clip angles, preferably of hot-rolled steel, to reduce their deformation under load.