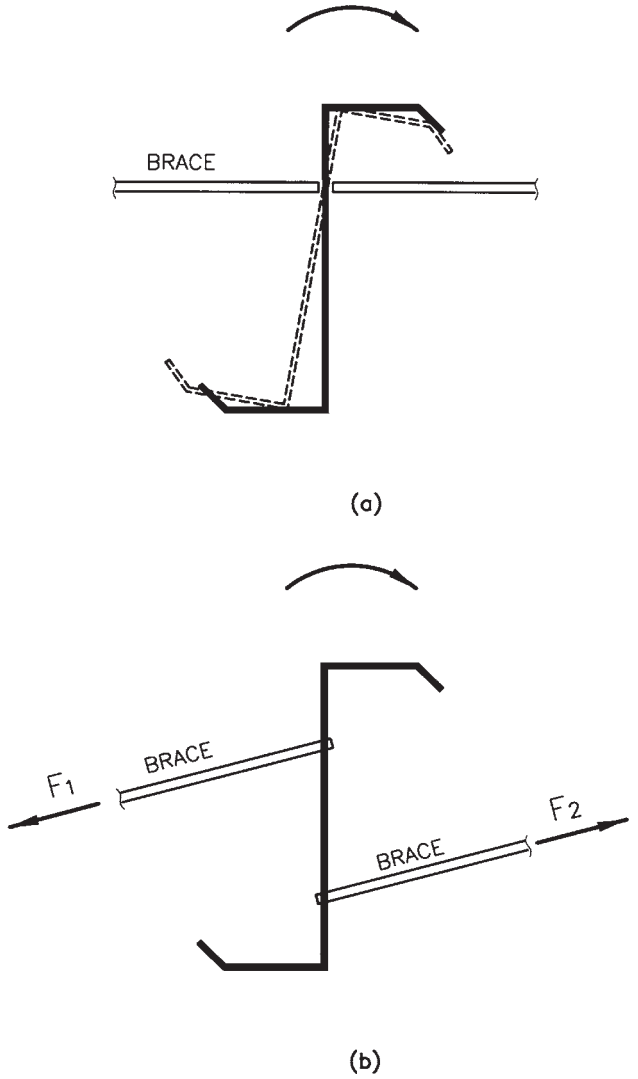

FIGURE 5.32 A single line of horizontal bracing (*a*) does not prevent purlin rotation under load, unlike properly anchored diagonal braces (*b*).

Alternatively, two rows of angle braces attached directly to the top and bottom purlin flanges can be used for smaller buildings (Fig. 5.23), if their angle and connection capacities are sufficient. The angles are cross-braced at the eaves, and perhaps at other intermediate points if needed.

It is also possible to combine both these approaches, with two rows of angle braces provided at the intermediate purlin bays and bolted channels placed near the eaves, instead of cross bracing. At the ridge, a sturdy channel or angle is essential for any design.

The size of bracing members is determined by analysis. The design forces in the braces can be computed by the formulas contained in AISI Specification,[1,4] Section D3.2.1 or D3.2.2. The formulas might change in the future, and therefore are not reproduced here, but it is vital to grasp that for large buildings the forces are measured in thousands of pounds. (See, for instance, the already-mentioned

"Four Span Continuous Z-Purlin Design Example—ASD" in the AISI Manual.[2]) For a typical purlin span of 5 ft, the required angle section might be 2 × 2 or 2.5 × 2.5 in.

The compression capacities of single-angle sections are available from a variety of sources and computer programs. According to Walker,[14] the allowable capacity of a 5-ft-long Grade 36 ∠2 × 2 × 1/8 is 1400 lb, and of ∠2.5 × 2.5 × 3/16, 3400 lb. These numbers are conservative for purlin bracing,* but it is clear that the commonly supplied small cold-formed angle sections, such as ∠1 × 1 or ∠1.5 × 1.5, will be inadequate for many applications.

5.4.9 Recommended Spacing of Purlin Bracing

How far apart should our recommended purlin bracing be spaced? As the AISI bracing formulas indicate, the fewer the number of purlin braces, the larger the forces in them. If the braces are few and far between, the exceedingly large forces in them not only result in the heavy angle sections being needed, but may also lead to purlin damage. When a light-gage Z purlin is subjected to large lateral forces applied to its flange, or to its web near the flange, the purlin section may fail in local buckling or distortional lip buckling (see Fig. 5.2). It may also be difficult to develop the large forces by means of the commonly available fasteners.

When the purlin bracing members are spaced at relatively close intervals, the unbraced purlin length in the weak direction, L_y, is reduced and the purlin strength is maximized. However, installing too many braces raises the cost of field labor and materials. The optimum brace spacing can be determined by several runs of trial-and-error analysis or by testing. The starting point for both of these may be the manufacturer's standards or the specifier's preferences. For example, Table 5.1 lists the optimum brace spacing (the purlin's lateral support distance) recommended by the LGSI.[8] To maintain cost-effectiveness, this spacing should not be increased by more than 2 ft, according to the LGSI.

The author's own preference is to specify the maximum spacing of purlin braces in the contract documents, so that the all the manufacturers vying for the job play by the same rules. However, since the actual purlin sizes may not be known until designed by the manufacturer, Table 5.1 is of little help to the specifier before then. Which purlin lateral support distance should be specified in this case? The author's practice is to specify the maximum unbraced purlin length of 5–6 ft or one-quarter of the purlin span (Fig. 5.33), whichever is less. The one-quarter-span criterion is found in the previous (1986 and 1989) editions of the AISI Specification.

*Walker assumes that the load on the angle is applied via a gusset plate, which is absent in purlin braces. This assumption introduces some eccentricity in the design and thus reduces the allowable angle capacity.

TABLE 5.1 Maximum Spacing between Purlin braces (Lateral Support Distances) used by LGSI

Section	Lateral support distance, ft
12 × 3.5 Z	5.1
12 × 3.0 Z	4.4
12 × 2.5 Z	3.4
10 × 3.5 Z	5.3
10 × 3.0 Z	4.5
10 × 2.5 Z	3.7
9 × 2.5 Z	3.8
8 × 3.5 Z	5.5
8 × 3.0 Z	4.7
8 × 2.5 Z	3.9
7 × 2.5 Z	4.0
6 × 2.5 Z	4.2

Source: LGSI.