

contemporary framing systems for buildings with purlin spans exceeding 30 ft. Bar joists are often found in warehouses, factories, mail processing facilities, and similar buildings that require wide bays. It has become quite common, for example, to design warehouses with a 40 ft × 40 ft column grid, in order to accommodate a popular storage rack layout. In this section, the focus is on the challenges of integrating open-web joists into metal building systems.

Many large metal building manufacturers produce their own open-web joists, while others order the joists from the specialized suppliers. Bar joists are typically field welded to the supporting rafters (Fig. 5.39), although some bolting may be required by OSHA regulations.

In regular (“stick-built”) construction, bar joists are used with essentially flat roofs, and they may be laterally braced by metal deck, which also provides a good diaphragm. In metal building systems, there are sloped roofs covered with standing-seam metal roofing, and the diaphragm action is provided by horizontal rod or cable bracing. The differences in construction present a unique set of design issues, the most obvious being the need to tilt the joists from the vertical position. The tilt introduces torsion into the joists, as in cold-formed purlins. The vertical load can be resolved in the directions parallel and perpendicular to the joist web (Fig. 5.40a). Unfortunately, bar joists cannot resist any appreciable torsion, because they do not have solid webs to transfer torsional stresses, and other avenues for resisting the perpendicular-to-web force component must be pursued.

When metal deck with adequate diaphragm rigidity is provided, it can resist the perpendicular-to-web forces. The sloped deck spans as a near-horizontal beam between the primary frames, and no additional joist bridging beyond that required for erection by the Steel Joist Institute (SJI) Specification²² is typically needed.

The situation is quite different when standing-seam metal roofing with concealed clips is used. We have already suggested that this type of roofing is rarely capable of providing reliable lateral bracing for cold-formed purlins, even though there is much controversy on this point. But there is no

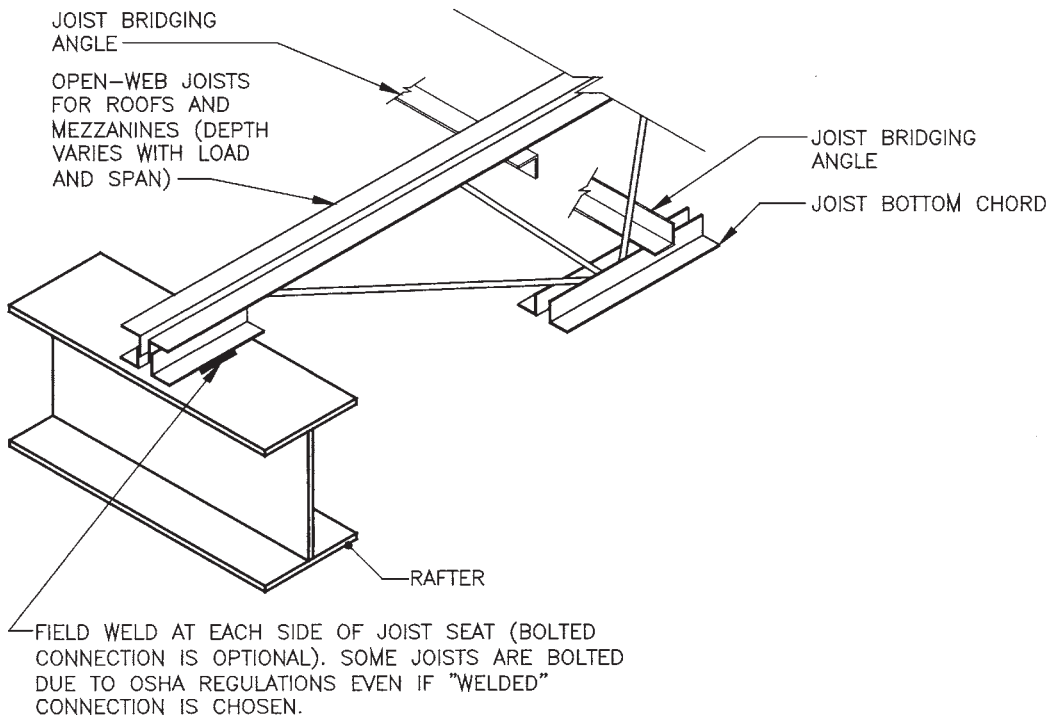


FIGURE 5.39 Open-web joist attached to frame rafter. (Nucor Building System.)

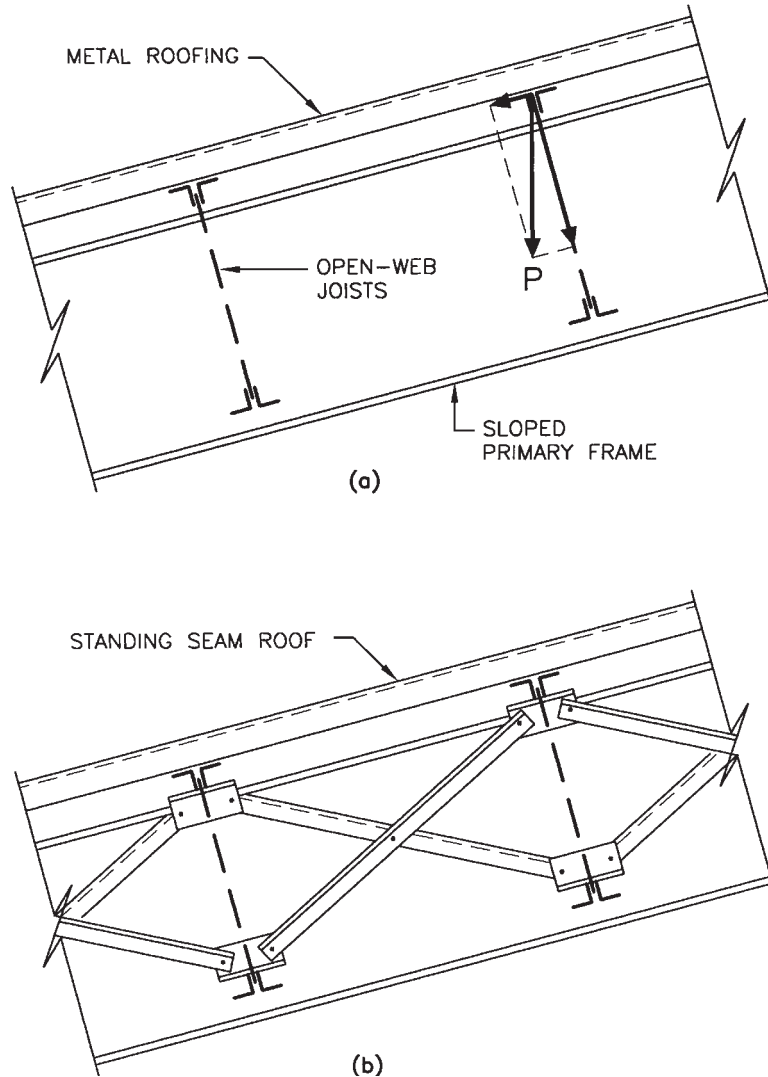


FIGURE 5.40 Open-web joists in sloped roofs: (a) torsion introduced by slope; (b) cross-bridging to ensure lateral stability.

controversy as far as the bar joist manufacturers are concerned: they generally do not recognize standing-seam metal roofing (SSR) as lateral bracing for open-web joists, as clearly stated in their catalogs.^{23,24} As one of them states, “Industry standards are to assume that SSR systems **DO NOT** adequately brace the top chord of joists” (Triple emphasis in the original).²⁴

Two different design approaches can be taken when bar joists must carry standing-seam roofing. The first is to use metal deck as shown in Fig. 5.40a and to add light-gage hat channels running on top of the deck in the direction perpendicular to its flutes. The hat channels allow the metal roofing run in the same direction as the deck.