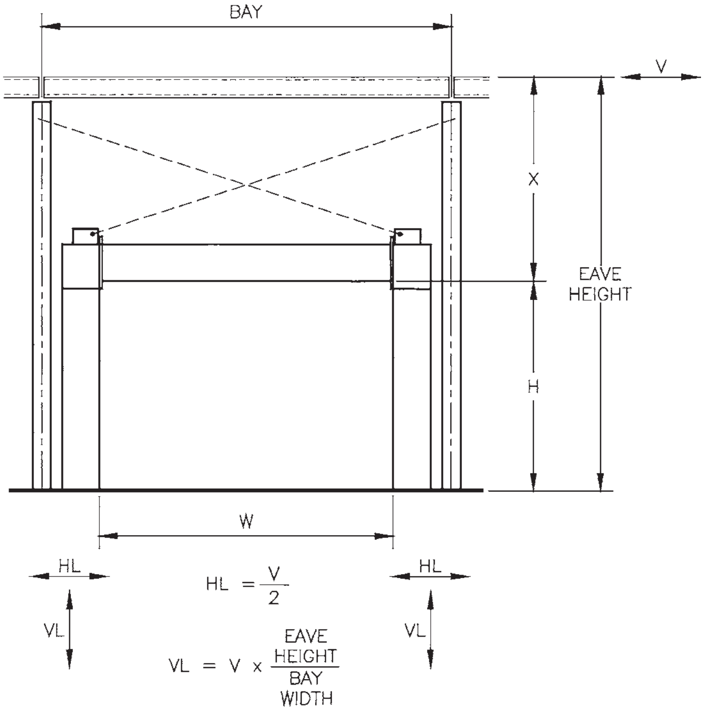


**FIGURE 3.32** Nomenclature of sidewall portal frames. (*Nucor Building Systems.*)

**TABLE 3.2** The Minimum Clear Width Provided by Standard Portal Frames as a Function of Bay Size, Force, and Desired Clear Height.

| Bay | Clear height, *H* | $5^K$ Load clear width, *W* (minimum) | $10^K$ Load clear width, *W* (minimum) | $15^K$ Load clear width, *W* (minimum) |
|---|---|---|---|---|
| 20′ | 12′-0″ | 16′-10″ | 16′-10″ | 16′-10″ |
| | 14′-0″ | 16′-6″ | 16′-6″ | 16′-6″ |
| | 16′-0″ | 16′-2″ | 16′-2″ | 16′-2″ |
| | 18′-0″ | 16′-2″ | 16′-2″ | 16′-2″ |
| | 20′-0″ | 15′-11″ | 15′-11″ | 15′-11″ |
| 25′ | 12′-0″ | 21′-10″ | 21′-10″ | 21′-10″ |
| | 14′-0″ | 21′-6″ | 21′-6″ | 21′-6″ |
| | 16′-0″ | 21′-2″ | 21′-2″ | 21′-2″ |
| | 18′-0″ | 21′-2″ | 21′-2″ | 21′-2″ |
| | 20′-0″ | 20′-11″ | 20′-11″ | 20′-11″ |
| 30′ | 12′-0″ | 26′-10″ | 26′-10″ | 26′-10″ |
| | 14′-0″ | 26′-6″ | 26′-6″ | 26′-6″ |
| | 16′-0″ | 26′-2″ | 26′-2″ | 26′-2″ |
| | 18′-0″ | 26′-2″ | 26′-2″ | 26′-2″ |
| | 20′-0″ | 25′-11″ | 25′-11″ | 25′-11″ |

***Source:*** Nucor Building Systems.

**TABLE 3.3** The Maximum Clear Height of Portal Frames as a Function of Bay Size, Eave Height, and Force.

| Load, (kips) | Eave height | 20′ Bay clear height, *H* (maximum) | 25′ Bay clear height, *H* (maximum) | 30′ Bay clear height, *H* (maximum) |
|---|---|---|---|---|
| 5 | 12′ | 9′-10″ | 9′-6″ | 9′-2″ |
| | 16′ | 13′-8″ | 13′-6″ | 13′-2″ |
| | 20′ | 17′-6″ | 17′-6″ | 17′-2″ |
| | 24′ | 21′-6″ | 20′-6″ | 21′-2″ |
| | 30′ | 27′-4″ | 27′-4″ | 27′-2″ |
| 10 | 12′ | 9′-6″ | 9′-4″ | 9′-2″ |
| | 16′ | 13′-6″ | 13′-2″ | 12′-8″ |
| | 20′ | 17′-4″ | 17′-2″ | 17′-0″ |
| | 24′ | 21′-4″ | 20′-8″ | 20′-6″ |
| | 30′ | 27′-2″ | 26′-8″ | 27′-2″ |
| 15 | 12′ | 9′-2″ | 8′-8″ | 8′-8″ |
| | 16′ | 13′-0″ | 12′-8″ | 12′-8″ |
| | 20′ | 17′-0″ | 16′-8″ | 17′-0″ |
| | 24′ | 21′-10″ | 20′-8″ | 20′-6″ |
| | 30′ | 26′-8″ | 27′-9″ | 27′-2″ |

***Source:*** Nucor Building Systems.

As Fig. 3.3*b* indicates, wind acts normal to the roof, either toward the surface (pressure) or away from it (uplift or suction). When wind pressure occurs, the roofing panels, the building's first line of defense, are pushed against the purlins and transfer the load by bearing. During wind uplift, the panels are pulled away from the roof; the fasteners holding them in place, if improperly designed, may fail and let the roofing fly. If the fasteners hold, the purlins get into flexural action, transferring the load into the primary frames. Again, the connections must be adequate, or the whole assembly of the roofing and purlins will be in the air.

The primary frames, in turn, resist the load by bending and might also fail if either their strength or connections are deficient. If the frames hold, and the uplift force is not overcome by the weight of the structure, the force travels to the anchor bolts attaching the frames to the foundations. And finally, if the anchor bolts hold, the wind load is transferred to the foundation, which, hopefully, has sufficient weight to counteract the wind uplift. Otherwise the whole building might be lifted up like a giant tree with shallow roots.

The final load transfer occurs between the anchor bolts and the foundation and is typically not the responsibility of the metal building manufacturer. This leaves the outside engineer to complete the final link of the load path and to design the foundations for the most critical loading effect, a task discussed in Chap. 12.

### 3.3.11 Bracing for Stability of Compression Flange

The bracing discussed so far was for lateral resistance of *buildings.* Each flexural *member*—purlin, frame, truss, or joist—needs to be stable under load as well. It is a well-known phenomenon that the compression flange of members in bending tends to buckle laterally and must be restrained from doing so by proper bracing. Compression-flange bracing for primary framing members is usually provided by roof purlins, while the purlins, in turn, rely on the purlin bracing or through-fastened roofing.

To be effective, this type of bracing should be attached to the compression flange or near it. While the top-bearing purlins are certainly in the right place for this task, the common purlin bracing consisting of sag rods or sag angles is often attached to the purlin web, some distance away from the