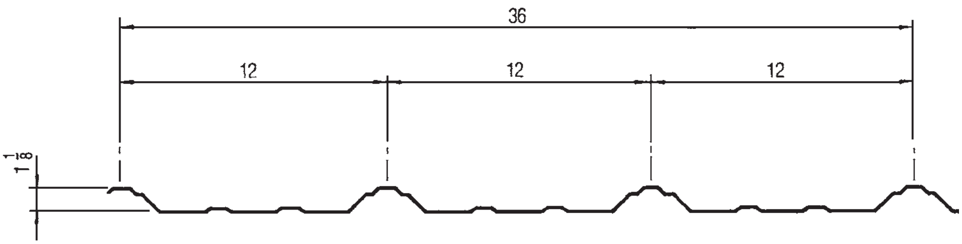

FIGURE 7.3 Typical liner panel dimensions. (*Star Building Systems.*)

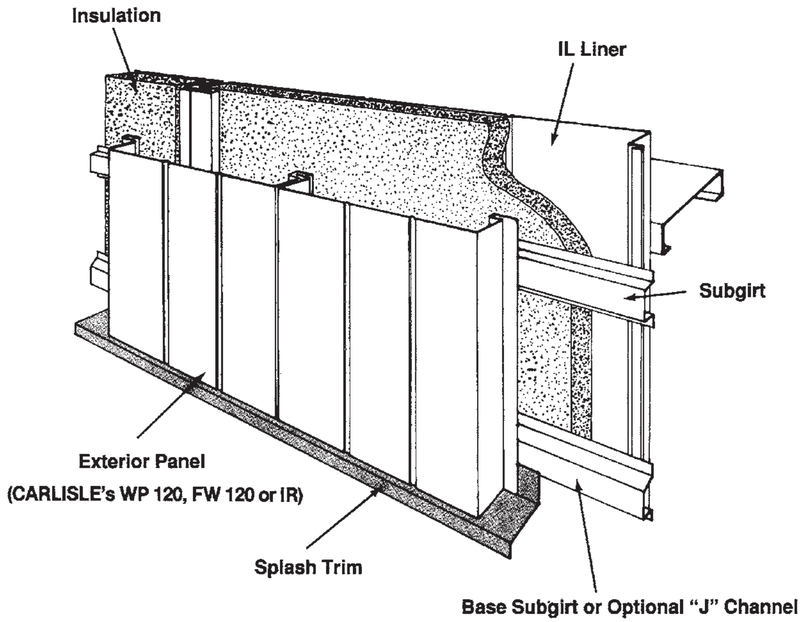

FIGURE 7.4 Field-assembled insulated panel. (*Carlisle Engineered Metals.*)

between the liner and face panels. The assembly may include multiple layers of gypsum board attached to hat channels spanning between the girts.

The disadvantages include loss of thermal performance at the points of panel attachment, where insulation is squeezed. Some manufacturers solve this problem by using thermal blocks, similar to the ones found in roofs, or by inserting a special caulking tape between the metal pieces in contact. It is also possible, of course, to place a layer of rigid insulation between the girt and the liner and to dispense with fiberglass, but this solution is uncommon. If a high level of wall insulation is required, it is better to use factory-insulated panels, described in the section that follows.

7.2.2 Shop-Assembled Panels

In shop-assembled panels, the same three system components—exterior siding, insulation, and interior liner—are delivered as a unit. In addition to better fit, shop assembly saves field labor. Rigid insulation, mostly urethane foam or polystyrene, provides better R values than fiberglass does. Depending

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WALL MATERIALS

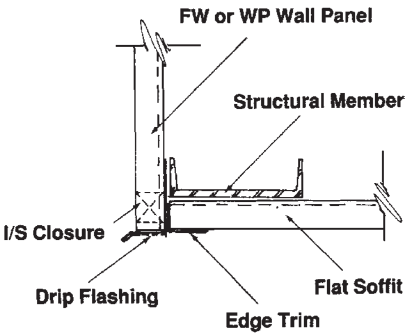

FIGURE 7.5 Detail at soffit. (*Carlisle Engineered Metals.*)

on the amount of insulation, panel thickness can vary from 2$^1/_2$ to 6 in; the width can range from 24 to 42 in. Custom panels with as much as 12 in of insulation can be made for specialized applications such as cold storage and refrigeration facilities.[2] The *R* value of a popular 2-in-thick panel usually falls between 15 and 16.[3]

Factory-insulated panels are filled with foam insulation and have interlocking joints to reduce thermal bridging. A typical panel is attached to supports at its top and bottom and at intermediate girts with concealed fasteners or with expandable fasteners installed from the inside (Fig. 7.6). There are two ways to get rigid insulation into the panels. First, the panels can be foamed in place by injecting liquefied polyisocyanurate or urethane insulation between two continuously fed metal sheets. In the process, the insulation is fused to the metal. In the second process, called *lamination,* the two metal sheets are bonded under high pressure to an expanded solid core of polyurethane, polyisocyanurate, or polystyrene.[2,3]

Composite panels consist of steel or aluminum exterior sheets laminated over rigid insulation or corrugated paper. Joined by high-performance epoxy adhesives, the assembly is lightweight, strong, durable, and energy-efficient. The composite panels are often manufactured with PVDF coatings, discussed in Chap. 6. For high-end applications they can also be given a special finish resembling granite or marble.[2] However, as Hartsock and Fleeman[4] have demonstrated, recent growth in popularity of these panels was not accompanied by rising engineering knowledge.

Foam insulation plays a structural role in composite design of foam-filled sandwich panels, enabling them to span longer distances than is possible with a face sheet alone. Composite design, however, may be governed not by the limits on deflection and bending stress under load but by thermal warp and skin buckling. Indeed, thermal warp from unequal temperature expansion or contraction of the two faces is a major cause of composite panel failure. Thermal warp, or bowing, matters less with simply supported composite panels than with multiple-span panels. Likewise, the choice of lighter colors can reduce surface temperature and thus the warping.

Another potentially critical item is panel support, as the fastener design capacity may control the panel's anchorage. The insulated and composite wall panels are typically attached to secondary structural members by concealed clips, similar to roofing (see Fig. 7.6, and Fig. 6.41 in Chap. 6). Like most wall siding, shop-assembled panels typically span vertically, but horizontal-spanning products are also available.

The required clip capacity can be determined by multiplying the clip's tributary area by the design wind loading specified by the governing building code for wall components. A clip supporting a 42-in-wide panel spanning between wall girts spaced 7 ft on-centers will have to resist wind loading acting on a 24.5-ft^2 tributary area. Using, for example, a 50-psf wind suction loading, this translates to 1225 lb per clip, which may exceed the pullout capacity of common self-drilling screws attached to thin-gage wall framing.[3]

To increase the fastener capacity, the metal thickness of secondary framing may have to be increased beyond that required for strength alone. Therefore, the metal building manufacturer should provide wall girts, eave struts, hat channels, and other secondary framing of a thick enough material to develop the panel fasteners, not just to resist a uniform wind loading. In theory, the specifier could establish the desired clip connection capacity by the tributary-area method shown above, but it is better to leave the design of composite panels and their attachments to the experienced suppliers. Ideally, the panel supplier will coordinate the connection requirements directly with the metal building manufacturer.

With shop-assembled panels, any field changes are difficult to make, and the locations of all wall openings must be established before the panels are made. Some installers attempt to "fix" any mislocated openings by using shears and nibblers to trim the metal and saws to cut the insulation, but the results are rarely perfect. Similarly, sloppy erection will make for a poor fit, defeating the advantages of this system. Installation of shop-assembled panels should be performed only by experienced erectors.

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