Randomly dispersed glass fibers account for perhaps only 5 percent of the panel weight, but the resulting increase in ductility is remarkable. GFRC skin is supported by lightweight steel frame with rigid (“gravity”) and flexible (“wind”) anchors embedded in thickened panel pads. The total panel weight is 8 to 20 psf.

The installed cost is high—in the \$20 to \$50 per square foot range[30]—and this restricts GFRC use to accent pieces, decorative parapets, column covers, elaborate cornices, and fascias.

While GFRC panels can add considerable interest to the project, they need to be specified with care, following the PCI’s Recommended Practice.[31] The fabricator’s and erector’s qualifications should be checked carefully, since, owing to some loss of GFRC strength with age, it is possible that damage during fabrication or erection may not become noticeable for a long time. Nicastro[32] tells a story of some badly warped GFRC panels that were “straightened” in the field by a contractor and developed numerous cracks within a year after the erection. In the author’s own experience, the panels are sometimes delivered cracked (mostly during transportation), discolored, and with delaminated anchor patches. It is wise, therefore, for architects to inspect the panels prior to erection and to insist that the manufacturer’s operations comply with PCI’s *Manual for Quality Control.*[33]

All these precautions do not guarantee success. GFRC simply has not been used long enough to reveal all its limitations. For example, GFRC skin of a 21-story office building in Texas mysteriously developed widespread cracking and eventually had to be replaced with another cladding system.[34] The problem was attributed to several factors. In some panels, “wind” anchors were made too rigid, restricting the panel’s expansion and contraction. Other panels delaminated at the interface of the face mix and GFRC base; the delamination was blamed on differential thermal and moisture movement—and buildup of stress—between the two materials. Numerous workmanship deficiencies have also been observed.

We can only hope that, once the weak points of GFRC are clearly understood, this promising material will overcome its problems and become commonplace in metal building systems.

7.8.2 Exterior Insulation and Finish Systems (EIFS)

Born in Europe, EIFS were introduced in this country in the late 1960s by Dryvit System, Inc., and for a while were called by that name. Today, this system is offered by many other companies represented by EIFS Industry Members Association (EIMA). The association publishes guideline specifications, technical notes, and other useful information about the product.[35]

The system most likely to be used in metal buildings includes steel studs spaced 12 to 32 in on center, exterior sheathing, rigid insulation attached to sheathing with adhesive, base coat, reinforcing mesh, and finish coat (Fig. 7.37).

There are two generic classes of EIFS: polymer-based (PB) and polymer-modified (PM). Class PB systems are made with thin flexible materials and are far more popular than the thicker class PM, or “hard-coat,” cementitious products.

The main advantages of EIFS are design flexibility, high insulation value, and low cost. EIFS make possible a variety of shapes and surface textures (Fig. 7.38); the systems can be applied over existing surfaces in the field or manufactured in panels with light-gage steel framing.

EIFS have become incredibly popular, but the failure rate has been dramatic as well. The author was intimately involved with production of EIFS panels in the early 1980s and later witnessed failures of many of those applications. Recent reports indicate that the first EIFS introduced in the United States were not nearly as good as their European siblings.

Today’s designs are much more advanced and will likely perform better. Still, the products that simply meet the minimum EIMA criteria might not be worry-free; some additional requirements will greatly improve the chances of obtaining a durable EIFS skin, although at an added cost. The following is a sampling of the experts’ recommendations, after Piper and Kenney[36] and others.[37,38]

- The PB class coatings are flexible, but they cannot cover large gaps and defects in the substrate without cracking. A classic source of cracks is the sloppy joint between pieces of rigid insulation that, instead of being filled with slivers of insulation, is left unfilled or is filled with adhesive.

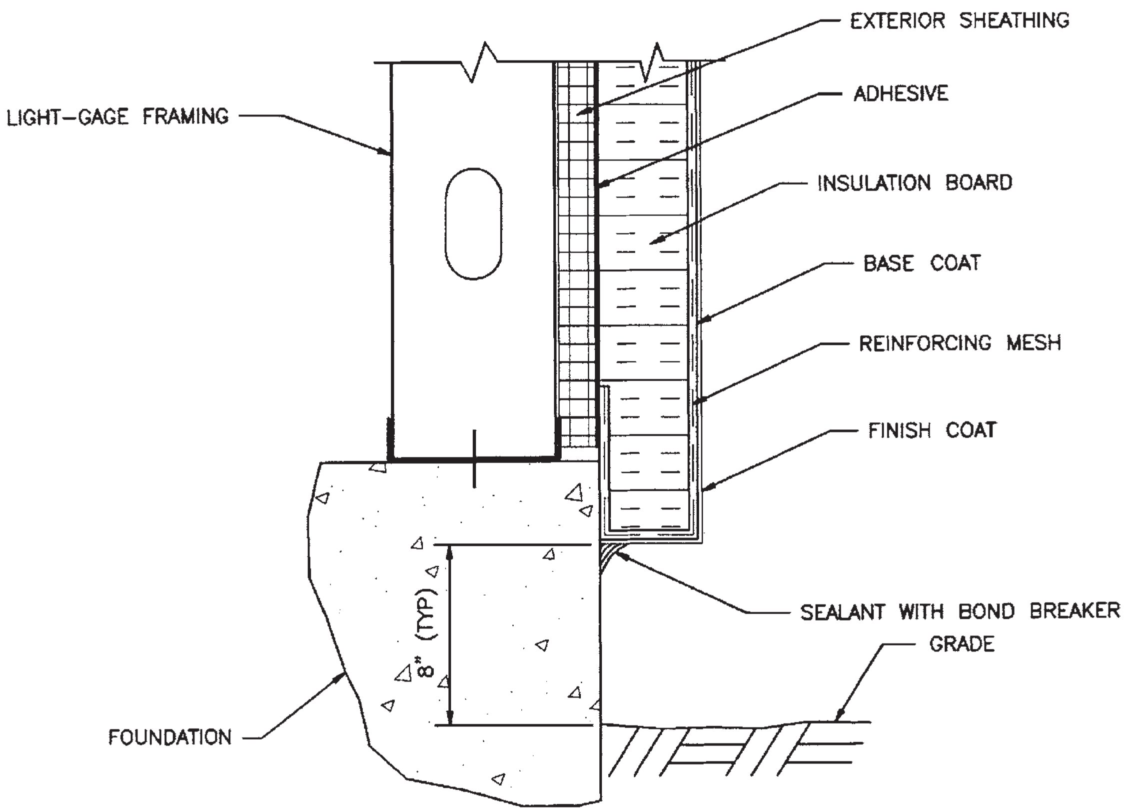

FIGURE 7.37 Detail at the base of EIFS panel.

- Although exterior-grade gypsum sheathing is allowed by EIMA, it can absorb moisture and lead to failure. Instead, Piper and Kenney recommend using cement fiberboard or proprietary products conforming to ASTM C 1177 such as Georgia-Pacific's Dens Glass* or the newest Dens Glass Gold.
- Expanded polystyrene insulation must have a good bead fusion; its joints should not be aligned with edges of the openings, sheathing joints, or rustications.
- The base coat should not be more than 33 percent cement, even though many products on the market have a 50 percent cement content. The extra cement not only reduces the coating's flexibility but also increases its alkalinity, which can break down an alkali-resistant mesh coating and eventually corrode the mesh.
- A common base-coat thickness is $^1/_8$ in, which does not provide adequate moisture protection. For best results, the base coat should be at least $^3/_{32}$ in thick and be applied in two layers.
- Use low-modulus sealants applied to the primed base-coat areas, not to the finish coat as is commonly done. Silicone sealants will likely provide the best service.

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*Dens Glass is a registered trademark of Georgia-Pacific.