Synthetic Stucco

Exterior insulation and finish systems provide an attractive, energy-efficient, low-maintenance siding; but should you trust them on your house given their recent failures?

by Steve Culpepper

What began a few years ago as a frenzy of business for installers of synthetic stucco in North Carolina has spawned a new trade: synthetic-stucco removal.

Synthetic stucco, or EIFS (exterior insulation and finish systems; the acronym is pronounced *eefs),* is being ripped from houses in almost every neighborhood in Wilmington, North Carolina (top photo). In its place: clapboards, shingles, hardboard siding, real stucco or brick. Rarely is EIFS going back up. The siding is being replaced because water got behind the synthetic stucco and damaged the sheathing. In some cases, even the framing suffered damage.

I found this panicky removal of EIFS at odds with much of what I knew about the material. I began researching an article on synthetic stucco a couple of years ago with the goal of writing about the material, how it's applied and detailed, and how it's maintained. Since then, the problems in North Carolina surfaced, and the story was no longer quite so cut and dried. From what I've since learned about EIFS, I'm not so sure I'd want it on my house—at least not the way it's been detailed in the past.

As a modern building material, synthetic stucco has a relatively long history. It was first used in post-World War II Germany to resurface buildings with damaged masonry. It came to this country in the late 1960s, and its use became widespread. In 1995, installers applied more than 260 million sq. ft. of the material in the United States, about 80% of that on residences. If applied properly, EIFS can be an attractive, low-maintenance siding. If not, it can be a disaster.

What began as a sticky issue local to North Carolina has blossomed into a small but thorny national one. On one side are EIFS manufacturers and the EIFS Industry Members Association (EIMA; 800-294-3462); on the other side are builders and contractors burned by their association with EIFS. In the middle are property owners. Of course, lawyers are present in the EIFS controversy, too, feeling their way through

What went up must come down. Although this EIFS-sided home in Wilmington, North Carolina, suffered only minor damage from water intrusion, the synthetic-stucco skin is being ripped off anyway—to make way for more traditional siding.

When water gets in, rot happens. This Cary, North Carolina, house was about a year old when moisture-testing showed that water had gotten behind the synthetic stucco. The main culprit for the leaking was the windows, where water dribbled past the caulking or through the jamb-and-sill connection to the OSB substrate.

an evolving legal crisis that has spawned many individual lawsuits and a half-dozen class-action suits representing numbers of homeowners.

Why does water cause so much damage when it gets behind EIFS?—Traditionally, residential EIFS refers to a surface-sealed, water-barrier siding system made up of a layer of foam-insulation board, fiberglass mesh and one or two base coats and a finish coat of synthetic stucco (top photo).

Commercial EIFS is generally thicker than residential EIFS and usually is applied over steel framing. For residential applications, the insulation board usually is glued onto the substrate, which can be plywood, gypsum, oriented strand board (OSB), cement board or masonry. Next comes a layer of fiberglass mesh, which is bedded over the insulation with an acrylic portland-cement base coat. A second base coat sometimes is applied before the finish coat goes on. Standard EIFS also relies heavily on proper detailing, especially caulking and flashing.

At $4 to $8 per sq. ft., EIFS is marketed as being price-competitive with brick and other masonry sidings. It expands and contracts with the seasons, its color goes all the way through the textured finish, it insulates, and it serves as a barrier to keep out the weather. Details can come in as many shapes as polystyrene can be cut into (center photo). Above all, EIFS looks like stucco but resists cracking, and it is supposed to be a low-maintenance siding.

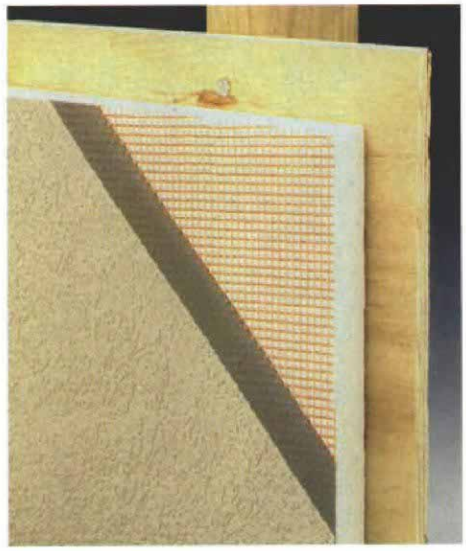
Ironically, the greatest strength of EIFS is also its greatest weakness. Because it is a water-barrier system, water can't get in—theoretically. When water does get in, it cannot easily get out. And when water gets trapped between sheathing and an otherwise impermeable covering, rot can occur (bottom photo, facing page).

Water intrusion is not unique to EIFS. Water can get inside almost any type of building envelope, and usually does. What's really important is that the water has a way to get out. Take cedar clapboards. The sheathing beneath clapboards is covered with building paper or housewrap; clapboards are nailed over that. Any water that blows around or through the clapboards hits the paper and dribbles out.

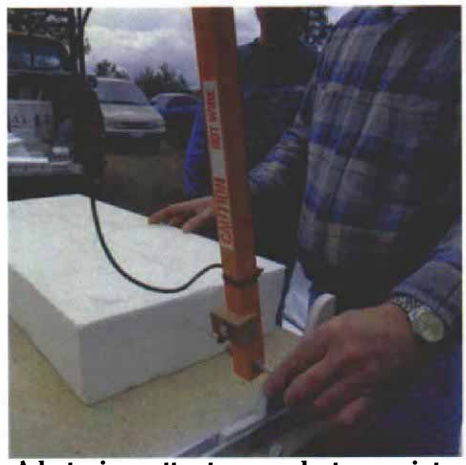
Standard cement stucco is applied over a substrate wrapped with waterproof building paper, to which is affixed metal lath. Three coats of stucco—scratch, brown and finish coats—are applied over the lath, which provides a gap between the building paper and stucco for water to drain out through a weep screen installed at the foundation.

In most residential EIF systems, there is no building paper or housewrap under the synthetic stucco because the insulation is glued directly to the sheathing. Because typical flashing isn't used with most residential EIFS, caulk becomes the first line of defense at penetrations. If water gets between the sheathing and the insulation board, it can stay there for a long time, travel along gluelines and cause damage far from the leak. In contrast, wood siding generally is caulked at doors and windows, where caulk serves as a secondary barrier against moisture. With wood siding, the main barrier against moisture is the building-paper covered sheathing.

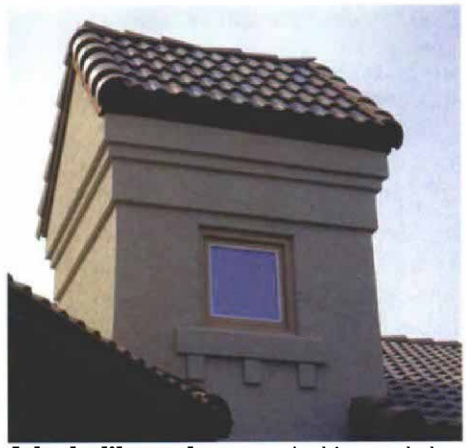
The usual suspects in water leaks are to blame for water intrusion in EIFS: windows, doors, flashings—anywhere the siding is penetrated.



These layers should add up to a protective barrier against the elements. Glued to the sheathing is the expanded polystyrene insulation board. Over that is a base coat embedded with protective fiberglass mesh. Topping off the system is a textured acrylic finish.



A hot-wire cutter turns polystyrene into crown molding. Using a template and a hot-wire cutter, an EIFS installer can slice through a thick piece of polystyrene to make almost any type of molding or detail.



It looks like real stucco. Architectural elements such as this EIFS-clad tower can be made to look like real cement stucco.

Water can get in where EIFS terminates—Unfortunately, the highly publicized failures in North Carolina call into question the materials and installation details of all EIFS. In Wilmington, the local American Institute of Architects (AIA) surveyed 209 EIFS-clad houses-most just a few years old-and found 90% with moisture-content levels above the acceptable limit of 19%. (Moisture levels below 19% require no further action, according to a National Association of Home Builders EIFS report, available by calling 800-898-2842).

Facts in the AIA report damaged the EIFS-industry argument that the problem was caused by a few crummy builders and installers. Houses surveyed by the AIA were in 16 different subdivisions, built by 19 different builders, had EIFS applied by 10 different applicators and used 12 different EIF systems.

However, EIMA's charge of poor detailing in Wilmington was at least partly on target. Of houses sampled by the AIA, 38% had improper caulking or no caulking around windows. That lack of proper caulking might not have been a problem had the houses been sided with a system that allowed water to drain out.

New Hanover County—where Wilmington is located—stopped accepting EIFS as an alternate to code-recognized building methods on February 15, 1996. For now, the only EIFS the county allows must provide a way for water to drain out. On May 1, the state capital city of Raleigh issued a notice to builders that its inspections department no longer accepts EIFS applied over wood-frame buildings as an alternative material or method. Beginning in 1997, rules for EIFS throughout North Carolina will require synthetic stucco installed over wood-frame construction to include elements to allow water drainage.

Code organizations and the American Society of Testing Engineers have committees that are evaluating EIFS, although no form of synthetic stucco has as yet received code approval.

In some places, EIFS works as planned—In Spokane, Washington, synthetic stucco seems to have worked well. Architect/builder Gerry

Top photo this page: Scott Phillips

Mesh reinforcing is embedded in the base coat. A thin layer of base coat is applied to the insulation before the fiberglass-reinforcing mesh is rolled onto the wall surface. More base coat is applied over the mesh.

Caulk the base coat, not the finish. Sealant recommended by the manufacturer is applied wherever the EIFS intersects other materials, such as at this strip of molding separating the EIFS from the clapboard siding.

One worker should trowel the finish coat. To ensure a uniform appearance, the same person should trowel the final coat of stucco. On big jobs one worker can apply the finish while a second worker textures it.

Copeland has put EIFS siding on more than a dozen houses in and around Spokane over the past decade (bottom photo, p. 67). He's never had a callback.

Except for a few dings and some cracks, the EIFS cladding that Copeland's subcontractors applied (and that he and I probed with a moisture meter) appeared to have held up well. However, experts say it's easy to miss areas with high moisture levels, so we could have overlooked areas of wet sheathing.

Clearly, synthetic stucco can work, or more precisely, it can be made to work, at least in some climates. In Spokane, I spent a few days with Bob Bogart, who owns Wall Tec Systems. Bogart has been applying Dryvit's EIFS (Dryvit Systems; 800-556-7752) for seven years and has done most of Copeland's EIFS applications.

I'll outline the steps Bogart followed when installing EIFS on a house in Spokane. First, there are a few things you need to know. Before the insulation board is attached to the substrate, the substrate should be flat, well-secured and free of defects. Next, a strip of fiberglass mesh is applied to the sheathing wherever the insulation board will terminate: at the foundation, at the roofline or at penetrations. Once the insulation board is attached, the mesh will be wrapped at least 2½ in. back around the edge of the insulation to protect it. This process is back-wrapping.

Most manufacturers make mesh in a variety of strengths, generally from 5 oz. per sq. yd. to 20 oz. per sq. yd. Ordinary mesh works in most applications, but around doors and high-traffic areas, a heavier-duty mesh should be used.

For most EIFS installations, the insulation is ¾-in. thick polystyrene, which also is used in thicknesses up to 4 in. Bogart uses polyisocyanurate board. The material costs more but is a lot more durable and resists denting better than polystyrene, he said.

Bogart mechanically fastens the insulation board to the substrate using Wind-Lock fasteners (800-872-5625), which are equipped with plastic flanges. Most residential EIFS is glued to the substrate. However, in high-wind areas, insulation board may be both glued and mechanically fastened to the substrate.

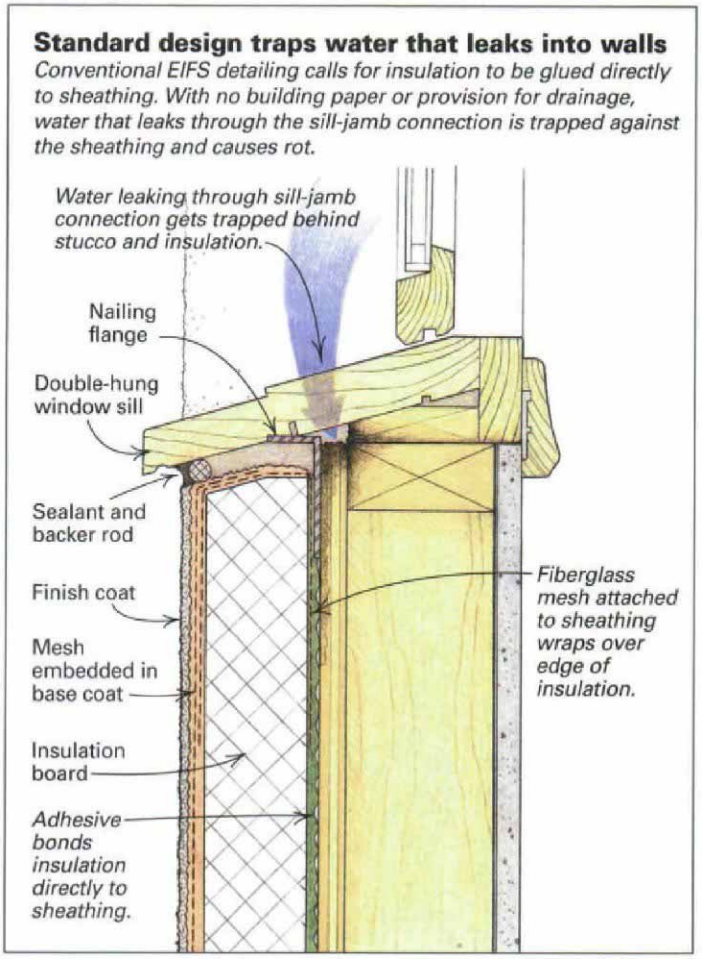
Once the insulation is secured—in a staggered, running-bond pattern-Bogart and his crew head around the house, plastering on the cementitious base coat, which serves as the system's main water barrier. The base coat must be a minimum thickness of 1/16 in. (StoCorp. recommends a ⅛-in. thick base coat.)

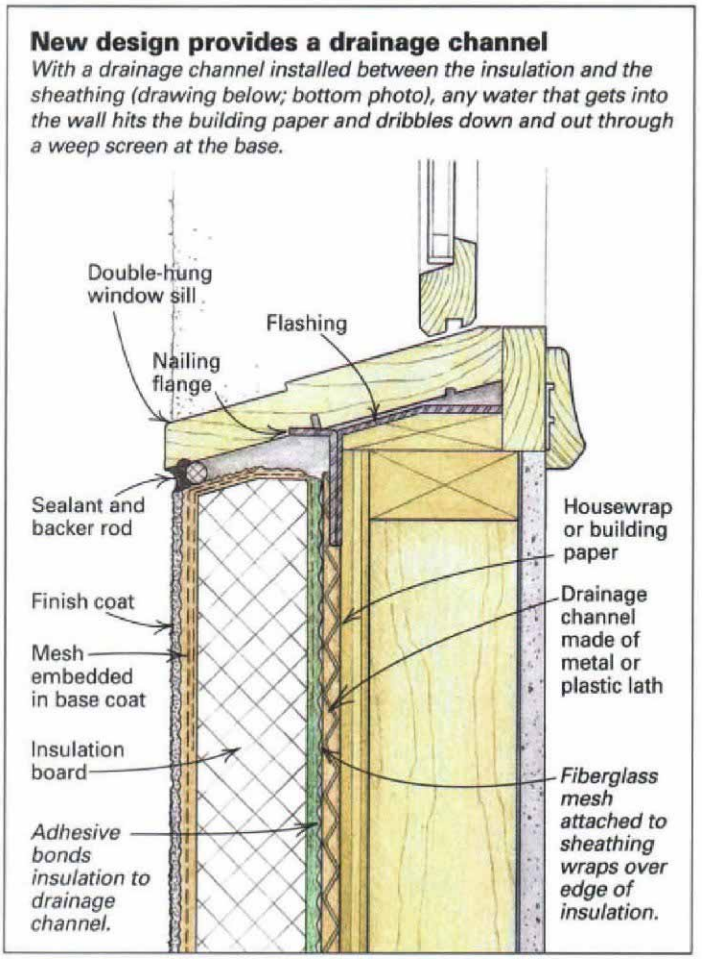
Embed fiberglass mesh fully in the base coat—The EIMA recommends that fiberglass-reinforcing mesh be embedded in the base coat until no mesh color is visible (top photo). Some researchers say that after you wait at least 24 hours, a second base coat should be applied until no mesh pattern can be seen.

Bogart adds impact protection around doors and windows by attaching small, diagonal strips of mesh, or butterflies, at comers of windows and doors and around all other penetrations before application of mesh. In cases where the EIF system passes below the floor level or on large runs of wall, a contraction joint is needed. It is caulked like an ordinary contraction joint.

The base coat must then dry for at least 24 hours. Dryvit, the largest manufacturer of EIFS in the United States, recommends the temperature be above 40°F and rising at the time the base coat and textured finish are installed (45°F and rising for nontextured finishes). This temperature must hold for at least 24 hours after installation. The material should also be protected from the elements for at least 24 hours. In other words, it's a lot like applying paint.

The industry recommends that during installation, EIFS be protected from dust, dirt, mois-





ture, freezing and humidity. Tops of walls should be covered immediately with cap flashing and final trim, or else temporarily protected.

Before the finish coat comes the caulking— In most cases, caulking means the difference between a successful EIF system and one that lets in water. It used to be recommended that caulk be applied to the finish coat at all terminations. But the finish coat proved to be an inadequate surface for caulking adhesion. Now it's recommended that caulk be applied to the base coat (photo bottom left, facing page).

Caulk joints should be no less than ½ in. wide and should adhere only to the insulation board and the adjoining surface, never to a third surface, such as the substrate. In cases where the depth of the joint is too great, backer rods (thin strips of foam) should be used to fill the joint.

To fill joints between EIFS and other elements, Bogart sometimes uses Willseal, an expanding insulation tape (Illbruck Sealant Products; 800-438-0684). The tape is made to be used by itself without caulking, although the manufacturer says caulking can be used. The tape is kept cold until it's installed; as it warms, it expands to a depth of about 1 in.

A watershed EIFS design. Sto now offers this design in North Carolina: a layer of building paper, plastic lath for drainage and the standard built-up insulation, mesh and top coat. The wall terminates at the bottom into a plastic molding that contains weep holes.

Finally, a finish coat is troweled on— On a small job such as the one shown here, Bogart usually assigns one person to apply and texture the finish coat (photo bottom right, facing page). That way, the texture that's troweled into the mix will be consistent throughout. On a larger job, one person applies the finish-coat mix and another trowels in the texture.

Weather plays a similar role in finish-coat application. The weather can't be too cold or wet, and the finish coat should not be applied in direct sunlight, which can cause uneven drying and hairline cracks. Also, it may be necessary to protect the wall surface with tents. If the temperature is below 40°F, heaters can be used inside tarps to allow application of the finish coat.

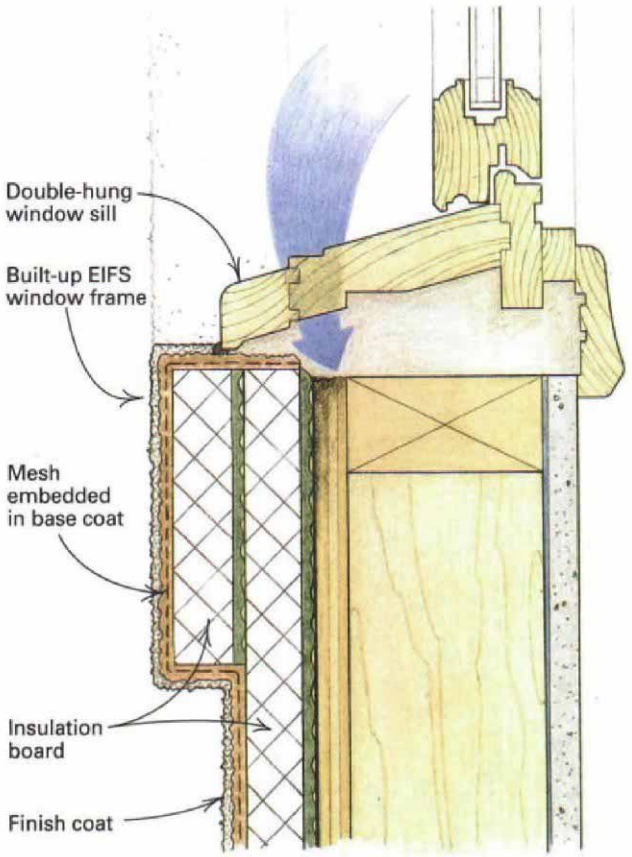
The finish coat an applicator orders depends on the texture specified. The most common textures are a smooth finish, a sand finish, a rilled finish and a troweled finish. Also like paint, EIFS comes in a wide range of silly-named colors, such as Wild Cattails, Smoked Putty, Good Earth and Broadway Blue.

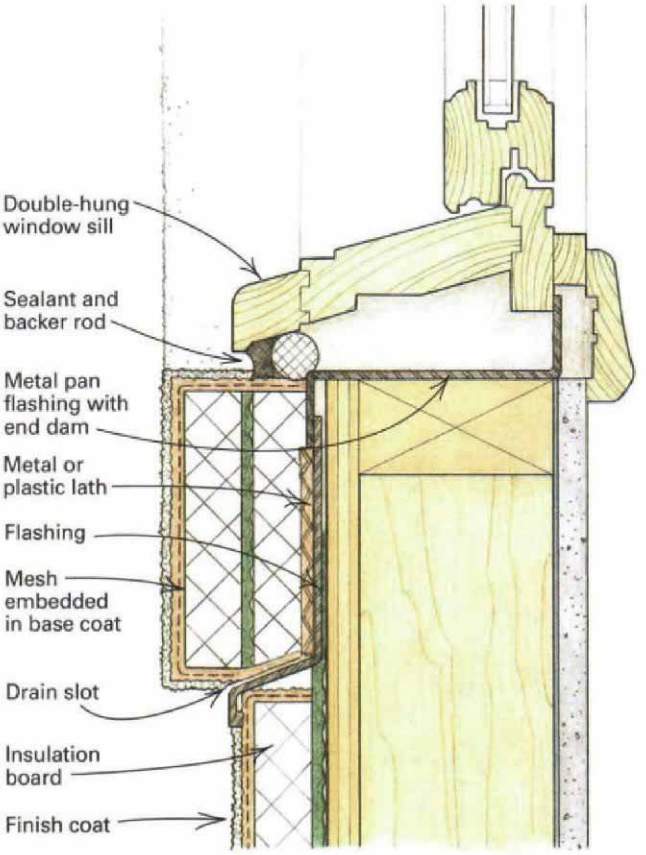
The devil is in the detailing— EIFS manufacturers seem to see their products only in terms of their insulation board, mesh, base coat and de-

Drawings: Heather Lambert. Photo this page: Scott Phillips.

An EIFS retrofit for leaky windows

In a typical EIFS window installation, which has an exterior frame of built-up EIFS components, water that gets through the sill is held against the sheathing, as shown in the drawing on the left. A retrofit design (drawing right) includes metal pan flashing under the window. If water gets through the sill-jamb connection, it dribbles down the pan flashing, through a layer of metal or plastic lath and out through another piece of flashing that exits in the shadowline of the lower window frame.





signer-color top coat. They don't seem to see their EIFS components in a context of windows and doors and all other components that, along with synthetic stucco, make up the exterior of a house. I asked a representative of one of the largest EIFS manufacturers about detailing around windows. She suggested I talk to a window manufacturer.

For their part, builders need to understand that an EIF system isn't like ordinary siding. Clapboards, brick and real stucco all withstand water. Inevitably, when water gets in, it also can get out. But with most EIFS, when water gets in, it's trapped. That's why caulking around penetrations is so critical in an EIFS-sided building.

Mark Williams, an architect and building diagnostician, and Barbara Lamp Williams, his wife, wrote the book on EIFS (ASTM manual 16, *Exterior Insulation and Finish Systems: Current Practices and Consideration;* 610832-9585). "It is clear that faulty integration of the EIFS with other building-envelope systems—roofs, fenestration and typical residential-building features—is a prime cause of leakage problems," according to Mark Williams.

Water got through even this brand-name window. In an experiment, the sill was dammed with duct tape and water poured in. After less than a minute, water began leaking through the sill-frame joint in this window.

Although the industry claims that much of the water damage in North Carolina occurred because of cheap, shop-built windows that let water leak behind the insulation board, Williams found that even the best windows leak.

As part of his research, Williams mocked up an EIFS-sided house at his office in Maple Glen, Pennsylvania. On one window (I won't name the brand, but it's a major window company, and the window wasn't a cheap one), Williams dammed up the sill using duct tape. Then he poured in a cup of water. After less than a minute, the water started dribbling through the joint where the sill is attached to the jambs (photo left). Builders can't be blamed for code-approved windows that leaked water into an EIF system, according to Williams.

EIFS research results vary—Experts, most of whom have been hired to conduct research for one side or another in the EIFS controversy, disagree on what it will take to fix the problems. Williams, who is working for an insurance company that wrote policies for a lot of North Carolina contractors, believes the industry must re-

think its residential detailing. Dick Piper, a forensic engineer with R. J. Kenney Associates in Plainville, Massachusetts, believes the main problem "isn't with EIFS itself but with the way it's installed. Our position has been that standards for materials and applications need to be improved."

Building engineer Gary Zwayer of Wiss, Janney, Elstner Associates in Northbrook, Illinois, says, "My belief is that if you follow current EIFS manufacturer's details, you're going to avoid a lot of problems."

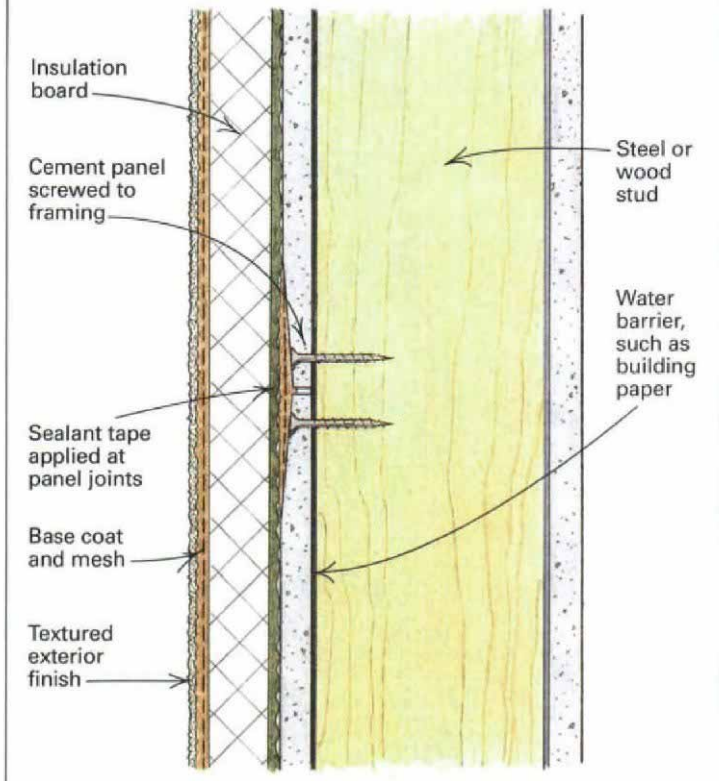
Zeroing in on windows—Assuming it's installed correctly, the actual EIFS surface is pretty good at staying put and at keeping out water. There have been problems with thin base coats or improperly installed insulation. But in general, a solid run of EIFS-covered wall has not been much of a problem.

Again, problems occur where EIFS is penetrated, especially at windows. So let's narrow our discussion to sealing around windows. Manufacturers detail their window treatments a little differently, so I'll look at the way Sto details windows Because Sto developed a water-drainage system in response to the problems in North Carolina. Sto is the second-largest EIFS company in the United States, and the largest worldwide. Based in Atlanta, it began in Germany.

In an ordinary Sto EIFS installation, the joint between the window and the siding is sealed with foam backer rod covered with sealant (drawing left, p. 69). There is no window flashing shown in Sto's detail drawings. Now imagine this is the window Williams used in his mockup. Any water that gets into the system through the sill-jamb connection drips behind the carefully laid backer rod and caulk seal.

Pan flashing installed under the window, along with some means of allowing water that leaks into the flashing to weep out, could have solved the problem, according to Williams, who designed a retrofit to channel water out of an EIFS-sided window assembly (drawing right, facing page). Proper sealing and adequate flashing details at windows, at doors and at roof-wall intersections would eliminate the need for a secondary weather barrier, such as building paper, according to Williams.

Cement board serves as sheathing. *The Durock Insulated System, produced by U. S. Gypsum in response to problems with its standard EIFS siding in North Carolina, uses cement board for sheathing and includes an interior water barrier installed directly over the studs.*



How things are changing—Sto Systems (800-331-2344) now has a modified version of its standard residential EIF system, which it has passed on to the building-inspection department in Wilmington. That system includes the use of a moisture barrier over the sheathing, flashing under windows and what it calls a "drainage mat," or plastic lath, behind the insulation board (drawing right and photo, p. 69). A second system Sto developed for North Carolina uses insulation board with grooves or channels cut in the back. Both are marketed in North Carolina.

Sto's Buck Buchanan, president of the EIMA, says Sto's standard system works just fine. "Outside of North Carolina, our approach will be this: If a builder is concerned about water, we've got these two systems, lath or grooved polystyrene. You still need proper details and windows that meet building code."

U. S. Gypsum (800621-9622) pulled its brand of face-sealed, water-barrier EIFS off the market after problems in North Carolina. Now it's back with what it calls its Durock Insulated System, which uses USG Durock cement panels as sheathing. However, the order of things in the USG system is a little different (drawing left). Building paper goes over the framing, and on top of that is either expanded metal or plastic lath, then sheathing—if it's a humid climate—or just Durock sheathing. The rest of the installation is the same as in an ordinary EIF system. (Of course, cement panels cost more than either plywood or OSB. In southwestern Connecticut, my local building supply sells ½-in. sheets of OSB for $7.15 per 4x8 sheet and ½-in. CDX plywood for $10.25 per 4x8 sheet. It charges $9.75 for a 32-in. by 5-ft. sheet of cement board.)

Parex (800-226-2424) is another manufacturer that has developed a drainage system for North Carolina. The Parex system is nearly identical to the Sto system shown in the photograph on p. 69.

The EIMA has established a training program for applicators, although most EIMA-member manufacturers train their own applicators. Seminars were to begin in April 1996, but to date the training program exists only on paper. Unfortunately, not all applicators receive enough training to follow installation instructions correctly. "All manufacturers say their products are applied by factory-trained applicators. But manufacturers don't police that well enough," Piper said.

Until the holes in the system are plugged, many experts suggest that a third-party inspection system be used to head off problems such as those that occurred in North Carolina. A report on North Carolina's problems issued in November 1995 by R. J. Kenney Associates suggests a range of precautions, including proper training, testing of the work and "an inspector, either a trained clerk or a third-party inspector hired for the EIFS work."

EIFS isn't a no-maintenance siding—Despite marketing that suggests the system is low maintenance, an EIFS-clad home needs regular inspection and care. Sto recommends replacing damaged caulk every three years. It also suggests occasionally cleaning walls to remove pollution and not scarring or denting siding.

Pigment does go all the way through the textured finish coat, so it doesn't have to be repainted like many types of ordinary siding. However, it may have to be pressure-washed every few years, manufacturers suggest. □

Steve Culpepper is an associate editor at Fine Homebuilding. *Photos by the author, except where noted.*