Exterior Insulation and Finishing Systems

Loss Control TIPS

Exterior Insulation and Finishing System, commonly referred to as EIFS, is an exterior siding system that has recently became the focus of the legal system in various lawsuits. The suits allege that water infiltration behind the siding system caused rot and insect infestation in a number of applications. This report provides information of the product history, composition, alleged problems, and emerging new technology to improve the product.

Introduction

EIFS is a barrier exterior finish system that combines insulation qualities with a durable and aesthetically adaptable finish. It is in demand by many builders and architects because of its detail capability and insulation qualities. The main concern that has developed with EIFS is that water apparently might get behind the barrier system and remain trapped. Under certain conditions, which are aggravated by humid and warm weather, the structure's substrate under the EIFS might become saturated. This saturation ultimately leads to deterioration, insect infestation, rusting in metal components, and delamination of foam from the substrate. When deterioration and delamination occurs, the system would be highly prone to damage from high winds, which might result in complete siding sections being torn free.

Water entry apparently occurs primarily at points where the EIFS joins other components in the structure (such as windows, roofs, decks, doors, etc.). Poor detail, sealant failure, shoddy construction techniques, and lack of maintenance, combined with the alleged deficiency of EIFS to drain water from behind the system as rapidly as it enters, may result in water being trapped, contributing to possible deterioration of the substrate.

The solution to this issue for EIFS is in two parts.

- The first step is to *eliminate the possibility of water entry into the system*. This must be done with water-tight joints, flashing to deflect the water, water vapor barriers on the substrate, sealant that is of the proper type and installed correctly, correct installation performed by qualified people, and maintenance and repair for damage or sealant failure.
- The second step is to *provide an exit for water or moisture* that might have made its way into the system.

EIFS systems which are correctly installed, which are properly sealed at all openings, and which have drain capability and water management for any moisture or water that gets into the system, should give years of service.

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Exterior Insulation and Finish System (EIFS)

EIFS is a non-load bearing exterior wall covering which combines materials that have insulating qualities with materials that provide weather protection and completed finish. Behind the EIFS wall components are the typical wall substrates used in construction. In this country, the most popular wall substrates are gypsum board, plywood, orientated strand board, insulation board, or masonry, with plywood the most prevalent.

The four primary components of EIFS are:

1. Panels of expanded polystyrene foam insulation, either glued to the structure's substrate or mechanically fastened with screws or nails
2. A base coat that is installed over the foam insulation
3. A glass fiber reinforcing mesh
4. A finish coat that is installed over the base coat and mesh to provide the exterior finish. The exterior coat can be installed in two layers, using different colors of material. This allows for lines to be carved in the final coat to allow the under coat to show, giving the appearance of stone or brick with visible grout lines, depending on the configuration on the carved lines.

The foam panels that serve as the base and insulation vary in size, depending on the building configuration. The panels are easily cut to form shapes or raised portions. The foam can also be cut to provide architectural detail. The joints between the foam panels are bridged with the Fiberglas mat. When completed, this gives an unbroken finish. Sealant is used to bridge joints between the EIFS wall surface and openings in the wall for doors, windows, decks, services, and other type openings.

The two basic EIFS types are *Polymer Base (PB) Systems* and *Polymer Modified (PM) Systems*. The most common is the Polymer Base (PB) System. There are some noteworthy differences between the two systems.

- The Polymer Base System base coat is usually applied directly onto the foam insulation. The reinforcing mesh is then imbedded into the base coat and is intended to bond the mesh to the foam insulation. It is also usually thinner than the Polymer Modified system.
- The Polymer Base System base coat and finish coat are usually a polymer base material.
- The Polymer Modified System base coat is usually installed after the mesh is attached to the foam and substrate by mechanical fasteners. The base coat is not intended to bond the mesh to the foam. This base coat is usually a cement base material that is modified with a polymer.
- The Polymer Modified System finish coat is usually a polymer modified cement material.

We are not aware of any data to support or suggest that either the Polymer Base System or the Polymer Modified System is superior in performance to the other.

EIFS, Stucco, Shotcrete, or Veneers

These similar systems, often confused, have some important differences.

Stucco is a exterior finish mortar composed of lime, Portland Cement, sand, and water. It is installed, usually by trowel, directly onto masonry, metal lath, or concrete substrate. In some applications, it has been installed over stone or brick veneers, but this is rare in new construction. It may be used as a finish during renovation of the masonry exterior.

Shotcrete is concrete or mortar that is sprayed onto a surface using pneumatic pressure at high velocity. It is frequently used to repair concrete, sprayed onto forms, graded ground, or masonry for pools and similar applications. Though it can be a finish material, it will rarely be used as a thin coat on a exterior finish that is not masonry substrate.

Veneers on a substrate are typically a non-load-bearing brick or stone or similar material. They are installed as a finish on structures. They will almost always have a vapor barrier of building paper or vapor fabric and air space behind the system, if the substrate is moisture sensitive. This system anticipates that some water or moisture will enter and must be managed. The vapor barrier and/or flashing will allow the water to be carried down and outside of the system. Small weep holes are usually placed at the low points to allow water to escape.

History of EIFS

EIFS was originally developed in Europe following World War II. During the rebuilding of Europe, construction materials were very scarce and desperately needed. It was at this time that EIFS was developed. It filled the need for use as a siding material on masonry and concrete walls which are typical in Europe. (The use of EIFS in Europe on a stud-type wall was, and still is, virtually unknown.)

EIFS made its entry into the United States in the 1960s for use as a finish on masonry and exterior concrete. It is different from the previously used masonry stucco materials, since masonry stucco uses primarily a lime, Portland cement, and sand base. EIFS got a big boost in popularity during the energy shortage of the 1970s because of its energy efficiency. It was at this time that EIFS was adapted to stud wall construction that is so popular in this country.

Market Share

The use of EIFS has grown rapidly in this country since the 1970s. It is a popular choice with architects and builders because of its ease of workability, and because architectural details can be created when it is installed in different shapes. It is also a very light-weight material with good insulation qualities. In 1995, EIFS was used as an exterior finish on about 25,000 homes in this country. The EIFS industry has also targeted the residential market for expanded market share. Currently, this accounts for about 4% of the residential siding market.

On commercial buildings, EIFS is also a popular choice because of its light weight, adaptability, appearance, and insulation qualities. It accounts for about 12% of the exterior commercial siding market.

EIFS Performance

EIFS is designed to be a barrier type siding which presents a water-resistant face to the elements. No moisture is supposed to get beyond the surface of the system. If water makes entry beyond the barrier, it may be restricted in its escape. The traditional EIFS does not incorporate any channels, flashing, or openings to ventilate the moisture or carry it back to the outside. Consequently, any water that enters behind the system may not be able to escape unless it vaporizes very slowly through the system.

Because EIFS is a water barrier, moisture that gets behind the system can accumulate over time. Under warm, damp, humid conditions, this accumulated moisture could cause decay in the substrate and structural members in the wet area. Meanwhile, the exterior wall may appear, in a visual inspection, to be in excellent condition. Another problem from accumulated moisture is that it can also cause the foam insulation board to delaminate from the substrate. This would make the insulation more vulnerable to wind pressure. High winds can strip the siding off the building in sections. This situation became visible during Hurricanes Opal and Andrew. Water penetration tests conducted on EIFS demonstrate that under optimum conditions, the tight system repels water very effectively. However moisture can get in behind the system through these four pathways:

- Physical damage (like cracks, dents or chips)
- Spaces around necessary openings in the walls (such as for windows, doors, decks, roof/wall intersections, and services)
- Windows and doors (especially in residential construction), which may allow some water to seep through the sills and jambs
- EIFS joints with other materials that are caulked with a bead of sealant (the sealant may be omitted or may be poorly installed)

Part of the problem that apparently developed in the North Carolina area was that during the housing boom that took place in the 1980s, the shortage of labor allowed unskilled installers to enter the business of installing EIFS. Also, installers who migrated into the area from very dry climates out West, and who had little or no experienced with the damp climates, were putting the systems in place. There were also situations in the failures where applicators mixed components from different manufacturers that were not compatible. This mixing could also void the manufacturers warrantee.

Therefore, the basic concern with EIFS is that *openings in the siding can allow water to penetrate around the exterior barrier surface when certain conditions are present*. Water penetration and interior decay are the most critical performance issues of the EIFS. Any water retained behind the EIFS can lead to deterioration and eventual failure of the substrate. Advanced cases of deterioration can affect other structural members in the area.

Commercial vs. Residential Construction

Extensive research has been done on the failure of the substrate in both residential and commercial buildings that have EIFS siding. However, the failure rate does not seem to be as pronounced in commercial structures. This generally can be attributed to the fact that construction and maintenance is typically of a higher quality in commercial structures. Also, commercial construction is almost always more closely supervised, maintained, and regulated.

Another feature of commercial construction is that the windows in commercial buildings are usually fixed and of an impervious material. Fixed windows are less prone to moisture infiltration than are wood jointed, moveable windows,

such as those commonly used in residential construction. Commercial roofs are also simpler than residential roofs. Residential roofs are more complex, with valleys, complex slopes, and other shapes.

Another difference of construction in commercial buildings is that most commercial buildings using EIFS applications have the siding installed over metal stud with a cement base substrate. Moisture resistant gypsum board has also been used. Though it is not as prone to water damage as the typical wood substrate of residential construction, rusting in the metal joists and breakdown in the gypsum has occurred in certain applications where water apparently accumulated behind the siding.

Commercial buildings are not totally exempt from damage. The U.S. Housing and Urban Development agency conducted inspections on fifty of their buildings, including commercial, institutional, and multi-family structures with EIFS siding installed from several different manufacturers. The inspections found that seven of the eleven buildings that were more than eight years old had high moisture content in some of the wall cavities. About 25 buildings had exterior sealant failure, and 42 of the buildings had cracks in the systems that were sufficient to allow water penetration.

In summary, if water enters behind the EIFS into the substrate of either a residential or a commercial structure and cannot escape, problems can occur in the form of rusting, rotting, and possible breakdown of the substrate. It is almost impossible to detect these conditions during exterior physical inspection until they are in extremely advanced stages. Substantial repair is required when the substrate has been exposed to moisture in the 30% range over extended periods of time.

Identifying EIFS

It can be very difficult to determine if EIFS is present simply by looking at the exterior siding of a structure. The simple and obvious way to find out if a structure has EIFS is to ask the owner. However, the owner may not know. Some alternative methods to determine EIFS would be to examine the exterior of the structure in areas that are prone to physical damage. There may be nicks in the panels or gaps in the sealant that provide a "peek" inside at the reinforcing mesh and polystyrene insulation. If no physical damage is present to provide the "inside peek" then consider the insulation system composition. Polystyrene is a relatively soft, light weight, and porous material. Push hard on EIFS and you should feel some "give" in the panels. Stucco is installed on masonry or metal lath, and it will not "give." Thumping EIFS with your hand will produce a hollow sound. Striking stucco on masonry with your hand will give you a solid sound.

Water-Managed EIFS

EIFS is a barrier-type cladding designed to present a waterproof face to the elements. No moisture is supposed to get behind the building skin. In "real life construction," however, water is a constant element that must be considered. In addition, EIFS is rarely installed on a solid wall, and openings are always required. Any type of opening that has even the slightest defect can allow moisture to enter. Traditional EIFS does not have internal drainage provisions to allow this water to exit.

Recognizing this situation, and responding to the fact that HUD came out with a directive banning the use of EIFS on gypsum board, early in 1996, US Gypsum, a major manufacturer and supplier of EIFS, took a proactive approach in a press release. They stated that its review of research performed on EIFS indicates that this system may not be practical and reliable in some market areas and building types. They concluded that barrier EIFS does not allow moisture, which penetrates at or around openings and gets behind the wall cladding or into a wall cavity, to escape rapidly enough to prevent moisture damage in certain climates. At the same time they presented their water-managed EIFS product.

The "water-managed systems" take into consideration the fact that in real life situations, imperfections, later mechanical damage, or other factors may allow some water to enter the system. Therefore, the water managed system is a practical approach that is based on basic technology used in other sidings. This basic technology assumes that water will find some type of entry point, and that it must be removed. The water-managed systems drain any water that makes its way into the system to the outside.

The basic difference between the water-managed EIFS and the original EIFS is that:

- A vapor barrier is installed on the exterior of the building's substrate
- Foam insulation board with corrugations on one side is installed with corrugations vertical and against the substrate and vapor barrier
- The foam insulation is attached using mechanical fasteners

To work properly, the components of the water managed system must be combined with a number of other factors. They are:

- Good construction detail is required for the joints and openings in EIFS. (This is basically the detailing that is required around any type of wall openings.) All flashing and detail should be done prior to the installation of the base coat. Detail must be done that is specific to residential construction.
- At all breaks in the system, flashing and sealant must be installed *watertight*.
- The expertise of the installer is critical. Installers must be familiar with EFIS, differences in climate, and compatibility of products and components of different types and from different manufacturers.

Incorporating this approach in future systems should provide a viable exterior finish that will give many years of dependable service for many applications.

References

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