1. EIFS - A Brief History

Exterior Insulation and Finish Systems is an insulating, decorative and protective finish system for exterior walls that can be installed on any type of construction. It is the only exterior wall covering that insulates and provides weather protection in a selection of shapes, colors, and textures that can replicate almost any architectural style or finish material, or stand by itself as an architectural finish. While similar in appearance to stucco, EIFS is an exterior cladding system that consists of components and installation requirements very different from traditional stucco *(see Figure 1 – Sectional View of a Typical EIFS Application)*. EIFS also requires very different care and maintenance than its "look-alike" cousin, traditional stucco.

In 1952, two significant developments took place that led to the development of EIFS in Europe. The first patent was granted for expanded polystyrene (EPS) insulation board and the first synthetic plaster, an organic plaster using water based binders, was developed. The use of EPS and synthetic resin materials together began in the late 1950s and in 1963 EIFS was marketed in Europe. EIFS answered a need in the European construction market for a material that could insulate older masonry structures and enhance their appearance. In Europe, the use of EIFS on stud/sheathing walls is rare, as most European buildings have solid masonry walls. European concrete or masonry substrates can function as exterior walls without the EIFS. European EIFS tend to have thicker and coarser finishes, which provides for better waterproofing. The systems used in Europe also feature the use of less portland cement and a higher resin content in the base coat, giving the system more flexibility and water resistance, albeit at greater cost.

The technology for EIFS was transferred to the United States in 1969, when Rhode Island-based Dryvit Systems, Inc. introduced EIFS in the U.S. During the oil crisis of the early and mid 1970s, EIFS becomes popular with energy-conscientious builders and buyers, who sometimes see energy bills halved. EIFS began by being used almost exclusively in the commercial building market, and was only gradually adopted for use in homes. By 1980, EIFS cladding accounted for one-half of 1 percent of the residential housing market, and by 1995 nearly 200 million square feet (18,580,608 m2) of EIFS were being installed annually on exterior walls in North America.

Also, in 1995, the industry suffered a setback when a number of EIFS clad homes in the Wilmington, North Carolina area were discovered with moisture damage behind the cladding. The damage was caused by poor construction detailing and practices, principally, the omission or improper installation of flashing in violation of minimum standards of construction set forth in building codes. A federal and several state class action lawsuits were filed, only one of which was certified (in the State of North Carolina). The North Carolina class action was settled by manufacturers. While the original problems were discovered first in North Carolina, it is really a nationwide issue.

In March of 1999, the **NAHB (National Association of Home Builders) Research Center** listed the most common problems they found that were associated with water intrusion in EIF systems as being:

- **Windows, Doors, Electrical Outlets**
- **Roof Flashings**
- **Deck Flashings**
- **Below Grade Installation**
- **Projections, Vents**

2. What Is EIFS (Exterior Insulated Finish Systems)?

While giving the appearance of stucco, EIFS is actually a multi-layered wall system that consists of the following components:

- **Insulation Board** - Made of polystyrene (or similar material), which is secured to the exterior wall surface.
- **Base Coat** - Applied on top of the insulation and reinforced with fiber mesh.
- **Finish Coat** - Applied on top of the base coat giving a durable, crack-resistant finish.

The first half of the acronym, "Exterior Insulation" is derived from the fact that the first component installed is a foam insulation board. The foam board is mechanically and/or adhesively attached to the exterior sheathing of the home. In this respect the foam board serves as an exterior insulating layer. Over this foam board is applied a synthetic base-coat material in which is embedded a fiberglass reinforcing mesh. This is typically referred to as the "base-coat". On top of the base coat is applied one or more "finish coats". This is the exterior layer that gives the product its stucco-like appearance. Hence the second part of the acronym "Finish Systems".

EFIS provides many advantages that other exterior finishes and sidings do not. Chief among these are **superior energy efficiency** and great **design flexibility**. As a matter of fact, studies have shown that EIFS can reduce the air infiltration in a wall by as much as 55%, when compared to standard brick or wood construction. One should bear in mind that an EIFS system is a non-structural component of the wall. In other words, it is not designed to be weight bearing.

Most early EIFS employed a **face seal** approach to rainwater management, and was thus very susceptible to failure. Because of these early problems, most EIFS now incorporates some sort of a drainage plane to allow for moisture drainage. Newer installations incorporating this design could be considered **concealed barrier** systems. However, due to the nature of the product and the realities of the construction process, even newer drainage EIFS systems can experience problems:

- “Short-cuts” are often taken in the application of EIFS systems, causing the primary face seal moisture barrier to fail and leak (lack of proper caulking, flashing, etc.).
- The integrity of the second line of defense is highly dependent on correct detailing by the designer and proper installation by the builder and his subcontractors. Very often, flashings, housewrap, windows, doors, etc., are improperly installed.
- EIFS does not breathe and will not allow trapped moisture to evaporate easily, which can cause great damage over time.

Because EIFS (Exterior Insulated Finish Systems) rely on a perfect seal at the exterior surfaces, they are susceptible to entrapment of moisture inside the system. Water can enter the system where seams and seals fail, where moisture migrates from inside the building and where punched openings (windows, doors, etc.) are present. Because of the low vapor permeability of the finish, water trapped behind the EIFS cannot dry out quickly toward the outside of the wall *(see figure 1)*. Depending on the rest of the wall system design and installation, there may also be limited drying potential to the inside. Limited drying potential in combination with high leakage potential can lead to moisture buildup inside the wall, and eventually to mold growth and structural decay.

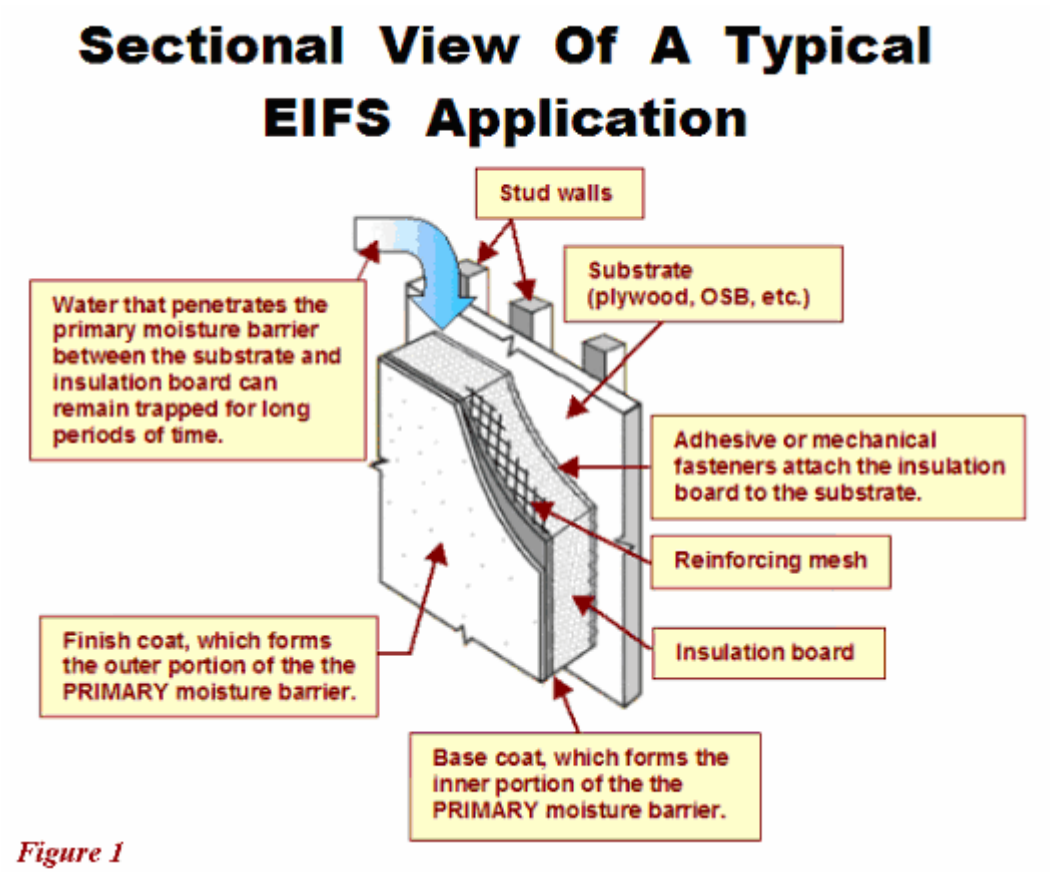

Figure 1

3. The Causes Of Most EIFS Problems

Since EIFS clearly provides many advantages, what's the big deal? The basic problem begins with the erroneous belief that homes can be made to be "water proof". The simple truth is, they cannot. For example, even when applied by professional caulking applicators, **All** caulk joints will eventually fail. . . .even those caulk joints made under laboratory conditions. **No** residential windows are fully waterproof. . . .they are designed and manufactured to a *water-resistant* standard. Some water will always find a way in. When it can't get out, you have a problem.

A. Why Can EIFS Be A Problem?

Homes clad with EIFS (Exterior Insulation and Finish Systems) a.k.a. *synthetic stucco* have a very strong tendency to retain moisture between the sheathing of the home and the finish system. The design of EIFS, unlike other systems (brick, stone, siding, etc.), does not allow the moisture to drain out. The problem is water intrusion and entrapment in the wall cavities. The moisture can sit in contact with the sheathing for a prolonged period and rotting may result. Damage can be serious.

While a brick or stone wall will contain an internal drainage plane behind it and weep holes along the bottom edge to allow for water drainage, moisture intruding into the EIFS wall cavities is more damaging because it cannot readily escape back out through the waterproof EIFS exterior as quickly as it can through brick veneer, stone, or cement stucco, leaving the internal sheathing and wood framing vulnerable to rot and decay.

Successful installation of EIFS depends upon keeping water out of the wall cavities. Consequently, in an effort to keep the water out, an industry-wide installation standard was developed that details installation procedures to be followed. In conjunction with this, the EIFS manufacturers then trained and certified applicators to install their products and supplied them with materials which met specification standards.

But, here is where the system begins to break down, because unfortunately, the manufacturers failed to take into account the realities of residential construction:

- **Barrier type systems rarely work.** The EIFS external barrier system depends upon a perfect external water barrier to keep water out of wall cavities. Since the outer shell is the only barrier against water intrusion, it must form a *"perfect"* barrier at *"all times."* When there are so many entry points for water intrusion in the exterior shell of a house, this is an unrealistic expectation.
- **Lack of inspection and enforcement of standards.** Most manufacturers, unrealistically expected that the building industry on its own (including public inspection departments), would maintain industry standards & specifications, provide oversight, and provide inspection of the EIF system as it was installed. Everyone thought that someone else was minding the store, consequently, the vast majority of EIFS applications nation-wide, have never been inspected. Compounding this problem is the fact that the EIFS manufacturers have failed to insist upon the very standards they helped originate, be met by the applicators they supply materials to.
- **Evolution of application guidelines.** Another consideration is that guidelines for EIFS installation have been evolving over the years. An example of this is below grade termination of the EIFS. While not allowed by building code, early on, it was allowed by some manufacturers specifications. However, due to problems with this type of application nation-wide, in 1996 Dryvit Corp (one of the largest EIFS manufacturers), changed all of its specifications to require an 8 inch separation be left between the EIFS and soil (termite problems in the South & carpenter ants in the North, moisture wicking up into the EIFS, frost damage, inability of the EIFS to drain water away if it is buried, etc.). Unfortunately, this type of new information has been slow to *"trickle down"* through the information chain (from the manufacturer ➔ distributor ➔ applicator). Some distributors even claim their insulation-board doesn't wick water, and consequently can be placed below grade (experience shows that it does, however).
- **Leaks and damage are hidden from view.** There are few, if any, external visual clues to an early leakage problem. As a matter of fact, it can take years for an intermittent leak to evidence itself as damaged sheathing, window leaks, rotted framing, mold growth, etc. Many insurance companies, builders, and applicators may not take a leakage problem seriously, until they can actually *see the damage*. The reason for this *"mind-set"* is understandable, because no one wants to be responsible to pay for repairs that may be unnecessary. Unfortunately, by waiting until a problem is noticeable as visible damage, the word repair can become the word replace. What was once a relatively inexpensive repair has become a very expensive replacement.
- **This is only a "North Carolina" problem.** Wrong, it's a national problem. It was *discovered* first in North Carolina.

B. Problems With Secondary Weather Barrier & Inability To Drain

Most wood-framed residential homes require a secondary weather barrier to be placed over the sheathing before the exterior cladding is installed. This barrier protects the home from incidental water intrusion and allows moisture to exit the home by traveling on top of the barrier, keeping the sheathing and structural members relatively dry. Eliminating a barrier and rendering a substrate unprotected invites trouble, no matter what type of exterior cladding is used.

Due to the design of the EIFS, a majority of EIFS clad homes built before 1997 do not have a secondary weather barrier placed over the exterior sheathing. A large number of EIFS applications use an adhesive to fasten the two-foot by four-foot insulation boards to the sheathing. If an adhesive is used to hold the insulation boards to the sheathing, then a secondary weather barrier cannot be used. Any water that infiltrates the system will become trapped between the EIFS and the sheathing.

It is estimated that 95 percent of homes clad with EIFS in the United States are barrier-type. Most barrier EIFS projects are adhesively applied because it is less time consuming to install. Adhesively applied EIFS prohibits a vapor barrier from being installed. It also prevents many self-flashing windows from being installed properly since the sill flashing must be cut off to accommodate the adhesively attached foam board.

EIFS homes built before 1997 have a greater chance for moisture intrusion problems. Newer EIFS homes built since 1997 using "drainage EIFS" may have a reduced chance of moisture intrusion, but are not immune.

C. Lack Of Applicator Training

EIFS must be purchased from an EIFS distributor. The manufacturer or distributor trains applicators and issues certificates stating that the applicator has been properly trained. It is the responsibility of the distributor to ensure that EIFS

is sold only to those certified applicators.

Unfortunately, certification, training, and insistence upon maintaining standards seems to have become almost meaningless in the marketplace. For example, although most every manufacturer requires the use of backer rod & sealant joints around windows and doors, and edge of the foam should be backwrapped, these very important details often omitted. Why?

Having said this, still the best way to assure a high quality job is to rely on members of the **EIFS Industry Members Association (EIMA).** EIMA members must meet all applicable building code testing requirements and industry performance standards.

You can contact EIMA at 1-800-294-3462, or write EIMA, 3000 Corporate Center Drive, Suite 270, Morrow, GA 30260.

D. Deviations From Installation Guidelines

Deviations from Industry Standard guidelines during installation, is likely the largest contributor to EIFS cladding problems. EIFS application requires the strict observance of manufacturer recommended specifications and guidelines, and involves meticulous workmanship and attention to detail. When improperly applied, the EIFS cladding does not perform its intended function and can allow water to infiltrate behind the cladding, where it becomes trapped.

Due to the lessons learned during the early years of the industry, around 1996 set of "Installation Details" were developed by EIMA (EIFS Industry Members Association), that have since become the industry installation standard. Each manufacturer may have its own specific requirements as well. EIFS Installation Details are procedures outlined by the EIFS manufacturer that provide guidance to the architect, builder and applicator as to the proper installation of the product. All EIFS manufacturers have details and procedures that builders and applicators are expected to follow. Installation details are typically very similar among EIFS products and EIFS manufacturers, but there are differences.

A common misconception among some applicators is that the *"Installation Details"* are designed for specific parts of the country, exposed to certain weather conditions, and not to them. This couldn't be farther from the truth, and has led to some expensive repairs having to be made. The Installation Details were designed to be used industry-wide, and are applicable whether the installation is in a northern cold climate, or southern warm climate. One should never make the mistake of dismissing as being insignificant, even some of the smaller deviations from the accepted industry installation standards. Unfortunately, there is a long history of applicators having done this in the past. . .to their great regret later on when the bills come due to pay for replacing the entire exterior. When installed properly, many EIF systems can perform well. However, EIFS is a very unforgiving product and even the smallest short-cut in installation standards and quality of components, can lead to big problems down the road.

The problem we face now is, sometimes an individual contractor may fail to fully follow the manufacturer's installation guidelines. Often times only a portion of the guidelines are followed, materials from different manufacturers are inter-mixed, etc. This can allow moisture into the wall system. Once the moisture is in it can't get out, which can lead to wood rot. Some of the more common installation *"short-cuts"* are listed below:

- **Foam insulation placed below grade.** Prior to recent building code changes, the foam board insulation used in EIFS was placed on the wall below grade. It was discovered that foam in contact with the ground causes conditions conducive to pest infestations (termites, carpenter ants, etc.). With EIFS-clad homes, the visible evidence of infestation is blocked from view by the exterior siding. In fact, the exterior siding typically looks pristine and shows no signs of any problems. Behind the EIFS cladding, pests can live in a protected environment and then establish themselves inside the home.
- **Another problem** with placing the foam below grade is the ability of water vapor to migrate upwards through the foam. When the temperature rises at the transition from masonry to wood, the water vapor condenses and causes water to settle on the sill plates and exterior band joist. If this water does not evaporate quickly, wood rot can set in and decay the structural members of the home.
- **Improperly flashed & caulked windows.** Window leaks account for the majority of water damage in EIFS houses. The EIFS itself isn't usually leaking; instead, water is entering between the window and the EIFS, or the window itself is leaking water. The solution requires a window flashing that works, as well as a correctly detailed joint between the window and the EIFS wall. Wherever a window, a door, or an electrical or plumbing fixture interrupts the EIFS surface, a proper joint must be constructed, that integrates a reliable flashing into the secondary weather barrier.
- **A very important component** that is often missing in window detailing is the backer rod. The backer rod serves two functions: **First,** it prevents the caulk bead from adhering to the back of the joint, allowing the caulk to flex in response to thermal expansion and contraction and other building movements. If the backer rod is omitted, the caulk will adhere to the back of the joint as well as the sides, limiting its ability to stretch and guaranteeing premature failure. **Second,** it controls the thickness of the finished application of caulk, which should ideally be about half as thick as it is wide. More often than not, though, the caulk and backer rod are never applied at all. It is important to keep in mind that no residential windows are *waterproof*, they are designed and manufactured to a *water-resistant* standard. The very best windows allow some water into the wall cavity through their own joints, and *"construction grade"* windows may leak a great deal. The quality of windows installed with the EIFS is directly related to the amount of water that will infiltrate. For example, wood windows perform poorly, while welded seam

vinyl windows perform substantially better than other window types. EIFS homes cannot be made totally *"water proof"*, and windows will leak. Regardless of how well the backer rod/sealant method seals the joints between window and the edge of the EIFS wall, windows will leak at some point (even those caulk joints made under laboratory conditions by EIFS industry engineers will eventually fail).

- **Flashings missing or improperly installed.** are an important element in protecting your house from leakage, and should be utilized to properly direct water away from the structure. Some of the more common locations where they are required are: deck ledger boards, kick-out flashing at roof / wall intersections, at window and door heads, headers and other horizontal surfaces, etc. All too often, flashings are not installed, or installed improperly.
- **Roof termination.** EIFS should be held off of roof a minimum of two (2) inches and backwrapped.
- **Expansion joints at dissimilar materials.** Expansion-joints should be used where EIFS terminates, or meets a dissimilar material. The typical expansion joint is a flexible, watertight joint utilizing, backer rod and sealant. Expansion joints are typically 1/2 inch in width.
- **Backwrapping.** Where the foam substrate terminates, it should be backwrapped, in order to provide for proper protection of the foam. Backwrapping also provides for improved attachment of the substrate to the sheathing.
- **Horizontal Surfaces: Trim Bands Quoins.** There should be no horizontal (flat) surfaces. All surfaces should slope away from the structure.

E. Divided Responsibilities

An EIFS applicator is responsible for the application process-attaching the foam insulation to the substrate, applying the fiberglass mesh, embedding the fiberglass mesh with base coat and applying a finish coat. EIFS installers have little control over construction details designed to prevent water intrusion into wall cavities from roofs, even including those details which are required by some state building codes and by the specifications of the EIFS manufacturers. Many details outlined by manufacturers require the services of other tradesmen. A typical EIFS applicator does not install backer rods and sealant, but should install the EIFS so that it is possible to install these critical components. The builder is responsible for subcontracting the backer rod and sealant components. Flashing around windows, doors, decks, chimneys and roofs is the responsibility of the builder and his roofer. Unless the builder required the roofing subcontractor to install step flashing and (EIFS required) kickouts, it probably was not done.

The applicator should recognize improper flashing and not continue the application process until the problem is corrected. Unfortunately, this also slows down the overall building process. . .costing the home builder extra money. It doesn't take an applicator long to recognize that an unhappy home builder may NOT call him to bid on the next project. According to the *National Association of Home Builders Research Center,*