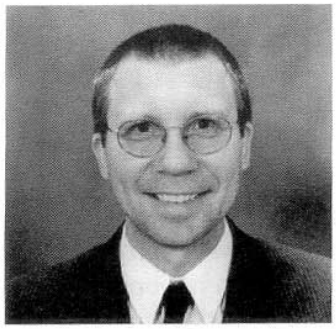


EIFS and the Fire Investigator

by Noel Putaansuu

Exterior Insulation Finish Systems ('EIFS') (pronounced "eee-fuss" or "eeefs") are building facades or siding that due to their versatility to conform to irregular building shapes and alleged minimum maintenance have been utilized greatly throughout the United States in recent history. The EIFS systems can be classified within two big categories: Barrier (weather protection depends solely on the watertight surface of the system) and Drainage Systems (weather protection is a combination of surface material and concealed moisture-control flashings).

When these systems are installed to perfection, the potential for water infiltration is minimal and its said the system is performing adequately. However, in the instance that water was to enter the system there is little or no provisions to allow the water to exit the façade. The moisture trapped in the system then goes to work deteriorating other building components. When exposed to fire the EIFS system reacts and displays burn patterns that differ from other types of exterior siding. This article will describe the EIFS, discuss the water penetration issues and review the fire performance and fire patterns associated with EIFS.

While employed at one of the country's leading building envelope consultant firms, Exterior Research and Design, I worked with numerous EIFS systems, which failed due to water penetration. Additionally, I participated in the fire testing of EIFS systems while employed at a fire research group, in Washington State, Western Fire Center. Currently employed as a Fire Investigator at MDE Engineers, Inc., I am researching the fire patterns and fire performance of EIFS.

Description of EIFS

Exterior Insulation Finish Systems (EIFS) are labeled as synthetic stucco, Dryvit, MasterWall, Omega, Parex, Pleko, Preswitt, Senergy, Sto, TEC (HB Fuller) Texas EIFS, US EIFS and others. EIFS is a unique building system that incorporates a thermoplastic insulation behind a thin synthetic stucco system [Base coat and finish coat approximately 1/8" (3 mm)]. The polymer stucco base coat incorporates a fiberglass mesh and a finish coat containing the aesthetic qualities of color and texture. EIFS should not be confused with traditional stucco that contains no insulation and contains a wire mesh.

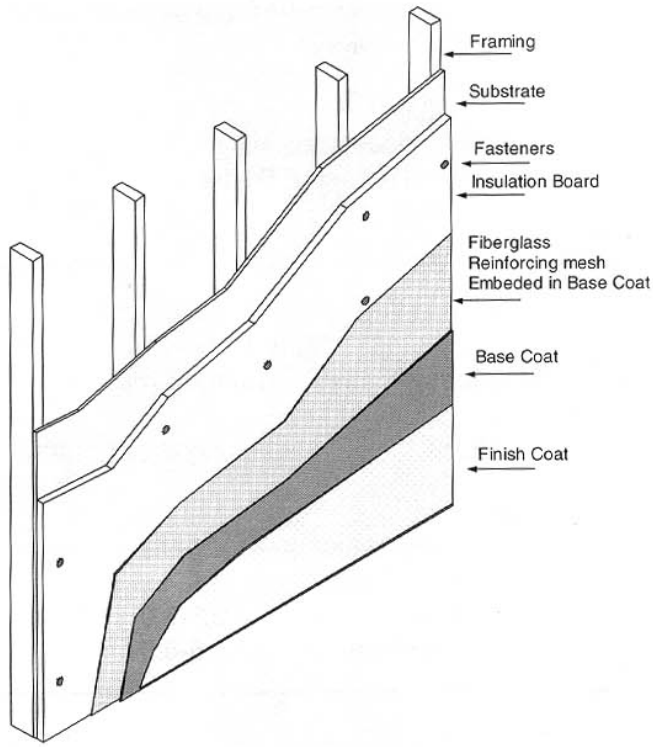


Figure 1
Diagram of EIFS system

EIFS is a very flexible building system that can conform to many building shapes and details. Conventional EIFS systems are barrier systems that are intended to provide a continuous barrier to water and typically provide an additional R value of 5 to a building's interior insulation qualities.

Not all EIFS systems incorporate thermoplastic insulation:

- Rockwool, a product of spun volcanic rock, has a high melting point and provides little fuel for combustion.

- Polyurethane or polyisocyanurate foam, in most configurations is not a thermoplastic, is thermosetting and will remain in place and char. Polyurethane is a significant fuel source when exposed to fire.

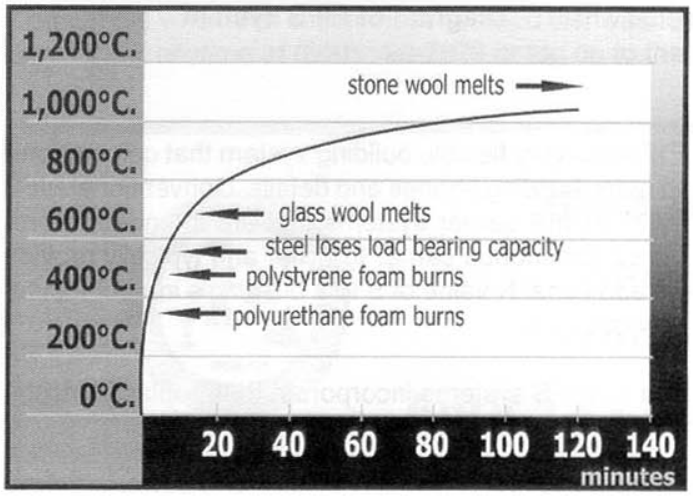
- Expanded Polystyrene ('EPS') is a thermoplastic and is the predominant insulation board utilized in EIFS in the Northwest. EPS is used because it has better dimensional stability than polyisocyanurate. Moreover, EPS does not require a facer to hold the material together during production, so the EIFS laminate can be applied directly to the foam material rather than to a facer material.

- The installation of an EIFS exterior does not compromise an existing fire rated assembly such as a one-hour fire wall.

Table 1
R-Values of various building materials

Material	R-value per inch
Vermiculite	2.3
Cellulose	3.1-3.7
Glass fiber batts	3.2-3.6
Rock wool batts	3.5
Polystyrene	3.6-5.0
Urethane foam	5.5-6.0

Chart 1
Standard fire curve (ISO 834)
similar to ASTM E119 time temperature curve



Problems associated with EIFS are water penetration and issues pertaining to fire.

Any imperfections in a barrier system become magnified over time and may result in water retention. Once the substrate becomes wet it loses strength and capacity. The problem is insidious because indicators are not visible until significant damage has occurred. Newer drainable EIFS systems are a much needed improvement but still have some of the associated problems.

Thermoplastics are synthetic polymers that usually soften and melt on heating. When compared to wood products and thermosetting materials that remain in place and char, the fire investigator will need to recognize different patterns.

Expanded polystyrene ('EPS') foam is used for coffee cups, coolers, insulation, packaging products for shipping, and is the primary insulation board used in EIFS. It is made up of about 2% polystyrene and 98% air. It is manufactured by heating styrene pellets with steam so they expand rapidly within a mold and form a large block of low density foam. The expanded beads remain as air filled closed cells that resist the conduction of heat, and therefore are efficient insulators.

This foam is light, usually 1 to 2 pounds per cubic foot, and very inexpensive. No CFC's are used in creating the foam. It doesn't degrade under normal circumstances because EPS is inert and is a very stable molecule. EPS has excellent dimensional stability and low moisture absorption (approximately 0.2%). EPS is increasingly being recycled, to the benefit of the environment. When expanded polystyrene foam is melted it recedes to the approximate volume of 2% from the foamed product's volume. Melted polystyrene foam that has cooled and solidified, has a specific gravity of approximately 1.05 and has look and feel characteristics similar to rock candy or glass.

Since the EPS is protected by a thin (approximately 1/8" (3mm) thick) synthetic stucco system the melting patterns of the thermoplastic foam may not be visible. The synthetic stucco may or may not display indications such as discoloration or displacement, but the foam underneath may have receded, melted and migrated away. Radiant heat from an adjacent structure can partially melt the foam under the synthetic stucco. When exposed, the EPS may display patterns related to the thermal exposure that has been subjected to.

The effective heat of combustion of polystyrene (39 Kilojoules/gram) when compared to wood (13 to 15 Kilojoules/gram) clearly indicates the larger fire growth po-

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tential. The smoke production of EPS foam is approximately 5 times that of wood which may affect soot deposits and witnesses may comment on the great amount of smoke.

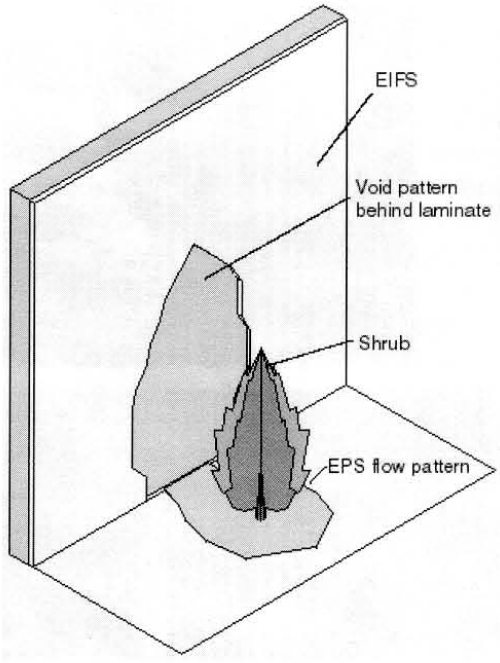

Diagram 2
Fire Patterns Attributed to EIFS

Voids in the EPS insulation may contain melt patterns useful to the fire investigator. To expose the voids a physical inspection may be required. One method to survey for voids in the foam is to press a finger into the synthetic stucco and the surface will normally resist the pressure.

If a void is present the synthetic stucco will feel like a cementitious sandy paper that has no backing. The investigator will need to determine the value of exposing the hidden patterns and obtain permission. If voids are prominent in an assembly then that area of the structure will require restoration. The surface of the EIFS can be cut with a box knife in smaller areas or a circular saw set at a shallow ¼" depth. Cut a pattern of squares and remove each square by peeling back the laminate.

When EIFS is subjected to direct flame impingement the base coat and fiberglass mesh will remain in place and maintain a protective membrane while the EPS foam backing melts, recedes and flows down the wall. If the melting is sufficient to flow outside of the EIFS system, a pool fire may develop and generate significant fire growth.

We can examine a hypothetical fire scenario with a bush or shrub near an EIFS façade. If the shrub were to become involved in a fire and the radiant heat energy from the fire were sufficient to cause the EPS foam to melt and flow out the bottom of the facade assembly and under the shrubbery. Witnesses might notice a burning bush with a large heavy soot black plume. Once the fire has been extinguished the façade might show little indication that the foam has receded behind the synthetic stucco. There might be evidence of polystyrene that has melted and solidified on the ground at the base of the façade.

Conclusion

Exterior Insulation Finish Systems are prevalent in all areas of the country including the Northwest. The benefits of insulation and endurance are associated with recognized problems with EIFS. The fire investigator should have a working knowledge of EIFS, the problems associated with it, the fire patterns associated with EIFS, and the potential for EIFS contribution to fire growth.

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