Technical Committee Supplement to The Constellation Volume 5 Number 8

Felt Tips

Published on an Occasional Basis April 1994

Evolving EIFS

If you remember looking at the December 1993 issue of The Construction Specifier, you were treated to a series of advertorials on Exterior Insulation and Finish Systems, commonly called EIFS [pronounced EeeeFffSss]. Disregarding the articles's contents, it was a masterpiece of slyly hidden advertising by the four major EIFS manufacturers. "Four?" you say. Yes! Four. There was the *Specifying EIFS* by William F. Egan (of Senergy, Inc.), the gray box *Pressure-Equalized EIFS* by Richard E. Kroll and Steven J. Collins (of Dryvit Systems, Inc.), and *Detailing Class PB EIFS* by Thomas E Remmele (of STO Corporation).

"That's three articles!" you say. True, however [always a "however"], there was the "Opinion" article *Standards for EIFS* by Richard S. Piper. Mr. Piper works for R.J. Kenney Associates, Inc, "a consulting firm specializing in building failure investigations and repair". "That article didn't state a preferred manufacturer," you say. True, however [again the "however"], in *EIFS Performance Review* of June 1992's issue of The Journal of Light Construction, Mr. Piper and Russell J. Kenney, describe a series of requirements they prefer to see in EIFS and summarize by saying "the only PB EIF systems currently marketed in the U.S. that meet all the criteria are Premium Cementitious System 3 and Premium Full Synthetic System 3 by Parex, Inc. of Redan, GA. We have successfully used other systems, however, they have been modified to meet our criteria." There is the tie to the fourth major EIFS manufacturer. Also, R.J. Kenney Associates has been a major contributor to a recently concluded U.S. Department of Housing and Urban Development study of EIFS which resulted in new HUD standards (Use of Materials Bulletin (UMB) Number 101) intended to become "final" in February 1994.[1] The opinions of R.J. Kenney greatly [and justifiably] temper the "isn't this great and wonderful stuff!" attitude of the EIFS manufacturers.

The point of this (if it hasn't hit you like a downpour of ice pellets [sorry, I just could avoid the reference to January's and February's weather]) is that EIFS articles appearing in the trade magazines are written by people with a hidden agenda, especially those by representatives employed by the major EIFS manufacturers. Remember, they are trying to "sell" this stuff; they just haven't learned to tell us the truth of when and how not to use EIFS. There are two classes if EIFS: PB ("soft" [thin] coat) and PM ("hard" [thick] coat). PB is less expensive [and less durable] than PM. Rare are independent articles like those of R.J. Kenney, but they lapse and fall into the trap of making product endorsements [which casts doubts about their "independence"]. Exterior Insulation Manufacturers Association (EIMA), the trade organization for EIFS manufacturers has not funded true independent product research; all of the research is done by the manufacturers (which cannot be viewed as being completely unbiased).

Calls for independent product standards (such as ASTM standards), by investigators like R.J. Kenney, may be unjustified. Many products specified for use in buildings are not specified according to ASTM standards, but are usually by ANSI standards. ANSI standards are written by trade organizations. Structural framing systems (concrete, masonry, steel, and wood), doors, hardware, metal windows and curtain walls, and tile, are among the many items used in buildings which don't solely rely on ASTM standards, but trade industry standards (American Concrete Institute, Brick Institute of America, American Institute of Steel Construction, Architectural Aluminum Manufacturers Association, Steel Door Institute, Building Hardware Manufacturers Association, Tile Council of America, etc.). Rather than being criticized for a lack of ASTM standards, EIMA should be encouraged to produce ANSI standards.

A rarely discussed criticism of EIFS involves warranties. Would you really want to specify a system whose manufacturer's maximum warranty period is 5 years? Does any other cladding/enclosure system say it will last this short a time period? [Can't think of any, can you?] Most standard EIFS warranties are pro-rated material warranties. Warranty critics say they are useless in this form. When EIFS manufacturers are forced to produce a system with a long (greater than 5 year) warranty covering material and labor replacement costs, they usually change the components (coating materials and thicknesses, insulation board, and sheathing) and request that bidding be restricted to a manufacturer-selected group of applicators, to produce a more durable and warranty-able system. [Doesn't this tell you something about the "normal" products EIFS manufacturers are selling?]

Another criticism of EIFS is the reliance on manufacturer-trained/certified applicators and manufacturer field services. Some critics recommend independent inspection to correct for poor installation skills and inspection by the product's seller. Independent inspection may be fine, but there are few qualified inspectors; even if inspectors were used, they won't be able to catch everything that goes wrong. Specifying and obtaining certifications that manufacturer-trained applicators are used, mandating a minimum quantity of manufacturer inspections during installation, and requiring "real" warranties would enhance the opportunity of obtaining a higher quality installed product. Having qualified independent inspection would also be nice [if obtainable].

Now for some product selection, design, and specifying suggestions [no manufacturers endorsed]. These suggestions assume that you know the basics. If you don't, read the December issue of The Construction Specifier:

Moisture Evaluation:

Sources of this potential system failure are moisture migration into the system and condensation where system layers are adhered together (coating to insulation, insulation to adhesive, adhesive to substrate, and facing paper to core of gypsum sheathing).

There have been reports of water vapor condensing within EIFS causing layers to delaminate.

Conduct a water pressure gradient calculation combined with a temperature gradient calculation in accordance with ASHRAE Handbook of Fundamentals guidelines, to determine dew point location within wall assembly.[2] Require this calculation from system manufacturer [they will do it for you]; materials used by different manufacturers cause differences in dew point location.
Intent is to have the dew point occur within insulation's thickness; condensation within stud cavity and sheathing should be avoided.
Should fibrous insulation be suggested in stud cavities as a substitution, perform vapor transmission and condensation calculations to relocate the dew point.
To avoid fall-off, mechanically fasten insulation to structure (not sheathing).

Vapor Retarders:
Use vapor retarders with extreme caution to avoid moisture build-up in the wall assembly.
Vapor retarders have been used between insulation and sheathing in PM applications to protect sheathing from moisture migration from the exterior.
Vapor retarders cannot be used between insulation and sheathing in PB systems.

Non-Vertical Surfaces:
Avoid creating window sills, parapet tops, and similar non-vertical surfaces with EIFS [this is one of those "never, never, never do this" things]; use metal flashing.
Research and performance history indicate failures when EIFS are used for non-vertical surfaces.
EIFS are not an acceptable roofing material, even for "small" roofs.
If water (as liquid or ice) remains on the surface, the surface will soften and promote system failure.
Manufacturers's minimum pitch requirement of 1:2 is not adequate to shed snow and prevent lengthy wetting. If unavoidable [usually when designers say "they'll hold their breath til they die"], use a minimum pitch of 1:1 (0.78 radians; 45 degrees)[3] [and then be prepared for a leak].

Below-Grade Applications:
Differs from above-grade application requirements; check with manufacturer for requirements. Some manufacturers prohibit the use of their systems below grade.
Manufacturers often require using mechanically-fastened extruded polystyrene for the insulation and changing coating materials atop insulation to create a "below-grade system".
Most manufacturers require that "above-grade" systems terminate 150 to 200 mm (6 to 8 inches) above grade, to prevent long-term exposure to moisture which can cause mildew growth.[4]
Terminating EIFS above grade allows for heat loss through slab edges; use manufacturer's below-grade system for portion below the limiting dimension for above-grade system.

Use at Interior Locations:
Do not use EIFS on building interiors.
Insulation coatings are not sufficient to comply with code requirements for covering foamed plastics.
It is possible to use just the coating to create the same texture as EIFS on building exterior.[5]

Sheathing:
Use glass fiber faced gypsum sheathing board (ASTM C1177), rather than normal gypsum sheathing board, to reduce potential for moisture migration causing sheathing failure. Only one gypsum board manufacturer makes this product [but this should change in a few years].
Cement fiber board is preferable glass fiber faced gypsum sheathing board, but cost premiums may make this option undesirable.[6] HUD UMB 101 requires the use of cement fiber board.

Substrates:
Substrate must be flat and even within tolerances prescribed by system manufacturer. If manufacturer has no substrate tolerance limit, the substrate should be flat and even within a tolerance of 3 mm in 1200 mm [(1/8 inch in 48 inches)].[7]
When system is applied as a retrofit on previously finished substrates, cover irregular and spalled existing surfaces with metal lath, mechanically fastened to the substrate (concrete and masonry) or framing beneath the substrate (for framed walls).[8]

Insulation Board Materials:
Expanded Polystyrene:
Usual maximum thickness is 100 mm (4 inches), due to fire code limits on fuel content.
Minimum thickness is 19 mm (3/4 inch), even at thinnest portion of aesthetic grooves and chamfers, but mechanical fastening requires minimum 1-inch thick insulation.[9]
Adhesive with mechanical attachment is encouraged since it provides redundancy should adhesive fail, but mechanical fasteners cannot be used in lieu of adhesive since expanded polystyrene is not as strong as extruded polystyrene used with PM systems. Using mechanical fasteners with adhesive is to keep insulation from falling off of the substrate should adhesive fail.
Extruded Polystyrene:
Usual maximum thickness is 50 mm (2 inches), due to fire code limits on fuel content.
Minimum thickness is 25 mm (1 inch), even at thinnest portion of aesthetic grooves and chamfers.[10]
Always mechanically fasten since adhesives will not stick to insulation's smooth skin.

Insulation Board Joints:
Create an interlocking pattern by alternating boards at corners.[11]
Offset board joints running parallel to aesthetic grooves a minimum of 100 mm [(4-inches)]. Since cracks often occur at joints between boards, offsetting aesthetic grooves from joints prevents board joints from creating a crack at the aesthetic groove.[12]
Offset joints in insulation from joints in sheathing a minimum of 250 mm (12 inches).[13]
Abut boards tightly at joints within and between courses to produce flush, even surfaces without gaps or raised edges between boards. If gaps wider than 1.5 mm (1/16 inch) occur, fill with insulation cut to fit gaps exactly; do not place adhesive in the gaps.[14] STO says that a spray foam can be used to fill the gaps.[15] [Consider STO's suggestion with caution; most field applied foam is polyurethane not polystyrene (chemical incompatibility is a problem); foaming action and applicator skill affects foam density and performance].

Insulation Board Surface Preparation Prior to Applying Base Coat:
Prepare insulation to receive coating application by abrading the surface to provide a rough texture. During abrading remove site dirt, ultraviolet light degraded insulation, and other harmful conditions which may impair base coat adhesion to insulation.[16]
Rasp or sand flush insulation surface irregularities which project more than 1.5 mm (1/16 inch), or less if required by system manufacturer.[17]
Do not fill depressions with adhesive and base coat materials to form flat surface to receive base coat application.[18]
Scrape board edges clean of adhesive.[19] Adhesive on edges will cause a cracked coating due to thermal movement

differences between the insulation board and adhesive in the joint between adjoining boards.
Where insulation is being applied to curved substrates, cut kerfs in the surface adjoining the substrate to a depth no closer than 19 mm (3/4 inch) to the surface receiving the coating. Do not cut boards which are 19 mm (3/4 inch) thick.[20]

Joints:
- Control joints (PM systems) and expansion joints (PM and PB systems) have to be located and detailed on Drawings.
- Expansion joints are required at building expansion joints, where substrates change, and where structural movement occurs.[21] Intent is to permit building structure to move and minimize transferring movement into EIFS. Although required by the manufacturers for PM systems, manufacturers usually do not mention need for these "movement"-permitting expansion joints for PB systems (except for wood frame construction). [Why only in wood frame structures? Are EIFS manufacturers trying to hide something?] These joints are similar to those provided in concrete and masonry wall systems at floor slabs and columns. If not provided, insulation boards will crush and crack the coating.

Aesthetic Joints and Grooves:
- Do not allow them to intersect with perimeter of openings (like doors and windows).
- Aesthetic grooves particularly those that line up with the head, jambs, and sill of wall openings, create weak points in the insulation, which cannot resist stresses as well as surrounding ungrooved insulation.[22]
- Manufacturers require use of reinforcing mesh "butterfly" panels at corners which do not have control/expansion joints.
- When joints are used at openings, use expansion joints in PB systems; use control joints or expansion joints in PM systems.

Joint Sealants:
- Manufacturers recommend installing sealants in joints immediately after base coat has cured and dried; before application of finish coat.[23] Refer to finish coat application comments below regarding color application on sides of joints
- If not installed before the finish coat, install sealants in joints immediately after finish coat has cured.[24]

Trim Accessories:
- Required for PM systems; not required for PB systems.
- PB Systems: Consider using trim accessories to permit eventual replacement of joint sealants without damage to EIFS coating. Some manufacturers, such as STO, do not permit the use of trim accessories with their products, but this may change due to the requirements of HUD's UMB 101. Review details and potential use of trim accessories with system manufacturers.[25]
- In PM systems, deep channel V-shaped groove control joint trim provide better stress relief in the system than surface mounted joints (which are mounted atop the insulation and only break the coating layers).[26]
- Zinc accessories won't rust like galvanized accessories [which eventually will rust]; cost premium exists for zinc accessories.
- Do not use galvanized accessories in high humidity climates or salt-laden atmospheres.[27]
- Vinyl accessories are available, but they are not recommended for freeze-thaw climates.[28] Problem is cold cracking; some trim manufacturers claim their products will not crack in cold weather

Reinforcing Mesh Application:
- Lap adjoining sheets of mesh over each other minimum of 65 mm [(2-1/2 inches)], or greater if required by system manufacturer.[29]
- Position reinforcing mesh edges a minimum of 150 mm [(6 inches)] from edges of insulation panels. This is to ensure that should the insulation panels shrink (which they will), the opened joint will not cause base and finish coats to crack open.[30]
- Do not cut reinforcing mesh embedded in base coat.[31]
- At openings, provide 240 by 300 mm [(9-1/2 by 12 inches)] reinforcing mesh "butterfly" panels, positioned with panel edges at an angle of 0.78 radians [(45 degrees)] from opening's edges.[32]

Coating Aggregates:
- Aggregate used in base and finish coats must be free of iron-containing compounds. Chemical problems cause rust stains.
- Marble and quartz are primary aggregate materials used.
- Quartz aggregate may contain iron compounds
- Quartz is harder than marble; marble is more expensive than quartz.
- Manufacturers that use quartz say that their coatings are more durable than marble-bearing coatings [but they offer scant evidence].

Base Coat Application:
- Apply base coat to exposed surfaces of insulation in minimum thickness required by system manufacturer.[33]
- Mesh and mesh pattern must not be visible after base coat cures.[34] If mesh and mesh patterns are visible after base coat cures, recoat them with additional base coat material. Most manufacturers permit the pattern to be visible, but if you asked them if they would allow it on a building they were going to own, they usually will say no pattern should be visible.

Primer Usage:
- Verify use with manufacturer; it improves adhesion of finish coat to base coat.[35]
- Some manufactures offer longer warranty periods because primers increase coating water resistance.[36]

Finish Coat Application:
- Do not extend finish coat into expansion joints. The problem involves natural softening of the finish coat when exposed to prolonged moisture through high humidity and other reasons. If the finish coat softens, it will lose cohesive strength and delaminates causing the sealant joint to fail when sealant expands and contracts.[37]
- Coating pigment can be "painted" onto expansion joint sides.

Finish Coat Colors:
- Do not use dark colors; they cause excessive thermal movement in the insulation,[38] and result in cracked coatings.
- Do not use colors containing deep blue and blue-red pigments. They have a tendency to fade over time; review this with manufacturer before selecting colors. Manufacturers are making some improvements, but their track record is unproven.

Where does this put us? If you use EIFS, don't blindly use manufacturer specifications, and critically question the manufacturers about system durability and building lifetime performance. You and the building owner have to decide how long the system is supposed to last and how much money is to be spent to achieve it. Only then, can an informed decision be made regarding the applicability of EIFS to a project. [Some cynics would say that it isn't worth the money, but how else do you create a "stucco appearance" that is lightweight and can create a thermal insulating envelope for a building?]

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References:

1. Building Design and Construction, *Ensuring successful EIFS Design and application* and *HUD issues EIFS standards*, February 1994, page 55.
2. PA, "Inside EIFS Systems," October 1989, p. 100.
3. The Journal of Light Construction "EIFS Performance Review," June 1992, p. 27.
4. PA, "Ensuring Good EIFS Performance," April 1993, p. 48.
5. Standardization News, Nov 1992, p. 58.
6. The Journal of Light Construction "EIFS Performance Review," June 1992, p. 26.
7. PA, "Inside EIFS Systems," October 1989, p. 101.
8. PA, "Inside EIFS Systems," October 1989, p. 101.
9. Wind Lock Corporation. "Wind Devil Fasteners" sample board.
10. STO Toughwall System Specification A140, March 1991, Paragraph 2.05.B; Parex I-C Gold System Specification, March 1993, Paragraph 2.02.A.4.
11. Walls and Ceilings, "Many Factors Affect Durability of EIFS," February 1993, p. 56. Also from STO Toughwall Detail T-4B.
12. Walls and Ceilings, "Many Factors Affect Durability of EIFS," February 1993, p. 56. The Journal of Light Construction "EIFS Performance Review," June 1992, p. 24. PA, "Ensuring Good EIFS Performance," April 1993, p. 46. Distance of 100 mm was obtained from The Journal of Light Construction "EIFS Performance Review," June 1992, p. 26.
13. The Journal of Light Construction "EIFS Performance Review," June 1992, p. 26. The drawing on page 26 says that the horizontal width of an insulation panel at a window opening is 250 mm (12 inches). Assuming that the window opening creates a similar break in the insulation as a joint, the distance should be the same. STO System I Specification A100, March 1991, paragraph 3.01.G, says a minimum of 8 inches.
14. Building Design and Construction, "Avoiding EIFS Application Pitfalls," April 1993, p. 68. The Journal of Light Construction "EIFS Performance Review," June 1992, p. 24. In Walls and Ceilings, "Many Factors Affect Durability of EIFS," (Feb 1993, p. 56), the author suggested the gap dimension and suggests filling the gap with foam-in-place urethane, but it may not be wise to allow this since the foaming action and density can vary with the applicator.
15. STO System I Specification A100, March 1991, paragraph 3.01.G.
16. PA, "Ensuring Good EIFS Performance," April 1993, p. 49.
17. Dryvit has a maximum 0.8mm (1/32 inch) protrusion.
18. From Dryvit, Outsulation Specification, July 9, 1991, paragraph 3.02.D.1.a.1)
19. PA, "Ensuring Good EIFS Performance," April 1993, p. 46.
20. Walls and Ceilings, "EIFS Shapes: Making Walls Aesthetic," April 1993, p.60.
21. U.S. Army Corp of Engineers, Specification Section 07240, 1988, Article 1.2 Editing Notes
22. The Journal of Light Construction "EIFS Performance Review," June 1992, pp. 25 to 26.
23. Dryvit, Parex, and STO show their expansion joint details without finish coat in the joint. Dryvit says on their detail to apply the finish coat up to the sealant. All three require that the system be sealed to prevent water intrusion as the system is being installed. The implication is that the sealant is applied before the finish coat is applied. This will prevent the potential finish coat delamination at the sealant joint.
24. BD&C, April 1993, p. 70. This is to avoid water entering the EIFS and causing problems before the project is complete.
25. Walls and Ceilings, "EIFS Detailing and Installation for Durability," February 1993, pp. 28 to 29.
26. From Parex's Insul/Crete System Detail E6.01, March 1993.
27. STO Toughwall System Specification A140, March 1991, paragraph 2.04.A.
28. STO Toughwall System Specification A140, March 1991, paragraph 2.04.A.
29. From Dryvit, Outsulation Specification, July 9, 1991, paragraph 3.02.D.2.c.
30. Distance established arbitrarily, but is based upon the minimum double lap dimension indicated in the drawing in The Journal of Light Construction "EIFS Performance Review," June 1992, p. 26.
31. PA, "Ensuring Good EIFS Performance," April 1993, p. 46. Inadvertent cutting of the fabric when the coating is being tooled can cause cracks to occur in the coating.
32. From Dryvit Outsulation Installation Detail for Wall Penetrations, Note #2.
33. PA, "Ensuring Good EIFS Performance," April 1993, p. 48.
34. Walls and Ceilings, "Many Factors Affect the Durability of EIFS," February 1993, pp. 56 to 57.
35. The Journal of Light Construction "EIFS Performance Review," June 1992, p. 27.
36. Walls and Ceilings, "Many Factors Affect the Durability of EIFS," February 1993, p. 54.
37. BD&C, April 1993, p. 70. This problem was also noted in The Journal of Light Construction, "EIFS Performance Review," June 1992, p. 24.
38. Walls and Ceilings, "Many Factors Affect Durability of EIFS," February 1993, p. 57.