

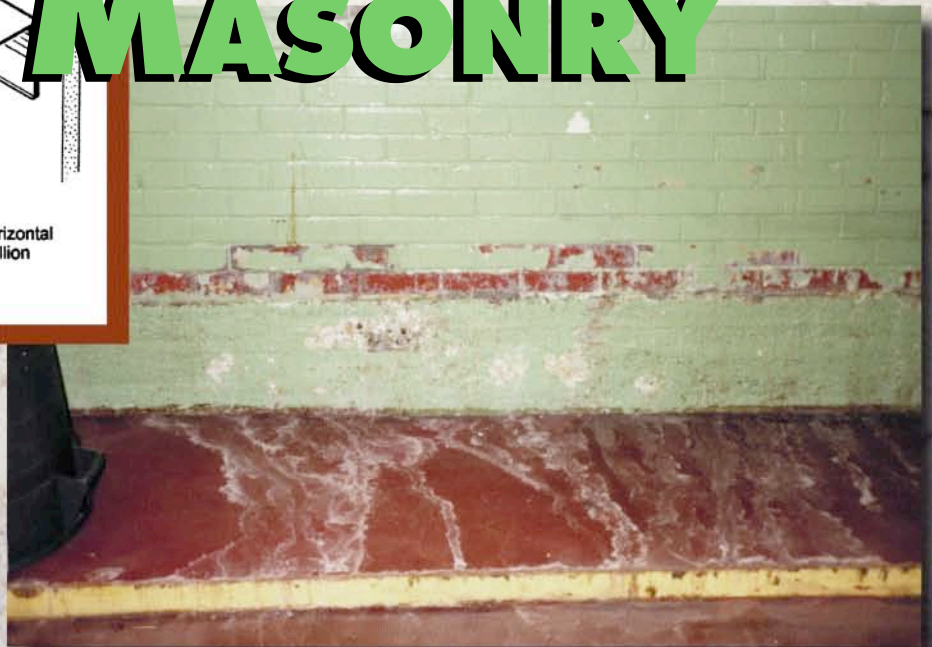
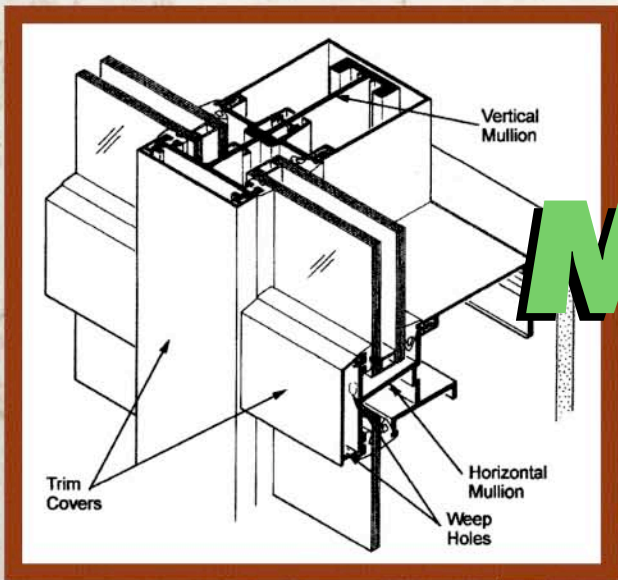


Journal of the Roof Consultants Institute

Interface

November 2000
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**INSIDE: EIFS,
CURTAIN WALLS,
&
MASONRY**



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In This Issue Interface

Features

- 4 ▶ Design & Renovation of a High-rise Retrofit EIFS Cladding; a Case Study
Warren R. French
- 17 ▶ Brick Masonry Takes on Water; So What's New?
Lyle Hogan
- 23 ▶ Water Leakage in Glazed Curtain Wall Systems: Cause, Effect, and Cure
William D. Smith

Special Interest

- 30 ▶ Talk About a High-Traffic Rooftop!
- 32 ▶ Phenolic Foam Class Action Settlements; A comparison of Beazer's and JM's Offers and Potential Impact on the Roofing Community
Richard P. Canon

Departments

- 2 ▶ President's Message
- 3 ▶ Letters to the Editor
- 39 ▶ Industry News
- 40 ▶ Industry Calendar
- 40 ▶ Advertiser Index

RCI was chartered, in part, to bridge the gap between the seemingly disparate elements of the roofing profession. It is the intent of *Interface* to connect with these elements, educate and inform about roofing-related and building envelope topics, establish a common ground for discussion, promote Institute programs, and branch out toward even more people. *Interface* is circulated monthly to over 3,000 people (nationwide and overseas) including RCI members, specifiers, facility managers, owners, industry contacts, and a growing number of highly placed professionals. *Interface* is frequently distributed at various trade shows, as well as educational and institutional functions. The articles contained in this publication are intended to provide information that *may* be useful to members of the Roof Consultants Institute. RCI does not necessarily endorse this information. The reader must evaluate the information in light of the unique circumstances of any particular situation and independently determine its applicability.

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On the Cover:

Analyzing moisture movement through construction assemblies requires knowledge of components other than the roof. This issue is devoted to wall construction matters as they may be encountered by the roof technologist.

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President's Message

New Appointments,

Strategic Plan

Lead Institute Forward



I would like to begin by extending my thanks to Mike Blanchette for the informative article about the RCI Foundation published in the September issue of *Interface* in the President's Message Column. Thanks, Mike, to you and the rest of the Foundation Board, for committing the time and effort necessary to ensure the growth and stability of such an important part of our industry.

The Institute Board of Directors has begun the process of formally requesting funding for specific education and research projects that meet the criteria of the Foundation. The commitment of RCI professional members in providing the initial financial support for the foundation has been exceptional. The continued support of our professional members and the support of the industry at large will enhance and strengthen the Foundation's position in funding targeted educational and research projects in our industry.

The Institute and the Board of Directors extend their thanks to Joe Hale, Past President and Fellow of the Institute, for his tireless commitment as he steps down as chair of the Education Committee to chair the new Foundation Board. Hitesh Doshi has accepted the appointment as new chair of the Education

Committee. I look forward to Hitesh's continued support and leadership in strengthening and expanding our educational programs.

Our summer Board meeting in Savannah, Georgia, was very successful. With participation from staff, the Board refined the strategic planning process we began in Vancouver last year. We now have the defined criteria for meeting the goals and objectives of the Institute as we continue to strengthen and grow the Institute. My congratulations to the Board and staff for the efforts put forth to complete this process.

With that, I'll sign off with this personal note: My wife and I became proud grandparents of Kira, a 9 lb., 2-ounce baby girl born on September 14th.

A handwritten signature in red ink that reads "William Cypher".

**William Cypher, RRC
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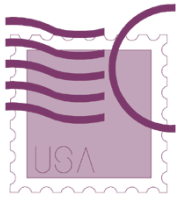
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Letters to the Editor



Re: May 2000 *Interface* article on PMRA

Dear Editor:

As a new member of RCI, I expected one of the most significant benefits of membership would be the solid information published in your magazine, *Interface*. I was surprised but very interested when my first issue (May 2000) arrived with a cover indicating that Protected Membrane Roofing Assemblies were the subject of feature articles. There were not one, but two articles—both written by people with a direct involvement in Dow Chemical.

The reason for my surprise is the fact that in this part of the country—the Maritime Provinces of Canada—PMRA has not been a roof of choice for about 15 years.

When I started practicing architecture in 1979, Dow Chemical was promoting PMRA on flat roofs. We all believed them and the bonus of being able to extend the building vertically in the future and have a flat roof deck for a future floor made sense. That advice led to lots of ponded roofs, insulation flotation, stone punctures of membrane, and membrane torn by the insulation as it tried to float. When leaks occur, they are among the most labor-intensive (read expensive) to find. No one told us that well-adhered or ballasted insulation, in a ponded area, in the freeze/thaw conditions we have, would drive water into the insulation to the extent that a re-roofing job we are doing now has insulation weighing 19 pounds per cubic foot. That is half the snow load for this area! By comparison, another re-roofing job we have underway now has PMRA on an excellent slope and the insulation is bone dry and is being re-used under ballasted EPDM.

In a review of the Dow Chemical product information recently, I see that they are giving a 15-year warranty on their insulation retaining 90% of its insulation value when used UNDER a membrane. No wonder PMRAs are the Forgotten Solution.

Thanks for the bit of roofing history contained in this article, but no thanks for trying to “pump up” an idea that has had its day and should now lie quietly in the history books.

**Harvey Freeman, MNSAA, MRAIC
Halifax, Nova Scotia**

Tietsma Responds:

The point of my article is that the PMR approach has evolved over time, and some of the initial problems have been corrected—just as have the initial problems with the ballasted EPDM systems that you are specifying. As a consultant and educator, I have absolutely no incentive to “pump up” PMR systems. However, I feel that PMR systems can be used effectively to solve roofing problems. Used correctly, today’s systems do not experience the problems you mentioned but, like all systems, they can be used inappropriately. Also, I can’t speak for Canadian manufacturers, but extended thermal warranties are available today from more than one U.S. manufacturer.

Gerard Tietsma, RIEI

Portable Pipe Hangers
B&W
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DESIGN & RENOVATION OF A HIGH-RISE RETROFIT EIFS CLADDING

A CASE STUDY

BY WARREN R. FRENCH, PE, RRC, CCS

Reprinted, with permission, from STP 1352—Water Problems in Building Exterior Walls: Evaluation, Prevention, and Repair, American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428

History and Background

A high-rise, low-income apartment project located in Minneapolis, Minnesota, was originally constructed in the 1970s with site-fabricated, concrete spandrel panels and column covers. Due to structural concerns, extensive panel cracking, and significant water leakage problems, the building was retrofitted in 1984 with a cladding system composed of polymer-modified (PM) Exterior Insulation and Finish System (EIFS). Within a few years, noticeable cracks had developed throughout the retrofit cladding system, and significant changes in the appearance of the EIFS became manifest. Extensive investigation and analysis revealed specific material defects that were particular to the mid-western EIFS manufacturer (no longer in business), as well as poor detailing during the design process and improper workmanship related to several key aspects of the building envelope. The EIFS wall cladding suffered progressive deterioration until early 1993, when a severe wind storm removed a section of the cladding from an upper floor at one end of the building.

The owner and manager of the property, a non-profit organization dedicated to community redevelopment and neighborhood preservation, commissioned a comprehensive inspection of the EIFS cladding on the entire building. The investigation included visual inspections by a number of different parties, field leak testing, and *in-situ* testing of the structural integrity of the EIFS assembly using a pull test method originally developed by this author.¹

Upon completion of the investigations, it was determined that the EIFS cladding system, after only ten years, had experienced widespread failure, was unsalvageable, and would have to be replaced. Litigation related to the cladding failure resulted in a settlement that allowed the building owner to initiate steps to successfully remove and replace the EIFS cladding. These steps included development of comprehensive construction documents, prequalification of bidders, competitive bidding, close project management and contract administration by the design professional, and full-time, third-party inspections of the installation. Due to the involvement of financial assistance from the

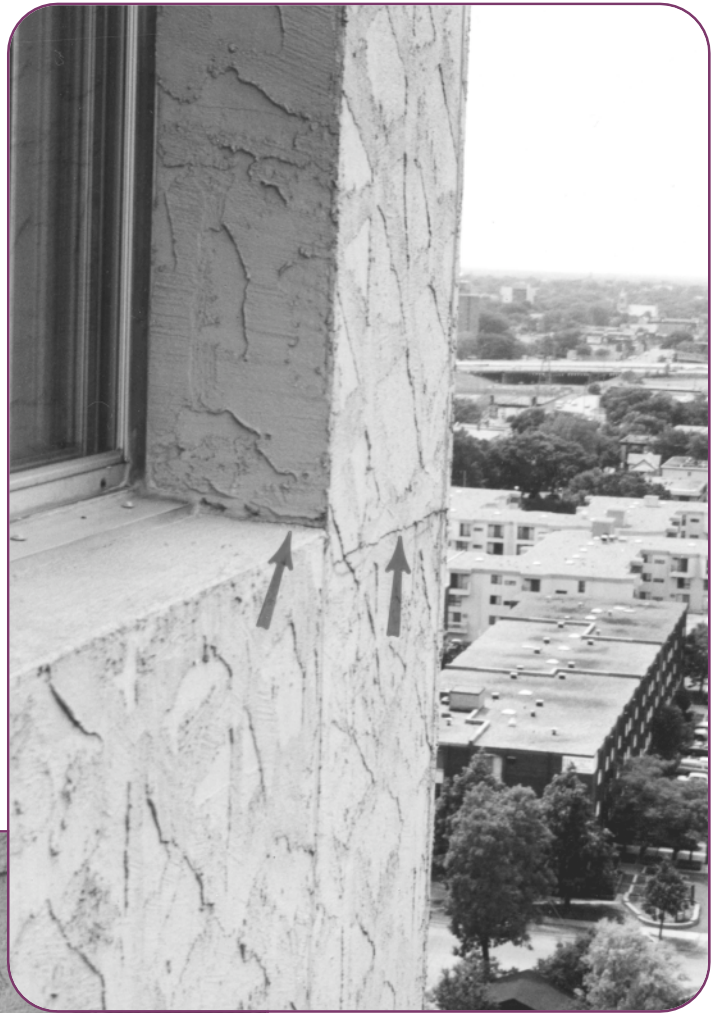
Department of Commerce, Housing and Urban Development (HUD), all of the project administration procedures were required to comply with regulations of that agency.

A number of conditions found at this project were attributable directly to poor workmanship during the original installation of EIFS materials and could be summarized as follows:

- Poorly finished EIFS edges and corners.
- Inadequate key-in of EIFS materials at edges of control joints and other metal accessories.
- Improper "mitering" of control joint corners.
- Inadequate applications of EIFS material finishes with respect to material thickness in some locations, as well as at corners.
- Incomplete applications of EIFS material finishes with respect to edges and corners.
- Improper termination of control joints at window recesses.
- Securement of insulation board and mesh to substrates using fasteners with spacing and patterns that exceeded 2 square feet per fastener.
- Glass fiber mesh that ran continuously behind control joints.
- Mortar bridges within bellows of control joints due to EIFS materials "slop."
- Omission of control joints at specified locations.
- Substitution of differing control joint materials, including zinc, galvanized steel, and PVC.
- Texture coat and acrylic color coat applied directly to scratch coat of EIFS material.
- Improper surface preparation prior to installation of building sealants.
- Omission of backer rod at sealant installations in some locations.

Based upon our observations, it also appeared that certain constituent materials utilized during the retrofit installation of PM EIFS cladding at this project may have been defective.

- Sealants installed within the building joints and at window perimeters exhibited extreme conditions of “reversion,” which have resulted in adhesive and cohesive failures, as well as lack of movement capability and dirt retention.
- Glass fiber mesh utilized within the PM EIFS lamina throughout the building had experienced embrittlement and loss of tensile strength, indicative of improper or inadequate application of protective coatings on the mesh, as well as advanced alkali attack of the glass fibers.
- Splitting of the metal control joints was a serious and widespread problem that may be due to manufacturing defects or stress fatigue within the metal alloys used for these building components.



Above. Figure 1—Inadequate slope at original sill.

DESCRIPTION OF PROJECT

General

The subject property is a cast-in-place, reinforced, concrete-framed structure. This twenty-one story building consists of two adjacent wings that have rectangular-shaped floor plans or footprints. The two wings have central axes that run parallel to each other, but were offset a certain distance laterally. This offset results in half-width end walls at each wing occurring at approximately the midpoint of the total building length, such that the East Wing has a west, half-width endwall and the West Wing has an east, half-width endwall.

Main entrances occur along the North and South elevations at the offset. The endwalls at all locations feature a vertical recess running the full height of the building. At the East Wing, east endwall, and the West Wing, west endwall, the notch occurs at the building centerline and corresponds to the stairwells at each end. At the half-width endwalls, the notch occurs adjacent to the continuation of the offset building wing. See Figure 8.



Left. Figure 2—Typical sill and A/C opening.

EXTERIOR WALL CLADDINGS

1970s Original

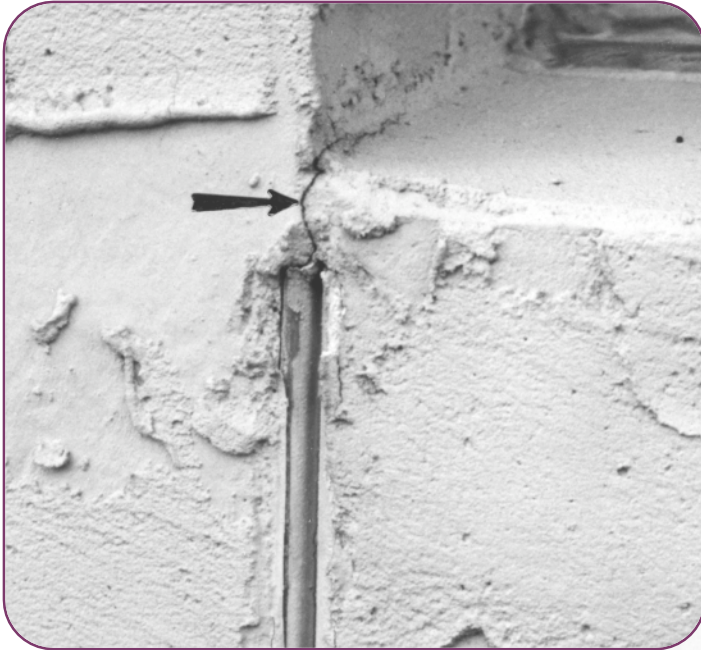
The original exterior wall cladding at this project, dating from about 1974, was comprised of site-fabricated concrete spandrel panels and column covers that were reportedly “shot-creted” in place using an innovative application procedure.

Details and historical records were incomplete, but it is reported that interior water leakage was experienced virtually from the beginning of the project. Ultimate investigation and analysis of the problems revealed significant strength deficiencies of the concrete materials comprising shot-crete spandrels, which resulted in severe cracking and the water infiltration. Since there was little confidence in the strength and security of the original shot-crete spandrels, it was decided in 1984 that the renovation cladding system would be supported on a steel stud framing system that

spanned from exposed floor slab to floor slab, with angle brackets installed at every stud for each floor level. This framing system was designed and installed at the north and south elevations prior to installation of the retrofit PM EIFS cladding.

1984 Retrofit EIFS

The retrofit building envelope was comprised of EIFS spandrel panels and column covers with aluminum and glass punched windows regularly interspersed on the North and South elevations. The East and West endwalls are "solid" walls that are only



Above: Figure 3—Control joint termination.

Right: Figure 4—Prefabricated sill.

broken up by control and expansion joints. Both wall assemblies utilized a polymer-modified (PM) EIFS as the primary cladding material, using mechanically-fastened, extruded, expanded polystyrene (XEPS) insulation board.

At the north and south elevations, the insulation and reinforcing mesh were fastened over a gypsum sheathing which was attached to metal studs using a screw fastener with one-inch diameter washers. At the end walls, the insulation and reinforcing mesh were fastened directly to concrete shear wall panels using a hand-driven concrete pin, set in pre-drilled holes. The concrete pins also had been provided with one-inch diameter washers. In both assemblies, the insulation board was covered with an acrylic-modified cementitious base coat that was reinforced with a glass fiber mesh.

The wall assemblies at this project have received a final application of a textured coat applied in a web pattern. During inspection, we found the texture coat to vary in texture as well as in composition. The texture coats at the West Wing, west end-wall were comprised of a lean mixture and easily disbonded from the underlying PM EIFS, while texture coats at the East Wing, east endwall were comprised of a rich Portland-lime mixture that

was well-bonded to the underlying PM EIFS. Texture coats on the North and South elevations ranged between these two extremes.

The entire system was finally coated with a waterproofing layer consisting of an acrylic, elastomeric coating. Total specified thickness of the entire synthetic stucco system, or "lamina" was approximately 3.2 to 4.8 mm.; however, we found that the actual installation varied considerably from these norms.

Primary advantages of EIFS-type cladding systems are exceptional thermal efficiency of the assembly, attractive finish color and texture, and economical initial cost of construction. However, there have been a number of problems identified with these systems, including inadequate design and detailing, lack of proper workmanship, cracking, and extensive deterioration of substrate materials when subjected to chronic and long-term building leakage, etc.²

Problems Observed in Previous EIFS Installation

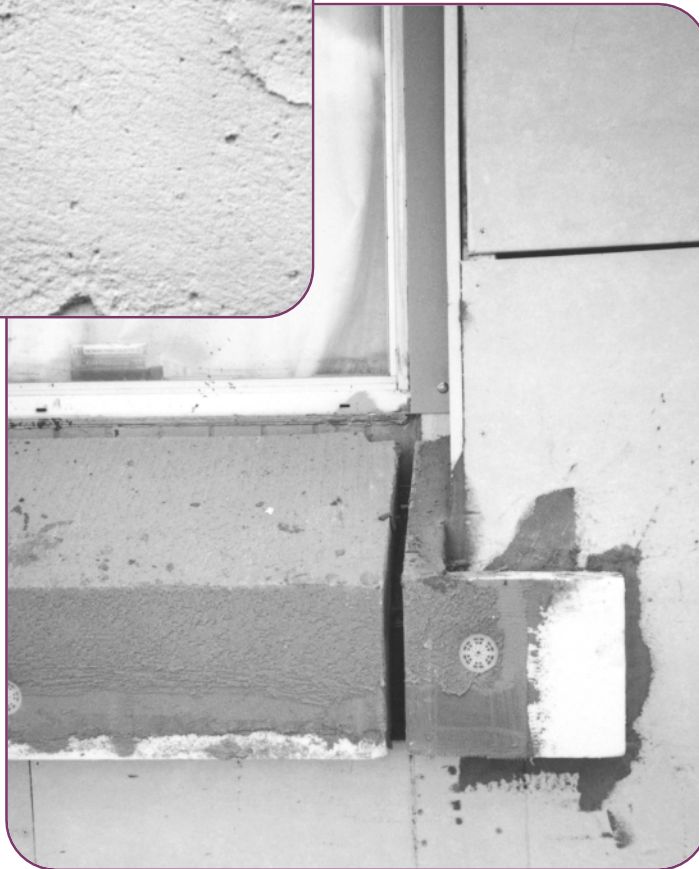
Patterned Cracking—

One of the most prevalent types of problems observed at this project related to the PM involved cracks occurring at regularly-spaced intervals throughout the wall surfaces. This patterned cracking was determined to correspond with the butt joints of adjacent insulation boards. Patterned cracking was observed at spandrel panels, shear walls, column covers, corner covers, roof eaves, notch returns, and main walls, as well as at penthouses located at the main roof levels. In addition, random cracking was observed at various locations which was attributed to diverse causes. It was noted that past remedial applications of elastomeric sealants

did not fully address this problem, and cracks extended beyond previous sealant applications in numerous areas.

Cracking within EIFS installations can occur due to a variety of causes, including defective substrates, poor workmanship, failure to comply with manufacturer's recommendations for proper installation, lamina applications that are too thick or too thin, etc. Cracking is a result of physical stresses that exceed the material's physical properties and its capacity to accommodate these stresses without detriment. Invariably, cracks have been found to contribute to water leakage within the wall system and may cause further damage due to moisture absorption, deterioration, and corrosion of materials.

Patterned cracking of the EIFS lamina was observed at regular intervals that appeared to correspond to the location of butt



joints within the insulation boards. Possible causes of this patterned cracking at insulation board joints are (a) dimensional instability of the insulation foam product, or (b) improper fastening of the insulation resulting in a "loose" substrate.

Thermal Movement—We also observed what appeared to be cracks occurring due to a lack of proper provision for accommodating expansion and contraction within the fenestration of this building. Our investigation indicated that panelization of EIFS wall cladding at this project exceeded typically recommended sizes and configurations, as well as locations where metal plastering accessories called for within the design were omitted by the installing contractor.

Deterioration of Glass Fiber Mesh—Another contributing cause for cracks occurring due to thermal stresses is a potential for EIFS membrane strength reduction due to alkali attack of the glass fiber mesh and deterioration of the fiberglass mesh associated with this physical phenomenon. The strength reduction observed within naturally-weathered, glass fiber-reinforced concrete (GFR) is well documented.³ This strength reduction is due to embrittlement of the glass fibers caused by cement hydration products that penetrate the fibers, resulting in an increased fiber-to-matrix bond strength. Although modern EIFS technology generally utilizes alkali-resistant glass fibers as well as special fiber coatings to reduce affinity of the mesh for calcium hydroxide (the primary hydration product responsible for embrittlement), strength reduction and other long-term durability problems cannot be completely eliminated. Embrittlement of the mesh was observed at this project within the remnants of EIFS materials examined during demolition of the original EIFS.

Re-entrant Corner Cracking—Cracking at re-entrant corners of various openings was also observed to be widespread and prevalent at this project. This type of crack arises due to unavoidable stress concentrations occurring at sharp angle re-entrant corners. At such locations, the stress concentrations must be either resisted or relieved. We observed cracks of this nature at the bottom corners of A/C openings and at the corners of punched windows.

Unfinished Edges—Numerous locations were observed where outside corners and terminations of EIFS panels exhibited poorly finished edges. Due to the relatively thin cross-section of EIFS, it is critical that applicators achieve full thickness throughout the panel, particularly at panel edges and corners. Failure to achieve full lamina strength at these stress points will typically result in poor performance and may cause cracking and associated water entry.

Delamination—In 1993, a relatively large section of EIFS lamina located on the East Wing, east endwall between the 13th and 14th floors fell from the building to the ground. This event caused the owner to commission an engineering investigation of the wall system, which found numerous other locations (particularly along cracks and control joints) that exhibited deficient and failing adhesion of the EIFS to associated substrates. These deficiencies prompted the engineer involved at that time to develop a program of installing supplementary fastening in the areas affected.

Upon my company's involvement, our investigation revealed that the extent of EIFS wall areas experiencing some degree of delamination went beyond those areas that had been previously addressed by supplemental fastening. In addition, the severity of

delamination varied widely from one location to another. Our observations indicated that the severity of existing delamination ranged from a narrow band occurring along cracks in the EIFS lamina to larger sections comprising several square feet in area. Our structural testing indicated that integrity of the EIFS lamina and ability to resist high wind pressures was compromised in most of these cracked areas.

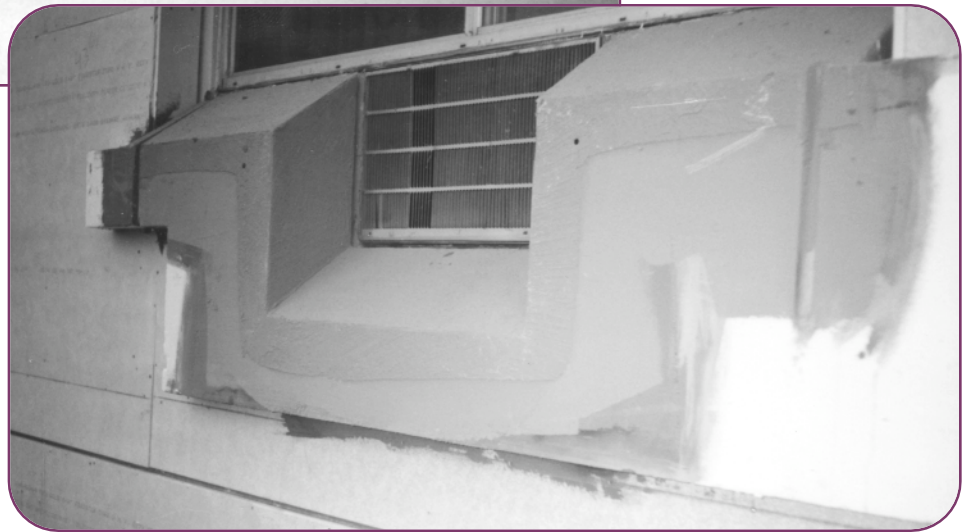
Exposed Mesh—At a number of locations throughout the project, we observed areas of exposed mesh and foam. Some of these areas were attributed to poor workmanship during the original installation, while other areas were undoubtedly due to physical damage occurring during subsequent maintenance activities. Regardless of their cause, these anomalies would have required immediate repair if a decision to replace the entire EIFS cladding had not been implemented.

Improper Steel Framing—As previously stated, adequate slope at the window sills was effectively non-existent, because the steel framing below each opening had been fabricated perpendicular to the plane of the wall. See *Figures 1, 2, 3 and 9*. This condition could not be effectively remedied without extensive modification to the original framing. In view of the potential costs for this aspect of the renovation, this work was bid as an alternate to the base bid. Fortunately, the costs from the successful bidder were not out of line and the owner recognized the need for this modification. The alternate was incorporated into the construction contract. See *Figures 4, 5, 6, 7 and 10*. In addition, selective demolition during the renovation revealed a number of areas throughout the existing steel wall framing that were inadequately fastened to the principal structure. In addition, the wall framing consisted of excessively long metal studs that had been installed continuously across expansion joints of the building envelope.

French Engineering
B&W
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Left: Figure 5—Prefabricated straight sill.



Below: Figure 6—Prefabricated sill on window with A/C opening.

Use of Defective Fastener—The original PM EIFS installation was comprised of a proprietary material that utilized a galvanized fastener with a round galvanized washer that was provided with a bonded rubber washer. However, the fastener was typically installed with the rubber washer to the exterior, causing disbonding of the EIFS base coat and finish coat at a majority of the fastener locations. In addition, at a number of locations, the steel washer had cut the reinforcing mesh embedded within the base coat, causing delamination of the PM EIFS at certain areas.

Sealant Reversion—Numerous sealant problems were observed at this project related to the EIFS installation. There was widespread evidence of a particular kind of anomaly which is specific to polyurethane sealants formulated and installed between 1982 and 1989. This anomaly has been termed “reversion” and is manifested by a tackiness or uncured consistency of the sealant subsequent to installation. It is manifested by dirt retention, a lower Durometer hardness, higher modulus, and susceptibility to mud-cracking.

We observed widespread adhesive failures of the original polyurethane sealants at numerous locations, including EIFS panel-to-panel joints and EIFS-to-metal joints. Since the main cause of sealant adhesive failure is improper surface preparation, most of these failures are unquestionably due to improper workmanship during original construction.

Water Intrusion—There were numerous locations where water intrusion through the EIFS cladding was occurring in varying degrees throughout this building. This leakage resulted in water stains as well as the presence of corrosion product at certain metal components.

Water leakage into the building cladding system occurred due to a number of different sources with varying effects and degrees of severity. The most common source of water intrusion would arise from normal precipitation, including rain, snow, and ice. However, we also observed that condensate occurring dur-

ing summer months from the window air conditioning units also resulted in water entry and building component damage.

Plastering Accessories—Improper installation of plastering accessories was common and widespread throughout the EIFS applications of this project. Installation problems included variations in the field fabrication, assembly, and securement of these accessories not in accordance with recognized industry standards. Corners of the control joints were found to be improperly mitered and fitted in numerous locations, particularly around window openings but also at standard outside corners. In addition, joint accessories were terminated improperly at window recesses at all locations throughout this building. Typically, these joints did not extend into the recess, resulting in a plaster bridge subject to cracking at the end of the metal termination. See Figure 3.

The most common type of damage observed with respect to metal control joints was splitting of the metal bellows that connects the two “J”-shaped flanges and provides a certain range of joint movement. This condition represented a significant problem to be dealt with during development of any renovation plan to be implemented at this project.

Numerous cracks in the EIFS were also observed occurring at and along metal plastering accessories. These cracks occurred adjacent to control joints utilized at various locations throughout the building as well as at the perforated flanges of corner beads used at outside wall corners. Cracking of both types was wide-

Page 9
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spread and prevalent throughout all faces of the building cladding. Cracks were common at control joints used within the plaster membrane. Often such cracks were due to improper key-in of the EIFS materials along the bead of the joint. This condition is a result of improper application technique (i.e., lack of appropriate hand pressure) regarding the EIFS base coat, or due to dirty or oily metal accessories incorporated into the work without proper cleaning.

Pull Testing

A program of *in-situ* structural testing related to the EIFS installation at various elevations of this building was implemented. Pull tests resulted in six of the eight specimens resisting negative pressure loads that exceed the anticipated design wind pressures for this building. All but one of the samples exhibiting adequate strength had failed by the fasteners pulling through the insulation. The failure mechanism occurring in those samples not meeting the wind load consisted of the EIFS lamina disbonding and separating from the insulation. It was noted that these failed samples were located at or adjacent to EIFS surfaces that incurred horizontal patterned cracking. Based on these results, it was our opinion that cracked areas within the EIFS assemblies at this project were subject to a higher instance of delamination and posed a significant risk of additional areas failing by delamination in the future.

REPLACEMENT EIFS DESIGN CONCEPTS

Correction of Original Design and Construction Defects

The general approach utilized to design the new remedial cladding system was simply to correct (as much as possible) the detrimental conditions observed during investigation and analysis that caused or led to the previously observed problems. In addition, the firm brought to bear the cumulative experience of almost ten years of investigating EIFS projects in distress and cataloging the common and prevalent mistakes made during both design and construction. Finally, we synthesized what we considered to be the "best" procedures, details, and application methods available from the industry leaders as well as from personal knowledge of research being carried out by various parties involved in similar pursuits. All of this information was brought together to establish the basis for our design as well as to guide the design decisions made during the renovation process.

It should be noted that previous design assistance for this project by other design professionals had considered and evaluated alternative cladding system renovations including metal panels, true Portland cement plaster, and a polymer-based (PB) EIFS. Based upon preliminary pricing, and in view of the owner's limited budget, it was determined that a PB EIFS cladding would



Figure 7—Sill and A/C opening with new sheet metal flashing.

have to be the alternate ultimately pursued. Our firm was brought in to provide final evaluation of the building and to develop the renovation design ultimately used.

Provision of Enhanced Performance Capabilities for New EIFS

Based upon our experience, it was our opinion that the EIFS renovation materials for this project would have to provide performance capabilities that exceeded the previous failed PM EIFS, and hopefully avoid the mistakes and problems observed on numerous other projects. Accordingly, we endeavored to design, specify, and incorporate what we considered to be the best materials and systems into the remedial cladding. This led to specification of what would be considered as the "premium" assemblies offered at that time by a number of the leading manufacturers. A traditional PB EIFS, utilizing a barrier wall system for water management, was specified since manufacturers had not developed or marketed the "drainable" EIFS materials available today. The following paragraphs describe some of the materials and design details utilized to obtain enhanced EIFS performance at this project.

Utilization of a Premium Sheathing Substrate—Based upon the most recent industry practice, the new EIFS installation utilized a proprietary sheathing material comprised of a siliconized gypsum core with a glass fiber facer on both sides. This material reportedly has a greater resistance to water absorption and an associated decrease in sensitivity to moisture damage. Although full field testing of these claims had not been performed at the time project specifications were written, it was determined that this material would be better than standard paper-faced gypsum sheathing. In addition, an alternate substrate consisting of a proprietary, rigid, cement board was also bid; however, final budget considerations precluded its use during this renovation.



Figure 8—Elevation showing numerous windows.

Two-to-One Polymer/Cement Ratio—Most traditional EIFS installations in the past typically used a one-to-one mix ratio of polymer-to-Portland cement for the base coat and adhesive components of the system. Some critics assert that this mix ratio results in a cladding assembly that is too rigid and which exhibits lowered performance capabilities. The two-to-one polymer-to-Portland cement mix ratio is believed to provide increased performance capabilities and enhance water resistance and greater flexibility. In addition, this mix ratio is reportedly more consistent with the modern EIFS applications typically utilized in Europe.

Double Base Coat—It was noted that the latest research indicates the importance of achieving a consistent base coat that is of adequate thickness as well as the critical nature of placement of the reinforcing mesh within the middle portion of the lamina. In addition, in recognition of the difficulty of workmen to achieve this “theoretical” lamina with consistent nominal thickness and the mesh placed in the middle of the coat while placing the materials in a single hand application, a second application of base coat was specified in order to fully cover the

reinforced mesh, avoid mesh patterning, and provide adequate cover over the mesh layer. Provisions were made at panel perimeters and the edges of wall openings to allow for the double base coat application.

Primer Application Prior to Finish Coat—Although not required or recommended by all EIFS manufacturers, a primer application on the cured base coat prior to applying the finish coat is required by a few leading manufacturers. These primers are reported to increase finish coat adhesion and enhance waterproofing performance of the overall assembly. The particular manufacturer selected for use at this project does distribute and recommend the use of a primer. The suggested application instructions

were followed as closely as possible.

Sealant Applications to Base Coat—In keeping with current industry standards as recommended by most leading EIFS manufacturers as well as the EIFS application guide, sealants occurring at opposing-side joints should be applied directly to the base coat and not to the finish coat of the joint. This type of construction requires a close coordination between the architect and the general contractor as well as proper sequencing of the sealants with other components of the building envelope.

Use of Low-Modulus Silicone Sealant—In order to avoid the stresses that could result in an EIFS cohesive failure, a low-modulus, silicone sealant having a high range of movement capability was specified and utilized consistently throughout this project. Most of these types of sealants are currently approved for use by most of the major manufacturers.

Utilization of Innovative Details

Modification of Window Sill Framing—Significant modification of the original steel framing was also specified and detailed in order to achieve proper slope of horizontal surfaces at

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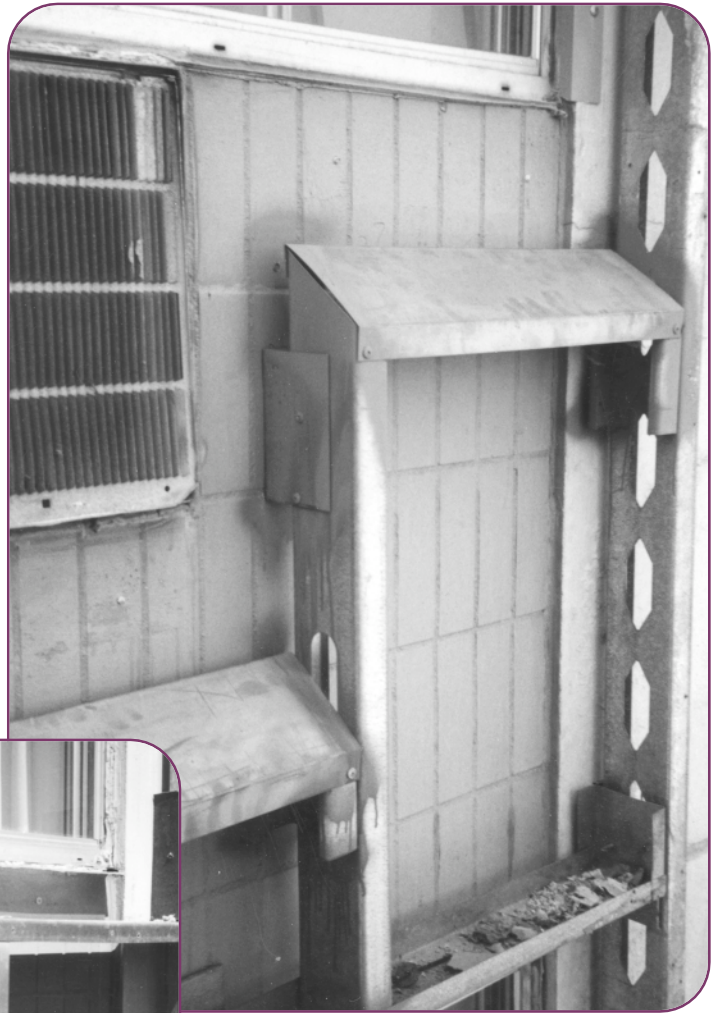
the window sills. Original sill framing had improperly created virtually flat surfaces at each window sill, resulting in inadequate drainage at these surfaces. See *Figure 9*. The renovation design was meant to correct this condition by cutting the original steel studs at a sharp angle and installing a bent plate to cap these framing members as a sloped track member. See *Figure 10*.

Prefabricated EIFS Sloped Window Sills—Due to a specific construction sequencing that we specified for the window sills and sheet metal sill flashings, the contractor developed and submitted for approval a pre-fabricated assembly comprised of foam that had been properly shaped, covered with the base coat and finish, then incorporated into the wall at the bottom of each window opening. Realizing the importance of achieving a completely base-coated foam installation (in conjunction with a sheet metal sill flashing that was to be incorporated into the wall behind the EIFS assembly at the window jambs), the contractor struck upon the idea to prefabricate the sloped portions of the sill as a method to achieve the required sequencing while allowing an acceptable production rate. See *Figures 4, 5 and 6*.

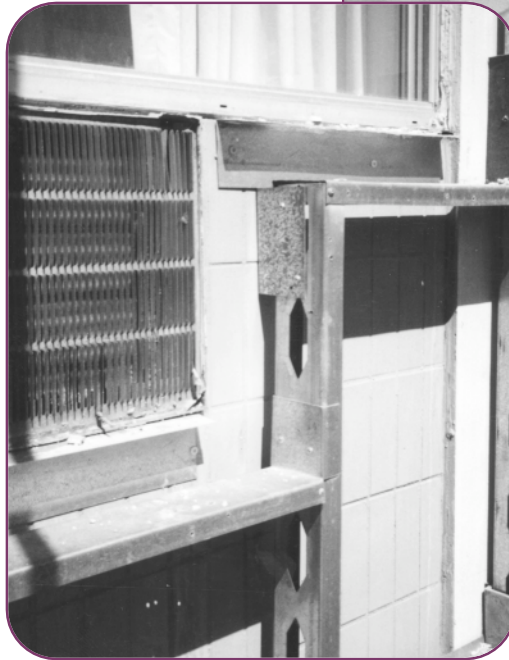
Sill Flashing Integral with EIFS at Jambs—Once the sloped sill of the window opening was fully finished, a special sheet metal sill flashing was installed in a bed of non-curing butyl sealant. Upturned end dams at each end were fastened directly to the sheathing at the recessed edges of the window opening, with the EPS foam board and finished surfaces extending down over the sheet metal at these jamb locations. The EIFS finish at the recessed jambs was incorporated into exposed front surface of the main wall systems. See *Figure 7*.

Stand-off Mounting Hardware for Appurtenances—Based upon numerous investigations of buildings having distressed EIFS applications, an attempt was made to provide specific details to support and mount various appurtenances through the EIFS assembly and onto the building structure. These appurtenances included fixed ladder brackets, sheet metal downspouts, and communication antennae. Each of these items could produce an undesirable penetration or opening through the new EIFS lamina if not detailed properly. Accordingly, special fabrications were utilized to create stand-off mounting hardware that secured the appurtenance with minimum disturbance of the EIFS lamina. See *Figures 11 and 12*.

Two-stage Sealant Joints—In addition to the use of a low modulus silicone sealant installed only at the base coat substrates, dual stage sealant applications were specified and detailed for both horizontal and vertical expansion joints within the EIFS panels created within the building fenestration. Dual stage sealant joints consist of an inner sealant bead applied against a bond breaker tape or backer rod, which is deeply recessed within the joint, as well as an exposed outer sealant bead applied against a second backer rod, creating a cavity or air



Above: Figure 10—Modified framing at sill.



Left: Figure 9—Original framing at sill.

space between the two sealant beads. The tops of panel joints are typically sealed off completely, while the air space created between sealant beads is left open at the bottom of the joint (corresponding approximately to each floor) in order to allow drainage of any water penetration as well as pressure equalization within the space.

Construction Administration, Logistics, and Progress

One of the predictable aspects of the fledgling EIFS industry is the constant change that has occurred over the last ten years, as well as that which will continue in the years to come. (Remember when it was required to apply sealants to the finish coat? When silicone sealants were not allowed?) In recognition of this and in view of the more pro-active role EIFS manufacturers began to play in the mid-1990s, we wrote our specification to include a mandatory review of the renovation construction documents by pre-qualified manufacturers. This review was intended to make sure the design concepts and details included in the renovation plan (which were based upon our experience in the

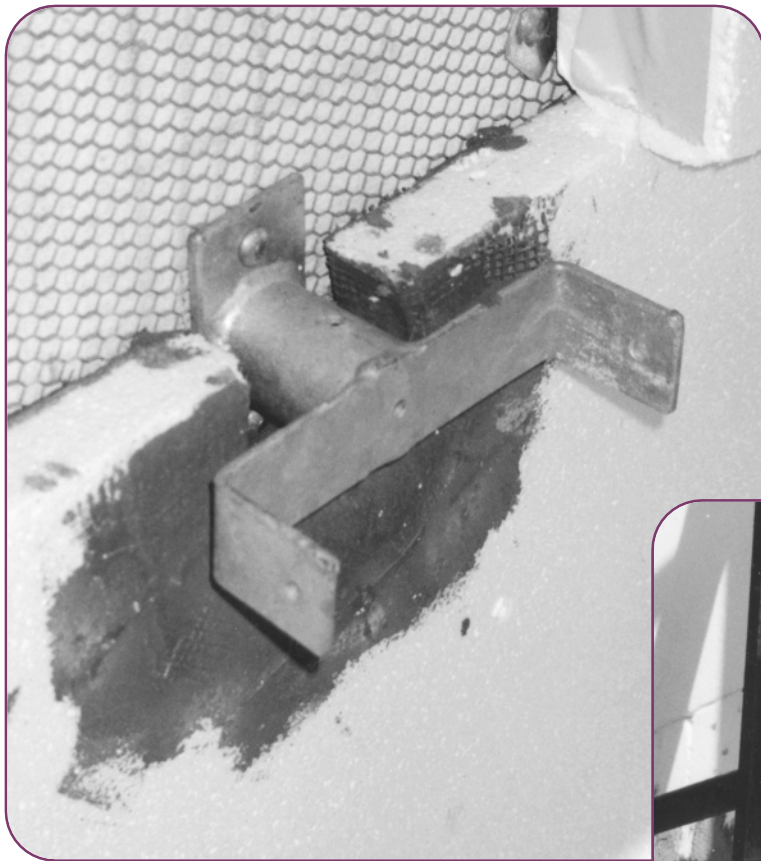


Figure 11—Stand-off downspout bracket.

industry and a synthesis of the “best” ideas from several sources), were consistent with the chosen manufacturers’ latest requirements, that the project would be eligible for the long-term manufacturer warranties that had been specified, and that any conflicts, qualifications, or inconsistencies between manufacturers could be evaluated. Each of the manufacturers approached with this review burden had already implemented a mechanism to achieve the desired results and did not balk at the prospect of “approving” and providing constructive input, some of which was proprietary to their particular system. Indeed, most of the manufacturers would most likely require such a review for larger projects.

Other more common construction management procedures and methods were also utilized. These included a pre-bid conference with pre-qualified contractors, a thorough review of submittals (particularly for proposed substitutions), and mandatory attendance at a pre-construction meeting by the contractor (job-site supervisory personnel, management, and estimating), all subcontractors, the owner, the property management company, the EIFS manufacturer, the local material distributors, and representatives from HUD. The pre-construction meeting covered not only coordination efforts, logistics, and procedural matters, but it also focused on technical issues with the job-site personnel (requirements, expectations, etc.), since this was their first introduction to the project after the “hand-off” from the contractor’s estimator and project manager. A job-site walk-through was also conducted to discuss various logistical matters and to point out locations where typical details would be utilized or where special procedures would have to be implemented.

Since the owners had previously been “burned” with the deficient installation of the original retrofit EIFS application, they recognized the value and benefit of implementing full-time quality assurance observations by an independent third party during progress of the work. Our firm was hired to provide these observation services in conjunction with normal construction contract administration services. The quality assurance observations were utilized to make certain that requirements of the construction documents and the EIFS material manufacturer were strictly adhered to during construction. The design firm and the design firm’s on-site personnel were also utilized as a conduit for information coordination, trouble-shooting, and facilitation of the daily activities between owner, contractor, resident guests, and outside jurisdictions.



Figure 12—Stand-off ladder bracket.

In consideration of the 110,000 square feet of replacement EIFS surfaces as well as 960 window openings, the construction period was estimated to require over ten months for completion. Due to these facts, construction logistics included renovation of the building envelope over two separate construction periods during the temperate weather periods of 1995 and 1996 in order to avoid application problems associated with the harsh Minnesota winters. It was determined that the possibility of “tenting” or covering portions of the project would be prohibitive due to increased cost, lowered productivity, and remaining risks involved with freezing materials or applied components.

Due to certain unforeseen delays during the first construction period, the contractor was not allowed to start work until mid-summer 1995 and worked until early November of that year, accomplishing approximately 35% to 40% of the required work. The second construction period began in early April and continued through late October, 1996. Accordingly, the total construction period for the renovation required approximately twelve months, including weather delays, punch list development, and resolution.

One of the items perceived by the contractor to be a time and labor intensive aspect of the renovation was the specification requirement to completely finish the sloped window sills (base coat and finish) prior to installing the sheet metal sill flashing, which had to be incorporated "behind" the EIFS at adjacent window jambs. This scenario required the contractor to modify the steel framing below each window, partially apply EIFS materials at the sill, coordinate sheet metal trades to install the flashing, then resume EIFS applications at the jambs—a sequence required for all 960 window openings.

Based on our observations of past problems with other projects, we were unwilling to back off this requirement during early discussions of this issue. During the winter of 1995-1996, job site foremen struck upon the idea to prefabricate the framing modifications and sill assembly. These assemblies were then incorporated into the cladding system to facilitate construction, save time, and reduce labor conflicts.

Since access to the exterior building envelope would be required for the duration of the project, the exterior would have to be accessed using either frame scaffolding or motorized platforms. Due to the labor costs involved in erecting and dismantling frame scaffold systems, the contractor elected to use proprietary, climbing mast, motorized work platforms that were approximately eight feet deep and 60 feet wide. The weight-carrying capacity and mobility of these work platforms far exceeded those of traditional swing stages, carrying more materials and workmen as required for this project. In addition, the interval connections to the building resulted in greater stability and safety during high wind conditions. In our opinion, the contractor's use of this equipment added to the productivity and overall acceptability of the cladding renovation at this project.

OVERALL RESULTS

The overall results of the efforts expended by everyone on the renovation team, owner, designer, and contractor resulted in a cladding system that should provide acceptable performance and useful life to this property for many years to come. The new PB EIFS provides a thermally-efficient building envelope that is aesthetically pleasing and serviceable for this project. It is anticipated that the enhanced performance EIFS will perform adequately for the conditions expected, and the owner has been informed about the importance of proper and timely maintenance. Accordingly, the owner has already taken steps to implement periodic inspections of the building envelope in order to

provide an "early warning device" against problems that may be exhibited by the new building envelope. At the time of those inspections, the innovative details will be monitored in order to ascertain their effectiveness and anticipated longevity. ■

ACKNOWLEDGMENTS

The author wishes to acknowledge the cooperation of LoAnn Crepeau of Seward ReDesign, Inc. for permission to publish specific information related to the renovation design at this project. In addition, we acknowledge the efforts of Tom Johnson, Chuck Pramann, and Rich Willox, of Mulcahy, Inc., Allendale, Minnesota, the specialty contractor who successfully installed the renovation design and developed the prefabricated EIFS window sill.

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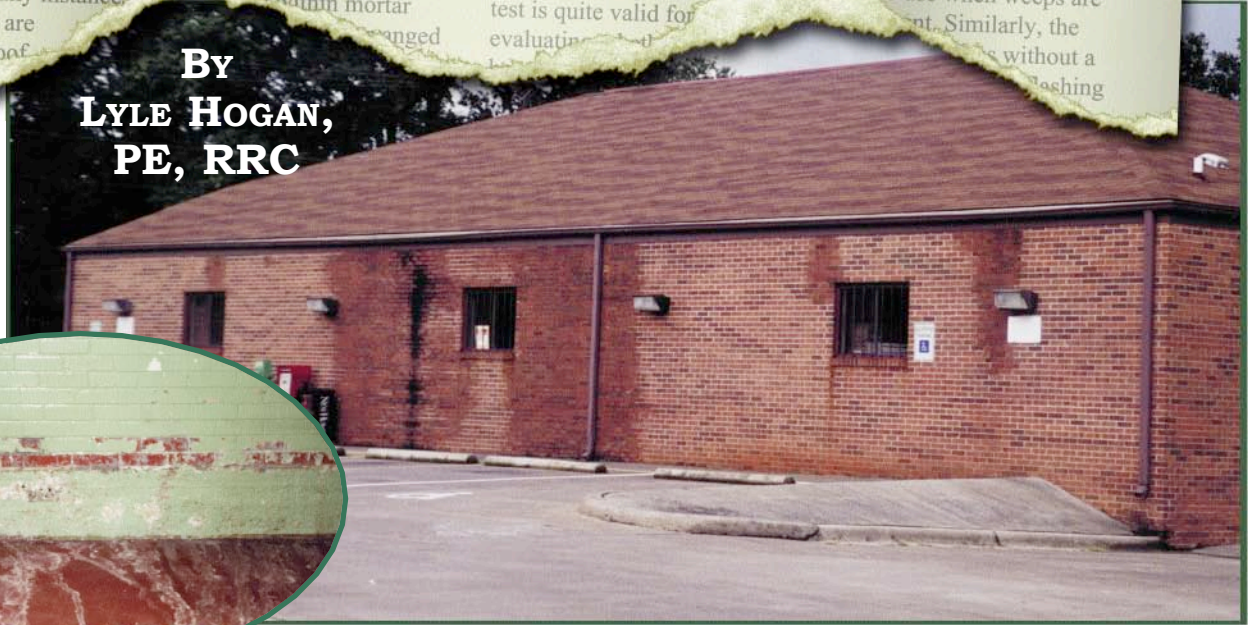
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Brick Masonry Takes on Water

So What's New?

BY
LYLE HOGAN,
PE, RRC



*Inset:
Figure 1
—Many instances of water invasion are unrelated to the roof. Investigation may reveal that the brick masonry veneer is the culprit.*

Above: Figure 2—Leaking gutters can supply a substantial amount of water for a masonry wall to absorb.

Introduction

It is common to hear complaints of water entry into a building or structure. The natural reaction is to blame the roof; however, many instances of water invasion are unrelated to the roof. Investigation may reveal that the brick masonry veneer is the culprit (Figure 1). Water's influence on brick masonry construction is well documented, yet the misunderstanding of its entry is so pervasive it merits discussion.

Brick construction will take on water. With or without a coating, and irrespective of the builder's talent, four inches of brick masonry will not stop wind-driven rain¹. Blowing rain can bypass eave overhangs and influence areas of a wall that do not routinely experience wetting. Leaking gutters (Figure 2) also supply a substantial amount of water for a masonry wall to absorb.

Improperly tooled joints will admit significant amounts of water (Figure 3). Inadequately filled head joints are a common observation. Wire reinforcing within mortar joints is sometimes arranged too close to the outside face (Figure 4). This causes the thin mortar cover to break away, resulting in yet



Above: Figure 3—Improperly filled mortar joints will admit significant amounts of water.



Left: Figure 4—Wire reinforcing within mortar joints is sometimes arranged too close to the outside face. This causes the thin mortar cover to break away, resulting in still more avenues for water entry.



Figure 5—One method for determining the rate of water absorption into brick masonry construction is the RILEM tube test. Unfortunately, the test results are often misunderstood or misapplied. While quite valid for evaluating water-repellent treatments, the test is often meaningless for evaluating a chronically leaking wall.

more avenues for water entry. Simply leak testing a wall assembly can pinpoint water entry stemming from haphazard workmanship

One method for determining the rate of water absorption into brick masonry construction is the RILEM² tube test (Figure 5). Unfortunately, the test results are often misunderstood or misconstrued. Since, as stated earlier, brick masonry is known to absorb water, confirmation of such behavior by testing is of marginal utility. Absorption rates on the brick surface are different than within the mortar joint region. Head joints will absorb at a different rate

than bed joints, and head joint absorption rate will vary top to bottom. The test is quite valid for evaluating whether a wall has been treated with a damp-proofing agent (water-repellent treatment). However, the test is often meaningless for evaluating a chronically leaking wall.

Brick masonry should be considered a “drainage wall,” anticipating that water will enter. Traditional claddings such as wood, brick, and stucco contemplate water penetration and incorporate secondary water barriers³. The water absorbed is of no great consequence if thru-wall flashing has been provided along with avenues for draining the wall cavity. Cavities clogged with mortar are not functional avenues for water removal (Figure 6).



Figure 6—Cavities clogged with mortar are not functional avenues for water removal.

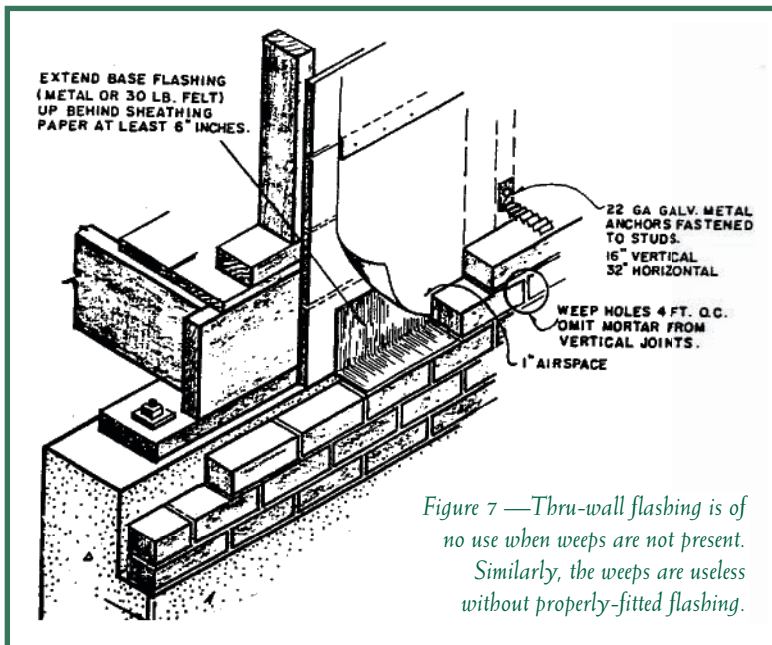


Figure 7—Thru-wall flashing is of no use when weeps are not present. Similarly, the weeps are useless without properly-fitted flashing.

Dewatering Avenues

Thru-wall flashings are integrated into masonry to induce removal of entrapped water. The thru-wall flashing is of no use when weeps are not present. Similarly, the weeps are useless without a properly configured flashing (Figure 7).

De-watering provision is needed along several regions of a wall. Standard plates published by SMACNA (the Sheet Metal & Air Conditioning Contractors' National Association)⁴ illustrate the multiple locations where thru-wall flashing may be needed. As a minimum, flashing is needed over all openings, under sills, and (most importantly) at the bottom of the cavity wall just above ground level. This can be accomplished by one of two methods.

- Open head joints are provided at regular intervals, both horizontally and vertically.
- Alternatively, weep tubes can be provided at similar intervals. Open weep holes provide the best

drainage, but rope wicks can also be used to attract water from the cavity⁵ (Figure 8).

Presumably, the spacing intervals desired would be stated in the construction documents.

When functional flashing is present in brick masonry construction, infiltration water will be diverted from the wall cavity. It is important to note that re-roofing in a manner that causes masonry flashing features to be covered will invite water behind, below, or into new roof flashing (Figure 9).

A related malady may arise when renovating old masonry buildings and retrofitting them with air conditioning systems. The inward direction of moisture vapor drive (now prompted by air conditioning) may produce condensation on surfaces inside the wall that were not cold beforehand.⁶ Absent thru-wall flashing, water accumulation within the cavity may become problematic.



Above: Figure 8—Weep holes may be detailed with rope to attract water from the cavity of this wall.



Left: Figure 9—Re-roofing in a manner that causes masonry flashing features to be covered will invite water behind, below, or into new roof flashing. Photo courtesy of Don Kilpatrick.

Variations of Thru-Wall Flashing Products

Historically, copper was the product of choice to direct water from a cavity (Figure 10). The material is easy to form and work. Joint work (miters, corners, laps, etc.) could be effectively closed with block tin solder.

Polymeric membrane products have been successfully substituted for conventional thru-wall metals (Figure 11). These membranes are usually PVC (polyvinyl chloride), although long-term durability in such application has been questioned. Asphalt-coated copper is also in wide use as a thru-wall component (Figure 12). It is easy to shape and can offer functional diversion of water.

Please note that all standard details from the publications referenced in this article provide for “continuous” flashings. That is,



Figure 10—Historically, copper was the product of choice as flashing. The material is easy to form and joints can be closed with block tin solder.

Below: Figure 11—Polymeric membrane products have been successfully substituted for conventional thru-wall metals (such as copper). Seaming along laps is still necessary for absolute removal of absorbed water.

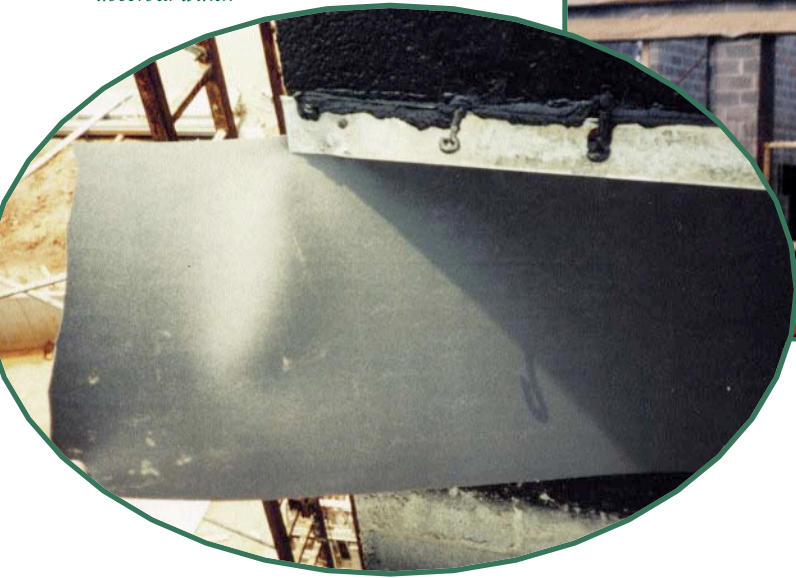


Figure 12—Asphalt-coated copper is now in wide use as the thru-wall flashing. It is easy to shape and can offer functional diversion of water when formed as a continuous component.

joints must be seamed in order to “turn water.” Failure to join the thru-wall materials in a continuous fashion may result in leakage. The difficulty in locating the actual leak culprit will be arduous once the masonry units are installed. It is far better to do it right the first time.

Summary Comments

To be fair, most wall construction assemblies will absorb water, but few are as forgiving as brick masonry. Masonry walls incorporating thru-wall flashing complemented with avenues for de-watering will perform as intended. Failure to provide these features will likely result in problematic construction. ■

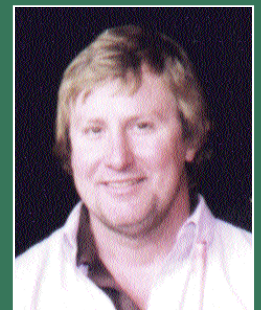
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WATER LEAKAGE IN GLAZED CURTAIN WALL SYSTEMS:

CAUSE, EFFECT, and CURE

BY WILLIAM D. SMITH

Figure 1—Four Corporate Center, Franklin, TN. Architect: Little & Associates, Charlotte, NC. Gen. Contractor: Ray Bell Const. Co., Nashville, TN. Glazing Contractor: Alexander Metals, Nashville, TN. Curtain Wall Framing: United States Aluminum 4250. © United States Aluminum Corp.

Introduction

Water infiltration related to glazed curtain wall systems is an all-too-frequent occurrence. Such leaks can result in significant damage to interior finishes, and if left unresolved for extended periods, can cause structural damage as well. Unfortunately, the assembly methods used to construct many of these systems can make discovering the cause of leakage a difficult challenge. Complicating this challenge is the fact that the appearance of water on the building interior may be far removed from the point of exterior entry, which often leads to incorrect assumptions about the cause of the leak.

This paper will describe the various water control methods incorporated in the design of glazed curtain wall systems, the defects most commonly found, and the recognized testing methods that can detect these problems.

Glazed Curtain Wall System Designs

Monumental glazed curtain wall systems are normally factory-fabricated assemblies that can be shipped to the job-site—either as pre-assembled panels or in knocked-down form for field assembly.

Aluminum is one of the most popular framing material choices because of its versatility, ease of fabrication, and light weight. But other materials, such as stainless steel or bronze, are sometimes used. Glazing choices include a myriad of glass products as well as stone panels such as granite or marble and a variety of composite panels.

Although there are a number of variations, glazed curtain wall systems can be generally grouped into two categories: internally-drained or face-barrier methods.

In spite of the exceptions, conventional, internally-drained curtain wall systems can often be identified by the framing that is visible on the exterior around each glazing panel (*Figure 1*).

Most commonly, these systems are designed so that the glass is retained within the frame using extruded EPDM gaskets. This is often referred to as "dry glazing." The gaskets are inserted between the face of the glass and the frame. Although a pressure fit is achieved, the gaskets are generally not intended to be watertight. Instead, knowing that the glass is not perfectly flat and the gaskets also have variations, it is anticipated that water will enter around the glass as well as at exterior metal joints. Thus, an internally drained system is constructed in a manner



Figure 2—Applied Industrial Technologies, Cleveland, OH. Architect: GSI Architects, Cleveland, OH. Contractor: Turner Const. Co., Cleveland, OH. Glazing Contractor: Architectural Product Sales Co., Brooklyn, OH. Curtain Wall Framing: Vistawall CW-600 and W-250.

that collects this water within the frame, diverts it to strategically located drainage points, then weeps the water back to the building exterior.

Since the framing is made of individual metal components that are mechanically joined together, every joint must be made watertight. To achieve this, sealant must be used during the assembly process.

Unlike the conventional dry glazed systems, face barrier curtain wall systems operate under the theory that the outermost face of the curtain wall system will be watertight, and thus water collection and drainage provisions are not necessary.

Normally, this is made possible by installing silicone sealant at the entire perimeter of each glass or

panel insert. Instead of inserting the glass or panel into the frame, its inside surface is adhered or "glued" to the frame using structural silicone.

Then the joints between the individual panels are also sealed with silicone, ultimately resulting in a fully sealed panel-to-panel water barrier. These systems can often be recognized by the lack of exposed framing on the exterior surfaces. This method of installing the glazing material is sometimes called "structural glazing," referring to the silicone sealant that adheres the glass to the frame.

Some curtain wall systems combine the dry glazed and face barrier systems together to provide additional design flexibility (Figure 2). Variations of these systems omit the exterior exposed metal from either the vertical members or the horizontal members.

Both dry glazing and wet glazing methods have certain advantages. For example, dry glazed systems can sometimes be more versatile than wet glazed systems. But installation and shipping constraints require that dry glazed systems be assembled and glazed in the field, while a wet-glazed system can often be pre-glazed in the factory and shipped to the job in fully-assembled panels. This erection method can dramatically reduce overall installation time.

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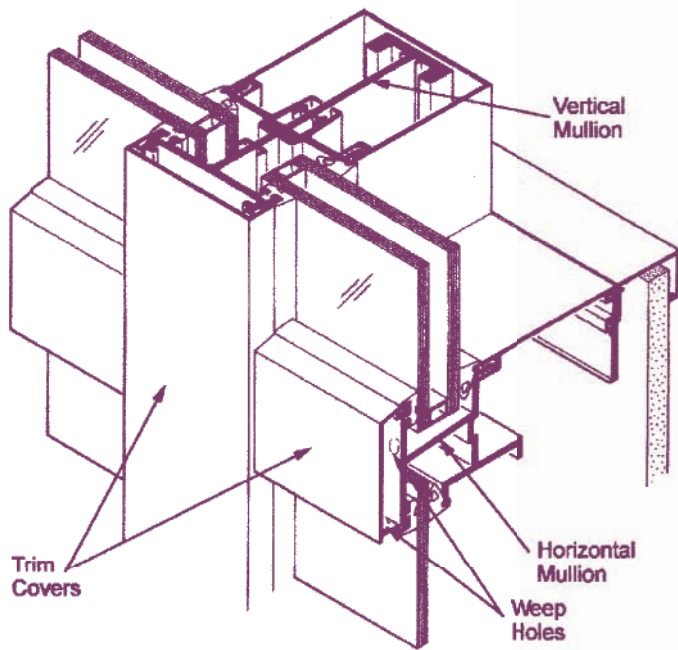


Figure 3—US Aluminum Series 3600 Curtain Wall System. ©U.S. Aluminum

Common Causes of Water Intrusion

As noted earlier, most dry-glazed curtain wall systems are designed to accept water. But proper performance demands that the water remain contained within the system until it is diverted to a drainage point. Thus, if water appears on any interior surfaces, a failure may have occurred within the system. Likewise, the observation of water on the interior surfaces of a wet-glazed curtain wall system also indicates failure, but the cause is usually different from that of the dry-glazed system.

Performance of the dry-glazed curtain wall system relies on sealant at the internal portions of each horizontal-to-vertical frame joint and at each expansion joint of the main frame components. An exploded view of one manufacturer's design is shown in Figure 3. Note specifically how this system is designed to control water. Each vertical mullion runs continuously, with expansion joints intermittently spaced, usually at every other floor. The horizontal mullions are cut to fit between and are attached to the vertical mullions. Sealant is installed at each of these metal-to-metal joints (detail at Figure 4) so that water flowing down the vertical mullion will be diverted into the horizontal. Holes in the outer face of the horizontal mullion allow this water to drain into the horizontal trim covers, and holes in the bottom of the trim cover allow this water to weep out to the building exterior.

Since wind loads and thermal changes cause movement of the curtain wall system, the type of

sealant selected and its application to metal joints are critical to system performance. Sealant selection must consider, among other things, movement capabilities and resistance to elevated temperatures. In addition, the installation of the sealant must take into consideration all aspects of proper application. This requires that the sealant bead be of the proper shape and size, that the surfaces on which it is installed are properly cleaned, that primer is installed if necessary, and that the sealant is properly tooled after application. It's been said that because of its critical role in system performance, the importance of proper sealant selection cannot be over-emphasized, and initial sealant cost should not be a determining factor in product selection.¹

If the sealant located at the horizontal-to-vertical metal joints fails, water flowing down the vertical mullion will escape the joint. When this occurs, the water is no longer controlled by the drainage mechanism of the system. Instead, the water can flow inside the glazing material, whereupon it eventually appears on the building interior.

Like dry-glazed systems, sealant also plays a critical roll in the performance of structural glazed systems. Due to the variations in framing designs, the critical points at which sealant must be applied will differ. However, the basic premise remains. That is, dissimilar materials—metal framing and glass or panels—must be married together in a manner that provides a waterproof skin. Achieving this goal with a structurally-glazed, face-barrier system requires the use of properly-applied sealant, as failure of the sealant will result in water intrusion.

Field Testing for Water Leaks

When they occur, water leaks often become a great source of irritation for building owners and occupants. Left unattended, the leaks can cause serious damage to interior finishes—and worse—to structural building components. Thus, field testing of curtain wall systems is common in forensic investigations. Testing is a diagnostic tool that is used to conclusively discover the source of water infiltration and thus the type of repair that is necessary.

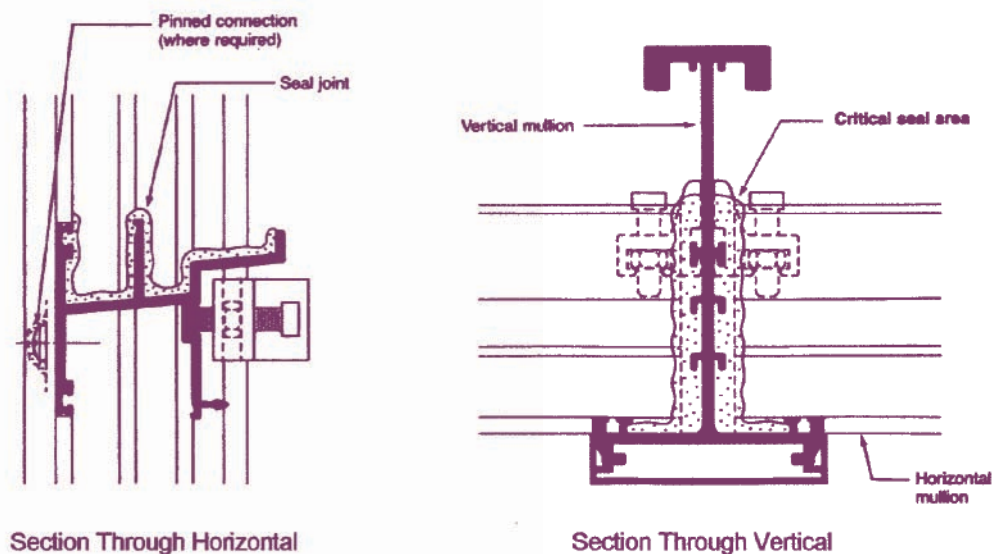


Figure 4—US Aluminum Series 3600 Curtain Wall System. ©U.S. Aluminum

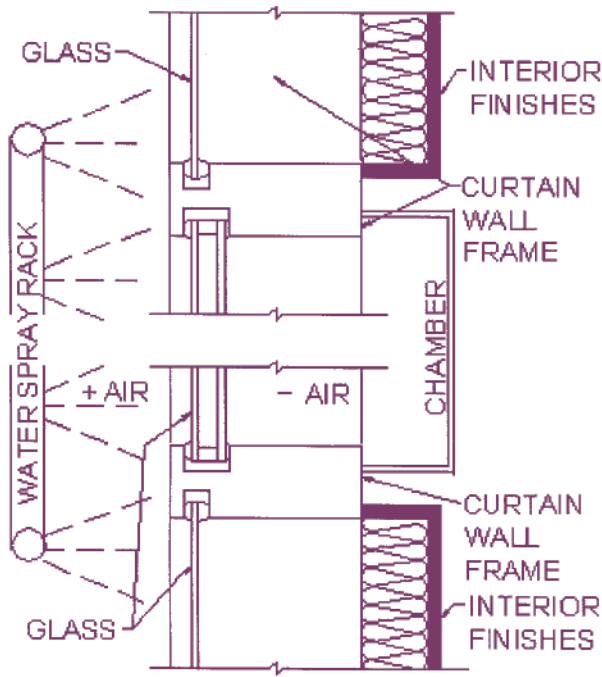
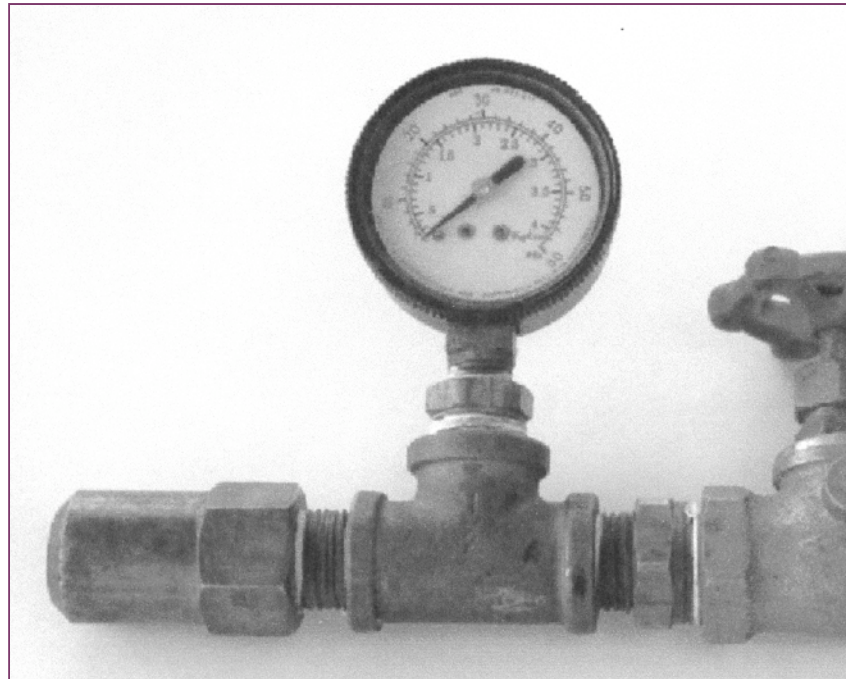


Figure 5, above left.

One method of testing is a procedure published by the American Society for Testing and Materials. ASTM E-1105 is a test method in which water is applied on the exterior surface of the glazing system while simultaneously creating a static air pressure differential between the exterior and interior surfaces.² The test method requires that water be uniformly applied on the exterior wall surface at a minimum rate of five gallons/square foot/hour by use of a calibrated spray rack. A chamber is built, most commonly on the interior side of the specimen, to create an air pressure differential. An example of the test set-up is shown in Figure 5. While the volume of water to be applied is specified by the standard, the amount of static air pressure differential is not stated. Instead, this must be deter-

mined by the testing agency, based upon specifications, the building code, or other reference documents.

Another procedure that is often performed in the field is published by the American Architectural Manufacturers Association. AAMA 501.2 is a method that applies water to the exterior in a sequential manner.³ This procedure, also commonly known as "hose testing," is often used during the construction process to check the integrity of joints that are intended to be watertight. In it, water is applied onto the exterior at a pressure of 30 to 35 psi using a special nozzle (Figure 6). Since this procedure does not use a static air pressure differential, it may not be effective in certain conditions.



If water intrusion occurs in a curtain wall system and an analysis is necessary, it is important that the proper testing procedures be selected and administered.

A study of the two test methods referenced above found that in some situations, AAMA 501.2 "hose testing" can provide "findings that are not consistent with the results of testing in accordance with ASTM E-1105 procedures."⁴ Consequently, the results of hose testing require careful interpretation.

Repairing Water Leaks in Glazed Curtain Wall

After the source of the leak is identified, an evaluation of the available repair methods can be made. As previously noted, performance of the curtain wall system is highly dependent on sealant. Thus, repairs most commonly will involve the repair or replacement of these sealants.

Since the weather resistance barrier of face barrier systems relies on sealant at the exterior face of the wall, the sealant in this location is readily accessible, and repairs can be per-

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formed with no major difficulty. Conversely, the weather resistance of internally drained systems relies on sealant installed within the framing. Thus, a repair to the sealant in these areas is much more difficult to access.

Summary

As can be seen, there are a number of variations in glazed curtain wall construction methods, the extent of which is so vast that one article could not possibly describe them all. However, nearly all can be grouped into one of two basic categories (or a combination of the two categories) when discussing resistance to water infiltration. These are the internally-drained and the face barrier systems. Although the concepts handle water in a different way, both heavily rely on sealant installation at critical areas to make them watertight.

For internally-drained curtain wall systems, the integrity of sealant at expansion joints of the framing and at the internal portions of horizontal-to-vertical frame member joints is most critical for system performance.

For face barrier systems, the weather-resistant sealant is normally located at the exterior face of the system, such as at the perimeter of each glazing panel. Failure of sealant at any of these locations will allow water to enter the building interior.

Proven methods for verifying causes of water infiltration are available. One of these, ASTM E-1105,

is intended to replicate in-service conditions by applying water to the exterior while simultaneously creating a static air pressure differential between the building exterior and interior. Another method, AAMA 501.2, which is also referred to as "hose testing," applies water to the exterior without the use of air pressure, but as a result, may not provide conclusive results in all conditions.

Discovering the source of water infiltration will aid in establishing the method of repair. Sometimes the repair can be as simple as patching an isolated sealant failure or as extensive as replacing all the sealant. ■

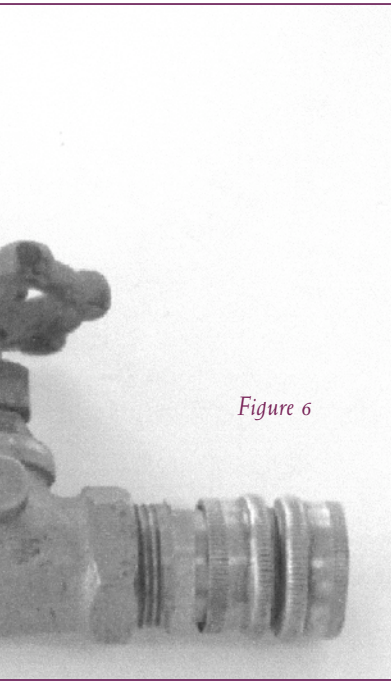


Figure 6

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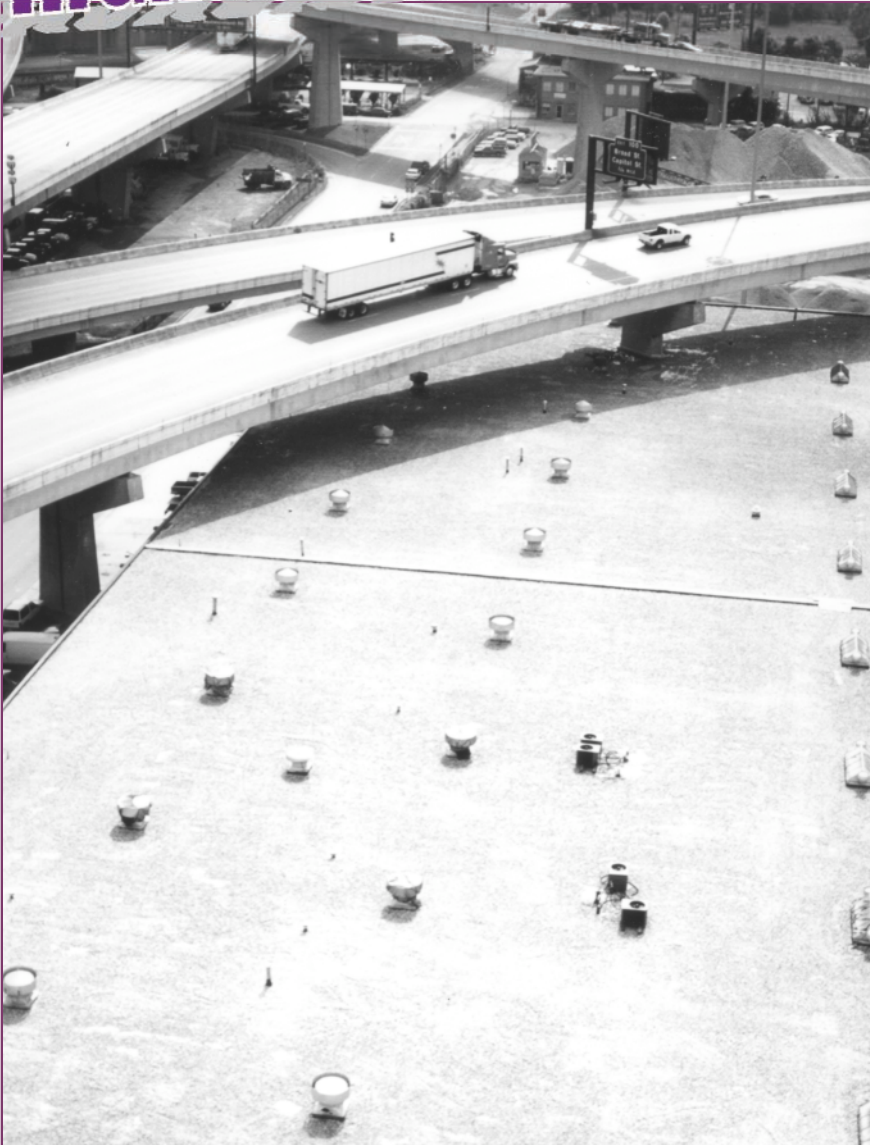
ABOUT THE AUTHOR

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TALK ABOUT A HIGH-TRAFFIC ROOFTOP!



Highways and interstates are constantly being developed to provide motorists with a speedy or convenient route to reach their destinations. With a population of more than 390,000, Charleston, WV, faces the same traffic dilemmas as other major cities in America. To relieve some of the city's congestion, Interstate 64 was constructed, benefiting travelers but presenting a unique situation for a local company.

Merchants Warehouse, an 180,000-square-foot building erected in 1946, was located in the center of the planned highway's path. After the development of a complex design, Interstate 64 was built over the top of the enormous, one-story brick building. The pylons that support the interstate were placed directly through the center of the warehouse, allowing vehicles to travel just feet above the building's roof.

General Corporation, owner of Merchants Warehouse, decided to initiate an 80,000 square-foot reroofing project that encompassed the area directly below the Interstate. Carlisle SynTec's Sure-Tough™ 75-mil reinforced membrane was chosen because of its durable, dual-ply construction. Boggs Roofing Inc. installed the roof during constant traffic on the Interstate.

First, the gravel-surfaced, built-up roof was removed, then one inch of Carlisle's polyisocyanurate insulation was loose-laid over the two-inch gypsum roof deck. Sure-Tough™ was then loose-laid over the polyiso board, the perimeter was secured with a securement strip, and a layer of river-washed stone ballast was then applied.

— Carlisle SynTec Inc.

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PHENOLIC FOAM CLASS ACTION SETTLEMENTS

A Comparison of Beazer's and JM's Offers and the Potential Impact on the Roofing Community

BY RICHARD P. CANON, RRC, FRCI, PE

Figure 1: Various levels of phenolic corrosion. Area previously remediated in upper left.

On June 30, 2000, the U.S. District Court for the District of Massachusetts approved a class action settlement against the two domestic manufacturers of phenolic foam roof insulation (PFRI): Beazer East, Inc. (formerly known as Koppers Company), and Johns Manville Corporation (also known as Johns Manville International, Manville Corporation, and Schuller International, Inc.). The suit stems from allegations "that, when exposed to moisture or humidity, PFRI releases acid which is corrosive to metal roof decks."¹ According to documents produced by the class action, "JM sold approximately 134 million square feet of PFRI in the U.S. from 1989 through 1992. (In contrast, Beazer sold approximately 350 million square feet of PFRI from 1981 through 1989)."²

A copy of the Official Court Notice, a press release, the proposed settlements from Beazer and Johns Manville (JM), and other attachments regarding the case can be found and retrieved at <http://www.pfriclaims.com>.

Anyone remotely associated with PFRI should read these documents in their entirety. There may be implications in the suit and settlement that affect consultants, architects, engineers, roof contractors, general contractors, deck manufacturers, distributors, membrane manufacturers, fastener manufacturers, and others.

In this article, I have decided to write in the first person. This article reflects my opinion, not that of RCI or the *Interface* staff. I am writing this as a consultant. Moreover, I cannot stress enough

that before you take any action, you should consult with your attorney to determine which is the best course of action. I am not an attorney, and as a result, my comments are limited to a technical analysis which may be materially different from a legal analysis.

Also, I am not an owner of a property with PFRI. But I have experience with 40 or so PFRI projects. I am gravely concerned for parties that may have been involved with PFRI. What you will read is my interpretation of the documents that are available about these cases. The purpose of my writing this is to provide information about what I perceive to be a very serious problem, one we have known about for years. Now, however, the class action suit may possibly affect how we deal with the problem and presents some disturbing legal ramifications. Time is also a factor, as explained below.

Corrosion Associated with PFRI

In 1992, I wrote an article published in *Professional Roofing* entitled "Metal Deck Corrosion: Three Case Studies."³ There, I gave some background on the phenomenon of corrosion of the deck from acidic leachate from the PFRI.

Since the writing of that piece, nothing I have seen has changed my opinion: phenolic foam insulation and water in any form will result in corrosion of the deck (*Figure 1*). Further, the pattern and extent of corrosion mandate complete removal of the roof system to remediate the deck. Contrary to the opinions of others, I do not believe that spot remediation procedures and

	Element of Settlement	Beazer East	Johns Manville	Comments/Remarks
1	Date of Manufacture	1980- Jan. 17, 1989	Jan. 18, 1989 - March 31, 1992	
2	Names of Product	Koppers Exceltherm Xtra, Koppers Rx, Censtar, Pittsburgh-Corning, Loadmaster™	UltraCard Premier™ InsulBase Premier™ Fesco-Foam Board™	
3	Product ID Code	OCP+##+6-digit date code (e.g., OCP3040888)	OCP+##+6-digit date code (e.g., OCP1050689)	Last 6 digits are usually the date of manufacture and help ID who made the product.
4	Range of product thickness and size	1" to 3.1"; 3'x4' and 4'x8'	1" to 3.1"; 2'x4' and 4'x8'	Per notice
5	Date of court approval of class action	June 30, 2000	June 30, 2000	
6	Cut-off date for ownership of property with PFRI to be able to file a claim	June 30, 2000	June 30, 2000	
7	Deadline for Class Members to file a written statement opposing or supporting the claim.	Nov. 10, 2000	Nov. 10, 2000	
8	Request for Exclusion (opt-out date)	Nov. 22, 2000	Nov. 22, 2000	
9	Fairness hearing date	Dec. 13, 2000	Dec. 13, 2000	
10	"Settlement date"	To be determined by court.	To be determined by court.	The date the court finally approves the settlement. This will be some time after the fairness hearing.
11	Deadline for submitting a claim	Dec. 14, 2002	Dec. 14, 2001	Per the notice. May be a typo.
12	Deadline for completion of remediation	Jan. 18, 2001	No deadline	
13	What if owner does not opt out?	Become part of class by default.	Become part of class by default.	
14	What if owner has PFRI but does not know it?	Become part of class by default, but no benefits after 12/14/02 deadline.	Become part of class by default, but no benefits after 12/14/01 deadline.	Per the notice. May be a typo.
15	Who can file a protest to the court?	Class members only.	Class members only.	All others apparently excluded.
16	Can a consultant, engineer, architect, distributor, roof contractor, general contractor, membrane manufacturer, or other address the court or file a protest?	Apparently no, unless also an owner and has not opted out.	Apparently no, unless also an owner and has not opted out.	In other words, no.
17	What protection does the settlement offer for designers who specified PFRI?	Not clear.	Not clear.	
18	What protection does the settlement offer for roof contractors who installed PFRI?	Not clear.	Not clear.	
19	What protection does the settlement offer for companies that distributed PFRI?	Not clear.	Not clear.	
20	What protection does the settlement offer for membrane manufacturers whose product was installed over PFRI?	Not clear.	Not clear.	
21	Does the manufacturer have good records of where its PFRI was installed?	No. Apparently records were lost in the transfer of production from Beazer to JM in 1989.	Some, but not all. About 20% of buildings with JM PFRI haven't been identified, estimated at 600 buildings and 19 million sf.	
22	Is settlement value based on roof replacement cost?	Yes	No	
23	What is the basis of the replacement cost?	Receipt of 3 bids, one from Beazer pre-approved roof contractor.	Unit Prices: 1. BLIR = \$0.45 psf (\$45/square) 2. Single-ply & shingles = \$1.00/psf (\$100/sq.)	
24	Is the roof replacement cost prorated? How?	Yes, based on Beazer's stipulated useful life tables (12-22 years).	Not applicable. Lump sum offer. See line 23, above.	
25	Is the deck remediation cost prorated?	1. No proration until Jan. 18, 2011. 2. After that date, Beazer pays: A. BLIR = 45 cents psf (\$45/sq.). B. Single-ply & shingles, \$1.00 psf (\$100/sq.) 3. Loadmaster™ = 30 yrs. For entire deck system (if code-compliant system).	Not applicable. Lump sum offer. See line 23, above.	
26	Is there allocation for the added cost of interior protection?	1. Yes, if no ceiling (25 cents/sf) 2. Yes, where deck is removed directly over a ceiling (25 cents/sf) 3. No, elsewhere and in vacant spaces.	No See line 23, above.	
27	Is there allocation for design services (preparation of specs, details, drawings, construction administration)?	Yes, non-prorated. Architect or qualified roof consultant. Up to \$2,500 for up to 25,000 sf. Up to \$5,000 in excess of 25,00 sf.	No See line 23, above.	
28	Payment schedule	First installment (?\$) upon execution of settlement. Final installment upon completion of deck remediation	Not stated	
29	Systems not covered in settlement	Non-metal roof decks (concrete, wood, gypsum, tectum), metal roof systems, JM PFRI, decks previously remediated by Beazer	Non-metal roof decks (concrete, wood, gypsum, tectum), metal roof systems, Beazer PFRI, decks previously remediated by JM	
30	Web site for settlement information	Http://www.pfriclaims.com	Http://www.pfriclaims.com	Links to Beazer and JM

Table 1: Comparison of Beazer East and Johns Manville settlements.

Terms Related to Phenolic Settlements

Class Action Lawsuit—This is a lawsuit filed on behalf of a group of persons (a “class”) with a common complaint. The attorneys representing the class file a suit outlining the charges against the defendant or defendants (in this case, Beazer and JM). The class attorneys seek to settle on behalf of the class if they feel the offer is favorable to their clients. A judge rules whether the settlement is fair at a Fairness Hearing.

Cut-off date for ownership—The date on or ownership of a building with PFRI.

Request for Exclusion—A formal procedure telling the court that you do not want to file a claim or do not want to settle through the class action lawsuit. The deadline to do this in this case is Nov. 22, 2000.

Opt Out—To voluntarily exclude one’s self from the class

Fairness Hearing—This is a hearing for those persons of the class and the defendants to state why they believe the settlement is “fair” or to present their dissatisfaction or request for changes. The Fairness Hearing for this case is Dec. 13, 2000. It is unclear in this class action if the court would hear from anyone other than class members. That would mean only those who have filed a claim on or before the cut-off date.

Settlement Date—The date by which claims must be filed. This is December 14, 2002 for Beazer and Dec. 14, 2001 for JM.

Deck Remediation—The techniques of addressing corrosion of the decking. Methods or protocols include:

- Coating with epoxy.
- Coating with epoxy and overlaying the deck.
- Removal and replacement of the deck.

Interior Protection—This refers to techniques and procedures utilized to contain or collect dust and debris that falls during the demolition and removal process. Deck removal will typically result in corrosion flakes and pieces falling into the interior. Building occupancy dictates the level of interior protection required. Although drop ceilings tend to catch the dust and debris, they also retain such. Therefore, unless the ceiling is removed and replaced or cleaned from the top-side, there may be debris that could cause person injury (eyes) later.

Design Reimbursement Compensation—This is the fee the settlement will pay for the preparation of bid documents: roof plan, details, specifications. Presumably, if the owner wants services for receiving the bids, attending a pre-bid conference, or for construction administration and inspection services, this would be included in this amount. See Table 1 for reimbursement amounts.

Replacement Cost—The cost of removal of the roof system to the top of the deck and replacement with a roof system “of like kind” except replacing the PFRI with another insulation such as polyisocyanurate.

Statute of Limitations—This is a law that assigns a certain period of time after discovery of a problem, beyond which rights cannot be enforced by legal action or offenses cannot be punished.

Statute of Repose—This is a law establishing the period of time after completion of a project beyond which legal action or offenses cannot be punished, whether one discovers a problem or not.

Figure 2: Terms related to phenolic settlements.

annual inspection programs are sufficient to safely address the problem. Failure to act could possibly pose life safety and definitely property damage issues.

There is also a significant amount of information in the documents produced by the class action—specifically, sections entitled:

- “Stipulations of Settlement Among Plaintiffs, Intervenor, and Defendants...”
- “Plaintiff’s Memorandum...”
- “Class Action Complaint of Intervenor and Demand for Jury Trial.”

I found these make for some very interesting reading and for an education on the legal system.

Class Action Matrix Chart

My understanding of the various elements of the settlements is summarized in Table 1. This presents some of the product information and settlement data. Terms that may need a little explanation are shown in Figure 2.

The two settlements have one major similarity: both address settling cases involving PFRI. Other than that they are quite different.

Manville’s Settlement Offer

The Manville offer is a flat unit price payment. The owner is given 45¢ per square foot (psf) for built-up and modified roof systems. For single-ply roofs and shingle roofs, the payment is \$1.00 psf. No further remuneration is offered.

JM documentation asserts the expectations of deck remediation summarized in Table 2. It states in the Notice⁴ that these values are from data gathered from their consultants’ test cuts on approximately 1,800 buildings. I have had the opportunity to document the complete tear-off on numerous PFRI projects. From these projects I do not draw the same predictions of remediation requirements that JM’s consultants have, as indicated on Table 2. I have also observed the performance of the acrylic remediation coating JM has used. I do not feel the acrylic coating is adequate to protect the corroded metal and to arrest the corrosion. Beazer agrees with the use of an epoxy coating, which I believe is superior and necessary.

So, the owner has the option to: do nothing, address the problem now, or address the problem in the future. If the owner elects to take the money and use it for other purposes, that is acceptable by the settlement. If this occurs and the property is later sold, the seller is supposed to inform the buyer that PFRI is present. There is no mechanism to assure that this will be done.

The JM settlement apparently assumes the roof can continue serving until its useful life is fulfilled. At that time the owner can (if he wants) remediate the deck. My experience suggests this could be very dangerous. *There is absolutely no indication or evidence I have seen that the corrosion subsides or ceases until the PFRI is removed and the deck is remediated.* The longer one waits to remediate, the worse the corrosion. At some unknown time and at some unknown location on the roof, the deck can lose its structural integrity and thus create a “trap door” waiting for a visitor. I believe this wait-to-remediate approach is not an acceptable option.

Regarding the payment offered, I believe the JM allocation

for a built-up roof is insufficient to cover the cost of demolition, or even apply the epoxy coating. To put this into perspective, we have seen demolition costs range from \$0.77 to \$1.87 psf. Epoxy coating preparation and application (material and labor) cost ranges from \$0.75 to \$1.00 psf. This leaves a significant deficit for an owner to pay whenever a decision is reached to remove and remediate.

One more concern is that the model building codes, including the International Building Code, permit recovering a roof. *There is no prohibition in the Codes against recovering phenolic foam insulation.*

There is no provision for reimbursement for design costs, interior protection costs, for the loss of useful life of the roof (if one does remediate now), or to account for the project location.

As an example, in the JM settlement scheme, a 100,000 sf built-up roof assembly over a surgical wing on a hospital on Long Island, NY that is eight years old, for instance, would get \$0.45 psf or \$45,000.

Beazer Settlement Offer

Beazer's approach is basically unchanged from those in its previous negotiations. They, first of all, are encouraging and giving incentives to remediate now. Under Beazer's settlement offer, the owner is to get a minimum of three competitive bids. One of the bidders must be a pre-approved roofing contractor experienced with this type of project. "The Settlement Compensation will be based on the Lowest Acceptable Bid for the removal and replacement of the existing roof with a Like Kind Roofing System, including remediation of the Metal Roof Deck."⁵

Beazer allocates payment for interior protection if there is no ceiling and for areas with ceilings where the deck is removed and replaced. There is no compensation for interior clean-up of other areas that do have ceilings or for vacant buildings, except at the specific location of deck removal and replacement. It is unclear what would be allocated for a special condition such as a roof over an operating room in a hospital.

About design fees. "The Settlement pays for reimbursement of actual costs incurred to have a professional roof plan design and/or bid package prepared by an architect or qualified roof consultant, not to exceed \$2,500 for eligible properties up to and including 250 squares of metal roof deck beneath Beazer PFRI and not to exceed \$5,000 for eligible properties in excess of 250 squares of metal roof deck beneath Beazer PFRI, which amount is neither pro-rated nor from which are any Class counsel fees deducted."⁶

As anyone knows who has prepared documents for phenolic re-roofing projects, the demands are greater than the average roofing project. Additionally, the liabilities are greater than on large, non-phenolic roofing projects. Design fees are typically in the 3% to 6% range, higher on smaller projects. Perhaps there are those who prepare documents for the settlement rates. But what kind of document can be produced for the settlement fees? I question the completeness of such a document.

Remediation Method Procedure	Johns Manville*		Canon Observations**	
	Single Ply	BUR	Single Ply	BUR
No remediation required	49%	57%	5%	10%
Brushing and painting	42%	37%	NA	NA
Power descaling and painting	6%	5%	90%***	85%***
Overlayment with new deck	2%	<1%	5%	5%
Deck replacement	1%	0.3%	5%	5%

* From JM Notice, paragraph 9. Based on test cuts and cores by JM's consultants.

** Based on observations and documentation of completed tear-off projects.

*** Includes epoxy coating deck that is to be overlaid.

Table 2: Deck Remediation Methods

And what about construction services? On most of my company's projects, we have not had a full-time inspector because the roof contractors are experienced and competent. On those where we did, it was primarily because the owner had full-time inspection on the original roof and expected to have the same on this project. We usually provide periodic observation services, visiting the project about once every week to two weeks depending on the quality and progress. If things get out of control, we'll camp out until we are satisfied the work is proceeding correctly.

We generally invoice for time and expenses, rather than for a fixed fee. Occasional observation services cost an average of about 4% to 6% of the construction cost, plus travel time and expenses. This varies from project to project, again based on size and complexity. How is this cost to be reimbursed?

On our projects, we establish four levels of the deck's condition and the corresponding remediation. Each is described below with a typical range of costs we have seen on our projects.

- Level 1—The deck is pristine or like new. The deck is merely cleaned of phenolic dust. No added cost.
- Level 2—There is light to moderate corrosion. The deck is prepared and painted with 2-part epoxy. Cost: \$0.75 to \$1.00 psf.
- Level 3—The deck is moderately to severely corroded, but there is no full penetration corrosion. The deck is prepared and coated with 2-part epoxy and then overlaid with new deck, properly attached. Cost: \$3.65 to \$3.85 psf.
- Level 4—The deck is so severely corroded that there are holes through the deck. The decking is removed and replaced. Cost: \$4.60 to \$5.60 psf.

As stated in the Notice, Beazer will pay 100% of the deck remediation cost, without a proration, provided the unit prices are reasonable. That is as it should be and is commendable.

In the Beazer settlement, there is an exhibit establishing the useful life of various roof systems. See Table 3. It is interesting to note that warranties that exceed the maximum useful life listed are available for all of the roof systems listed. Most roofs continue to serve for some period after the warranty expiration. There seems to be no consideration of this. This is an important factor when establishing the depreciation or proration constant used in the settlement.

Single ply products other than EPDM are not addressed in

Roof Type	Standard Useful Life Months (years)	Maximum Useful Life Months (years)	Minimum
Shingled roof	216 (18)	240 (20)	192 (16)
Ballasted EPDM	168 (14)	192 (16)	144 (12)
Mechanically-attached EPDM	168 (14)	204 (17)	144 (12)
Fully adhered EPDM	180 (15)	216 (18)	144 (12)
3-Ply BUR	180 (15)	216 (18)	156 (13)
4-Ply BUR	216 (18)	240 (20)	192 (16)
5-Ply BUR	240 (20)	264 (22)	216 (18)

Table 3: Beazer's Exhibit "A" — Useful Life for Various Roof Systems

Table 3. The material cost of EPDM is generally less than all other single ply membranes. Also, there is no differentiation between BUR types (asphalt, modified, and coal tar bitumen or pitch) or surfacing (smooth, emulsion, gravel, pavers, etc.). Obviously, these items and perhaps others will have to be clarified.

Tit for Tat?

I had to look up the term "tit for tat" before I used it. Webster says it means an equivalent given in return (as for injury). Do the settlement offers give an equivalent in return? The two certainly do not seem to be the same. With a little tweaking, the Beazer offer appears to be reasonably fair. The settlements offer an explanation for the disparity. One point is the difference in the dates of manufacture of the products. (Beazer's product is older than JM's). That is apparent and correct.

Another stated explanation in the difference between the two settlements is that, "The Johns Manville Settlement is designed to enable an Eligible Claimant to retain the remaining useful life of its newer roof systems, while providing a cash payment *that should be more than enough to remediate any portion of the metal deck that will require remediation at or before the end of the roof system's useful life.* [Emphasis added.] In contrast, the Beazer Settlement is designed to facilitate removal and replacement of the older Beazer PFRI roof systems and, at Beazer's expense, remediation of the deck."⁷

Further, JM says it has identified most of the roofs it thinks have its PFRI in them, whereas the settlement says, "Beazer has identified a lower percentage of roofs with Beazer PFRI..."⁸

It continues, "Johns Manville believes that it has already overlaid or replaced virtually all portions of the Settlement Class Members' metal roof decks that it has inspected and *which it determined required overlayment or replacement.*"⁹ (Emphasis added).

I do not see the logic by which an owner with a newer roof should get less than an owner with an older roof. That is unless it has been concluded that all corrosion has already been remediated and there would be no more corrosion of the metal. That has not been established.

If, then, the owner of a new roof elects to remediate now (as they should), there is only 45¢ per square foot to do it.

Classless Folks?

"Classless" people are not people without class, just people who are not part of the class. Who are the classless? Well, one group is those who do not even know that they have PFRI on

their building. If they have not filed a claim, they are (ironically) part of the class but unidentified. If they have not filed a claim by Dec. 14, 2001, for JM and 2002 for Beazer, they are apparently out of luck. If they find out they have PFRI after the deadline for opting out, they are (by default) a part of the class. Therefore, they are bound by the settlement with no legal rights to withdraw from the class and have limited or no legal rights to bring suit. If they do not like the terms, that's just too bad.

What about we other classless folks? Do we have any opportunity to address the court? I do not see an open door to anyone except class members, which we are not. Do we have reason to be concerned about this? I think so.

As an example, let's say an owner settles with JM on a six-year-old, 70,000 sf BUR roof and receives his compensation (\$0.45 x 70,000 sf = \$31,500). The owner is content because he has a good roof, no leaks, and no problems. About three years later (or three months for that matter), the owner finds out he does, in fact, have a problem. He gets his favorite roof consultant to come in. Ol' Harve, as his clients and friends call him, did the original specification package. He now prepares a new bid package and receives the bids.

Oh-oh! This thing is going to cost more than that modest compensation—in fact, a lot more. Say about \$4.50 psf for the roof plus an average deck remediation cost of about \$2.75 psf! \$7.25 psf is a long way from 45¢ psf. Where is the owner going to get the extra money to pay for all of this? He is not happy and says somebody is going to pay for this. Ol' Harve is in deep trouble. You see, the owner is no longer calling him Ol' Harve. Now he's calling him *Defendant*.

A similar example could be built around the installing roof contractor, membrane manufacturer, and other classless persons and companies. Mr. Owner could sue on the basis they all should have known about this. Why didn't somebody tell him of the risk with PFRI?

One defense for all classless people may be the statute of limitations and/or the statute of repose. My understanding is that a *statute of limitations* is a law that assigns a certain period of time after a legal right arises, beyond which that right cannot be enforced by legal action. A statute of repose is a law establishing a maximum period of time beyond which time a suit cannot be filed, even if the problem has not yet manifested itself or even occurred.

For example, let's assume a case in a state where the statute of limitations is three years, beginning from the date of discovery of a problem. But the statute of repose is 13 years from project completion. In this situation, if you first discover a problem 12 years after the project is complete, you may have only one year (not three years) left to file a suit. And, if you discover the problem 13 years and one day after project completion, you probably have no right to file a suit whatsoever. The above may be an oversimplification and vary from jurisdiction to jurisdiction. You should seek local legal counsel for the statutes in your states of

operations and activities.

For most classless entities, the *statutes may be a redeeming defense*. But a defense costs money. Even if these turn out to be frivolous lawsuits, who pays for your defense? Does your state reimburse you for attorney fees in such cases? Even with insurance, you may have to pay a deductible. Without insurance, legal expenses for such a defense are out of pocket. I see no clear protection in either settlement that protects, defends, or holds harmless persons from being sued because they specified or installed phenolic foam roof insulation.

Membrane manufacturers may have another potential risk. *Their warranties probably constitute a contract* between the owner and themselves. The warranty coverage term may (and probably does) establish a new time line beyond the original construction statutes.

So, a manufacturer with a 20-year warranty on a project such as Ol' Harve's may be a viable target for a disgruntled owner seeking restitution. The owner could assert that the designer and manufacturer accepted the installation of PFRI under the membrane product and they, more than the owner, should have known better.

Options to Owners

Owners who know they have PFRI have several options:

- Join the class and accept the final settlement approved by the court.
- Join the class and submit by Nov. 10, 2000, a written statement opposing all or part of the settlement offer. Since owners are part of the class, however, the final settlement approved by the court is apparently binding and you cannot exclude yourself or opt out later.
- Exclude yourself or opt out of the class and attempt negotiations directly with the manufacturers (which they probably will not do in most cases) or pursue legal action.

The decision for selecting the best option is not an easy one. There is no easy answer because there are so many parameters involved with each project. These make a single answer of what to do impossible. Owners should seek qualified attorneys experienced with PFRI cases to help them make a good choice.

The important thing now is to:

- Find out if you have phenolic foam on your buildings.
- Act quickly to meet the deadlines the court has preliminarily approved.

Options to Those with PFRI But Do Not Know It

This oddly addresses those who have PFRI but don't know it. What about them? Since they do not know they have PFRI, they do not know to file a claim or to opt out. Thus, they become a part of the class by default. Therefore, they give up legal recourse against the PFRI manufacturer. Consequently, they probably will bear all of the cost of roof removal and replacement and all of the cost of remediation of the deck if they have not filed by December 14, 2002, for Beazer and 2001 for JM.

What is Our Responsibility?

First and foremost, we must *notify all owners* we know who have the product on their building, whether we designed the project or not. For example, you may have discovered PFRI during an investigation four years ago. You should notify the owner if you know PFRI is on the building. Search your files for PFRI. Next, be pro-active in disseminating information about the class action settlement.

Some Closing Thoughts

There are some valuable lessons to be learned from this:

- Beware of new and improved products. Research products for yourself. If it looks too good to be true (as the old adage goes), it probably is.
- Read all that you can about product performance.
- Network with other consultants, contractors, and manufacturers.

Follow-up on your work. Be pro-active in addressing problems when you hear, read, or observe them. Remember, like an ostrich, when you have your head stuck in the sand, your butt is fully exposed! ■

Footnotes

1. Notice of the class action settlement to owners of buildings with JM PFRI, paragraph 2 (similar statement is in the Beazer Notice, paragraph 2).
2. "Plaintiff's Memorandum in Support of Motion for the Conditional Certification of the Class for Settlement Purposes and for Preliminary Approval of Partial Settlement with the Defendants Johns Manville Corporation and Johns Manville International," footnote 24, page 31.
3. *Professional Roofing*, August 1992, pps. 28-33. An unabridged copy of the article is available from the author.
4. JM Notice, paragraph 9a and 9b.
5. Beazer Notice, paragraph 7.
6. Beazer Notice, paragraph 8 (ii).
7. Beazer Notice, paragraph 30, sub-paragraph 2.
8. Beazer Notice, paragraph 30, sub-paragraph 3.
9. Beazer Notice, paragraph 30, sub-paragraph 4.

ABOUT THE AUTHOR

Richard P. Canon, RRC, FRCI, PE, is the President of Canon Consulting & Engineering Co., Inc. in Spartanburg, South Carolina. He has been involved with over 40 projects with phenolic foam roof insulation on metal decks. Dick is a Charter Member of RCI and was President of the Institute from 1985 to 1986. He can be contacted at canon@innova.net.



**RICHARD P. CANON,
RRC, FRCI, PE**

Page 38
Full Page Ad
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Industry News

PEOPLE

U.S. TILE PROMOTES BEETLER

The U.S. Tile Company announced the appointment of Scott Beetler as General Manager for Sales and Marketing, responsible for all roof tile sales, marketing, shipping, and customer service activities. Prior to his appointment, Beetler served for six years as New Construction Sales Manager for U.S. Tile. The company is located in Corona, CA.



Scott Beetler

IRT WELCOMES EDWIN WILLIAMS

Independent Roof Testing and Consulting of South Florida has hired Edwin Williams Jr., RRC, to its staff of roofing professionals. Williams, most recently owner of Ed Williams Roof Consultant, brings over 35 years of roofing experience to IRT, and is a member of RCI.

NRDCA NAMES DUDLEY EXEC. DIRECTOR

The National Roof Deck Contractors Association has retained Hubert T. Dudley of Constructive Consulting, Inc. to be its Executive Director. Dudley has 37 years of product experience in construction, the last 23 with Siplast, Zonolite Roof Insulation Systems, and W.R. Grace. He has been a representative to the NRDCA for over 20 years and has served on its board of directors.



Robert Delaney

FIRESTONE NAMES DELANEY VP OF SALES

Firestone Building Products Co. has appointed Robert Delaney as vice president of sales. He will be responsible for domestic and overseas sales of Firestone Roofing Systems. Delaney joined Firestone in 1994, after ten years in a variety of sales and management positions in commercial and residential roofing.

PRODUCTS

HITACHI INTRODUCES CORDLESS PLANER

The P20DA 3-1/4" Cordless Planer by Hitachi Power Tools utilizes a high-capacity 12V, 2.0 ah battery and a two-blade cutting head. It weighs 6.4 pounds. For further information, phone 1-800-546-1666.

MEANS INTRODUCES CUSTOMCOST ESTIMATOR

R.S. Means has introduced the CustomCost Estimator, part of its CostWorks building models online. Estimators can now prepare conceptual cost estimates that are localized to their area by logging on to the R.S. Means website (www.rsmeans.com) and accessing the estimating tool. For information, call 1-800-334-3509.

PURCHASES/ PARTNERSHIPS

CARLISLE AND PECORA ENTER JOINT MARKETING AGREEMENT

Carlisle Coatings & Waterproofing Inc. and Pecora Corp. announce a joint marketing agreement for the promotion and sales of Carlisle Deck Coating Systems.

Infrared Inspections
B&W
Pick-up from 10/00, page 16
Remove this border.

CORRECTION

There was a typographical error in a table in the article, "Energy Efficient Roof Design" by Patrick L. Downey in the September issue of *Interface*. In Table 4 on page 9, the "energy cost" for a white roof should be \$82,952, not \$182,952. We regret any confusion this may have caused our readers.

Industry Calendar

November 2000

- 2-4 North American Building Material Distr. Assoc.
Dallas, TX
Info: (888) 747-7862
- 9-10 Cool Roof Rating Council
Bay Area, CA (TBD)

December 2000

- 3-6 ASTM D-08 (roofing, waterproofing & bit. mat.)
Orlando, FL
Info: (610) 832-9720
- 5-6 ASTM C-17 (fiber-cement tile)
Orlando, FL
Info: (610) 832-9714
- 5-8 ASTM C-15 (masonry tile)
Orlando, FL
Info: (610) 832-9736

January 2001

- 13-17 RCMA Annual Conference & Expo
Rose Hall, Jamaica
Info: (410) 546-3888
- 15-17 Restoration & Renovation
Washington, DC
Info: www.egiexhib.com

- 21-24 Structural Engineering Winter Institute
Phoenix, AZ
Info: www.NCSEA; (312) 372-8035

February 2001

- 14-17 NRCA Convention
San Francisco, CA
Info: (847) 299-9070

March 2001

- 20-22 NERCA Convention
Boston, MA
Info: (617) 472-5590

April 2001

- 1-4 ASTM E-06 (metal roofing)
Phoenix, AZ
Info: (610) 832-9726
- 1-4 ASTM C-16 (insulation)
Phoenix, AZ
Info: (610) 832-9736
- 19-24 RCI Convention & Trade Show
Baltimore, MD
Info: (919) 859-0742

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