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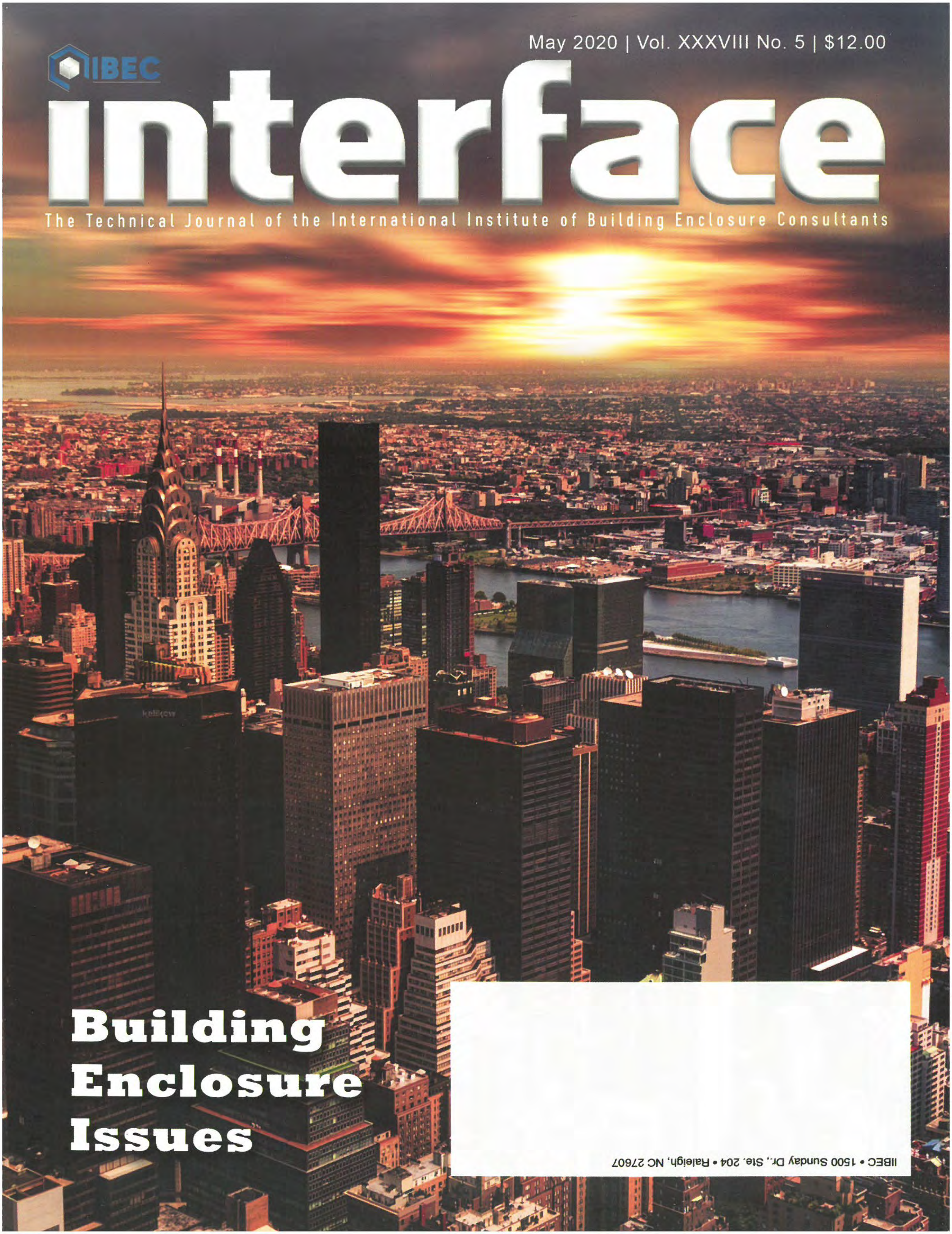
The Technical Journal of the International Institute of Building Enclosure Consultants



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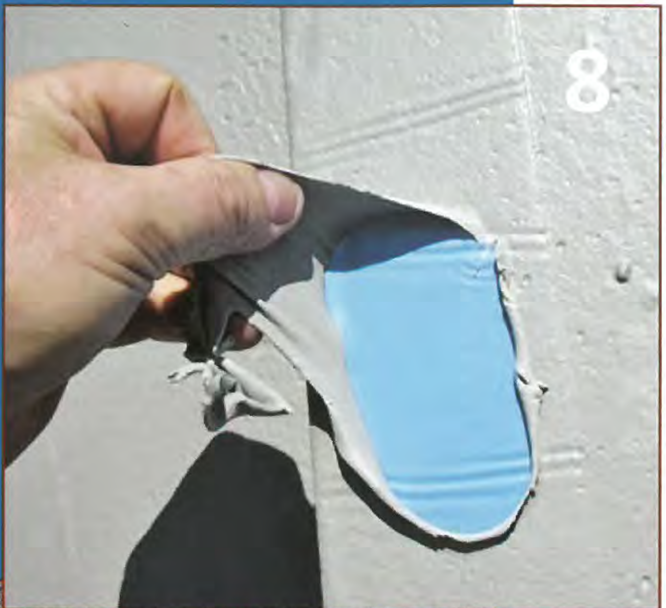

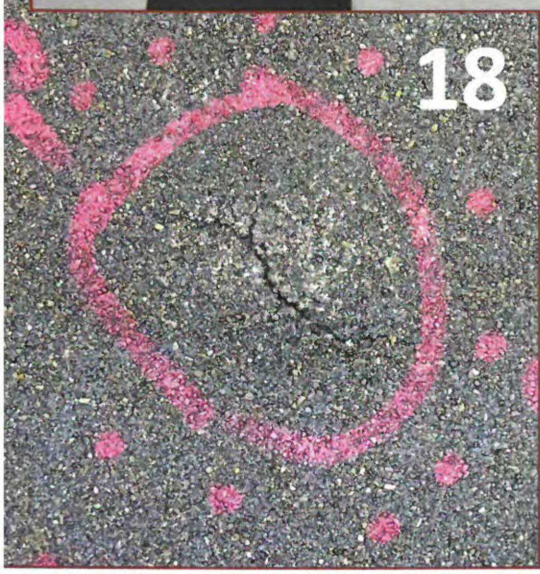

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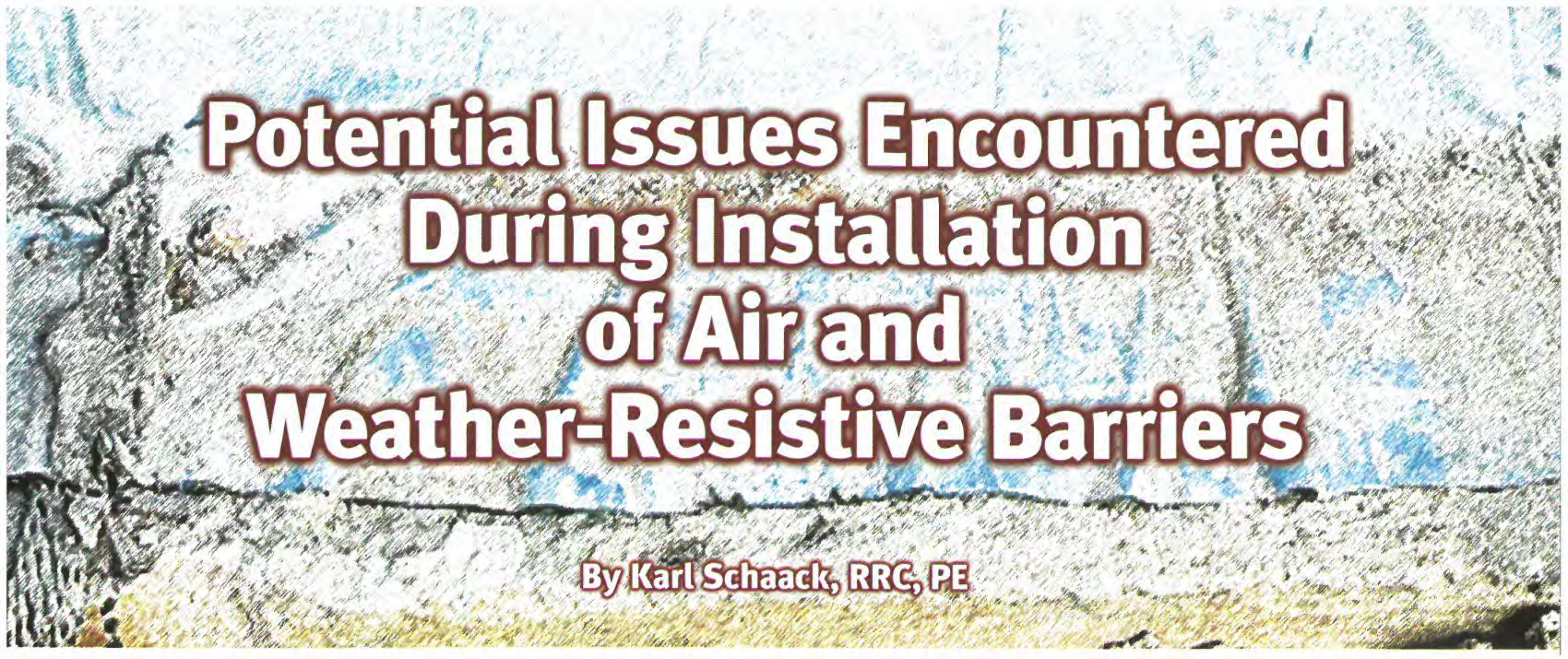

Potential Issues Encountered During Installation of Air and Weather-Resistive Barriers

By Karl Schaack, RRC, PE

BACKGROUND

A variety of materials and technologies are currently being used in exterior wall construction of structures to form a membrane on the exterior face of the backup wall/substrate to function as a barrier to prevent air and/or moisture infiltration into building interiors. In general, regardless of the design intention of the wall assembly—whether permeable or impermeable, barrier wall or rain screen—the material is installed with the main intention of preventing the transfer of moisture (either in liquid or vapor state) to the building interior. Therefore, for the purposes of this article, the material will be referred to interchangeably herein either as a weather-resistive barrier (WRB) or air barrier.

WRBs that are currently available consist of a variety of material options, including sheet goods (mechanically attached or adhered), spray-applied polyurethane foam, fluid-applied products, sheathing with pre-applied barrier, and rigid board insulation. There can be multiple issues associated with the installation of these products or the subsequent installation of exterior cladding/finishes applied over the top of the WRB that can affect the overall performance of the WRB/air barrier and the entire wall assembly.

WRB materials have product-specific properties that must be tested to ensure they will meet rigors encountered during their service life and under the buildings' imposed loads to be considered approved air barrier materials and assemblies. An air barrier assembly is a collection of materials and accessories (e.g., sealants, tapes, transition membranes) assembled together to form a continuous barrier to air or water infiltration into the conditioned space. It is understood that the air barrier materials/assemblies are tested in a laboratory setting that is much different than real-world applications commonly encountered in the construction industry. The purpose of this article is to highlight several conditions that have been repeatedly encountered during the installation of these WRBs that could adversely impact the overall building performance.

Figure 1 – Exposed face of sheathing along heavy build of sealant at joint.

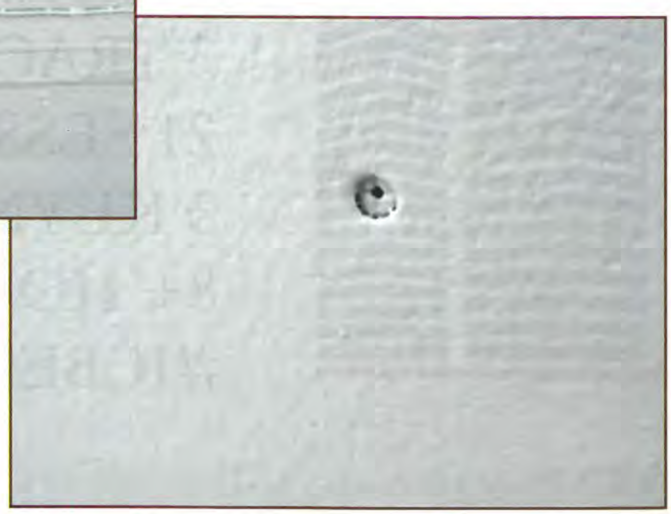

Figure 2 – Void in air barrier at screw head.

INSTALLATIONS/APPLICATIONS

Fluid-Applied Air Barriers

For fluid-applied air barriers, pretreating joints in sheathing is a standard procedure that commonly utilizes gun-grade sealant, which is compatible with the air barrier, or a "trowel-grade" consistency air barrier material. The material can be applied with a bulk gun over the respective sheathing joint and then is often smeared or haphazardly tooled by a technician with a flat-blade spatula. This practice can result in heavy applications of the product with profiled (thick) edges, in lieu of feathered edges. When the fluid-applied air barrier is applied over the heavily treated joints—particularly during spray-applied applications—the heavy-build treatment can act as a shield, blocking the fluid from reaching the surface of the sheathing, unless the applicator takes the time to apply the material in a multidirectional method (*Figure 1*). Even during roller applications, the high-build edges can act as a bridge when the roller is brought across the material, and the sheathing facer—located directly along the sides of the sealant—does not receive a proper application of the fluid material.

Pretreating heads of fasteners used to secure sheathing to framing is commonly recommended by air barrier manufacturers when the fastener is overdriven and fractures the fiberglass facer on the sheathing. Even when the fastener head is properly seated flush with the surface of sheathing, the formed indentions in the head of a Phillips screw can draw the fluid material down into the indentations, pulling the material from the screw head and resulting in small voids around the perimeter of the head (*Figure 2*). Since holes in the air barrier due to inconsistencies at fastener heads are found to be very prevalent, pretreating of each and every fastener head is highly recommended so as to alleviate judgment calls by the applicator on which specific fasteners need treatment. Furthermore, since sheathing joints are required to be pretreated, applying additional material over fastener heads at that same time does not involve significantly more time and material compared to the effort required to go back and search and identify voids at heads and then to perform respective repairs (apply additional material). See *Figure 3*.

Figure 3 – Pretreatment of sheathing joints and fastener heads.

Spray-Applied vs. Roller-Applied

Whichever application method is implemented, it is essential that the wet thickness of applied material is routinely checked and verified by the applicator to confirm proper coverage is achieved. Since there are a wide variety of fluid-applied air barrier material types and required thicknesses, ranging from 10 to 60 mils, confirmation of coverage is critical. Applying too much material can cause the material to become "heavy" and run or slough off of the substrate (*Figure 4*). Applying an inadequate amount of material will obviously result in a finished product that does not meet specifications or performance requirements. Spray equipment is often utilized by contractors for enhanced production during application. A condition observed with spray-applied products is the creation of "craters" in the applied barrier material (*Figure 5*). This condition occurs when globs or large drops of fluid material impinge on the applied wet film and displace the material in crater shapes, resulting in thinning of the material at the bottom of the crater and

Figure 4 – Sloughing of excessive application of fluid-applied air barrier.

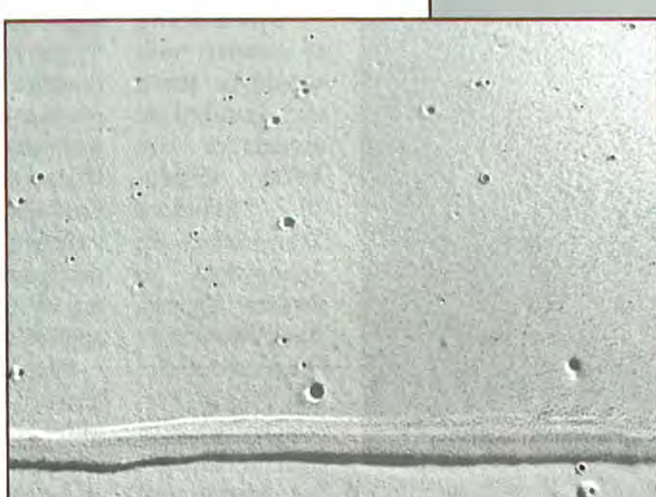

Figure 5 – Craters in surface of fluid-applied air barrier.

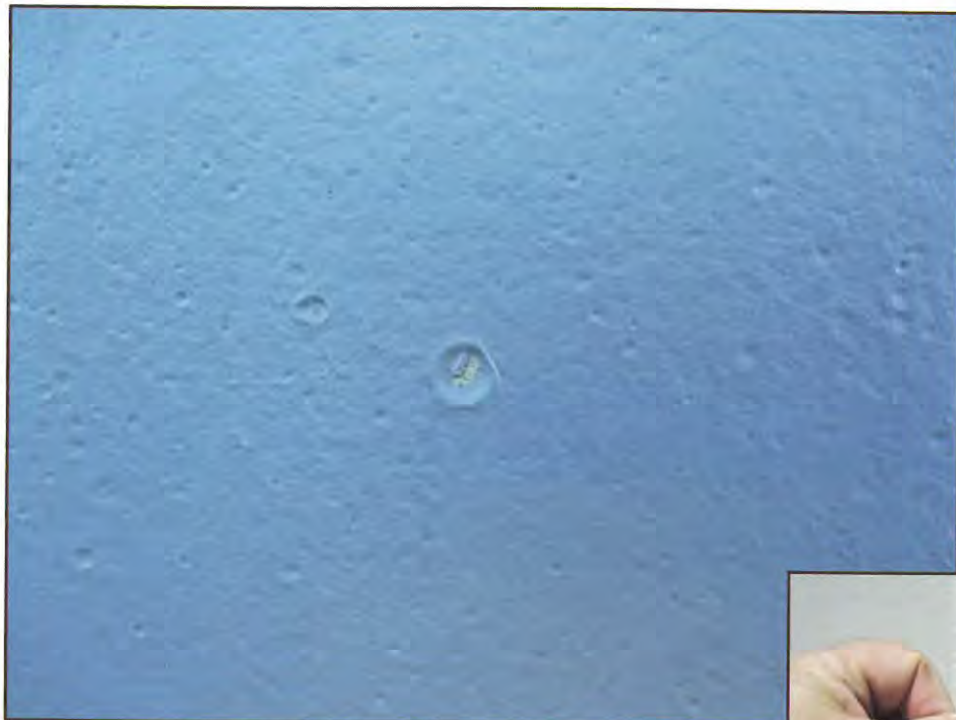

Figure 6 – Close-up view of a crater in surface of fluid-applied air barrier.

Figure 7 – Delamination of fluid-applied air barrier from transition membrane sheet.

exposure of the underlying facer of the sheathing (*Figure 6*).

Polyethylene-faced self-adhering sheet membranes are often used in conjunction with fluid-applied air barriers to form transitions at openings, joints, terminations, and other similar locations. This material is often applied in the respective locations (e.g., corners, openings, through-wall flashings) prior to application of the fluid-applied material. Then the fluid-applied material is applied onto the substrate and on top of this membrane. Due to the polyethylene facer (which can act as a bond-breaker), the fluid-applied material commonly does not achieve a proper bond to the sheet without the use of primer applied onto the surface of the film. Without proper preparation, the fluid-applied air barrier can easily be peeled off of the sheet membrane (*Figure 7*). Another material option to enhance the opportunity to achieve proper bond of the air barrier could involve the use of a transition membrane with a metallic-film (aluminum or stainless steel) facer, in lieu of the polyethylene-faced membrane, so that the fluid-applied material will readily bond to the metallic face.

Figure 8 – Soil-contaminated base of wall.

Substrates

Sheathing

Sheathing in exterior walls should be stored and installed in accordance with ASTM C1280-18, *Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing*[1] and Gypsum Association Technical Bulletin GA-253, "Application of Gypsum Sheathing."[2] Sheathing soiled with dirt or other contaminants does not provide a good substrate for achieving proper adhesion of the air barrier. During new construction projects, sheathing that is installed on exterior walls of a building will commonly become contaminated with dirt along the base of the wall due to wet weather and exposed soil conditions. Water that drains freely from the structure and down to the ground can result in splashing of muddied water and dirt up onto the surface of sheathing. This results in an unsatisfactory substrate to receive an air barrier/WRB (*Figure 8*). Improperly stored sheathing or over-exposure after installation on new construction sites are other common events that result in contaminated products resulting in undesirable conditions to receive applications of new air barriers.

Outside corner conditions of sheathing installed on exterior walls can pose issues with achieving a proper application of an air barrier/WRB. Sheathing should overlap at outside corners, a practice sometimes referred to as a "neat 90." This is critical to providing continuous support around the corners because most fluid-applied air barrier materials cannot span a gap greater than $1/4$ in. and $1/2$ in. for adhered sheet products. Excessively large joints could cause a self-adhered sheet air barrier to "balloon out" or billow and fail due to excessive internal building pressures at open sheathing joints. Additionally, exposed gypsum core commonly occurs at corners due to installation practices (*Figure 9*). The gypsum core does not provide a suitable substrate for either fluid-applied or self-adhering WRB product and will require specific treatment (applying sealant, primer/adhesive, etc.) to achieve a proper installation. For fluid-applied air barriers, large joints will require additional preparation with sealants, tapes, fabrics, etc. Joints in sheathing should be butted tight and staggered. Sheathing also needs to be installed flush with the edges of openings to allow the air barrier to wrap inside without resulting in bridging at corners.

When sheathing gets damaged during construction, it needs to be replaced in a size that spans stud to stud. Air barriers/WRBs are designed and tested to adhere to the facer, not exposed or damaged gypsum. Consequently, if sheathing is damaged, it needs to be replaced and not just covered up. The attachment of sheathing to framing is well defined by industry guidelines, which typically call for fasteners 8 in. on center and no less than $3/8$ in. from the edges and ends of the panel. Proper attachment and fastener placement rely on the proper positioning of the panels so that the edges are centered over the underlying framing member. Then it is up to the installer to secure the fastener in the proper location. Commonly, fasteners are haphazardly placed too close to the panel edges, which can pulverize the gypsum core, resulting in an inadequate substrate to receive an air barrier/WRB (*Figure 10*).

ASTM C1177, *Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing*,[3] provides the material and performance standards for the sheathing materials used in exterior wall construction. The fiberglass facer can be either partially or completely embedded in the gypsum core. Studies by Bowen and Velten[4] have found that the facers on the various sheathing boards that are commercially available differ and result in varying coverages for fluid-applied air barriers. Consequently, the applicator should be fully aware of which sheathing product is being used prior to commencing the application and be aware of potential implications with achieving proper coverage.

Concrete Masonry Units (CMUs)

One obvious condition that can affect the application of a fluid-applied air barrier is the profile of mortar joints between CMUs. The joints should be struck flush, in lieu of tooled concave, to provide a smooth and uniform substrate to receive the air barrier material. When an air barrier is applied with a roller, proper coverage is difficult to achieve down into a tooled concave joint. The eye hooks of masonry pintle-style anchors are embedded in and protrude out from joints of masonry used for backup walls. At these locations, the mortar is typically rough and protrudes beyond the

Figure 10 – Improperly positioned fasteners in sheathing.

Figure 9 – Exposed gypsum core at outside corner of wall.

Figure 12 – Voids in fluid-applied air barrier on porous CMU.

Figure 11 – Void in fluid-applied air barrier at eye hooks of pintle masonry anchor.

face of the CMU. This results in a rough substrate on which it is difficult to properly apply a fluid-applied air barrier, often resulting in voids in the material (*Figure 11*).

The porosity of the CMU can also become an issue with achieving proper coverage of the air barrier. ASTM C90, *Standard Specification for Loadbearing Concrete Masonry Units*,[5] provides material and performance standards for CMUs. The standard identifies three density classifications with different water absorption rates as follows: lightweight = 20 pcf; medium = 17 pcf; and normal = 15 pcf. The lower-density units have a greater number of open pores, consequently requiring more fluid-applied air barrier material to achieve specified coverage (*Figure 12*).

Transitions

Creating transitions at openings in walls and at intersections of walls with roofs is critical in achieving continuity of the air barrier. The transition is formed by using a self-adhering sheet membrane or a liquid-applied flashing. The transition membrane is extended into openings and adhered or bonded to the substrate at heads, sills, and jambs. After a window or louver frame is installed into the opening, an exterior-grade sealant is placed into the joint and required to bond to the frame and the transition membrane, so the transition membrane has to be a suitable substrate to achieve adhesion for the exterior sealant. Most self-adhering sheets have a polyethylene facer that can act as a bond breaker for sealants. A metallic film-faced self-adhering sheet provides an acceptable metal substrate to receive sealant. Some sealants may achieve an adequate bond to a polyethylene facer with the use of primers applied on the facer. Other sealant technologies have been developed that can achieve proper adhesion without the use of primers; but that testing should be performed to confirm adequate adhesion can be achieved and is suitable for the respective accessories and components of the wall assembly.

Often the project design requires that window frames are installed to project out from the opening. This practice results in placement of the primary sealant joint in a location out beyond the opening. In this detail, a sheet metal angle is commonly installed around the perimeter of the

Figure 13 – Corner joint of sheet metal flange installed around window opening.

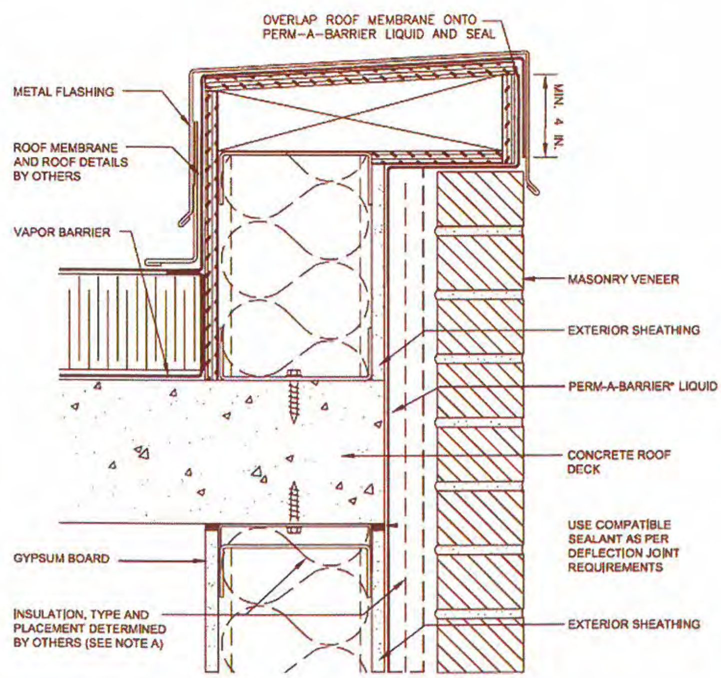

Figure 14 – Typical WRB transition detail at top of wall.

opening to provide a substrate to receive the sealant beyond the opening. The sheet metal angle is installed on top of the WRB applied around the opening, secured to the framing around the opening, and then the flange is stripped into the WRB—typically with a self-adhering transition membrane. A concern with this type of detail is achieving a proper watertight seal at laps and corners in the sheet metal angle (*Figure 13*). Utilizing pop rivets and sealant sandwiched in the laps may not provide an adequate seal when subjected to testing with a spray wand, and it will definitely not maintain a seal in a pressure chamber. Using stainless steel sheet metal, pop riveting, and soldering the joints can result in watertight joints but requires highly skilled technicians to properly achieve this result.

Another common transition occurs on tops of walls where the continuity needs to be maintained between the air barrier and roof flashing. When the roofing material is TPO or PVC single ply, material compatibility is critical when the transition membrane is a modified asphalt-based sheet. Self-adhering sheets with a butyl-based adhesive can be used at these locations and are also typically suitable for in-service high temperatures, such as those that would be expected under sheet metal coping cap flashings (*Figure 14*).

CLADDINGS

Cladding materials for buildings in today's construction market can include, but are not limited to, such systems as metal lath and stucco, metal panels (composite or roll-formed) on furring strips, mechanically attached EIFS, and various masonry elements with metal ties, sub-framing members, or anchors and other similar systems that require the use of mechanical fasteners to secure to the structure. The intention during construction and as required by manufacturers and code is to install the various cladding materials so that the attachment with fasteners will penetrate through the WRB, sheathing, and into the underlying stud framing. However, this intention is not always achieved due to dimensional issues or ill-fated installation procedures.

Fluid-applied WRB materials are often thought of as having self-sealing characteristics; consequently, this lends itself to creating a false sense of comfort regarding fastener installation. The fluid-applied products are promoted as "self-gasketing," which, if the fastener is installed properly (i.e., straight and snug), achieves a gasket effect with the fluid-applied air barrier membrane. Many sheet and fluid-applied products have successfully passed the respective "nail sealability test" outlined in ASTM D1970.[6] However, the test is performed with just the fastener driven through the product and does not include the placement of a brick tie or steel girt between the fastener and air barrier material.

Z-shaped or hat-shaped girts commonly used for attachment of cladding materials are typically 16-gauge to 20-gauge sheet metal provided in 10-ft. lengths. When light-gauge steel framing, sub-girts, hats, and masonry ties are installed on top of the WRB and fasteners are secured into the backup structure, the rigid steel subframing or steel tie typically cannot conform to uneven areas in the substrate and the fastener cannot develop full compression against the WRB to achieve an adequate seal (*Figure 15*). The horizontal flanges of these sub-framing members are not perfectly straight and are typically "out of plane" as the members are

Figure 15 – Void in fluid-applied air barrier at top edge of masonry anchor plate.

somewhat warped. Because of these factors, achieving a compressed seal against the vertical face of the air barrier is extremely difficult, if not impossible. Even though many of the fasteners used to secure these items have gasketed washers, the seal that is achieved is between the fastener and the outer face of the flange, and the back of the flange may not be completely compressed to the WRB. So, if water enters into the cavity wall and runs down the face of the air barrier/WRB, the shank of the fastener penetrating through the barrier may still be susceptible to moisture migration.

When Z-girts and other similar framing members are installed in a horizontal manner, they can create a damming effect whereupon moisture that accumulates at the surface of the WRB migrating downward can be prevented from draining freely or can be dammed by the steel element, allowing the moisture to be directed and concentrated at fastener penetrations. Installing properly positioned shims between the steel element and the WRB can create an adequately sealed drainage plane. The shims can be effectively made with cut strips of self-adhering membrane placed at the fastener locations. This installation can serve two functions, including providing self-adhering/self-sealing material at fasteners and creating a drainage plane. Another option to facilitate drainage and direct water away from fastener locations can include applying and tooling a bead of sealant along the top edge of the girt.

Installation of cut strips of self-adhering sheet, sized to match the compression surface, between the steel girt or tie and the fluid-applied air barrier, can aid in achieving seals at fastener penetration (*Figure 16*). Additionally, the heads of fasteners may need to be treated with a dollop of compatible sealant or a trowelable version of the liquid membrane to provide a more desirable seal. Another practice could include setting the masonry tie in "wet" fluid-applied WRB when securing to the substrate. Issues are

Figure 17 – Multiple screw holes in insulation and underlying WRB.

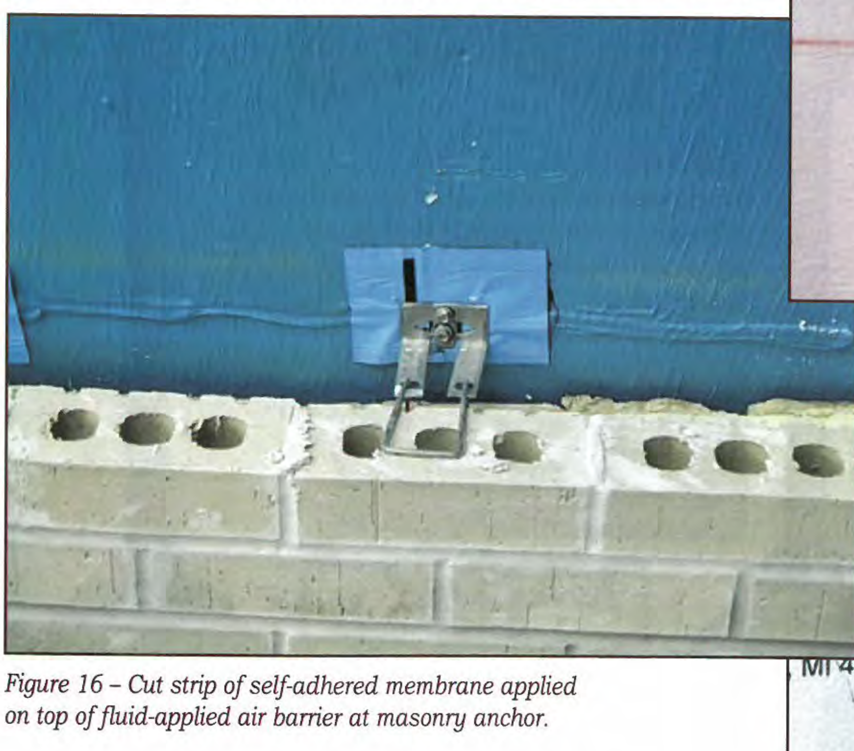

Figure 16 – Cut strip of self-adhered membrane applied on top of fluid-applied air barrier at masonry anchor.

Figure 18 – Damaged foil facer on insulation used as WRB around over-driven fastener.

commonly encountered with fasteners for cladding attachment installed through air barriers/WRBs and are presented in a previously published article, "Fasteners and Self-Sealability of Weather-Resistive Barriers."[7]

The use of continuous insulation within the cavity wall has also created some challenges with achieving proper-functioning WRBs. Some assemblies utilize insulation applied on top of the WRB, and then the cladding anchors are installed through the insulation in a "blind" method with the good intention of penetrating into underlying structural elements (*Figure 17*). Since the insulation is in place, the only possibility to confirm that the fasteners indeed penetrate into the underlying framing is to perform a visual inspection on the interior side of the backup wall prior to installation of interior finishes. Then, if fasteners are found to be improperly installed, the proper corrective measure must be determined.

One corrective method could involve cutting out and retaining a small section or block of the insulation down to the surface of the WRB, applying sealant over the hole in the WRB, and then setting the retained cut block back into the hole, with the intention of also becoming adhered with the sealant. A type of masonry anchor designed for this application has a small aluminum washer with rubber seal intended to create a seal at the top surface of the air barrier/WRB. When this type of fastener is driven through rigid board insulation and does not secure into a framing membrane, the installer realizes this miscue, then withdraws the fasteners to reposition and reinstall, and the washer can slide off of the shank of the fastener and become embedded within the insulation board. Subsequently, when this same fastener is repositioned and reinstalled into a framing member, the washer is no longer present to serve the intended function.

The author believes that installation of anchorage devices directly on top of the surface of the WRB and prior to installation of the insulation can achieve a better-performing assembly with fewer risks of compromising the air barrier/WRB. The rigid insulation is then installed either friction-fit between ties or adhered over the air barrier with an approved adhesive, such as dollops of sealant. Gaps or voids in joints between rigid boards or around penetrations could then be filled with cut slivers of the same insulation or a spray foam type of insulation.

Another product/system option for creating an air barrier consists of rigid board insulation—either polyisocyanurate or extruded polystyrene—with a foil facer. The insulation is attached directly to the metal studs without the use of exterior gypsum sheathing. Issues observed with this technology include similar conditions, including the "blind" installation of fasteners, for either attachment of the insulation or for attachment of masonry, to engage underlying stud framing—commonly resulting in holes in the exterior facer/barrier. In addition, damage to the foil facer of these products can readily occur due to either physical impact or overdriving of fasteners (*Figure 18*). Another condition that can occur is voids present at joints between adjacent insulation boards. The treatment of joints in the insulation boards can include either applying a self-adhering tape or a liquid-applied flashing (typically unreinforced) over the joints. Use of a preformed tape achieves a more positive result, as voids can manifest in the liquid flashing as the material sags down into the joints or an inadequate amount is applied by the technician.

SUMMARY

In the process of performing on-site inspections for building enclosure commissioning or for general project requirements, the conditions noted herein have been and continue to be observed on an all-too-often basis. The industry still needs to improve in the continuing education of those involved in this relatively young and evolving construction component so that the quality construction materials being produced can perform as intended, and the buildings can provide long-term performance as desired by the design community and sought by building owners.

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"Be That One Guy" Program Fights Sexual Harassment

When Vicki L. O'Leary, a union ironworker, heard about the 2017 beating death of union carpenter apprentice Outi Hicks on a worksite following days of harassment, she and fellow ironworkers formed the "Be That One Guy" campaign. The psychological violence of workplace harassment, O'Leary says, is a safety concern that the Occupational Safety and Health Administration (OSHA) hasn't dealt with. The program's aim is to "turn bystanders into upstanders."

"I realized...that every woman who has worked construction has been, at some time in her career, afraid. This fear isn't about being injured during the work itself, but for her personal safety," said O'Leary, who is general organizer for safety and diversity for the Ironworkers International.

The training program aims to help people learn how to defuse hostile situations and gain the confidence to be able to react when they see or experience harassment. Hicks had been harassed for days before Aaron Lopez attacked her physically, but she had neither reported the harassment to her union, nor told colleagues.

Scores of tradeswomen signed a portrait of murder and harassment victim Outi Hicks.

Harassment has a domino effect, putting individuals and crews on edge, which can have deadly repercussions on a worksite. Employers need to take harassment complaints seriously. Often the victim is moved to a different worksite to defuse a situation, but that response can punish the victim and not the perpetrator, who may continue to harass others.

A recent survey by *ENR* showed two-thirds of over 1,200 respondents had experienced or witnessed sexual harassment in construction-sector workplaces. A U.S. Department of Labor study found that 88% of women working in construction and extraction occupations have reported experiencing sexual harassment at work.

See https://www.nwlc.org/sites/default/files/pdfs/final_nwlc_womeninconstruction_report.pdf and https://tinyurl.com/rwkdf7c to read the reports.

Be that one guy.