LOW-RISE FOAM

NOTES FROM THE FIELD

By Don Kilpatrick

The not-so-recent widespread acceptance of low-rise foam as a viable means to bond insulation to varied substrates has gained appreciable market share as evidenced by the sheer number of product manufacturers that offer their own versions of the technology. The industry has embraced the science and materials as an acceptable means to attach all layers of system components, from the base and intermediate layers of insulation to the structural deck to the coverboard and, in some instances, fleece-back membranes.

In the October 2010 issue of *Professional Roofing* magazine,[1] published by the NRCA, an article, entitled "Understanding Low-Rise Foam Adhesives Is Critical to Their Successful Performance" provided a market segment review of the product and practice. The author cited the use of low-rise foam as an opportunity for increased performance problems over any other means of attachment, "mainly because low-rise foam adhesives are sensitive to job-site and environmental conditions and are unforgiving of deviation from the manufacturer's recommendations." Closing statements included the recommendation to include "quality-control monitoring during the installation by an individual knowledgeable of techniques and principles of foam adhesive application as the means to ensure that installation requirements are met." The above-cited commentary is as open-ended as the manufacturers' available written installation instructions for the use of low-rise foam as a means of primary attachment for roof system components.

THE BASICS

The materials are generally described as a kit with two resin packs of equal parts. The resins are extruded from their cartridges through metered ports entering a static mixer on the end of the cartridge. The operator either hand-dispenses the material using a dual-cartridge caulking gun or loads multiple cartridges into a machine with electrical assistance that can activate one or more kits at the same time as a pass is made across the roof. Single-component foam adhesives are also available but were not considered in preparation of this paper.

Common to most is the understanding that the dispensed material is applied in wet bead (generally ¼ to ½ in. wide) to the substrate at prescribed frequencies. Bead frequency at corners and roof edges is greater than that in the field of the roof in order to realize improved wind uplift resistance. In the limited testing we have done, wind uplift values in excess of 200 lbs. per sq. ft. have been realized with beads placed 12 in. on center. Amid all the accolades, options, and outstanding wind uplift resistance that the technology provides, where do the manufacturers stand with their commitment to end use of the product—moreover, the installation procedures?

MANUFACTURER RECOMMENDATIONS

Below is a sampling of manufacturers' recommendations for consideration when their product is used for the installation of roofing materials. Each provides some very basic information specific to bead/ribbon size and distribution across the substrate, targeting increased frequency at the perimeter and corners. Others mention watching for a homogenous blend of the two materials exiting the nozzle as a means to confirm the materials are of correct ratio for proper cure. Other obligatory recommendations, consistent with standard practice for the installation of most roof systems, include the need for a clean and dry substrate prior to the installation and confirmation of "bond" as the work progresses. Under the heading of each manufacturer, as sourced from readily available Internet websites, language specific to product use or "installation procedures" is set in italics as a means to focus on that portion of the document that provides direction for the end-user of the product(s). [Language has been edited for grammar and punctuation.]

Firestone[2]

5. Apply the adhesive on the substrate in bands spaced 12 in. (300 mm) on center. Allow adhesive to rise ¾ in. – 1 in. (19.0 mm – 25.4 mm) in height and then lay the suitable insulation into position. *Continue to place pressure using adhesive pails, etc. on the insulation until the adhesive sets (typically 4-8 minutes) to ensure proper adhesion.*
6. To ensure that the insulation makes adequate contact with the I.S.O.Stick adhesive during the critical setup period, set the insulation board [4 x 4 ft. (1.22 x 1.22 m) maximum] in fresh I.S.O.Stick before a skin coat develops.
7. Immediately after setting each insulation board, thoroughly walk on each board. It is imperative that freshly installed insulation is continuously in contact with the substrate and insulation until the I.S.O.Stick sets. *Ballast, such as full pails of bonding adhesive or fasteners, can be used to ensure adequate contact between the insulation and substrate during the setup period.*

Olybond[3]

a. Install Part 1 and Part 2 components following instruction on the package.
b. Open flow valves on the dispenser completely and turn machine on. This allows adhesive to be pumped at a 1:1 ratio through the disposable mix tip and onto the substrate in a semiliquid state.
c. Apply fluid mixture in…1-in.-wide wet beads spaced maximum of 12 inches on center that spreads in excess of 2 in. wide while rising…to 1 in.
d. *Lay insulation board into place and walk-in to assure complete adhesion.* Curing typically occurs in 4 to 8 minutes, depending on temperature and weather conditions.
e. Check with roof system manufacturer for project-specific spacing requirements.

Sarnafil Sarnacol 2163 Adhesive[4]

With a utility knife, cut away the plastic plugs from the…mixing head. Attach a mixing tip to the threaded mixing head. Place the cartridge into the applicator. At the beginning of the tube, some of the material should be pumped out initially to make sure of a proper mix. Apply…adhesive directly to the substrate, using a ribbon pattern. Space ¼- to ½-in.- (6- to 13-mm-) wide beads, 12 in. (30 cm) o.c. to achieve proper coverage rate. *As adhesive is applied, place insulation board into wet adhesive. Do not allow the adhesive to skin over.* Eliminate uneven surfaces to ensure positive contact between the insulation board and substrate. Unused adhesive can be applied at a later date by simply replacing the mixing tip.

3M Polyurethane Foam Insulation Adhesive CR-20[5]

After the adhesive has attained its initial bond strength, the boards can be "walked in" and will be compressed to the deck or *substrate, exhibiting minimal slippage or movement. The boards should be exposed to minimum traffic for at least 10-20 minutes (depending on temperature) after they have been "walked in place" to avoid breaking the freshly formed bond.*

NOTE: Membranes can be applied once the adhesive has achieved sufficient bond strength to the immediate substrate to which it is adhered. It is recommended that the contractor inspect the installed insulation for proper adhesion and re-adhere any boards and/or corners that are not adequately attached.

NOTE: *Boards that will not lie flat due to cupping, warping or crowning, or surface irregularities of the substrate should have weights placed on the boards until the... adhesive has achieved adequate adhesion to hold the boards in place.*

Tremco Low-Rise Foam Insulation Adhesive Green[6]

Snap off the molded cap on the top of the adhesive cartridge and screw on the mixing tip. Make sure mixing tip is tight to prevent adhesive leakage. Install the cartridge into the battery-powered or pneumatic single-bead applicator. Refer to applicator data sheet for complete operating instructions.

Apply ¼-in.- to ½-in.-wide adhesive beads to the substrate or insulation board in ribbons spaced a minimum of 12 inches on center (spacing may need to be decreased depending on wind uplift requirements). Install insulation boards immediately into the wet adhesive. Do not allow adhesive beads to skin over before placing the boards. *Walk on boards to fully press them into the wet adhesive. Adhesive will lock boards down in approximately 5 to 7 minutes.* Replace mixing tip if application is interrupted for more than 1 minute, as adhesive will cure in the nozzle and prevent proper flow of material. Note: Mixing tips for cartridge material should not be used with 5-gal. box material.

Carlisle[7]

1. Apply a ½-in.- to ¾-in.-wide bead of...adhesive using a portable 1:1 applicator (oversized, dual-cartridge caulking gun)... with beads spaced as outlined on the following chart for 5-, 10-, or 15-year, 55-mph warranties (20-yr. requires 6 inches o.c.) in the field: Applying a wet bead less than ½ in. wide is not acceptable.

[Chart omitted.]

3. Place 4 x 4 ft. maximum-insulation boards into...adhesive after allowing it to rise ½ in. and develop string/body (approx. 1 min. at room temperature) but before the adhesive reaches a "tack-free" state. String time will vary based on environmental conditions like temperature and humidity.
4. *Designate one person to walk and roll boards into place using a 150-lb. weighted roller, adding constant weight or slitting boards where necessary until adhesive sets up.*
5. At the beginning of the insulation attachment process and periodically throughout the day, check the adhesion of boards to ensure a tight bond is created and maximum contact is achieved.

Johns Manville – JM Green Two-Part Urethane Insulation Adhesive[8]

[The product] is dispensed in a semiliquid bead that rises ¾ in. to 1 in. (19 mm to 25 mm) above the substrate. Beads are typically 12 in. (305 mm) on center. *Within two minutes, the insulation board is placed into the adhesive and walked into place.* The adhesive cures in approximately 4 to 8 minutes after application, depending on temperature and weather conditions. *Note: Board stock must be placed into the adhesive while it is still wet (before it reaches its tack-free state).*

Typical coverage rates* are 400 ft.^{2} to 600 ft.^{2} (37.16 m^2 to 55.74 m^2) per case of 4 cartridges. Typical coverage rates for a 10-gallon Bag-in-Box are 1,000 ft.^{2} to 2,000 ft.^{2} per box (9.29 m^2 to 18.58 m^2). The application rate must be increased for rougher surfaces, and coverage rate will vary depending on roughness.

*Coverage rates depend on weather conditions and substrate. Refer to specific code.

Advantages

- No primers or catalysts are required for application.
- *No ballasting of boards is required.*

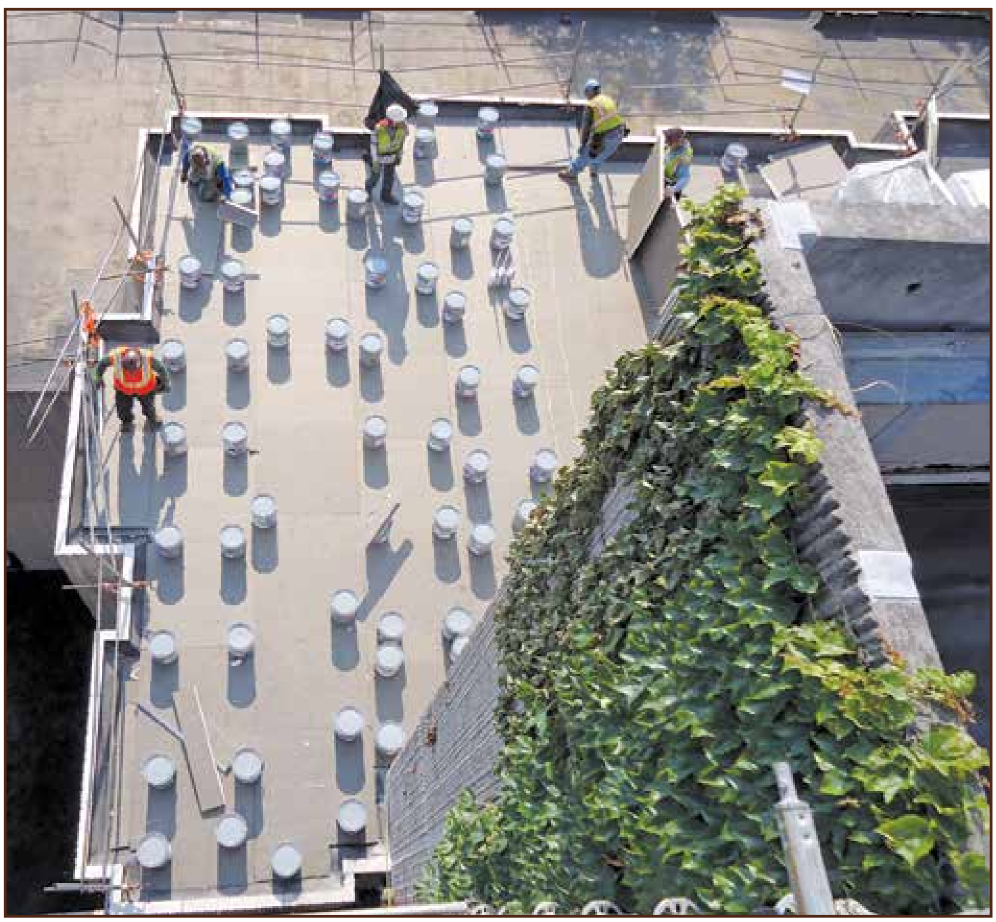

Photo 1 – Contractor using pails of materials that have exceeded their shelf life as temporary ballast on a low-rise foam installation.

INSTRUCTION INCONSISTENCIES PREVAIL

Some of the manufacturers inform the end user that "bond" is critical to the integrity of the installation, and spot checks should be used to monitor bonding as the work progresses. To that end, excerpts from the Firestone and 3M written instructions recommend adding weight or temporary ballast of some kind to hold the boards in firm contact with the substrate as a means to achieve improvements in the character of the bond. Others recommend the practice of "walking in" or the use of a weighted roller to assist gravity for the short term through the cure or ultimate set time of the materials. Clearly, the sampling of written installation instructions for materials of like kind lack consistency.

NOTES FROM THE FIELD

Bolstering the need for this discussion was a recent experience with two reputable contractors concerning projects in which low-rise foam was specified as the primary means for the attachment of the insulation and cover board. Both projects required the removal of all existing materials to the concrete deck, followed by the installation of a torch-applied vapor barrier. Subsequently, the insulation base, tapered layers, and cover board were to be installed in low-rise foam.

On the first day of new material installation, Contractor A was observed loading the roof with five-gallon pails of old bonding adhesive that had far exceeded the posted shelf life. When asked why, the foreman indicated that they were used as temporary ballast during the cure time of the low-rise foam adhesive. As witnessed, the laborers faithfully moved the cans across the roof as the installation progressed (*Photo 1*).

With Contractor B, the first day of new material installation was a slightly different story. Having developed an appreciation for the temporary ballast concept procedure used by Contractor A, our documents included a written directive that similar provisions for temporary ballast be used during the cure or open time of the adhesive. When inquiries were made to the foreman as to what his intentions were for temporary ballast, the lengthy blank stare and lack of response suggested he was lost in the context of the question.

How can two upper-tier contractors have such very different understandings of product end use and best-practice instal-

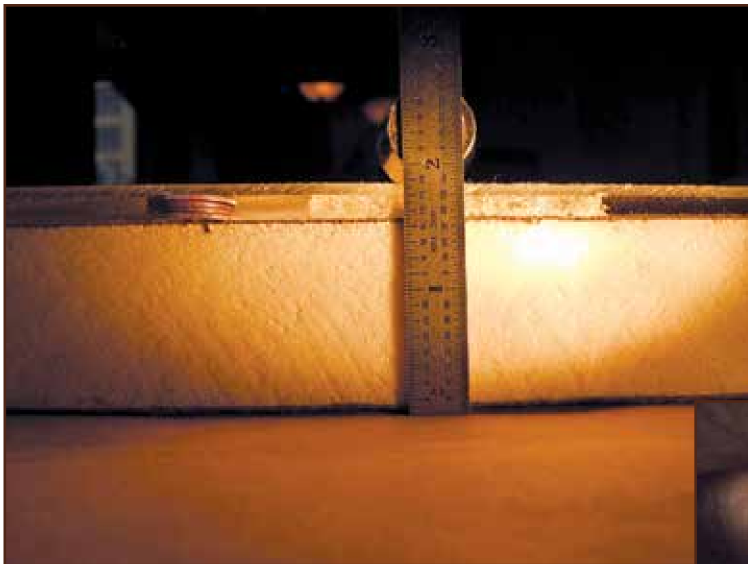

Photo 2 – Cured adhesive film thickness between insulation and acrylic in the nonballasted configuration (four dimes inserted in the gap for reference of scale).

Photo 3 – Improvements in the distribution and finished cured thickness of the adhesive film and significant reduction in the gap between materials were observed in the ballasted test panel.

lation procedures for materials offered by multiple manufacturers that are arguably based on similar technology? Not personally knowing anyone who is fully knowledgeable in the techniques and principles of foam adhesive, the author offers the following commentary for review.

Sheet acrylic and 1.5-in. isocyanurate were used to make two test panels. Ribbons of adhesive were laid out across what would represent the base layer insulation in a multilayered system. After approximately 40-50 seconds, the acrylic was set on the ribbons of adhesive on the insulation panels. One test panel was immediately ballasted with a second layer of insulation and a five-gallon pail of old adhesive. The second panel was left to carry only the weight of the acrylic sheet with no additional ballast. The cure period or point at which the acrylic could no longer be shifted or moved laterally was in the range of 6-8 minutes.

Subsequent to final cure, it was noted that in the unballasted configuration, there was a gap of approximately 0.25 in. between the facer of the insulation and the bottom of the acrylic sheet (*Photo 2*). The gap between the acrylic and insulation facer in the ballasted version was in the range of 0.093 in. (*Photo 3*). In addition, it was noted that the initial "wet" bead of adhesive in the ballasted version was broadcast over a much larger surface area than its unballasted counterpart. It is assumed that the broader footprint of the adhesive across the horizontal plane between boards in the ballasted configuration would maximize or enhance the bond achieved by broadcasting or spreading out the adhesive over a larger area, in addition to the clear evidence that the gap between boards is minimized. The amount of the gap left between boards after installation will predictably vary to

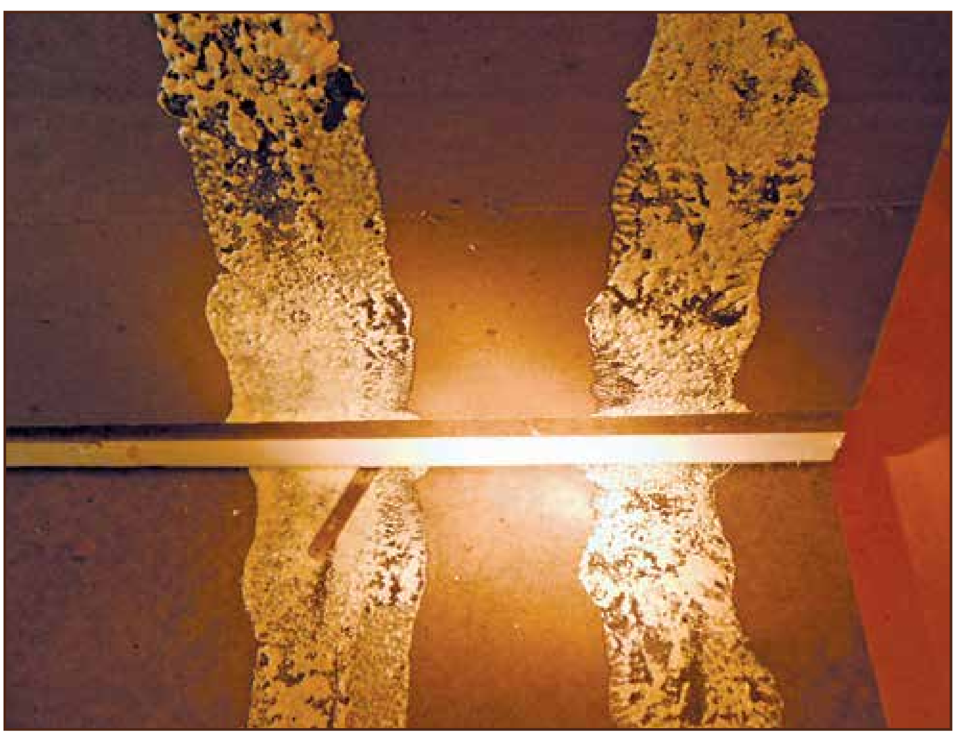

Photo 4 – Field mock-up sample assembled with known deflection (a shim was placed parallel to an edge condition of the lower board). The top board was "walked in" as recommended by most manufacturers. The temporary load distributed the adhesive horizontally across both the upper and lower boards, yet no bond was achieved.

extremes, based on the installation procedures (ballasted, walked/rolled in, and left to gravity).

Understanding that the material is generically referred to as "low-rise" foam, the above observations come as no surprise. So where and how do the manufacturers' recommendations—more notably walking in and rolling—bring added value to the process?

Rolling is generally thought of as a means to engage pretreated sides of an assembly where contact or bonding adhesive is used as the primary means of attachment. If insulation boards are not lying flat (i.e., deflection), rolling will provide temporary, moving point loads that may distribute the adhesive materials across a wider area than its initial "wet" footprint. However, the board will likely rebound soon after the roller has passed, and the void born of deflection will remain (*Photo 4*). Boards simply walked or rolled in will exhibit a cured gap greater than that in a ballasted scenario. What happens to the bead after that is anyone's guess, but you can be assured that the finished product will not have the crisp, clean lines of the sample coupons distributed at the trade show (*Photo 5*).

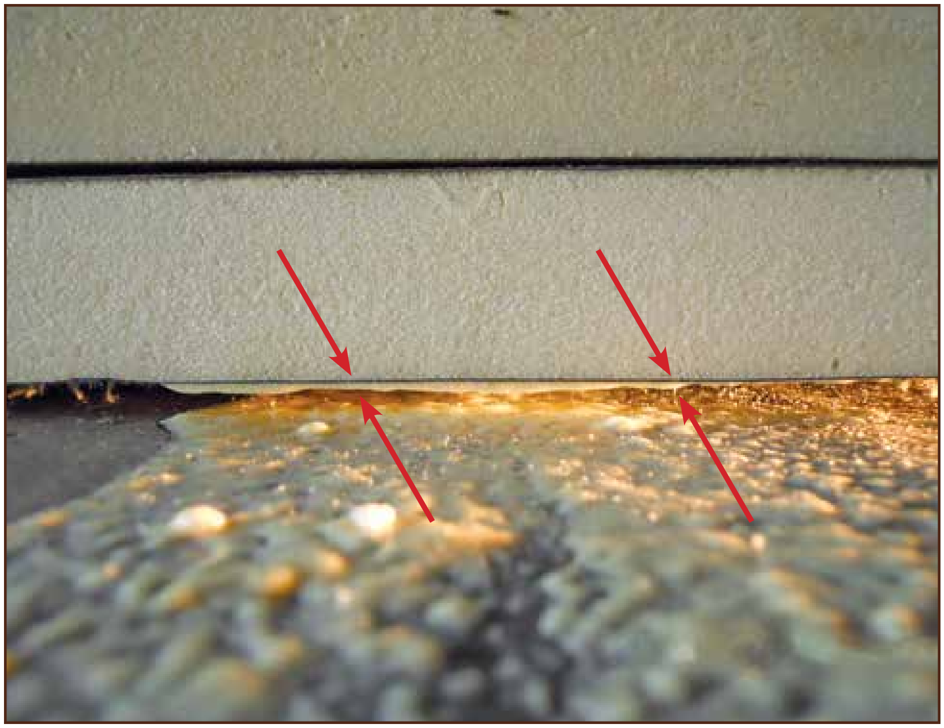

Photo 5 – Cured adhesive film and gap between boards with known deflection that were walked in after assembly with no bond achieved.

CLOSING REMARKS

Gravity alone will not provide reasonable assurance that roof products installed in low-rise foam will result in an installation that maximizes the benefits of the technology. The material—from its liquid state, morphing to a semirigid, cross-linked, chemically cured compound—carries with it properties of expansion that have a tendency to lift and separate interfaced components during the cure process (*Photo 6*).

Left unrestrained (without ballast), gaps of 0.25 in. or greater, based on the application rates, are a predictable outcome between interfaced substrates. It would seem that the practice of using low-rise foam for roof system attachment and the so-far-favorable uplift resistance may be trumped or minimally compromised by the upward lifting (expansive characteristics) of the product in the absence of temporary ballast during the critical cure period. We have heard from at least one contractor who recently installed a multilayered system, losing critical flashing height due to the cumulative gaps at the interfaced layers of materials. Moreover, roof consultants have been conditioned to believe that gaps in insulation of ¼ in. or more—as exposed in plan view (board-to-board joints) as the materials are laid out—are subject to scrutiny to the extent that they get filled prior to the installation of cover board and/or membrane. So what becomes of the gaps on the horizontal plane between board stock materials in multilayered systems? Will the absence of air barriers potentially introduce moisture vapor into the gaps, resulting in condensation and mold? Is it a suitable habitat for insect infestations? Is the thermal efficiency of the assembly compromised?

Based on our observations, it would appear that the manufacturers (those in the best position to know) may want to take another look at their installation instructions and consider including the requirement or recommendation of temporary ballast as best practice for the use of low-rise foam as a means for primary attachment of roof system components.

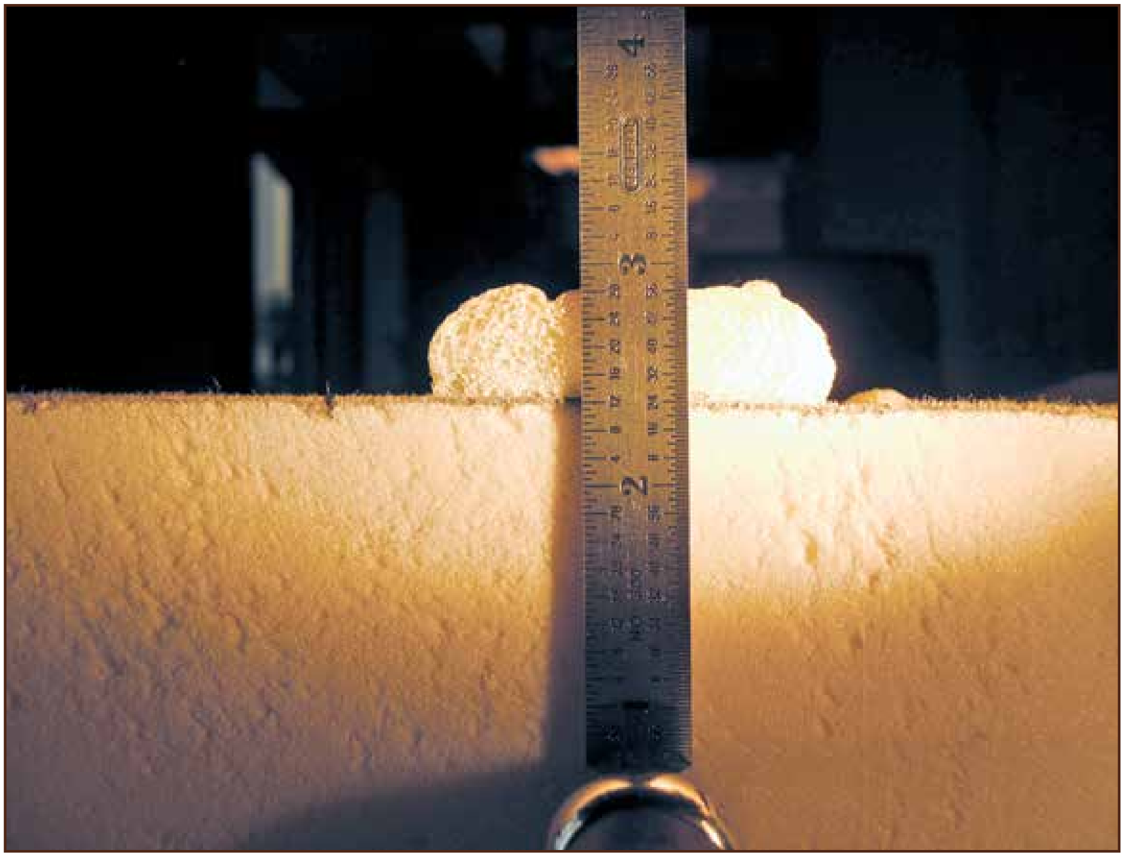

Photo 6 – Maximum rise potential of a nominal fully cured 3/8-in. bead of adhesive left unattended or without the overburden of subsequent material(s).

REFERENCES

1. Maciek Rupar, "Understanding Low-Rise Foam Adhesives Is Critical to Their Successful Performance," *Professional Roofing*, October 2012.
2. http://technicaldatabase.fsbp.com/downloadFile.ashx?fileId=%5Bfid=10727%25
3. http://www.olyfast.com/product-details/product/olybond-five.html
4. http://usa.sarnafil.sika.com/dms/getdocument.get/494f9344-725f-3621-8991-3e4faf5bc14a/Sarnacol%202163.pdf
5. http://multimedia.3m.com/mws/mediawebserver?mwsId=LLLLLNnS1XzlEQMmGRMXfQMmyonJyXnS0o4Lyo4LyLLLLLL--
6. http://www.tremcoroofing.com/fileshare/specs/LowRiseFoamAdsvSpecDataMar2011.pdf
7. http://www.carlislesyntec.com/default.aspx?page=view&mode=media&contentID=1226&frompage=search&category=136&mediatype=literature
8. http://staging.specjm.com/products/roofing/tpogreentwopartadhesive.asp?system=sbsbituminous&type=cold

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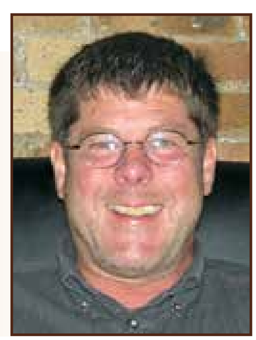

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