Alternative Fastening System for Thermoplastic Roof Membranes

By Josh Kelly and Stan Choiniere

Change is as inevitable in the roofing industry as it is in life. In fact, during the past decade or so, we've seen extraordinary change in the industry, particularly as it pertains to single-ply materials.

Besides the acceptance of an entirely new generation of material called thermoplastic olefin (TPO), the thermoplastic segment has continued to expand its product offering with wider materials, peel-and-stick options, and a host of new fastening patterns and systems designed to accommodate higher wind loads.

It should be no surprise, then, that as these materials and assemblies have evolved, so, too, have new technical issues that consultants, owners, and contractors must now address. One of the ongoing challenges facing many single-ply manufacturers is the desire to develop mechanically attached systems for wide (i.e., 10- and 12-ft-wide) membranes that effectively meet increasing wind requirements. In addition to ensuring that the system remains securely in place during high-wind events, the challenge is to develop systems that also minimize roof flutter and the related noise that it may cause.

OMG Roofing Systems has developed an alternative technology for mechanically attaching thermoplastic membranes in a manner that spreads the wind load more evenly across the roof surface rather than relying exclusively on in-seam fastening (*Photos 1* and *2*). The system, called RhinoBond, is a nonpenetrating alternative for installing TPO and PVC roofing membranes that is based on microprocessor-controlled induction welding technology called Sinch®. Because the fasteners are spread evenly across the roof, it places a more uniform load on the fasteners and significantly limits membrane flutter, regardless of membrane width.

Sinch® is a technology platform used to focus heat into a specific target area. In short, the technology generates a safe elec-

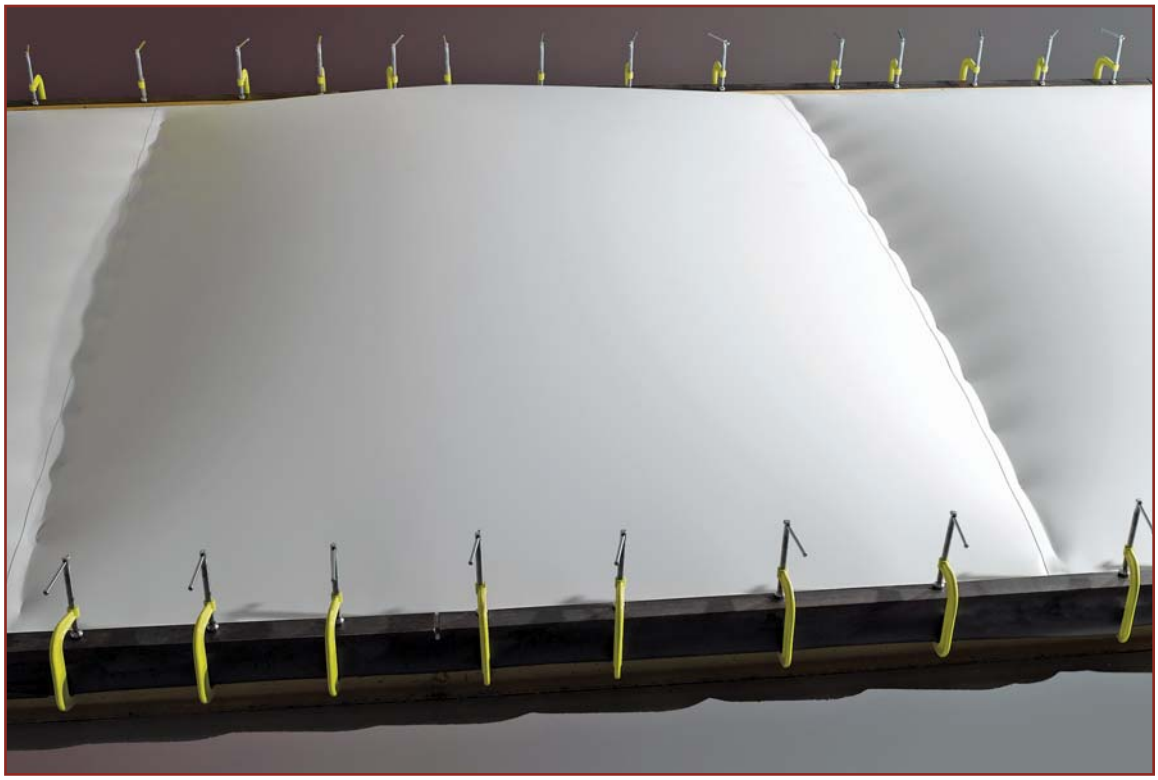


Photo 1 – Traditional in-seam fastening can result in fluttering, particularly with wide membranes as shown on this wind-test deck.

tromagnetic field that remotely heats the target – in this case, the material/insulation plate – through nonmetallic materials such as roofing membranes. The end result is a process that creates a strong bond between the bottom side of the roofing membrane and a specially coated plate, without penetrating the membrane. In static testing, the bonds have demonstrated the ability to resist over 500 lb of force.

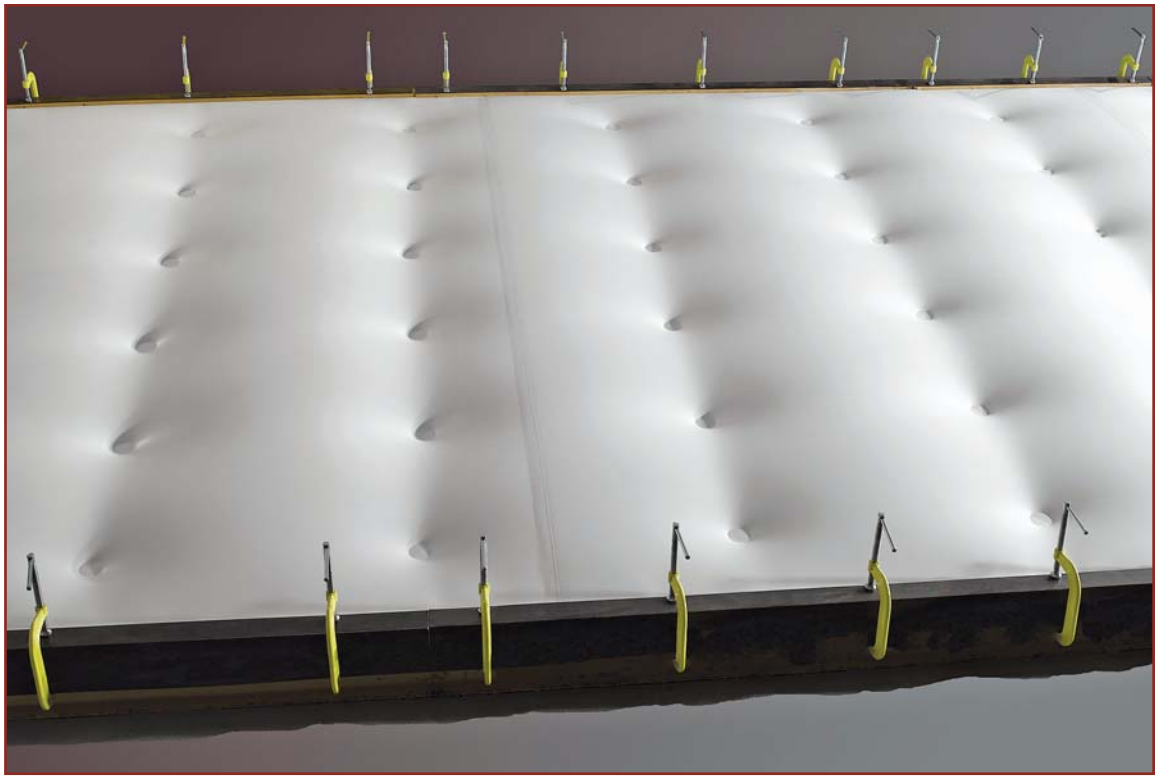


Photo 2 – The alternative system for mechanically attaching thermoplastic membranes spreads the wind load more evenly across the surface of the roof, thereby reducing the point loading on each fastener and minimizing fluttering.

THINK OUTSIDE THE SEAM

While some manufacturers offer advanced or engineered systems that spread the forces to accommodate higher wind loads, the vast majority of mechanically attached assemblies have been designed around in-seam fastening patterns. In these systems, the insulation is secured to the deck using a specific number of fasteners per 4- x 8-ft board. A second set of fasteners and plates or batten bars is then installed through the membrane in the lap, and subsequently, these are protected by an overlapping heat-welded seam that eliminates potential points of entry for moisture.

Unlike a traditional mechanically attached roofing system, the alternative system uses only one fastener and plate (*Photo 3*) to secure both the insulation and the membrane to the deck. In addition to reducing the number of required fasteners by 25% to 50%, depending on the specific wind requirements, the system also reduces the number of fasteners that penetrate the deck by the same percentage.

While the installation procedure is relatively straightforward, contractors using this system must take a different approach when estimating the project. For example, rather than estimating the number of insulation fasteners/plates and seam fasteners/plates, one simply determine how many of the new plates and fasteners are required to achieve the desired wind rating.

A Factory Mutual 1-90 rating, for example, requires six fasteners per 4- x 8-ft insulation board, or 19 fasteners per square. In this example, the insulation is secured with the six fasteners placed in two rows of three, located inward 12 inches from either edge. As with any mechanically attached system, prescriptive corner and perimeter enhancements are required per Factory Mutual compliance.

The membrane is then rolled out across the roof over the plates and hot-air welded according to the manufacturer's specifications but without any fasteners in the laps. The TPO or PVC membrane is then bonded to the top of the plates used to secure the

Photo 3 – The system includes 3-in-round, specially coated plates – one for PVC and one for TPO.

Photo 4 – Fasteners are installed across the entire roof in a grid pattern to distribute the wind load more evenly. Membrane width is inconsequential, with no need for perimeter half sheets.

insulation. Since the fasteners are installed in a grid pattern across the roof, wind loads are distributed more evenly, resulting in less point-loading on individual fasteners. As a result, the system can achieve higher wind performance ratings with fewer fasteners (*Photo 4*).

In addition, because the system is based on a grid pattern of attachment points, membrane width is not a factor. There is no need for perimeter half sheets or for anything other than full-width material. In corners and along perimeters where wind loads can be the strongest, following FM-prescriptive enhancement provides extra attachment points for full-width membranes. By eliminating perimeter sheets, there are fewer seams to weld on the roof and fewer potential points for water intrusion.

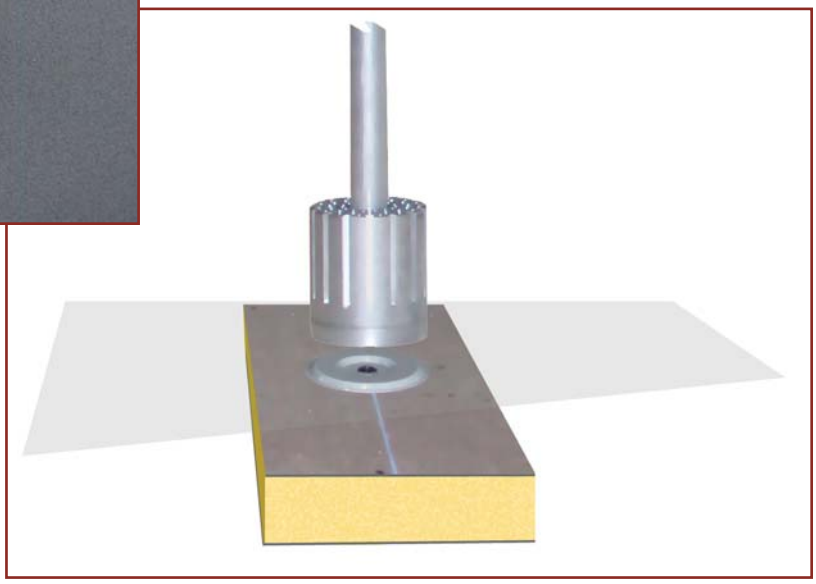
FASTER DRY-IN

In addition, the system has been shown to provide faster dry-in time when used in new construction. Depending on the project, the location, and the weather, the membrane can sometimes be installed, seamed, and bonded at the perimeter and around the penetrations before all of the plates are bonded in the field of the roof. This allows the roofing contractor to get a larger portion of the building dry and to

Photo 5 – There are three components to the system: the welding tool, a series of magnetic cooling clamps, and the specially coated insulation/membrane plates.

Photo 6 – The tool must be calibrated based on the ambient temperature to provide an optimal bond. A properly bonded plate will provide total, even, and consistent fusion of the membrane.

Photo 7 – Immediately after welding the material, a magnetic cooling weight is placed on the top of the plate to promote a strong bond and to help cool the plate.



reassign skilled workers to complete other parts of the installation such as detail and flashing work before completing the bonding process.

INSTALLATION PROCESS

There are three components to the system: the welding tool, a series of magnetic cooling weights, and the insulation/membrane plates (*Photo 5*). The plates, which are specifically designed for use with either a TPO or a PVC membrane, are generally installed with extra-heavy-duty (#15) fasteners or super extra-heavy-duty (#21) fasteners, depending on the specific application. Typically, the system is used on steel or wood decks, but it can be installed as a metal retrofit system and used on concrete decks as well.

For roof consultants and contractors alike, understanding the concept that the roof will be attached in a grid pattern rather than in the seams of the membrane is critical, as wind-uplift ratings dictate how many fasteners are needed per square and thus per 4- x 8-ft insulation board.

The welding tool runs on 120-volt, 20-amp power and is height-adjustable, lightweight, and portable. It is preset at the factory to provide an optimal bond when the ambient temperature is 70˚F. Therefore, before a project can begin, roofing contractors must calibrate the tool for the specific temperature at which they are working. For temperatures below 70˚F, the energy level of the tool must be adjusted up (+1, +2, etc.) from the factory-set position of "0" and down (-1, -2, etc.) when the ambient temperature is above 70˚F. This process, including several test welds, will take an experienced contractor about 10 or 15 minutes at the start of the day (*Photo 6*).

Once calibrated for the ambient temperature, welds are completed by activating the

tool after it is centered over the installed plate. An LED display lets the operator know when the unit is ready, and a button on the handle of the tool activates the welding process, which takes approximately five seconds to complete. An audible tone lets the operator know when the process is complete. Since the plates are under the membrane and therefore not visible to the installer, it is important that they are installed in straight rows so that they can be easily located.

Immediately after welding the material, the installer places a magnetic cooling weight on top of the newly welded plate (*Photo 7*). This not only promotes a strong bond by securely holding the membrane and plate together, but also, it serves as a heat sink to help cool the recently welded plate.

Feedback from many roofing contractors who have used the system indicates that the tool is easy to learn and use, with many individuals stating that the most inexperienced member of the crew operates the tool so that the more experienced roofers can complete detail and flashing work, which require a greater level of skill.

TESTING AND APPLICATION

Many manufacturers have tested and achieved wind approval ratings at Factory Mutual for this system. Ratings of up to FM 1-240 have been achieved, depending on the manufacturer and assembly being tested. The system is currently being marketed by Sika Sarnafil, GAF, and Flex Roofing Systems. Projects have been successfully completed in many market segments, including big-box retail, technology, software, manufacturing, and distribution, among others.

The new system requires building owners, contractors, and consultants alike to think about mechanically fastened thermoplastic roofing systems in an entirely new way. While long-term performance will continue to be monitored and evaluated, results during the past few years look promising for this nonpenetrating option, which requires fewer fasteners and seams and also limits rooftop flutter.

Josh Kelly

Josh Kelly is vice president of marketing for OMG Roofing Products and has 19 years of experience in the roofing industry with OMG. Josh has held numerous roles with the company, ranging from technical assistant and national account manger to international sales manager and marketing director. He has been instrumental in developing and commercializing several product lines for OMG, including the RhinoBond Induction Welding System, and remains active in the industry through memberships with SPRI, NRCA, and The Roofing Industry Alliance for Progress.

Stan Choiniere

Stan Choiniere is national technical manager, OMG Roofing Products, Agawam, MA, and has 28 years of experience with OMG. During that time, he has worked extensively to develop and test fastening systems to meet the changing needs of commercial roofing. Stan holds several fastener and equipment patents and has served on technical committees with NRCA, ASTM, and ERA. In addition, he has held several positions during his 26 years of association with SPRI, including Technical Committee chairman, vice president, and president. He was chair of the committees responsible for developing ANSI standards for Field Testing for Fastener Withdrawal (ANSI/SPRI FX-1), Field Test Procedure for Mechanical Uplift Resistance of Insulation Adhesives (ANSI/SPRI IA-1), and the Standard for Retrofit Drains (ANSI/SPRI RD-1). Stan is currently on the board of directors of SPRI and ERA and a member of Factory Mutual's Industry Advisory Council. He has been a member of RCI for 21 years.

HEALTH REFORM BILL AMENDMENT PUTS BURDEN ON CONSTRUCTION INDUSTRY

A provision included in a last-minute "manager's amendment" to H.R. 3590, the Senate's health care reform bill, includes language authored by Senator Jeff Merkley (D-OR) that targets the construction industry. The 383-page amendment, presented by Senate Majority Leader Harry Reid (D-NV), was attached on December 19 to secure votes needed for the bill's passage on Christmas Eve.

The bill exempts small businesses with fewer than 50 employees from the mandate requiring employers to provide health insurance meeting a minimum federal standard. But the construction industry is explicitly excluded from this exemption, making the mandate effective for all construction firms employing five or more people. Those who do not provide health insurance coverage with at least 60% of an employee's premium paid and less than 9.8% of the employee's income going to pay for their share of the premiums will face fines up to $750 per employee.

Bill Good, executive vice president of the National Roofing Contractors Association (NRCA), has called the "rifle-shot provision…an unprecedented assault on construction firms" that "could very well exacerbate unemployment in our industry." Good noted that unemployment in the construction sector "currently exceeds 18%...this provision is particularly ill-timed and could have devastating consequences for roofing contractors and their employees. It's simply outrageous."

The bill has yet to come before the House and must pass there before a final bill is produced for signing by President Barack Obama.

— Independent Electrical Contractors (IEC at ieci.org) and nrca.net