Non-penetrating roof systems: a good concept gets a shaky start

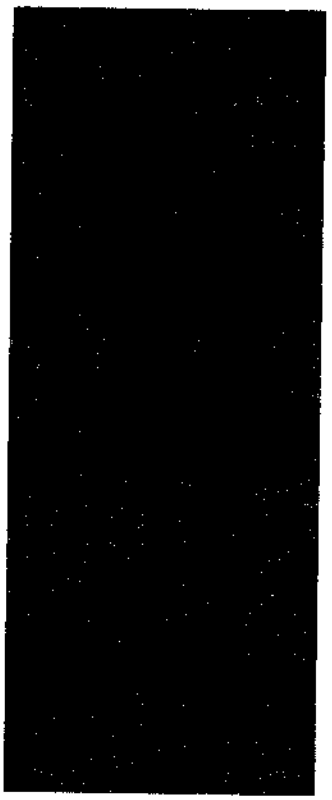
For the past five years roofing contractors have watched a tidal wave of new roofing systems come in, invited ashore by consumers looking for economical roofing. Shop talk among professionals who found themselves knee-deep in new products normally dwelt on the vast numbers of different roofing specifications and membrane systems that were becoming available.

Like any tidal wave, this incoming rush of new products drastically changed the surrounding countryside. As the swell has subsided, we have been left with some strong survivors that have become permanent features of the landscape. This isn't true of every product washed ashore, however. Some seem to be foundering in the backwaters and tidepools; they may still be around, but they may not remain for long.

The non-penetrating roof system for use with EPDM membranes was a part of this new wave of products. It remains to be seen if it will last as long as the other EPDM membrane systems, or if it will be swept away with the next tide.

What is a non-penetrating system?

The name "non-penetrating system" normally refers to mechanically fastened single-ply roof installations where the fastener does not penetrate, either in the field of the membrane or hidden in a lap. As can be seen in Table 1, there are a large number of methods to mechanically fasten EPDM systems. The most popular mechanical fastening method for EPDM sheeting is strip fastening, where a batten is installed in the seam. This is, by definition, a penetrating system. Two non-penetrating systems are the NP anchor, which employs a spot fastening method, and the strip system, which uses a track.



The non-penetrating systems were developed for reasons of economy. Building owners couldn't have cared less how the sheet was installed or held down as long as the method gave them warranted roofs at the lowest possible price. After all, they reasoned, a 10-year warranty makes all roofing systems equal. But now the question must be asked: are non-penetrating systems really equal or do they pose additional problems that have yet to surface?

The design concept behind non-penetrating systems is quite simple. The idea is to take a sheet of EPDM, laid out and spliced together, and attach it to the substrate with an ingenious mechanical anchor system that does not penetrate the membrane. This seems to be a very simple goal. But, in my opinion, the products that have been devised to reach this goal have a much lower factor of safety, especially when compared to a ballasted or fully adhered EPDM membrane system. If one fastener fails, that fastener's load must be spread among the surrounding fasteners, doubling or quadrupling the area of the roof they must hold down.

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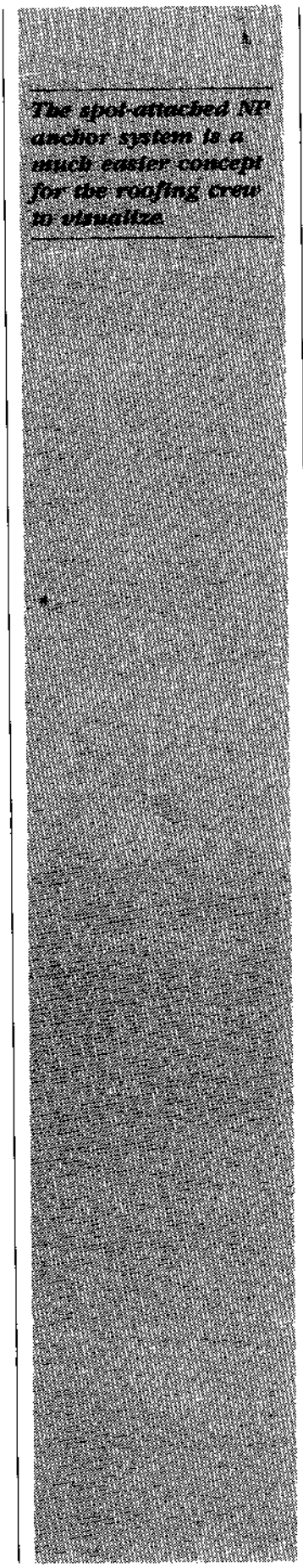

The spot-attached NP anchor system is a much easier concept for the roofing crew to visualize.

Installation gets complicated

The two primary types of non-penetrating systems on the market install a bit differently. The spot-fastening system uses NP anchor caps attached to plastic boss plates placed in a 3-foot-by-3-foot grid over the field of the roof. To install this type of system, workers first lay out the EPDM sheet over the boss plates and allow it to relax. Then plastic anchor caps are forced down over the membrane, mechanically binding it between the boss plates and the caps. This type of attachment creates a very high local stress on the EPDM sheet.

The track-fastening system uses tracks laid down on the insulation and fastened along the tracks' lengths. The track profile runs the length of the roof with a spacing pattern of 5 feet to 7 feet on center, depending on the anticipated wind forces. The EPDM sheet is then laid over the track, and a plastic insert is laid on top of the membrane and track profile, and forced down into the track. This crimps the EPDM into the concave track receptacle.

Other differences between the spot-fastened and track systems become obvious when they are compared side by side. For instance:

- A spot-fastened, non-penetrating system demands that each and every fastener work. A failed fastener or anchor cap turns a 3-by-3-foot square into a 6-by-6-foot square with no anchor point inside the grid.
- The NP anchor cap used in the spot-fastened system now calls for the application of a bead of lap sealant on the underside of the cap to help hold the cap on.
- A track-fastened system is relatively stiff. Any structural movement forces a change in the track, due to the dense fastening pattern.
- The track system's design causes water to pond, one of the last things a fastening system should be responsible for.

The two systems also differ in the complexity of their installation procedures. The track system is the more complicated, although it appears to be simple in concept and fast to install—on paper, adapting the system's track spacing and layout to the roof's requirements looks easy. Contractor experience, however, has shown that a much higher level of expertise and manpower is required to install this system. Because the installation requirements will differ from roof to roof, roofing contractors need to get the manufacturer's approval for each roof that is to be recovered with a track-type system.

Crews familiar only with Factory Mutual's (FM) fastening guidelines will find the fastening pattern for the track system very different. Following the fastening pattern for the linear strips of track will require a totally new thought process. Crew members may also find that the steel track itself presents problems; sharp edges or steel burrs remaining on the cold-formed piece may cut the EPDM membrane.

The spot-attached NP anchor system is a much easier concept for the roofing crew to visualize. The perimeter and corner areas of this type of roof end up being fully adhered using a 60-mil sheet of EPDM to meet the manufacturer's design recommendation. This system is not without its complexities, however. Fastening the insulation boards in the perimeter area of this system calls for a fastening pattern that only a finish carpenter could appreciate. The pattern appears to be a bit complex for the average member of a roofing crew.

In either system, roof penetrations present yet another complex installation problem. Even simple roof openings require installers to use more fasteners, adhesives and track to seal the roof around them.

TABLE 1
Typical Mechanical Fastening Methods for EPDM Membranes

	SPOT FASTENED	STRIP FASTENED
Penetrating	Disc	Batten
Non-Penetrating	NP Anchor	Track

Even though the spot and track systems differ, they do share some rooftop performance characteristics.

Wind performance similar

Even though the spot and track systems differ, they do share some rooftop performance characteristics. One is their reaction to the dynamic wind forces that are constantly present on a roof. There is no other single-ply roof system so tested by wind. Unreinforced EPDM has one of the highest elongation capabilities of any single-ply membrane. When winds moving across the roof edge produce a negative pressure at the perimeter, it causes the roof system to uplift. An EPDM system subjected to this type of stress will ripple, elongate and pull against the fastener devices.

Both spot- and strip-fastened non-penetrating systems may have passed the FM wind uplift test using the 5-foot-by-9-foot chamber, but they may not be ready to face the challenges of actual rooftop conditions. The FM test cannot adequately reflect the true wind forces that pull at a roof's perimeters. One manufacturer has stated that its system will withstand 89-mph winds, but this may not be an accurate assessment of the product's capabilities. Anyone who has ever stood on a mechanically fastened roof in a 45-mph wind gust will agree that at 89 mph only the manufacturer's rep will be left standing there; everyone else will have run for cover.

There are ways to make a non-penetrating system roof more wind resistant. If the system is installed on a roof that has a good air seal, then very little membrane movement will be seen. If it is not possible to tightly seal the perimeter, an equalizer valve can be installed that will help balance the pressure differences above and below the membrane.

Concept is still evolving

As can be seen by the problems that need to be overcome, the non-penetrating concept is a good idea, but the realization of this concept is still evolving. In the future, better designs that will answer some of the concerns I have mentioned should be forthcoming. When these products come on the market, it is doubtful that the systems that are available today will continue to be available.