Am I Using the Right Fastener?



BY STAN CHOINIERE

There are several different deck types used in commercial buildings with low-slope roofs. The deck types have a wide variety of structural characteristics that require several different fasteners, some unique, to meet all of the needs of the roof coverings.

Fasteners have evolved a great deal since they were first used to attach insulation in the early 1980s. While Factory Mutual created the need for roofing fasteners, none had been engineered for the roofing environment. Pullout, backout, and corrosion-resistance demands were unknown; consequently, fastener performance was not always up to the task. As fastener manufacturers started to work more closely with roof cover manufacturers, and with what was learned through testing at Factory Mutual and with real-world experience, more sophisticated and task-specific fasteners were developed.

At first, the only decks that could be mechanically attached were steel and wood. Cementitious wood fiber (Tectum), gypsum, lightweight insulating concrete, and even structural concrete decks posed unique properties that did not allow attachment of insulation and membrane with traditional screws. Fastener manufacturers began to see the roofing world as a new opportunity and dedicated resources to engineering fasteners to meet the demands as they were known at the time. New fastener companies emerged that were solely dedicated to the roofing industry. Several new fasteners were developed for better performance with conventional decks as well as for decks that could not be fastened with traditional screws. Many "out-of-the-box" ideas and designs were spawned by this demand. Some became very successful and patented designs that are still in use; others, while interesting, never made it past the prototype stage.

Here is a generic description of the most common decks and fastener options.

Steel Deck

The most common deck type is steel, but it is available in several different configurations, gauges, and tensile strengths. Gauge and tensile strength play a major role in fastener performance. (Remember that when a screw pulls out of a steel deck, it's the deck that fails, not the screw.) The change in test frames at Factory Mutual from 5 ft x 9 ft to 12 ft x 24 ft for all mechanically attached systems over 4 ft wide and for fully adhered, built-up, and modified bitumen systems requiring wind ratings over 90 psf exposed the limitations of many of the screws used in steel. Today, we have a variety of screws for steel decks.

The component being attached (insulation or membrane) will determine which screw to use. "Standard" screws, often referred to as #12s, are typically used to attach insulation (*Figure 1*), while larger diameter screws (#15 and #21) are used for membrane attachment. These larger diameter screws also have thread (but-

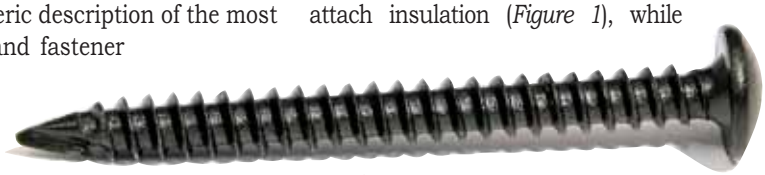

Figure 1

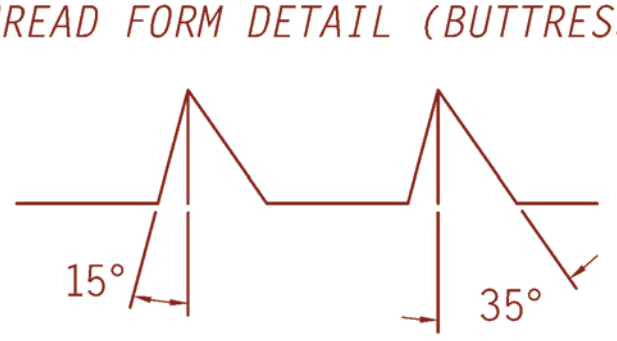

Figure 2

tress) and point configurations (see *Figure 2*) that maximize pullout and backout resistance. Insulation attachment is less dynamic, and insulation fracture is more likely to occur than fastener pullout, so insulation screws are less sophisticated. All of these screws are used with a stress plate that is configured for the specific use. Most roof cover manufacturers have fastener programs and generally require the use of their fasteners to comply with warranties. Approvals, especially Factory Mutual approved systems, have minimum deck requirements; therefore, the roof cover manufacturer must be consulted for specific deck and fastener requirements.

Wood Deck

Wood decks will be composed of dimensional lumber, plywood, or OSB. Currently there are no roofing screws that are designed specifically for wood decks. Steel deck screws – especially the "standard" screws – are commonly used in wood. The coarser thread provides the best pullout resistance for wood. There are also some screws referred to as Heavy Duty #14 or all-purpose that can enhance pullout resistance in wood decks (*Figure 3*). Dimensional lumber usually doesn't pose much of a problem; because of the thickness and density, pullout will be very high. It can sometimes be difficult to get consistent and adequate pullout values with plywood and OSB, especially when less than ¾ in thick, due to limited thread engagement and voids in the laminations. This is of particular concern with mechanically attached single ply, where the loads are more dynamic. Manufacturers continue to work to develop a fastener that will address the needs of plywood and OSB decks.



Figure 3

Cementitious Wood Fiber (CWF)

These decks are not capable of holding a "traditional" screw. The wood fiber and cement construction are not dense or stable enough to hold small-diameter, shallow-thread screws.

The author's introduction to roofing and roofing fasteners 26 years ago was with the Roofle, a ¼-in-diameter toggle bolt in long lengths with 4 inches of thread to attach insulation and membrane to these decks. While this provided very positive attachment, it was a very labor-intensive product. It is this family of decks for which the outside-the-box thinking described earlier comes into play. Large-diameter, coarse-thread, auger-type fasteners made from glass-filled nylon (*Figure 4*) were developed to accommodate the varied density of the deck and could be installed without pre-drilling. Denser decks may require a predrilled hole. Some of these fasteners have a mechanism that prevents backout when used to mechanically attach membranes (*Figure 5*). There are other fasteners of this general design that are made from steel

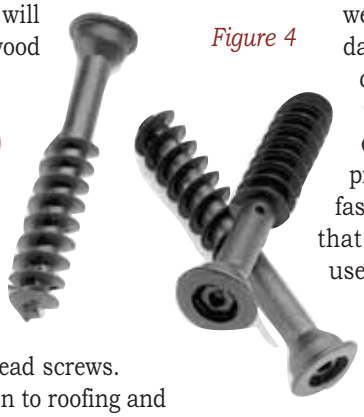

Figure 4

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and look like monster screws. It is also common to attach base sheets to this kind of deck. Drive-type fasteners having barbs that are extended into the deck after the fastener is seated provide an excellent attachment method (*Figure 6*). Having a qualified technician perform pullout tests is a must with this type of deck.



Figure 5

Gypsum

Like CWF, this deck won't hold a traditional screw. Many people have tried putting heavy-duty screws into this type of deck and achieved relatively high pullout resistance. The problem is that over time, the screw will be worked back and forth due to movement of the insulation and/or roof cover. The deck is not resilient enough to take this movement, and pullout resistance will greatly diminish. The same auger-type fasteners that are used for CWF are used for gypsum; however, with gypsum one must predrill the deck before installing these fasteners. For base-sheet attachment, there are a few options, all drive-style installed with a weighted "pogo" driver. The extendable barb-style used in CWF or a base-sheet fastener may be used.

Again, pullout tests are required for this deck type.

Lightweight Insulating Concrete

Density is all over the scale with this deck type, depending on mix design and condition of existing decks. Curing of new pours also impacts pullout performance as well as the amount of force needed to install fasteners. The drive-type fastener, with barbs in some cases, can be used to attach insulation. The practice of using a screw that is normally used in steel decks has become fairly common, especially in some high-wind applications. For this application, the screws are driven through the lightweight insulating concrete (LWIC) into the steel form-deck, which helps to hold the LWIC in a "sandwich" between the steel deck and the insulation board.

It is, however, more common to attach a base sheet to this deck type. Fasteners that are formed from light-gauge steel have been used to attach base sheets for over 20 years and have proven their worth in high wind areas such as South Florida, where LWIC is commonplace (*Figure 7*). Insulation and/or additional plies can then be mopped in or adhered with insulation adhesive and an adhered single-ply, built-up, or modified-bitumen system installed on top. Mechanically attached single ply over LWIC is seldom used unless there is a steel form-deck

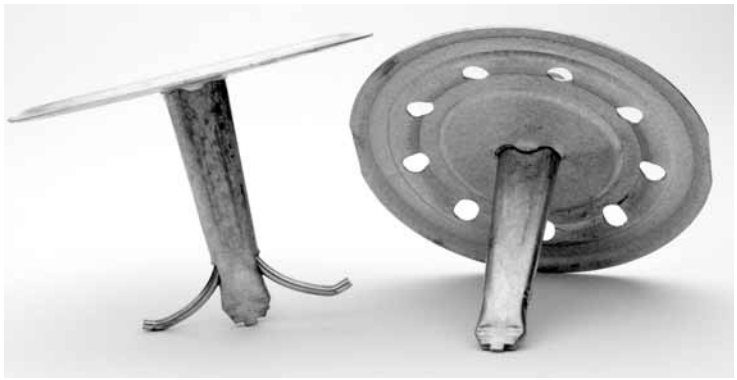

Figure 6



Figure 7

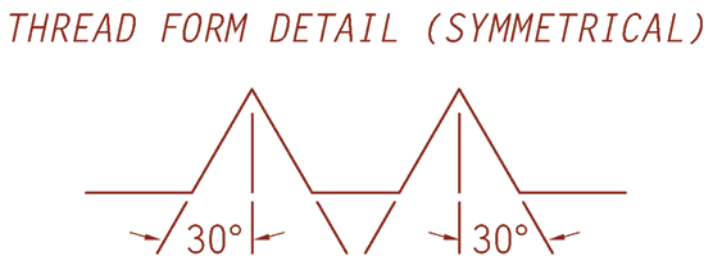

Figure 8

under the LWIC that is capable of providing adequate pullout resistance, or the membrane can be fastened to purlins. With purlins that are heavier than 18 gauge, special fasteners with drillpoints and fine threads are required. The auger-style fasteners are not acceptable with LWIC.

This deck type also requires pullout tests.

Structural Concrete (SC)

There are a lot of different options for structural concrete. Both insulation and membrane can be attached to SC and pullout will be very high in a sound deck.

Whatever the choice, a pre-drilled hole is required, and installing fasteners into SC is labor intensive. One can use a heavy-duty screw with a symmetrical thread (*Figure 8*). Unlike the buttress thread, this thread style has matched angles on the top and bottom of the thread and will cut a clean thread when properly heat-treated and installed into a properly sized, pre-drilled hole. What has become a more popular style for SC is the drive-type fastener, which has a deformed or fluted shank that, when driven into a properly sized predrilled hole, creates an interference fit providing very high pullout resistance (*Figures 9* and *10*).

Each fastener has its advantages. The drive fasteners are easier to install, but if they need to be removed, good luck! Screws take a good-quality, high-torque screw gun and a little more time and finesse, but they can be backed out. As drill bits wear, the hole gets smaller and the fasteners are harder to install, so drill-bit life can be

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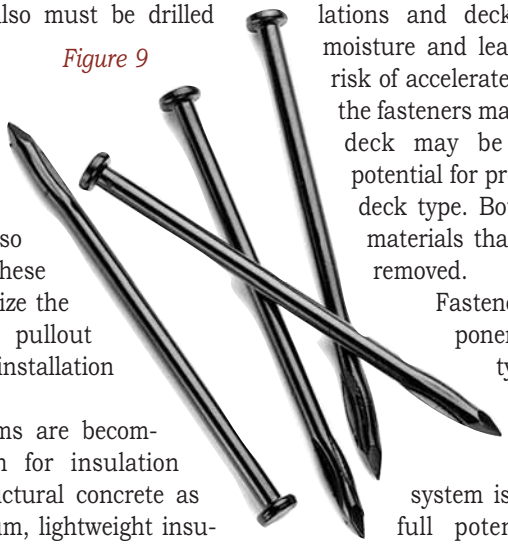
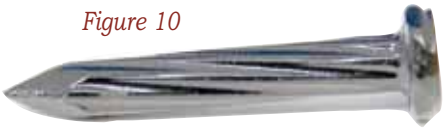
short. The holes also must be drilled sufficiently deep to accommodate the debris that falls back into the hole when the fastener is installed. Pullout tests are also a good idea for these decks to properly size the hole for optimum pullout performance and installation ease.

Figure 9



Adhesive systems are becoming more common for insulation attachment to structural concrete as well as some gypsum, lightweight insulating concrete, and cementitious wood fiber decks. Material costs are higher, but labor is significantly reduced (*Photo 11*).

Figure 10



Let's not forget good roofing practices when selecting and evaluating fasteners for reroofing projects. Corrosion-resistant coatings have evolved from primitive versions 25 years ago to very high tech products today. The industry has transitioned from "sacrificial" coating to "barrier" coating.

Sacrificial coatings react with the corrosive elements and, as the name implies, sacrifice themselves to protect the base material. Eventually, the coating will be depleted, causing the base material (steel) to be exposed, and corrosion will quickly consume the steel. Depending on the corrosive, depletion of the sacrificial layer will occur at different rates.

Barrier coatings form a protective layer between the potential corrosive and the steel. As these coatings are not consumed, they will provide longer corrosion resistance against other potential corrosives as well.

All corrosion needs a catalyst, and in roofing, it's water. Reroofing over wet insulations and decks can trap that moisture and lead to the potential risk of accelerated corrosion. While the fasteners may be protected, the deck may be vulnerable. The potential for problems varies with deck type. Bottom line: existing materials that are wet must be removed.

Fasteners are a key component of nearly every type of roofing system. Proper selection is imperative if the system is to perform to its full potential. It is very important to work closely with the roof cover manufacturer to make sure the right fastener is being used, as well as the correct stress plate, and that you are following the manufacturer's specific fastening patterns and installation procedures, as they are not as generic as they once were.

There are also several constructions that have very high wind ratings if installed in accordance with strict guidelines, including deck attachment and preparation.

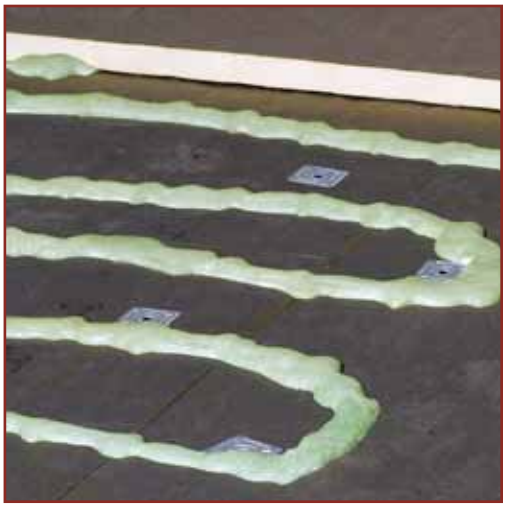


Figure 11

Special demands have led to a large number of task-specific fastening systems. Don't let it be intimidating; work with the manufacturer to help with selection and field support.

Reference

Hogan, Lyle, "Hostile Environments," *Interface*, June 1995.

Stan Choiniere



Stan Choiniere has 27 years of experience in the roofing industry, all with OMG Roofing Products. Over that time, he has worked closely with roof cover and insulation manufacturers to develop and test fastening systems to meet the changing needs of commercial roofing. Stan holds several fastener and equipment patents, with additional patents pending. Choiniere has served on technical committees with NRCA, ASTM, and ERA. He has held several positions during his 25 years of association with SPRI, including Technical Committee chairman, vice president and president. He was chair of the committees responsible for the development of 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 for SPRI and ERA and is the Technical Committee chairman at SPRI. He is also a 20-year member of RCI.