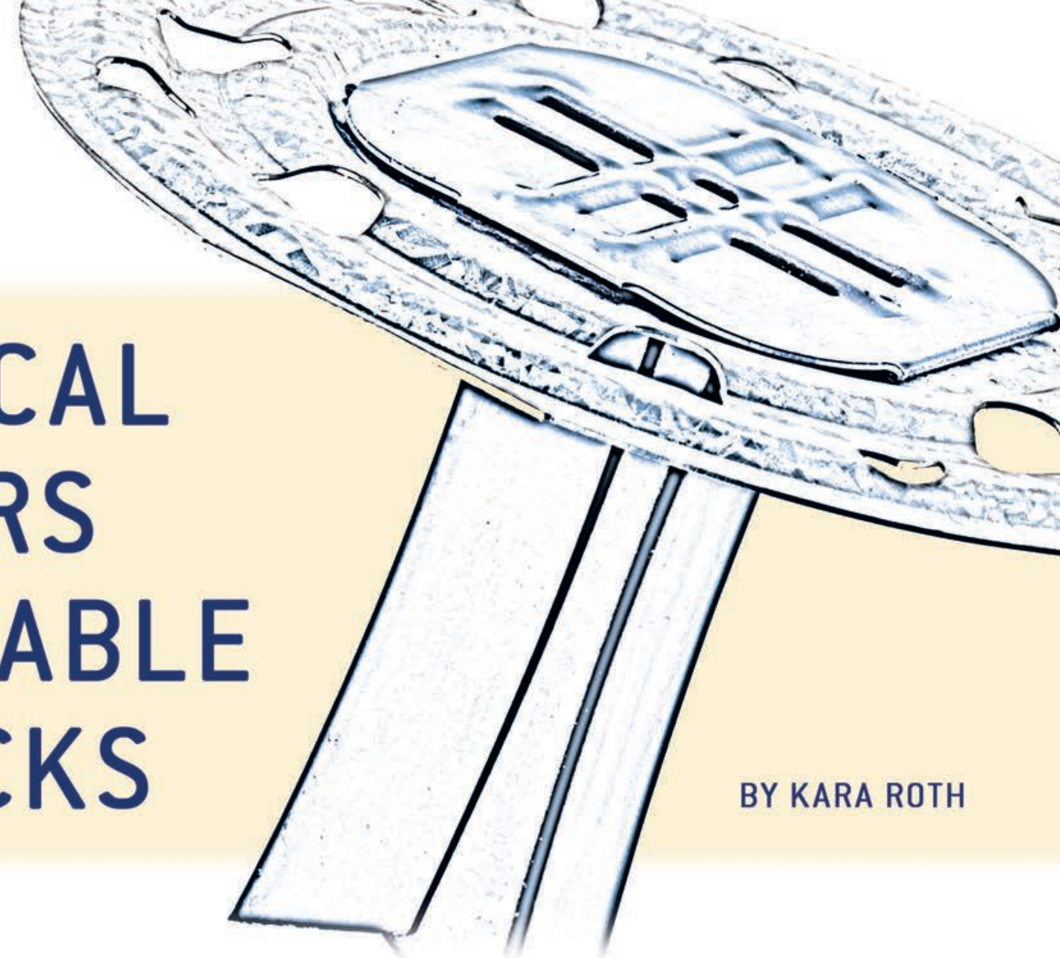


MECHANICAL FASTENERS FOR NAILABLE ROOF DECKS

BY KARA ROTH

The performance of a roof is determined by many factors. While the quality of the installation is critical, so, too, is the roof system—from securement, to the deck, to the roof cover. The method by which the roof system is constructed and affixed to the roof deck helps determine the longevity of the assembly and how it will withstand severe weather events.

While commercial low-sloped roof assemblies have evolved over the years, the importance of using fastening systems to ensure that the assembly performs as intended has remained a constant. Although the most commonly understood commercial roof decks today are corrugated steel and concrete, some roof decks are constructed with wood, poured gypsum, gypsum plank, cementitious wood fiber, or lightweight insulating concrete. Additionally, roof decks incorporating unknown poured-in-place materials are discovered during reroofing and re-covering applications. Collectively, these decks are often referred to as nailable roof decks. For many reroofing and re-covering applications over nailable roof decks, field pullout tests using the *Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners* (ANSI/SPRI FX-1) are necessary to confirm that the fastener can be installed, to quantify the withdrawal resistance, and to validate the overall integrity of the roof deck material.

As nailable roof deck materials and building code requirements have evolved, the design of fasteners used to secure membranes and insulation has as well. Up until the mid-1950s, non-insulated, asphaltic roof assemblies were secured with hot asphalt and nails with tin caps. After a major fire in 1953, asphalt and other combustible materials were severely restricted in roofing applications.

In 1992, Hurricane Andrew devastated south Florida, prompting significantly increased requirements for wind loads on structures and the way the roofing industry tests for wind resistance. Between 2007 and 2016, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, was updated three times with the intent of increasing energy efficiency of buildings, saving U.S. homes and businesses an estimated $126 billion, and avoiding 841 million metric tons of carbon dioxide emissions through 2040.[1]

ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, has been updated twice in recent years, resulting in increased wind load requirements and changes to perimeter zones, particularly in coastal areas. These events, along with other loss experiences, changed the building codes and related test standards. The roofing industry responded by driving innovation in materials and systems, including mechanical fastening systems in nailable roof decks.

In many cases, mechanical fastening to nailable roof decks is preferred over adhesives because:

1. There are several varieties of adhesives on the market that allow the installer to apply the roof system directly to the nailable roof deck. However, one drawback is that the assembly eliminates the vapor barrier in the system.
2. Industry experts have suggested that all roof decks experience moisture migration. Roofs that have poured-in-place nailable roof decks are more sensitive to moisture migration while the deck cures.[2] Fully adhered roof cover systems typically incorporate mechanically attached venting base

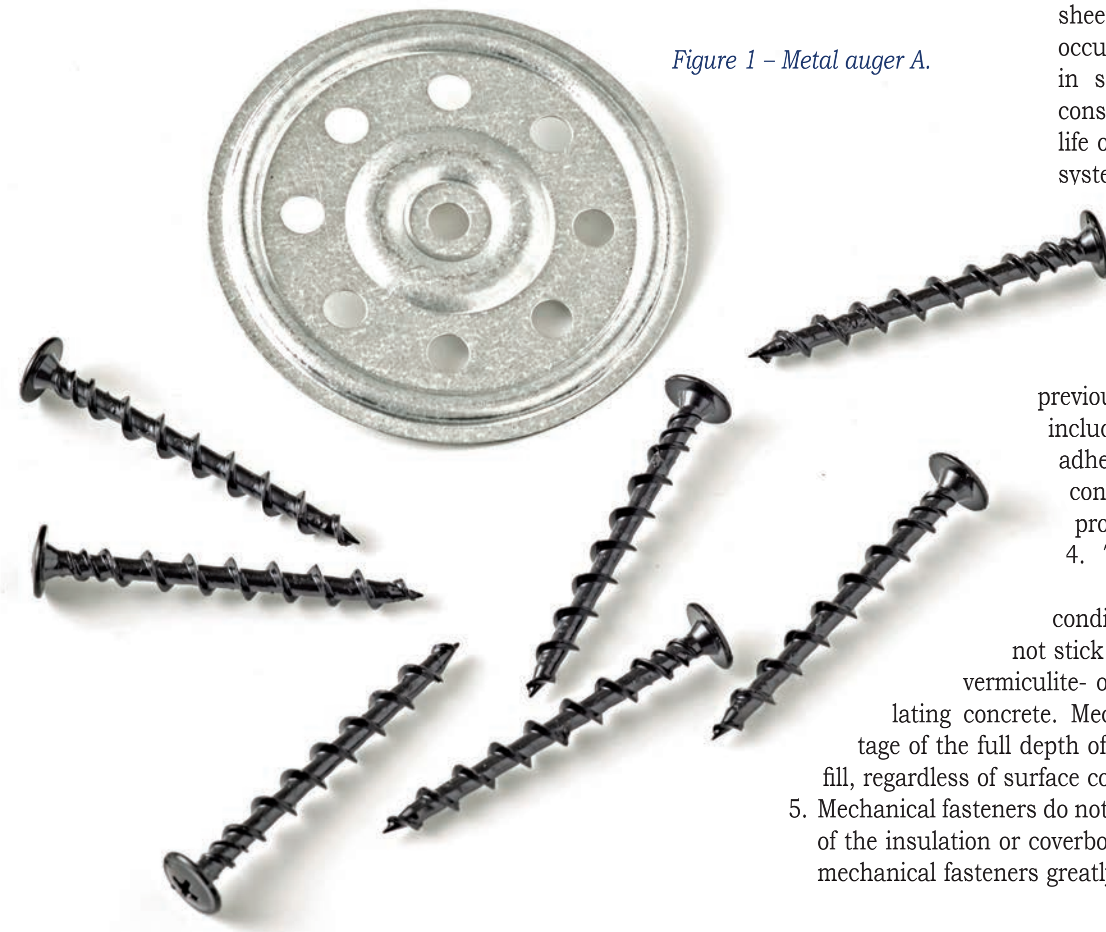


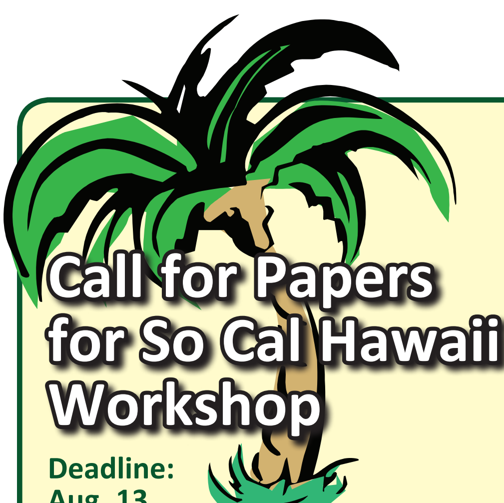
Figure 1 – Metal auger A.

sheets to allow lateral venting to occur. Not having a vapor barrier in some roof systems may cause considerable problems during the life of the roof. Note: Some adhesive systems can be used with a vapor barrier.

3. The surface of existing nailable decks may have surface contamination from the installation of previous roofing systems. These could include residual active asphalt, prior adhesive residue, or other residue or contaminants that would preclude proper adhesion to the surface.
4. The integrity of adhered systems is reliant on the surface condition of the deck. Adhesives may not stick well to the chalking surfaces of vermiculite- or perlite-filled lightweight insulating concrete. Mechanical fasteners take advantage of the full depth of lightweight insulating concrete fill, regardless of surface conditions.
5. Mechanical fasteners do not rely on the strength or integrity of the insulation or coverboard facer. The requirements for mechanical fasteners greatly improve corrosion resistance.

		Can be Used in:			Fastened Component			
Type of Fastener	Fastener Description	Cementitious Wood Fiber	Light Weight Insulating Concrete	Gypsum	Base Sheet	Insulation Board	Cover Board	In Lap Attachment
Impact Fastener	Diverging Leg	No	Yes	Yes	Yes	No	No	No
	Tubular with Nail	Yes	Yes	Yes	Yes	Yes	Yes	No
	Tubular with Staple	Yes	Yes	Yes	Yes	Yes	Yes	No
Threaded Fastener	Polymer Auger	Yes	No	Yes	Yes	Yes	Yes	Yes
	Metal Auger A	No	Yes	Yes	Yes	Yes	Yes	Yes
	Metal Auger B	Yes	Yes	Yes	Yes	Yes	Yes	No

Table 1 – Fastener types for nailable roof decks.



Call for Papers for So Cal Hawaii Workshop

Deadline: Aug. 13

The So Cal Chapter of RCI, Inc. is seeking abstracts for presentations at the 19th Annual Hawaii Winter Workshop to be held January 14-15, 2019, in Honolulu, Oahu. The workshop will focus on developing solutions to challenging building envelope issues. The scope for addressing building envelope issues through innovation can be specific or broad and can include research and development of enclosure products/systems, novel application of existing technologies, advances in investigation methods and testing techniques, and challenging new construction and repair/rehabilitation projects that require thinking outside of the box.

The deadline for submitting presentation proposals for consideration is Monday, August 13, 2018. Proposals should be submitted as a 250-word (maximum) abstract. Any questions about presentation submissions should be sent to hawaii2019@socalrci.org.

Gypsum roof decks have been in use since the 1940s, but have become less common and are found primarily in reroofing/re-covering projects. Lightweight insulating concrete roof decks are constructed with cellular, vermiculite, or perlite fill, and most commonly used south of the Mason-Dixon Line. Both gypsum and lightweight insulating concrete roof decks provide excellent fire and insect resistance, low sound transmission, and can be applied in the field to create slope to drain.

Both existing gypsum and existing lightweight insulating concrete decks can be challenging substrates to fasten to due to variations in composition, moisture content, density, and compressive strength. As an example, if the deck is too hard, diverging leg fasteners may not be capable of fully penetrating the deck. If the deck exhibits low density or a high moisture content, significantly lower withdrawal resistance may occur. For these reasons, roofing contractors, specifiers, and system manufacturers often require field withdrawal resistance tests on nailable roof decks to verify the design of a roofing system and to determine the type and number of fasteners to be used.

How does one select the proper fastener? In areas that are not in a high-velocity hurricane zone (HVHZ), multiple fastener choices are available for nailable roof decks (see *Figure 1*). Factors that influence the fastener selection include: wind design pressure, applicable building code, system manufacturer's warranty requirements, field withdrawal resistance, the roofing system to be installed, type of base layer (insulation, cover board, base sheet, etc.) to be secured, and many other factors. Fastener types for nailable roof decks include those in *Table 1*.

Most roof system suppliers and designers require that field withdrawal resistance tests be performed on all nailable roof decks to verify the withdrawal resistance. ANSI/SPRI FX-1 stipulates the minimum number of withdrawal tests that need to be performed based on the roof area (ft^2). Most fastener suppliers, roofing system manufacturers, and many RCI members offer this service. The site-specific withdrawal values are used to determine the fastener density required for the tested fastener based on actual withdrawal data. If withdrawal values are lower than specified, an increase in fastener density is required.

In extreme cases, this could lead to fastener spacing that is not practical. For instance, the fastener spacing may be so close together that proper attachment to the substrate being fastened (base sheet, cover board, etc.) may be suspect, or the integrity of the nailable deck may be compromised. In perimeters and corners of very high-wind regions, fastener spacing can be so close that the stress plates touch. Given the recent changes in ASCE/SEI 7-16, this scenario of increased fastener density could become more prevalent.[3]

To complement the abundance of roof covering options, there are several mechanical fastening options available to affix roof system components to the nailable roof deck.

Metal auger A is designed so that multiple fasteners can be used with one metal stress plate to improve withdrawal resistance without predrilling (*Figure 1*).

Metal auger B is designed for use with a metal stress plate or metal batten bar. It features a coarse thread design for high withdrawal resistance. Pre-drilling is required for gypsum roof decks (*Figure 2*).

Polymer augers are coarse-threaded glass-reinforced nylon fasteners designed for use with metal stress plates and metal batten bars. Predrilling is required for gypsum roof decks (*Figure 3*).

Diverging leg impact fasteners feature a metal diverging leg fastener preassembled with a metal stress plate. A specialty impact tool is used to install the fastener (*Figure 4*).

Tubular nail impact fasteners feature a metal tube with flat head encasing a high carbon steel nail. A metal rupture disk is available to improve pull-over resistance. It can be installed with a hammer or specialty impact tool (*Figure 5*).

Tubular staple impact fasteners feature a metal tube housing a metal staple assembled to a metal stress plate. It is installed by use of a specialty impact tool. Metal tubes and staples are also available

Figure 2 – Metal auger B.

Figure 3 – Polymer auger.

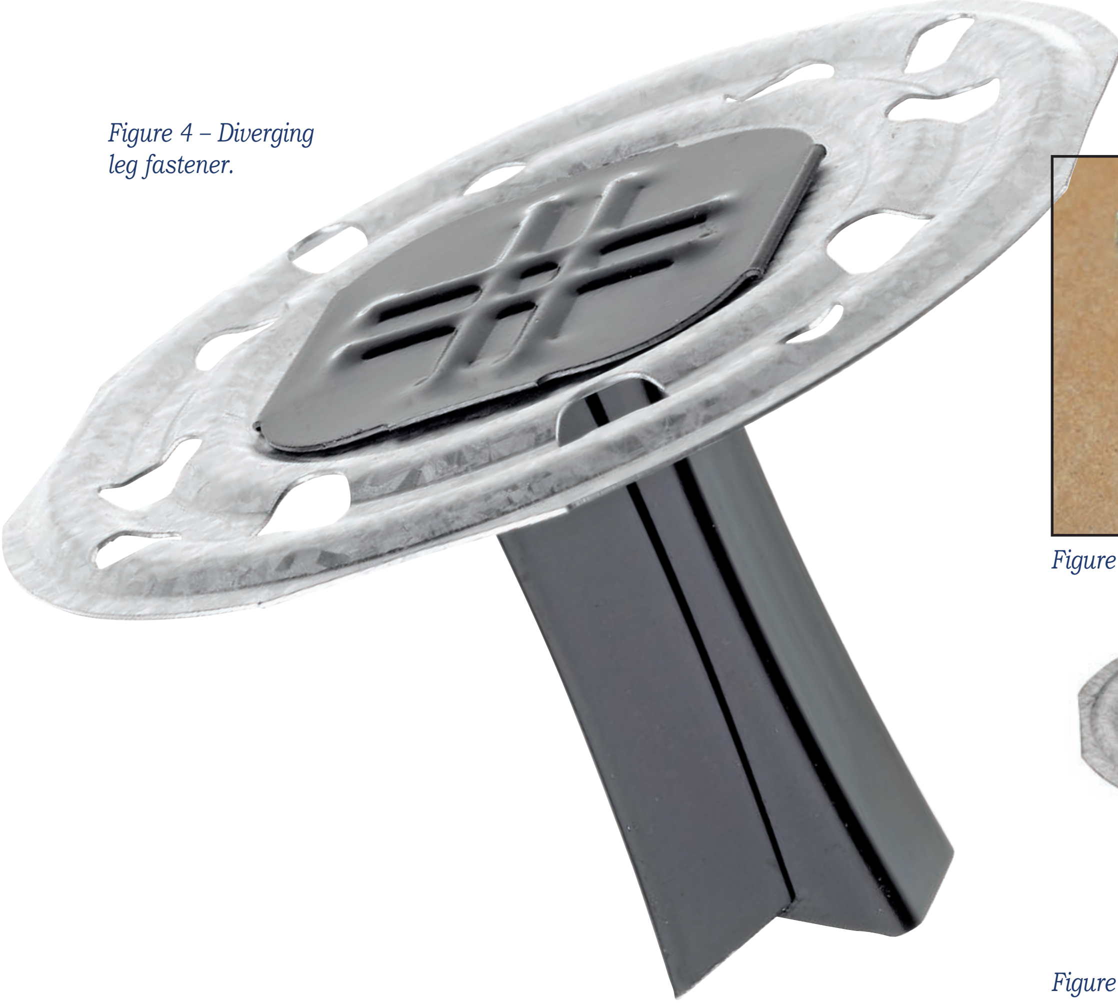


Figure 4 – Diverging leg fastener.

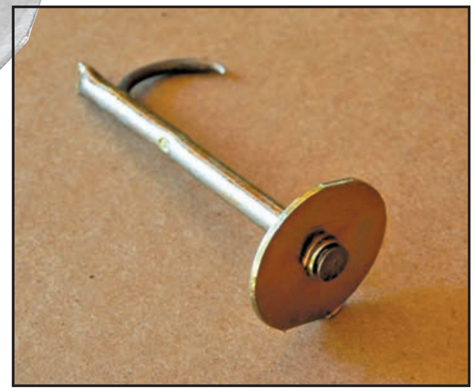


Figure 5 – Tubular with nail fastener.

Figure 6 – Tubular with staple fastener.

Deck Type	Metal Auger A	Metal Auger B	Tubular with Staple A	Tubular with Staple B	Diverging Leg A	Diverging Leg B	Tubular with Nail A	Tubular with Nail B	Polymer Auger A	Polymer Auger B
Light Weight Insulating Concrete	216	na	na	61	77	60	na	120	na	na
Gypsum	143	342	131	93	60	68	na	365	259	200
Cementitious Wood Fiber	na	122	176	55	na	na	32	115	141	253

Table 2 – Typical static withdrawal resistance values (pounds/force).[4,5]

for use with metal batten bar (*Figure 6*).

For typical static withdrawal resistance values of the various mechanical fastening options, see *Table 2*.

If history is any indication of what the future holds, changes in building codes will continue to drive product improvements. The 2018 International Building Code (IBC) and ASCE/SEI 7-16 will prove to be catalysts in the next evolution of roof system testing, specification, and installation.

For most nailable roof decks, mechanically fastened base layers (vapor retarder, base sheet, insulation, or other) are often the best fastening solution. Mechanical fastener installation can be adjusted/extrapolated based on actual field pullout data to ensure the roofing system is properly attached in accordance with design wind pressures.

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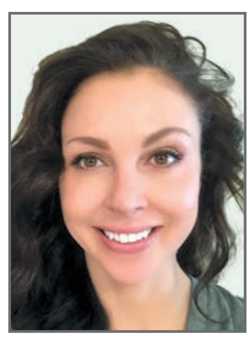

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