ROOF DECKS A TO Z
PART 18: When the Deck . . . Isn't

By Lyle D. Hogan

This is the 18th article in a series examining various deck types. This installment features five examples where a functional roof deck is not present. Potential risks associated with these types of examples and mistakes in judgment that may occur during the course of decision-making are discussed.

IT HAS LONG been held that there are four main elements of a composite roof system: the deck, the vapor-control layer, insulation, and the covering material.[1] Certainly, there are also flashings, adhesives, fasteners, and accessories to consider, but these four main elements are the widely regarded fundamental components. Of course, some roofs do not have insulation, and many do not require a vapor retarder; thus, we are left with two components that must be in place for something to be considered a roof.

While many mistakes have been experienced with improper or poorly performing coverings, mistakes can also abound from poor decisions regarding what *is* or *is not* a roof deck.

Figure 1. Corrugated asbestos panels are a vintage product that were widely used as siding and roofing materials alike. They are inappropriate for use as the substrate for over-roof assemblies.

CORRUGATED ASBESTOS AND FIBER-REINFORCED POLYMER PANELS

Corrugated asbestos panels are vintage products that were widely used as siding or roofing materials (**Fig. 1**). Leaks manifesting on a pitched roof constructed from this type of material may often be related to a flashing or penetration, and appropriate repairs may well extend the service life. **Figure 2** depicts a steeply pitched asbestos-panel roof that has served for decades, owing heavily to its generous slope. When the time comes for complete reroofing, corrugated asbestos panels should be removed by a professional qualified to handle asbestos and disposed of in a regulated landfill. Consideration can then be given to the new system selection.

The corrugated fiber-reinforced polymer (FRP) roof shown in **Fig. 3** sustained impact damage during a hailstorm. This product has a different profile when compared with legitimate FRP decking (a topic to be explored in a later installment). The temptation to apply materials over corrugated FRP should be quickly dismissed, as its load-carrying capacity is dubious, and fastening difficulties are sure to arise. It is inappropriate to place additional materials on top of corrugated asbestos or FRP panels.

LIGHT-GAUGE RIBBED METAL

Light-gauge 26- or 24-gauge (0.017- or 0.024-in., respectively), ribbed metal has been widely used as siding and for roof coverings. A variant known as "5-V" has been mostly relegated to agricultural applications but can still be found on some vintage rural dwellings and historic downtown districts. If you are tempted to over-roof one of these forms, don't do it. They are usually located over spaced supports and were not intended to serve as substates for eventual roof-over applications. While certain coating treatments may be worth considering, this form of metal panel is seldom appropriate to receive additional materials. Metal roof "retrofits" can be carried out using proprietary support girts that do not depend on the older metal panels for anything.

Figure 4 depicts ordinary ribbed metal panels situated over iron bulb-tee rails that were left in place following removal of the old poured-gypsum deck and formboards. The mechanically attached ethylene propylene diene terpolymer (EPDM) roof above was quite loose underfoot for reasons that were not fully recognized at first. Underside examination revealed that metal panels had merely been "loosely laid" over the iron rails, which clearly created a fastening problem. This type of construction was a completely irresponsible choice on the part of the installer and the consumer; hopefully, no consultant or "designer of record" was involved.

Figure 2. This steeply pitched asbestos-panel roof has served for decades.

Figure 3. This corrugated fiber-reinforced polymer roof sustained impact damage from hail exposure. Materials should not be applied on top of this roofing product.

SHINGLES OVER SLATES OR WOOD SHAKES

Figure 5 depicts two layers of asphalt shingles applied over an original slate roof. It is perplexing to consider what the installer was thinking as nails were being driven through these materials. The shingle installers evidently assumed that the overall stack of materials was bulky enough to hold the nails. However, this structure had spaced wood sheathing (skip-sheathing). While a spaced substrate is fine for slate, it is not intended as a deck for shingles—especially two layers of shingles over old slates;

Figure 4. Ordinary ribbed metal panels are situated over iron bulb-tee rails left in place following removal of the old gypsum deck.

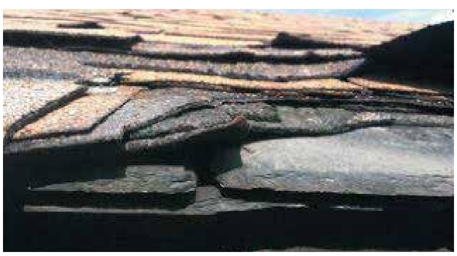

Figure 5. Two layers of asphalt shingles over a slate roof. It is perplexing to consider what the installer was thinking as nails were being driven.

predictably, this installation failed. Slates have even been found wired to iron framing (**Fig. 6**), but they would still not be suitable for receiving any kind of additional material placed atop.

More unsettling is the building featured in **Fig. 7**, where roll-roofing had been placed across an old wood-shake roof. This kind of work is a departure from rational thinking, as the building would have been better served with a blue tarp. Although this arrangement was undoubtedly driven by financial concerns, one still struggles to understand the logic behind it. As discussed in Part 12 of this series, wood shakes can perform very well over skip sheathing **(Fig. 8**); however, this form of roofing is not a suitable substrate for any additional layers. As Benjamin Franklin is credited with saying, "The bitterness of poor quality remains long after the sweetness of low price is forgotten."

Figure 6. Slate roofs can sometimes be found wired down to iron framing. Slates are not suitable for receiving any kind of additional material.

PROPRIETARY TRUSS-PURLIN SYSTEMS

All types of steel roof framing are not the same. Some types make use of cold-rolled shapes whereas others use hot-formed mill shapes (that is, traditional purlins, bar joists, open-web joists). Proprietary cold-formed systems are a small part of the steel framing marketplace. An example of this type of proprietary system is the Landmark 2000 by Butler Manufacturing. These truss purlins can form a long-bay framing system that can span up to 60 ft (18.3 m). It is important to recognize proprietary trusses that are cold-rolled shapes when encountered, as they are not found in the "Vulcraft catalog."[2] (Named for Vulcraft, which is a manufacturer of open-web steel joists and joist girders in North America, the "Vulcraft catalog" tabulates load-span relationships for various traditional bars and joists. The current edition is published by the Steel Joist Institute.)

The focus of this discussion is one distinctive feature of the truss purlin: the light-gauge metal liner that supports board insulation below a premium standing-seam metal roof covering (**Fig. 9**). It resembles a "formboard" of the type used for some poured decks, but its sole function here is to support the board insulation. It has no sidelap stitching, and it isn't even attached to the framing girts—and it doesn't need to be. Micrometer measurement (**Fig. 10**) can confirm that this 26-gauge metal liner is incapable of serving as horizontal shear diaphragm; that function is gained by rod bracing, as it is in other buildings with structural metal roofs. The liner can be cut with household scissors (**Fig. 11**) and is incapable of holding threaded deck screws.

Most standing-seam metal roofs have a fiberglass insulation blanket merely draped across the sub-purlins, although wire or mesh netting can also be used. In any event, this metal liner is *not* a roof deck. Remember that a structural standing seam, by definition, does not require a subdeck of any kind. It would be somewhat unusual to need to over-roof a premium standing-seam system, but over-roofing proposals should not suppose that this liner can be engaged with threaded deck screws—or any other kind of fastening device. It simply isn't a deck.

INSULATED FREEZER PANELS (VINTAGE TYPE)

The type of panel discussed here would have been used in freezer construction during the 1950s through the 1970s. Well before energy conservation came into vogue, thermal performance was necessary for cooler and freezer applications. A produce cooler may operate between 35°F and 45°F (1.7°C and −7.2°C), whereas an ice cream freezer is often held at −15°F to −25°F (−26°C to −32°C).

Wall panels were usually between 7 and 11 in. (178 and 279 mm) thick with expanded polystyrene (EPS) insulation making up the core and a very thin layer of plywood comprising both surfaces. The same panels were also situated across steel framing supports to serve as the deck for built-up roofs, as was customary for the time. Later in the roof's service life when reroofing was deployed, a loosely laid and ballasted system was often selected.

Figure 12 depicts an unstable structure where collapse was imminent (circa 1984). Part of a large midwestern food distribution center, this low-slope assembly was experiencing creep deflection from long-term overloading. In this example, the old built-up roof was still in place, the heavy ballasted roof had been added years prior, saturated wood-fiber insulation was present, and there was a snow drift potential against the higher building wall. Surface deformation had resulted in a considerable depth of ponding water (more than 4 in. [100 mm] deep at midspan).

Collapse scenarios are almost always caused by a combination of factors. **Table 1** presents the estimated loads observed at the time of inspection. This estimate does not include contribution by periodic drifting snow, which can be very high, especially during a "rain-on-snow" episode. Moreover, the author has encountered freezer panels of this type that were completely impacted with ice from decades of slow moisture

Figure 7. Roll-roofing placed across an old wood-shake roof.

Figure 8. Wood shakes can perform very well over skip sheathing. However, this form of roofing is not a suitable substrate for any additional layers.

Special interest

Where Office Furniture goes to Die

THE POST-PANDEMIC RETURN to the office continues, but its slow pace in major cities like New York, where only about half of office space in the metro area was occupied as of June 2023, means a lot less demand for office furniture.

What's become of it?

"The answer can often be found in the back of a moving truck—en route to the auction block, a liquidator or, more likely, a landfill," wrote Stefanos Chen in the *Wall Street Journal*.

While storage also is an option for cast-off office furniture, most of it ends up in the trash. Trevor Langdon, chief executive of sustainability consulting company Green Standards, estimated that more than 10 million tons of office furniture in the United States finds its final home in a landfill each year.

Source: *The Wall Street Journal* / ImageFlow@shutterstock.com

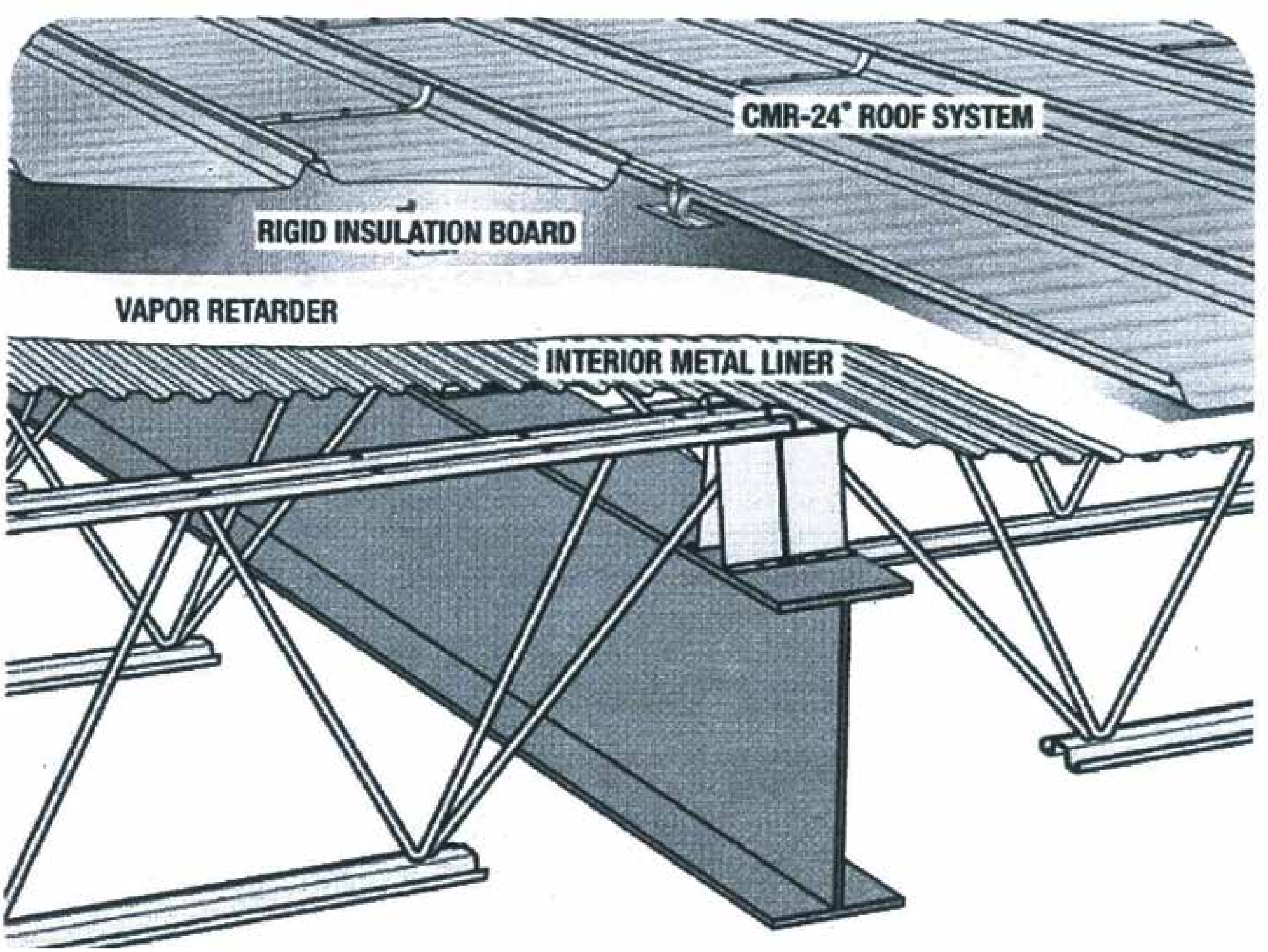

Figure 9. This proprietary metal assembly has a metal formboard/liner that is merely used to support the board insulation; it is not *a steel roof deck. Photo used by permission of Butler Manufacturing.*

Figure 10. Micrometer measurement confirms that this 26-gauge (0.017-in.) metal liner is not intended to hold fasteners.

Figure 11. This light-gauge metal liner can be cut with household scissors. There is no wind rating whatsoever to be had when materials are fastening with screws to this type of liner.

diffusion during service life (remember that a freezer has extremely high *inward* drive for moisture vapor). This ice accumulation, of course, adds yet more to the load tally.

Not to be confused with modern structural insulated panel (SIP) systems, these vintage panels do not meet current standards for a code-compliant roof deck. They may have been satisfactory for the walls, but they are grossly inadequate for carrying loads of the magnitude shown in Table 1. Fortunately, the owner understood the peril, the roof was radically reworked, and collapse was averted. During reroofing on vintage freezers of this type, several lightweight options can be considered, but any negative camber should be eliminated, and more underside bracing will probably be needed near higher adjacent walls to accommodate periodic drifting snow. Old, deformed, ice-impacted roof panels should be replaced, and modern SIP products can fill the bill.

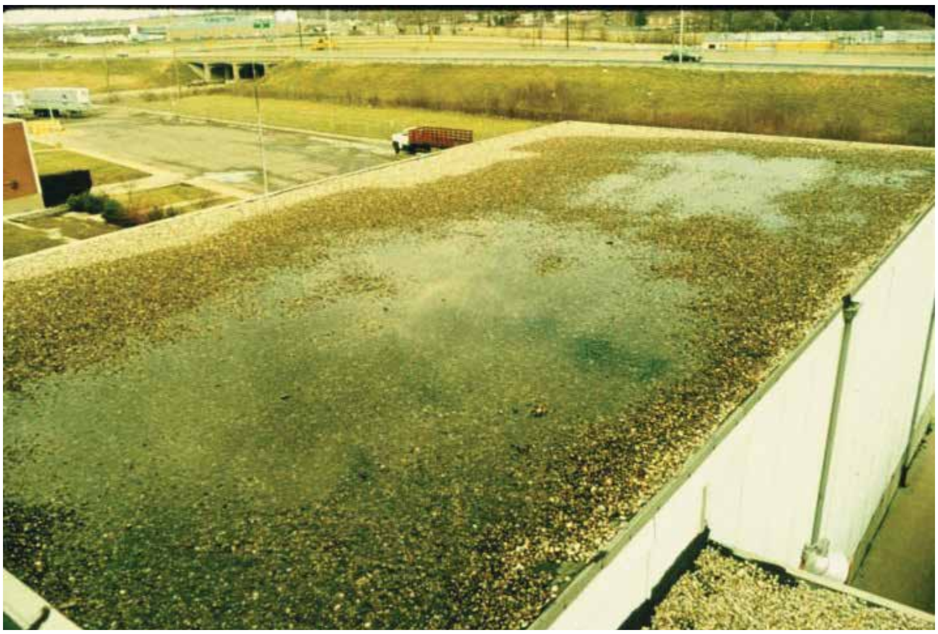

Figure 12. Insulated freezer panels can present genuine problems when over-roofing is needed. This midwestern freezer had experienced long-term creep and was subject to periodic drifting snow loads. As a result, it was perilously close to collapse when this photo was taken (circa 1984).

Table 1. Total service load observed at time of inspection for low-slope freezer assembly experiencing creep deflection

COMPONENT/ELEMENT	LOAD (lb/ft^2)
Gravel-surfaced built-up roof	6.0
Wood-fiber cover board insulation (saturated)	2.5
Stone ballasted roof assembly	10.5
Ponding water (approximately 4 in. at midspan)	20.8
TOTAL OBSERVED (conservative estimate)	**39.8**

Note: 1 in. = 25.4 mm; 1 lb/ft^2 = 4.88 kg/m^2.

CONCLUSION

The foregoing examples represent only a few of the mistakes that can be made with roof system selection, but they share a common attribute: They are not proper decks, regardless of attempts to make them so. Mistakes of this type may stem from poor understanding of the materials being considered, the tendency to do things cheaply, or a myopic fixation on delivery of some warranty.

REFERENCES

1. Griffin, C. W. 1970. "The Roof as a System." In *Manual of Built-up Roof Systems* . New York, NY: McGraw-Hill.
2. Steel Joist Institute (SJI). 2020. *45th Edition Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders*. Florence, SC: SJI.

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