Feature

Roof Decks A to Z

Part 19: Fiber-Reinforced Polymer (FRP)

By Lyle D. Hogan, F-IIBEC, PE, RRC

This is 19th in a series of articles examining various deck types. While used in siding/cladding, as exposed corrugated roofing sheets, and as form deck for poured concrete, this article will concentrate on fiber-reinforced polymer (FRP) as the substrate for low-slope roofing.

THE STRENGTH AND versatility of FRP have long been recognized for concrete repair, such as in parking deck rehabilitation (**Fig. 1**) and bridge pier wrap. Moreover, FRP can be fabricated into structural framing shapes, industrial grating, cable trays, channels, angles, tubes, and rods. These varied shapes are called pultrusions, which is a blended word derived from *pull* and *extrusion* (this is in contrast with ordinary extrusions that are "pushed" through the shaping dies or tracks).

FRP enjoys good fire resistance and flame spread ratings. Review of product literature indicates a flame spread rating of 25 when evaluated by ASTM E84[1] (broadly known as the Steiner tunnel test). FRP decking is often used in paper mills, natatoriums, food processing facilities, animal rendering plants, textiles, fertilizer production and storage, metal treatment, and similar high-humidity or corrosive environments.[2] It is a good replacement selection for rotted wood decks and deteriorated/spalling concrete planks. **Figure 2** depicts a decades-old built-up roof (BUR) and FRP deck in a corrosive environment with stainless steel decking as the replacement deck in this instance.

Figure 1. *The strength and versatility of fiber-reinforced polymer have long been recognized. Here, carbon-fiber wrap is being deployed during extensive repairs to a parking deck.*

The decking product is addressed under ASTM D3841.[3] That standard mostly concerns itself with classifying FRP products according to flammability and dimensional tolerances. But beyond this, good information (that is, white papers, research, testing standards, project profiles, and the like) is quite sparse for FRP as a substrate for commercial low-slope roofs; the reader will encounter this with a simple web search for "FRP roof decking"—or anything remotely similar. Being a specialty product, FRP occupies a small slice of the commercial low-slope roof deck market. But such decks do exist, and the building enclosure consultant would do well to recognize when they are encountered.

The decking gains stiffness from bidirectional arrangement of glass reinforcement, which usually constitutes about half of the product weight. In contrast with exposed FRP panels, roof deck products do not need a UV-stabilized resin or coating. Resin binding the glass fiber core is either isophthalic polyester or vinyl ester; while both provide outstanding corrosion resistance, vinyl ester is the widely preferred resin in environments having elevated operating temperatures.[4]

CONSIDERATIONS DURING ROOF SYSTEM DESIGN AND SELECTION

FRP is considered a "nailable" deck, meaning it can be mechanically anchored to support framing *and* it can receive fasteners for membrane and insulation. Yet, because it is likely to be found in high-humidity or corrosive environments, the use of modern adhesives

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should be considered when selecting the roof assembly. Adhesives would sidestep concerns for eventual fastener corrosion or enlarging of the openings where membrane and insulation fasteners penetrate.

Conventional threaded deck screws can secure membrane and insulation materials, but fracturing of the deck can sometimes occur if these "fixings" are overdriven (**Fig. 3**). Toggle bolts require predrilling, but they are prone to losing preload over the service life—such as when securing nailers or anchoring the flanges of a rooftop curb. Splitting-shank rivets are approved for this application and are preferable.

A vapor retarder is also likely to be a component in FRP construction because of some environments listed above. Forty years ago, kraft paper might have been applied directly to a steel deck in bituminous adhesive (**Fig 4**). The vulnerability to puncture is clearly evident, and many such vapor control layers were often damaged before insulation was even installed. A thin layer of hardboard installed prior to vapor retarder application can allay this risk.

Modern adhesives lends themselves to remaining layers and components. Indeed, an entire plausible roof assembly could be

Figure 2. *Old built-up roofing and decades-old fiber-reinforced polymer deck in a corrosive environment being replaced here with new stainless steel decking (Image courtesy of Teamcraft Roofing, Salisbury, NC).*

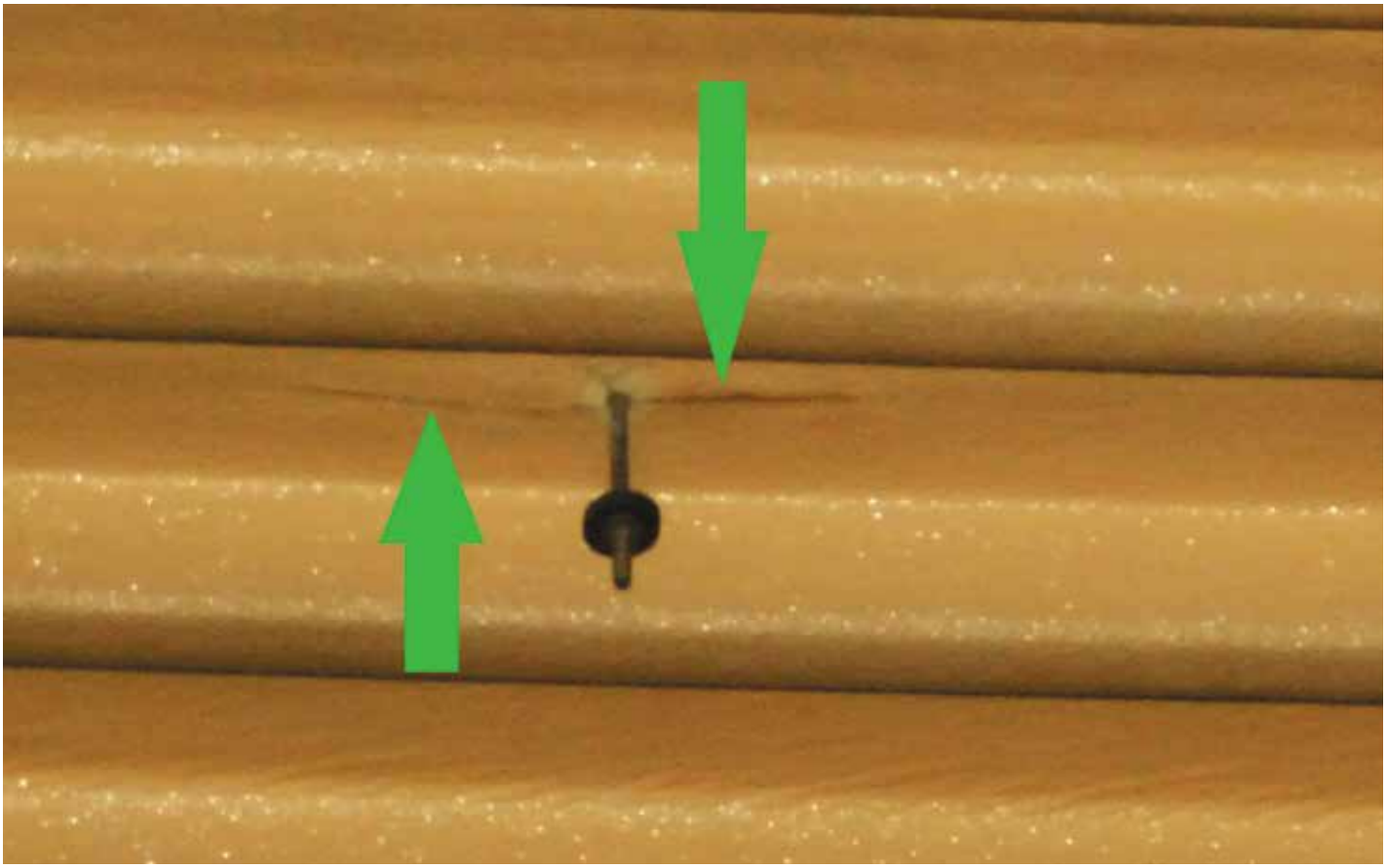

Figure 3. *Threaded deck screws can secure membrane and insulation materials, but fracturing of the deck can sometimes occur if these "fixings" are over-driven. Toggle bolts will require predrilling, but they are prone to losing preload over the service life. Splitting-shank rivets are approved for this application and are preferable (Image courtesy of Teamcraft Roofing, Salisbury, NC).*

Figure 4. *Forty years ago, kraft paper may have been applied directly to a steel deck in bituminous adhesive as the vapor control layer. The vulnerability to puncture is clearly evident. Accordingly, a hardboard layer should first be installed over fiber-reinforced polymer prior to vapor retarder application.*

configured using no fasteners at all—other than those used to anchor FRP deck panels to structural supports and the related sidelap stitching screws.

From casual viewing, FRP can be deceptively similar to conventional painted steel decking. During underside evaluation of an existing roof, be alert for minor differences that will assist in correct deck identification. Close scrutiny (using binoculars if necessary) will reveal that FRP has more rounded rib edges than the angular edges of a steel deck's ribs. Moreover, rib/flute depth is likely to deviate from the ordinary 1.5 in. (38.1 mm) dimension of most steel decking—sometimes ranging up to 3.5 in. (89 mm). The horizontal module may be different too, ranging to 8 in. (203 mm) on center. Misidentifying FRP early on could spell embarrassment later in the bidding and contracting phases of a project.

The evaluation phase offers opportunity to explore for other matters of importance. The old FRP deck shown in **Fig. 5** had electrical conduits improperly situated over the supports. While certainly easier for the electrician, this arrangement can create big problems for mechanically attached roofs. High conduits should always be located and considered prior to roof system selection. Again, when encountered with FRP decks, modern adhesives can be deployed to address attachment of roof layers and to avoid conflict/delays during construction.

Ordinary load/span tables are published by respective vendors for sizing the module of deck needed; notably, the values appear to be predicated on the use of washers coupled with fasteners that engage structural supports. But as outlined above, roof decking is just one shape/profile in a rather vast product line, so technical inquires beyond printed span properties may be met with frustration (as it was for the author during development of this article).

CONSIDERATIONS DURING CONSTRUCTION

If threaded deck screws are to be used, ordinary pull testing should be deployed to determine the necessary spacing/pattern. Just as with conventional steel decks, sidelap stitching screws are necessary, and deck fasteners for membrane and insulation (if used) should engage the high rib. As outlined in Part 17 of this series,[5] engaging the high rib can be a challenge when installing tapered insulation, but it can be managed with some forethought regarding the board layout.

Framing for roof openings would be necessary as in the manner of conventional steel decking. Moreover, sump pans (or receiver pans) are required for drain openings, and a continuous shelf angle (or other appropriate support) should be present at walls for the long dimension of deck panels.

SUMMARY REMARKS

The foregoing discussion is offered as 1) a spotter's guide for correct deck identification and 2) a baseline of issues to be considered when dealing with this specialty deck type. Again, FRP should not be mistaken for painted steel decking, or when it is merely serving as form deck for poured concrete—as well it might.

Vendors of FRP products are diversified and manufacture quite a variety of shapes and products to fulfill a host of applications. And why not? Once in business for production

Figure 5. *This old fiber-reinforced polymerdeck had electrical conduits improperly situated over the supports. Notice the line of sidelap stitching screws and the specialty fasteners used to secure roof insulation (Image courtesy of Teamcraft Roofing, Salisbury, NC).*

of fiberglass items, there are multiple viable markets. But as suggested above, the paucity of technical support for matters of commercial low-slope decking may become evident. One vendor offers a noteworthy clause stating that FRP decking is not addressed by the governing building code(s), so the ultimate responsibility for and approval/acceptance rests with the local building official or design professional.[6]

REFERENCES

1. ASTM International. 2024. *Standard Test Method for Surface Burning Characteristics of Building Materials*. ASTM E84-24. West Conshohocken, PA: ASTM International.
2. Toler, Tom. 2011."FRP Roof Deck: A Solution for Challenging Conditions." *Interface*, November. Raleigh, NC: International Institute of Building Enclosure Consultants (IIBEC).
3. ASTM International. 2021. *Standard Specification for Glass-Fiber-Reinforced Polyester Plastic Panels*. ASTM D3841-21. West Conshohocken, PA: ASTM International.
4. Personal communique with Mr. Aaron Barth, Sales Director of Building Products, Enduro Composites (April 11, 2024).
5. Hogan, L.D. 2022. "Roof Decks, A to Z: Conventional Steel Decks, Part 17," *Interface*, August. Raleigh, NC: IIBEC.
6. Stabilit America. n.d. "Tred-Safe Deck." Tech data sheet. https://www.stabilitamerica.com/wp-content/uploads/2021/08/Tred-safe-deck-tech-data-sheets.pdf <accessed September 24, 2024>: p.2.

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