Differences among steel roof decks

by **Mark S. Graham**

Steel roof decks commonly are used as components in low-slope roof assemblies. Most roofing professionals know there are visual differences among roof deck types. However, you may not be aware of nonvisual differences among steel roof decks, which significantly can affect roof deck performance. Some of these differences follow.

Loads and spans

The Steel Deck Institute (SDI) publishes span tables based on structural properties of roof deck sections computed according to "Specification for the Design of Cold-formed Structural Steel Members," published by the American Iron and Steel Institute. Uniform loads determined for these tables are based on single-span and equal, adjacent two- and three-span conditions. Spans typically are governed by calculating theoretical allowable maximum deck deflections under construction loading prescribed as a 200-pound (900-N) concentrated load at the midspan of a 12-inch- (304-mm-) wide deck section.

ASTM E936, "Standard Practice for Roof Assemblies Employing Steel Deck, Preformed Insulation and Bituminous Built-up Roofing," provides another method for determining deck span. With this method, an 18-inch- (457-mm-) wide deck strip is analyzed for span based on concentrated loading, deflection caused by uniform loading and stress caused by total load. The resulting maximum allowable span value is the least of these three computations.

FM 4451, "Approval Standard for Steel Roof Decking," provides yet another method for determining deck span. In this method, deck spans are limited to the wind-resistance requirements for a roof assembly or maximum allowable deflection under loading, whichever is less. The maximum deflection under loading is determined using a two-span condition with a concentrated load of 300 pounds (1.3 kN) applied at the center of one span.

Compliance of steel roof decks with FM 4451 specifically is required by FM 4450, "Approval Standard for Class 1 Insulated Steel Roof Decks," which provides the basis for FM's I-60, I-90, etc., ratings for roof systems installed over steel roof decks.

Generally, FM 4451 is considered the most conservative analysis method.

Steel type

Steel roof decks typically are manufactured from steel that has a minimum yield strength of 33 ksi (230 MPa) and conforms to ASTM A1008, "Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability," or ASTM A653, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process."

In certain instances, steel roof decks with yield strengths of 80 ksi (550 MPa) or higher are specified because they typically provide for greater fastener-withdrawal resistance values. Some FM approvals for 10- to 12-foot- (3- to 3.7-m-) wide mechanically attached single-ply membrane roof systems require such steel roof decks.

ASTM A653, Grade 80 designates steel with a minimum 80-ksi (550-MPa) yield strength. "Grade E" steel decks that comply with ASTM A611, "Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Structural Quality," previously also met the minimum 80-ksi (550-MPa) yield-strength requirement. ASTM A661 was discontinued in 2000 and replaced with ASTM A1008. Currently, ASTM A1008, Grade 80 is the appropriate designation for 80-ksi (550-MPa) minimum yield-strength steel.

Closing thoughts

Those who design roof systems to be installed over steel roof decks should be knowledgeable of the properties, including deck span, load capability, and steel grade or yield strength, of specific roof decks that are incorporated into their roof assembly designs.

If a deck's properties cannot be readily determined, such as would commonly be the case in reroofing situations, I recommend a conservative approach be taken when designing the new roof assembly. Such an approach should include assuming a steel roof deck is not FM-approved. This would largely preclude the ability to install an FM-approved roof assembly. Similarly, steel roof decks should not be assumed to have yield strengths significantly greater than 33 ksi (230 MPa). This largely eliminates the ability to install most widely spaced, mechanically attached, single-ply membrane roof assemblies in approved configurations.

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