Sheet Steel Facts 23

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CSSBI Position Paper on Attachment of Roofing Membranes to Steel Deck

This Fact Sheet has been published by the *Canadian Sheet Steel Building Institute* (CSSBI) as a position paper in response to discussions taking place in the roofing community about the screw attachment of roofing membranes to steel deck following line patterns with large spacing. The impetus for this paper is in response to testing being carried out by the *Special Interest Group for Dynamic Evaluation of Roofing Systems* (SIGDERS) at the Institute for Research in Construction, National Research Council of Canada. The mandate of the SIGDERS joint research program is to carry out generic, pre-competitive research on the performance of flat roofing systems subjected to dynamic wind loading. The objective is to develop improved roofing systems and design methods.

The SIGDERS research is looking at roofing systems that incorporate wide membranes sheets attached to the steel deck following **line patterns spaced at up to 3,65 m (12 ft.)**. While the membrane itself has the performance characteristics to accommodate this size of tributary loading, the existing design methods for steel deck under wind uplift are typically based on the uniform application of the wind suction to the deck. The large majority of the roof steel deck used for commercial buildings in North America is profiled with 38 mm (1 1/2") flutes, with the structural supports usually spaced between 1.52 m (5'-0") and 2.03 m (6'-8"). Under uplift conditions the attachment of the roofing membrane along lines with large spacing could produce localized loads that exceed the capacity of the deck, whereas those same loads applied uniformly on the surface of the deck would be acceptable.

The strength of the screwed connection between the membrane and the steel deck, as well as the strength of screwed, nailed, or welded attachment of the steel deck to the structural supports can be computed according to the CSA Standard S136 *North American Specification for the Design of Cold-Formed Steel Structural Members*. These design values are based on the specified minimum mechanical properties (i.e. base steel thickness and yield strength) specified for the steel sheet roof deck, and should be lower than the strength determined by field-testing. The use of field-test results for properties such as the pull-out strength of a screw into a steel deck needs to recognize that the properties of the steel deck can be higher that the minimum limits required by the steel specifications. Therefore, field-test results must be adjusted accordingly to account for the difference between the actual properties of the deck and the minimum properties of the steel according to the material specification used in design.

The screw-fastening of wide roofing membranes (up to 3.6 m), and the corresponding spacing of the lines of screws holding the membrane on the deck, will have a very different effect on the deck and structural supports than a membrane that is adhered over its entire surface. The screws will produce a line load along the deck instead of a uniform load of the entire deck surface. The line loads can be perpendicular or parallel to the deck flutes depending on the orientation of the membrane: each condition can have different implications of the loading that is applied to the deck.

If the roofing membrane seam is perpendicular to the flutes of the deck, as illustrated in Figure 1, there are two special conditions that need to be considered.

1. if the membrane seam occurs at the mid-span of the steel deck; and
2. if the membrane seam occurs at the structural support (joists).

If the membrane seam occurs at the mid-span of the deck, it is possible to produce a bending moment in the deck that is **3.8 times** that of the moment produced by the equivalent uplift load applied uniformly over the surface of the roof. If the membrane seam occurs at the structural supports, it is possible to produce an uplift load on the joists that is **2 times** that of the uplift load produced by the equivalent uplift load applied uniformly over the surface of the roof.

If the roofing membrane is parallel to the flutes of the deck, as illustrated in Figure 2, it is possible to produce a bending moment and shear in the deck that can be up to 12 times what would occur in the deck if the uplift load is applied uniformly over the surface of the roof. This reaction is so much higher because the load is not resisted by the entire width of deck, but only those deck flutes adjacent to the applied line load.

For those reasons, **the CSSBI does not recommend the use of roofing membranes attached to the steel deck using line patterns with large spacing unless a structural engineer has reviewed the adequacy of the steel deck and the steel supports to resist to wind uplift loads transmitted along the lines of attachment. Those lines of attachment should only be perpendicular to the flutes of the deck.**

For More Information

For more information on sheet steel building products, or to order any CSSBI publications, contact the CSSBI at the address shown below or visit the web site at **www.cssbi.ca**.

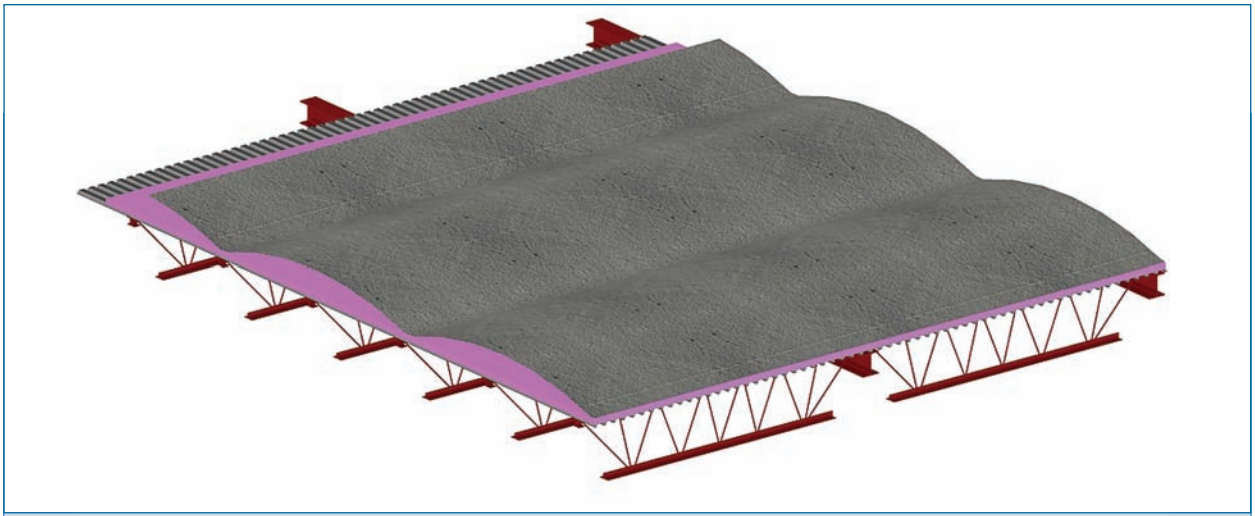

Figure 1: Roofing Membrane Seam Perpendicular to Deck Span

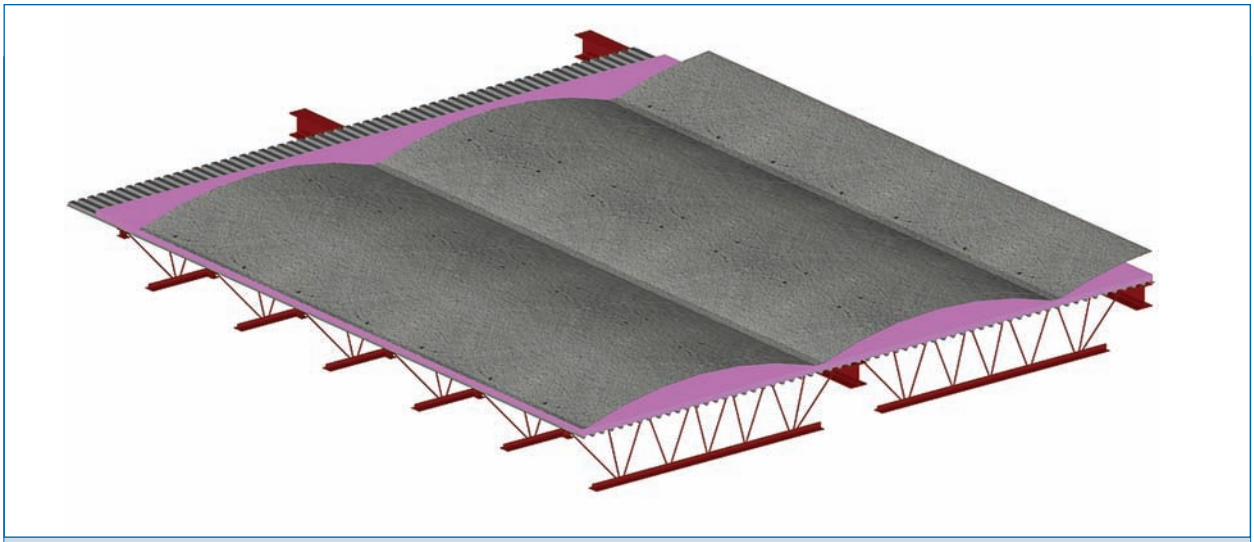

Figure 2: Roofing Membrane Seam Parallel to Deck Span