Can Your Metal Roof System HANDLE THE LOAD?

By Richard Davis

Metal Roof Systems (MRS) construction has been gaining in popularity because it's relatively inexpensive, flexible, and can be easily assembled. Metal Roof Systems are designed as systems; they work well when all design elements are provided. FM Global has found, however, that the design of some MRS — particularly older ones — may not be adequate for potential snow loading, even though the design appeared to have met all specifications and standards at the time of construction. As a result, the performance of some MRS may be unpredictable in maximum snow load conditions.

To increase awareness of MRS design problems, FM Global has been working very closely over the past few years with the Metal Building Manufacturers' Association (MBMA) and the American Iron and Steel Institute (AISI). As a result, there are standards in place that provide clearer and more reliable design criteria for MRS construction.

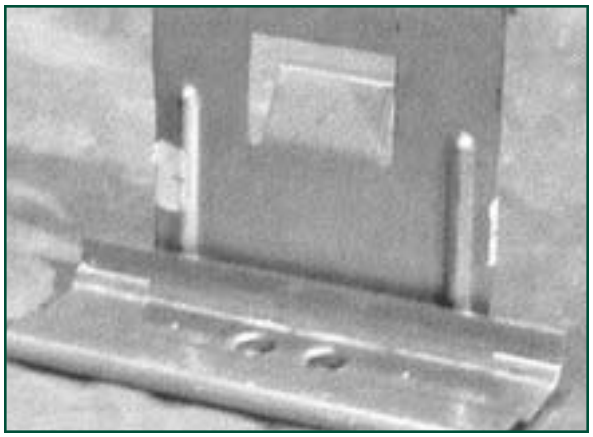
Snow and Ice Can Cause Collapse

The two main MRS are the standing-seam and lap-seam (through-fastened) systems.

Standing-seam systems use concealed clip fasteners to attach the metal roof panels to the building purlins. The fasteners are primarily one-piece, fixed-type, or two-piece, sliding-type clips. While this method of attachment can reduce leakage, in some cases it provides less lateral support to the roof purlin during loading from snow, ice, and freezing rain.

Lap-seam roofs use screw fasteners that penetrate the metal panel and attach directly to the steel purlins. When the panels are in good condition, this method provides lateral stability to the roof purlins through solid mechanical connections; however, lap-seam roofs are generally not suitable for larger buildings.

Both of these systems are composed of metal roof panels that transfer the applied loads to the structural frames. During a winter storm, snow or ice will begin to accumulate on the roofs. Snow, which can be uniform or drift into piles, can occur at elevation differences or on the leeward side of the building. As snow or ice accumulates, a downward force is applied to the roof panel. In a standing-seam MRS, this force is transferred through the concealed clip to the roof purlin. As the weight of the snow increases, the purlin tends to rotate toward the peak of the roof.



Concealed clip fasteners attach the metal roof panels to the building purlins.

Without adequate support, the purlin can rotate from the original orientation until its structural integrity is compromised. This is called purlin "rollover," and can cause the purlin to buckle and collapse, thus beginning a domino effect that results in the collapse of a large portion of the building. In fact, there have been several documented cases of an entire building collapsing in as little as 10 seconds!

Some collapses occur because the weight of the snow that fell and, in come cases, drifted on the roof, exceeds the design loads for the primary building supports. Another major cause is failure of purlins that support the roof panels. These types of failures may have resulted from snow loads that were actually lighter than the design load. Inadequate bracing or lateral support of the purlins is a major cause of the failure of these structural members. Adequate purlin bracing could have helped to prevent it.

Point Bracing Required

Those who have not addressed MRS construction should not wait any longer. Contact the building manufacturer or a structural engineer to evaluate the building according to AISI's *Specification for the Design of Cold-Formed Steel Structural Members*, which was published in 1996. This specification requires the design of standing-seam roof systems to utilize discrete point bracing or to

be quantified according to a "base test." This test, well defined by AISI, is used to quantify the lateral support of the purlin provided by the standing seam MRS.

Where there is a deficiency, develop a customized energy response plan for snow removal at the facility. Have the necessary equipment and supplies needed to carry out the plan, monitor weather conditions, and implement the plan early, *before* snow becomes too deep for safe removal.

About the Author

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