Changes to FM Global Loss Prevention Data Sheets

There are few organizations that have attained as much prominence and influence in the roofing industry as FM Global. From its humble beginnings in the early 1800s, FM Global has grown to become one of the world's largest property insurance and loss prevention engineering firms providing service in over 100 countries.

A key contributor to FM's success has been its research division. In its newly built 1,600 acre (648 ha) Research Campus, the performance of many construction materials and systems is evaluated. FM Approvals tests, certifies and approves products and services, including roof materials, systems, and installations for the purpose of assisting FM's underwriters in adjusting rates for its insured. Roof systems are evaluated for a variety of performance characteristics, including their fire resistance, both from the exterior and interior, hail resistance, water leakage, resistance to foot traffic, UV degradation, corrosion of metal components, and wind uplift resistance.

It should also be emphasized that only FM can determine whether a roof has been installed in accordance with their technical requirements. Although they do accept some limited test data from other laboratories if there is an interlaboratory agreement, all their testing, inspection and certification is done in-house. They do not accept testing data from other organizations. In other words, only an FM engineer can certify that a roof assembly complies with FM requirements when those requirements have been specified.

Sufficient wind resistance is particularly important in roof construction as a roof that blows off exposes the building interior and its contents to the elements. Interior damage, loss of building contents and subsequent business interruptions can lead to catastrophic losses for the building owner and the insurer. FM evaluates and predicts the wind performance of roofing systems on steel decks by testing them on a specially designed test apparatus. Positive air pressure is applied to the bottom (interior) side in increments of 15 psf (700 Pa). Each increment is held for 1 minute. To qualify for a rating, the roof deck assembly must withstand the specified pressure for one minute without showing any evidence of failure. In a totally adhered system, any separation, including delamination of field seams is deemed to be a failure of the roof cover. When the cover is applied to an insulation, curling, lifting, delamination or fracture of the insulation is also considered a failure.

FM reports pressures from 60 to 999 psf (2.87 kPa to 47.8 kPa) assigning designations of FM1-60 to FM1-999. It should be noted that the numerical designation has no relation to wind speed. An assembly that has received a 1-60 rating would have resisted a sustained pressure of 60 psf (2.87 kPa) for 60 seconds. Because FM applies a safety factor of two to the tested assembly, this assembly would be recommended for use on buildings with a design wind load pressure of 30 psf (1.44 kPa).

FM Global not only evaluates roofing products and systems, but it also provides design guidance to the building industry and design community through its *Property Loss Prevention Data Sheets*. These are engineering guidelines written to help reduce the chance of property loss due to fire, weather conditions and failure of electrical or mechanical equipment. They incorporate loss experience, research results, input from consensus standards committees, equipment manufacturers and others. Included in these is the appropriate FM Global Research minimum roof system wind uplift rating.

Two Property Loss Prevention Data Sheets —*1-28, Design Wind Loads and 1-29, Roof Deck Securement and Above-Deck Roof Components* provide guidance with respect to designing for wind loads. The first gives information on how to determine wind load requirements for building components and cladding and their immediate supports (e.g., siding, roof assemblies, etc.). The second is intended to be used in conjunction with Data Sheet 1-28 and provides recommendations for the proper securement of various roof decks to supporting members, and for the proper design and installation of above-deck roof components including roof covers, insulation, vapor retarders, fasteners, and recover assemblies.

FM now provides design professionals an on-line calculator to determine the proper roof classifications for wind uplift resistance, fire, and hail at www.roofnav.com. In addition, both FM roofing materials and assemblies approvals and Loss Prevention Data Sheets can be accessed and downloaded free of charge.
In the requirements and recommendations contained in the Data Sheets, FM differentiates between
"adhered systems" and "mechanically attached" systems. An adhered system consists of a layer of roof insulation that is mechanically attached with screw and plate fasteners to the structural roof deck with additional insulation and/or a roof cover attached to the mechanically fastened insulation with some type of adhesive. The roof cover can be asphalt based or a single-ply synthetic membrane. A mechanically attached system relies on mechanically fastening the roof components, including the roof cover, to the deck with screw and plate fasteners to achieve its wind uplift resistance.

In the wake of the major wind event that occurred worldwide in 2004 and 2005, FM Global issued a revised Loss Prevention Data Sheet 1-29 in early 2006 and again in 2007. The changes contained in this data sheet were substantial and caused considerable controversy within the industry. Due to the nature of wind dynamics, the highest uplift loads occur at the roof corners, somewhat less at perimeters and significantly less in the field of the roof. FM has typically addressed this wind behaviour by requiring more fasteners in the roof corners and perimeters. The most significant revisions to the Data Sheets are enhanced requirements for wind uplift resistance in the perimeter and corner of the roof in adhered systems. Currently, very few systems can meet these very stringent perimeter and corner requirements virtually eliminating the use of adhered systems requiring a 1-90 rating or above on standard steel decks. In most cases, if the uplift requirements for a roof are 90 psf (4.3 kPa) or greater in the field of the roof, a mechanically attached system will most likely have to be used in the perimeter and corner areas of the roof.

FM approvals apply to FM insured buildings and the stringent requirements are intended to mitigate the risk of loss from wind, fire, hail and other perils. However, due to the dearth of information on wind effect on roof assemblies until recently, FM 1-90 wind resistance requirements became the benchmark for the roofing industry, due in large measure to its promotion by roofing systems manufacturers as it was, at one time, the highest rating achievable. In light of the recent changes to Property Loss Prevention Data Sheets —*1-28* and *1-29*, manufactures and many other industry organizations are questioning this practice. Unfortunately, many designers have and continue to insert the phrase: "must meet the requirements of FM 1-90 even though the building is not insured by FM. More importantly, such requirements are often erroneously specified even though the building may not require such a high wind resistance rating, imposing needless costs on the building owner with little benefit.

How to calculate the required wind load for a particular building in Canada is set out in Section 4.1.7 of the 2005 edition of the National Building Code of Canada. One should be aware that although a system may meet FM requirements, it may not conform to the Code, which may have more stringent requirements. An excellent discussion relating to wind loads and resistance on roofs can be found in "A Guide for the Wind Design of Mechanically Attached Flexible Membrane Roofs" , available from the National Research Council.[1] This Guide also contains detailed information on other sources of information on Wind Uplift, including SPRI, RCI, UL and SIGDERS, whose test method for evaluating the wind resistance of roofing systems is now the accepted standard for determining a roof's uplift resistance when subjected to dynamic wind loads.[2]

The optimal roof design, with respect to wind resistance, will be one where the wind uplift resistance is sufficient to resist the loads to which it will be subjected while in service. Under designing the roof may expose the building to serious damager and losses from blow-off. Over designing the roof may incur substantial costs without any corresponding benefit. The wind loads on a roof and its required resistance will vary depending on several factors including the building's location, size and height, geometry, surrounding topography, number of openings, slope and other architectural features. Calculating a roof's required wind resistance is a complicated procedure that should be undertaken only by a qualified design professional.

References:

1. Baskaran, A. and Smith. T.L. A Guide for the Wind Design of Mechanically Attached Flexible Membrane Roofs. Institute for Research in Construction, National Research Council of Canada, Ottawa, 2005.
2. SIGDERS, the Special Interest Group for Dynamic Evaluation of Roofing Systems was formed under the direction of the National Research Council of Canada's Institute for Research in Construction in 1994 for the purpose of developing a method for evaluating mechanically attached roof membrane systems. The test method developed by the SIGDERS Consortium is now the CSA National Standard– A123.21-04, *Standard test method for the dynamic wind uplift resistance of mechanically attached membrane roofing systems.*

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