SIGDERS

Phase V Update

By Phil Dregger, RRC, PE

Meeting on May 5 and 6, 2010, at the National Research Council Canada facility in Ottawa, representatives of the 18 current members of the Special Interest Group for Dynamic Evaluation of Roofing Systems (SIGDERS) received updates on Phase V research objectives.

SIGDERS, established in 1994, represents a joint undertaking between the Canadian government and several roofing industry groups interested in dynamic evaluation of roofing systems. For more information about SIGDERS, its formation, members, and publications, visit **www.sigders.ca**. RCI, Inc. has been a member of SIGDERS since 1997.

Updates regarding the progress on the three Phase V objectives follow.

FIELD MONITORING

The third and most elaborate system of monitoring "real-life" wind speeds, differential wind pressures, and a roof system's response is now up and running at a large Target distribution center in Rialto, CA. Field instrumentation consists of two anemometers (propeller and ultrasonic), 17 pressures sensors (11 corner, three edge, three field), two load cells monitoring wind-induced loads on roof membrane fasteners, and a deflection sensor to monitor both membrane fluttering and deck deformations. The roof covering, from top to bottom, consists of a mechanically attached 60-mil PVC, 1.5 in of polyisocyanurate insulation, and a steel deck.

Figure 1 – Overview of roof recently instrumented to gather information about wind uplift pressures and roof system fastener loads associated with actual wind gust events (source: Google Earth Pro).

Initial results and discussions of particular interest to this reporter include the following:

- Wind-induced loads measured at roof system fasteners are significantly lower compared to the load estimated by using ASCE 7's tributary area procedures and gust wind speeds measured on site.
- Correlation of the measured rooftop pressures to measured wind speeds must consider the time lag which may be associated with the wind travel time from the anemometer to the pressure taps (see *Figure 2*).

AIR INTRUSION QUANTIFICATION

A special double-sealed test chamber apparatus measures the rate and volume of air that intrudes into different roof systems under a series of differential pressures (i.e., 5, 10, 15, 20, 25 psf). Testing, which is now complete, indicates that air intrudes more slowly into roof systems with air retarders than those without (see *Figure 3)*. Although this was an expected result, the testing also indicated some less-than-expected results:

- If pressure differentials are held long enough, equal amounts of air will eventually intrude into a roof system, whether a retarder is present or not.
- Even without an air retarder, it takes about a minute, not merely just seconds, for most roof systems to fully "inflate" (i.e., for tensile loads in the membrane to stabilize).
- Air intrudes into a roof system with one layer of insulation at about the same rate as into a roof system with

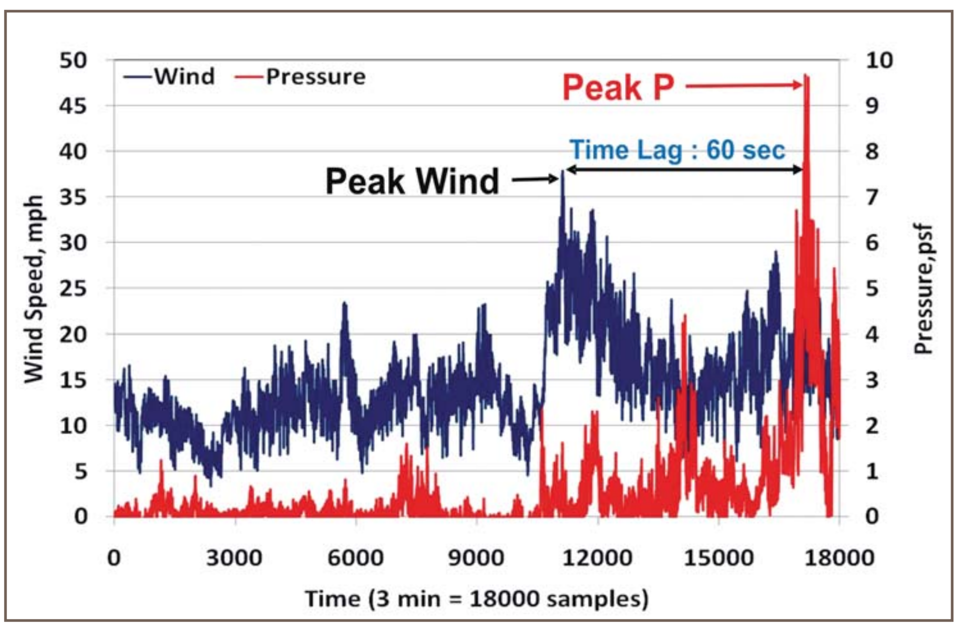

Figure 2 – Field monitoring indicated a time lag between when a peak gust event was measured at the anemometer and when it was "felt" by the roof.

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two layers of insulation, even though joints are staggered and compressed together by mechanical fasteners.

UPDATE CSA A123.21-04

The third objective of Phase V is to update CSA A123.21-04, which is focused on mechanically attached roof systems, to include wind uplift resistance evaluation of all membrane roof systems (e.g., include systems with adhered components). Tasks of this objective include checking the viability of using an 8-ft by 10-ft test specimen to evaluate systems with adhered components (rather than a 12-ft by 24-ft test specimen) and checking the viability of reducing the total number of load cycles required (e.g., 875 cycles rather than 2,200 cycles for 1.00 P).

Initial test results were generally supportive of the proposed changes, suggesting that "edge effects" due to the smaller test frame were limited to "over-estimations" of 15 psf or less when compared to the 12-ft by 24-ft test specimens. However, one adhered roof system experienced damage at pressures well below those expected, and some other adhered systems did not experience damage at all, preventing meaningful comparisons between the two test specimens.

After review of the initial results and a few somewhat animated discussions, the group agreed on the following.

- Test trials at pressures higher than 120 psf are needed.
- More information regarding the role that metal fatigue may play is needed since the primary damage modes included fastener pull-out of the deck, fastener stress plate pullover of the fastener heads, and fastener stress plate pull through the foam insulation. See *Figures 4* and *5*.

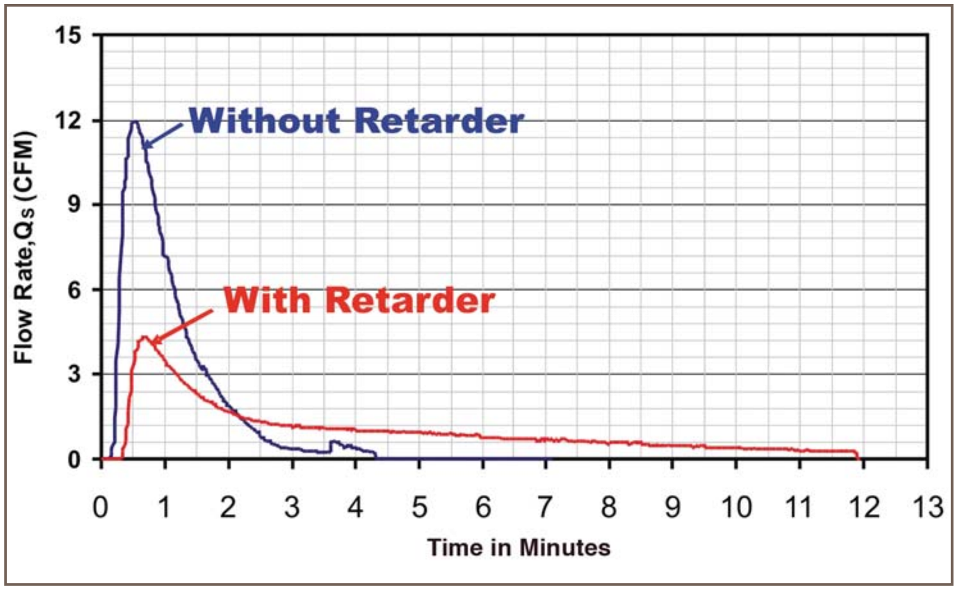

Figure 3 – Testing confirms air intrudes more slowly into roof systems with air retarders than those without.

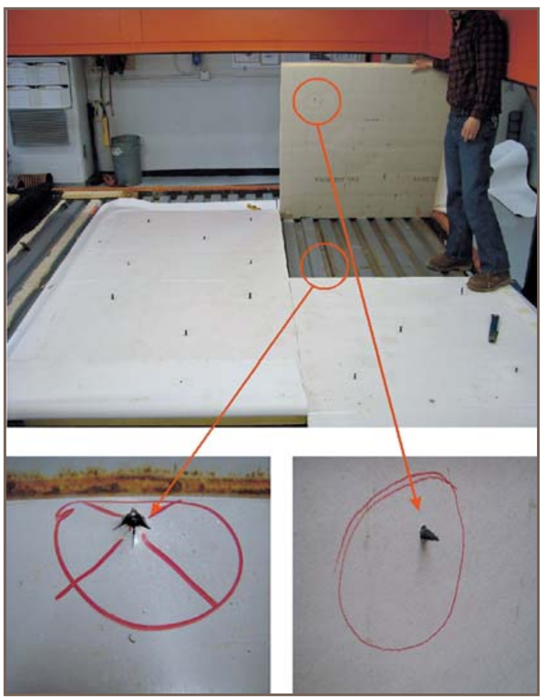

Figure 4 – Tests suggest metal fatigue may play a role when roof systems experience damage as part of dynamic testing.

Figure 5 – Damage modes included fastener stress plate pulling through the foam insulation.

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