SIGDERS Enhances ROOF WIND INSTRUMENTATION at Target Rialto Site

By Philip D. Dregger, RRC, PE

True to expectations, gale-force Santa Ana winds greeted representatives of the Special Interest Group for Dynamic Evaluation of Roofing Systems (SIGDERS) at their January 25 and 26, 2011, meeting in Rialto, CA. As part of its Phase V activities, SIGDERS has fully instrumented two locations on the roof of a large Target distribution center in Rialto and closely monitors uplift pressures and deck deflections associated with strong winds. Since November 2010, when the site first became operational, several wind events with gusts over 50 mph have been recorded at the Rialto site. By recording and analyzing how roof assemblies respond to real-life wind events, such as from Santa Ana winds, SIGDERS hopes to confirm, among other things, the reasonableness of current methods used to predict the magnitude of wind uplift forces transferred to fasteners securing thermoplastic single-ply roof membranes.

SIGDERS, established in 1994, represents a joint undertaking of 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, see www.sigders.ca. RCI, Inc. has been a member of SIGDERS since 1997.

The Target Rialto site represents the third and most elaborate system SIGDERS has developed to monitor real-life wind speeds, differential wind pressures, and a roof system's response. 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 deflections. The roof covering, from top to bottom, consists of a mechanically attached, 60-mil PVC; 1.5 inches of polyisocyanurate insulation; and a steel deck.

Initial results from Rialto and the previ-

Photo 1 – View looking north from east Target Rialto site.

ous two SIGDERS field-monitoring sites (Ottawa, Ontario; and Mount Pleasant, Michigan) strongly suggest current methods may significantly overestimate the magnitude of forces effectively transferred to roof membrane fasteners as part of real-life high-wind events. Currently, fastener loads are determined by multiplying uplift pressures (determined using procedures outlined in ASCE 7) over the fasteners' tributary area.

Although the data were already quite informative and useful, the SIGDERS steering committee reviewed the information collected to date at the Rialto site and suggested a few ways to enhance the project as it moves forward. Example highlights of meeting discussions and planned instrumentation enhancements to the site follow:

- **Add Pressure Tap Below Roof Deck –** The distribution center has large doors facing windward very near one of the two instrumented sites. Since significant amounts of internal pressurization may be occurring, a pressure tap will be installed below the deck to help quantify the amount of internal pressurization and estimate its contribution to recorded deck deflections and fastener loads.

Photo 2 – Copper and nylon pressure tap tubes.

- **Add Pressure Tap Below Membrane –** Since this is a mechanically attached single ply, a pressure tap will be installed between the roof membrane and the roof insulation to help quantify "bubble" pressures and to monitor how fast pressure differences equalize above and below the roof deck.
- **Add Anemometer –** Wind uplift pressures recorded at the north Rialto site (near where the two anemometers are installed) are consistently lower than those recorded 2,000 ft away at the east Rialto site. This makes sense, in terms of Santa

Photo 3 – Propeller anemometer (L) and ultrasonic anemometer (R).

Photo 4 – Anemometers installed on mast near north Target Rialto site.

Ana winds, since the north site has a residential area (~terrain exposure B) in the upwind direction, while the east site has a large paved area (~terrain exposure C) in the upwind direction (see *Photo 1*). Accordingly, an additional anemometer will be installed near the east site.

- **Include Three-Second Peak Gusts –** The peak gust wind speeds currently gathered are essentially "instantaneous" wind speeds, since they represent maximum peak gusts recorded at one-hundredth of a second intervals by an ultrasonic anemometer. To allow ready comparison to ASCE 7 wind speeds, the published data will include information about how the three-second gust data correspond to the instantaneous peak gust data.
- **Copper Versus Nylon Pressure Taps –** Pressures recorded by the copper pressure taps are consistently less (on the order of 10% to 20%) than those recorded by the nylon pressure taps (i.e., those typically used in wind tunnel research). The reason for this difference is as yet not well understood. It may be due to a "damping effect" associated with the copper tubes vibrating or oscillating in response to the winds or because of the different-sized openings at the ends of the tubes. See *Photo 2*.
- **Propeller Versus Ultrasonic Anemometer –** Wind speeds recorded by the propeller anemometer are consistently 10% to 15% less than those recorded by the ultrasonic anemometer. The reason for this difference is not yet fully understood but may be related to differences in the sensitivity of the anemometers to recording very short-duration gusts. Data showing side-by-side comparisons of the propeller and ultrasonic anemometer data will be included in the final SIGDERS Phase V reports. See *Photos 3* and *4*.

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EDITOR'S NOTE: Senior Research Officer Bas Baskaran and his colleagues at NRC/IRC have written a paper on current findings cosponsored by SIGDERS on the effects of table size on wind uplift performance. That paper will be presented by Baskaran at RCI's 26th International Convention and Trade Show in Reno, NV.