Roof Edge Blow Offs

NRC Completed 2 Years of Wind Study to keep them on

Insurance industries claim that roof covering contributes to 90% of claims after major wind events. As part of the Roofing Industry Committee on Weather Issues (RICOWI) Wind Investigation Program (WIP), the North American roofing professionals completed a major fact finding investigation for the cause of commercial roofing failures. WIP collected factual data of roof failures immediately following hurricanes Charley, Ike, Ivan and Katrina. Failure data clearly supported that the majority of the roof failures were due to the failure of metal roof edges (Figure 1). These findings suggest that current building codes in North America (i.e. NBCC and ASCE) do not accurately identify wind design loads acting on roof edge metal systems.

The Roof Edge Technologies and Systems (REST) project is a consortium of academia, government and roof industries, which was created to develop wind testing protocols and design guidelines for roof edges. To study the wind loads acting on metal roof edges, the REST project decided to study these loads on the Canada Post Pacific Processing Centre building in Vancouver, BC. Three edge configurations, namely the Anchor Clip Configuration (ACC), Continuous Cleat Configuration (CCC) and Discontinuous Cleat Configuration (DCC), were installed on the building's penthouse roof to study the measured wind-induced pressures acting on the surfaces (Figure 2).

The Canada Post Pacific Processing Centre, located on the south side of the Vancouver International Airport, was identified as a suitable field monitoring site for this study. Positioned at an airport location, the building can be categorized as having an open terrain exposure with the predominant wind direction ranging from south-west to north-west. In order to be exposed to the critical wind direction range, instrumentation was placed on Penthouse 6, located on the west side of the building with a parapet facing the incoming west wind. Building owner, Michael Bryson, said ***"Canada Post has been involved with the NRC for the past 20 years, including participation in a major study to understand roof membrane properties in the late nineties. When the NRC was in search of a new building site, the Canada Post Pacific Processing Centre in Vancouver was an ideal choice for wind performance. For building owners like myself, this provides a comfort zone to know that the measured wind uplift forces are less than the designed values".***

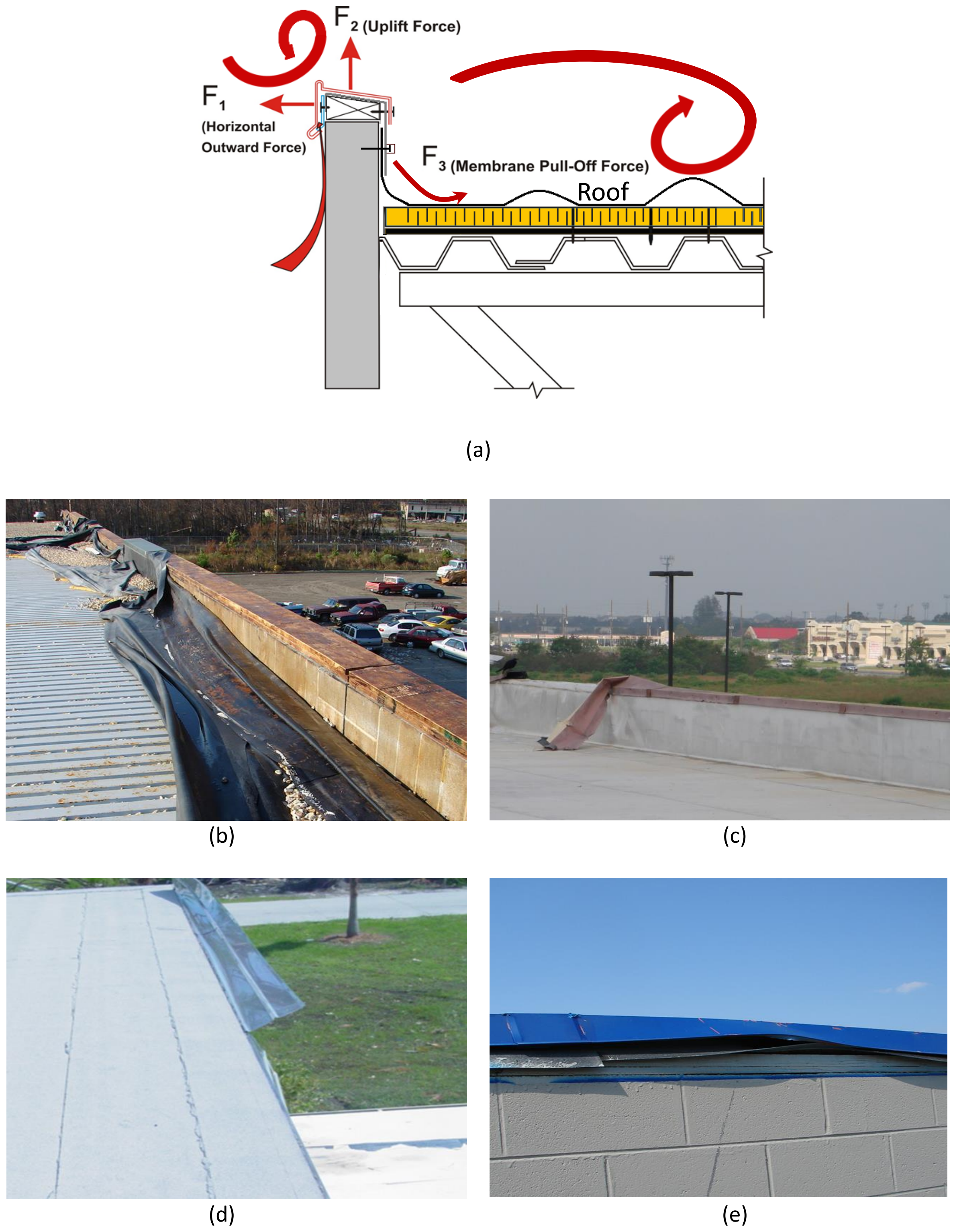
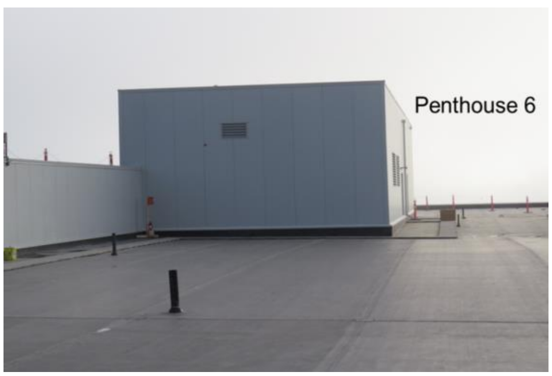


Figure 1: Typical roof edge forces and failures during high wind conditions: (a) Wind-induced forces on roof edges: (b) complete failure, (c) partial failure, (d) cleat failure and (e) coping failure

(a)



(b)

(c)

(d)

(e)

Figure 2: Sensor Installation Process: (a) Canada Post Pacific Processing Centre in Vancouver (b) Penthouse 6 of the Canada Post Building (c) Wind tower (d) Installation of sensors by Marine Roofing and NRC (e) Pressure sensors at roof edge

All installation and roofing work was completed by Marine Roofing, one of the main roofing contractors in Vancouver, with material provided by Carlisle Syntec Incorporated. Larry Lemke of Marine Roofing said ***"We have installed several million square feet of roofing in the Western region of Canada, and found it interesting to be a part of a new research study of this kind, especially considering that Marine Roofing is the first in its field to be able to contribute to scientific research of this nature".***

Field data was collected continuously from October 2013, consisting of wind speed, direction, and pressures. The main focus of this study was to compare and contrast the performance of the common roof edge metal configurations used by North American industries (ACC vs. CCC vs. DCC). This was successfully accomplished by concluding that there is minimal difference in the induced loads due to variation in the configurations. At the highest recorded wind speed of 60 mph (27 m/s), the roofing assembly and edge metal systems performed well without failure. Pedro Padron of Carlisle Syntec Incorporated, a leading company in commercial single-ply roofing, agreed that ***"having our product monitored for wind performance through such a thorough and detailed study by world class researchers at the NRC is an excellent way of knowing how our product performs in the field under the most extreme of conditions".***

NRC's analysis also showed the presence of negative pressure (suction) acting on all three faces of the roof edges. These findings differ from the current code specifications for parapets. As such, the design of the roof edge attachment should consider pullout forces from the parapet.

Rob Harris, Technical Manager at the Roofing Contractors Association of British Columbia (RCABC) said ***"This is the first collaborative project which took place with all major players of the roofing community – manufacturers, installers, building owners and researchers. As a regulatory body for roofing in BC, we offer a RoofStar guarantee, where technical information of this nature is vital for success of such a program."***

The outcome of this study will have a major impact on the Canadian roofing community, including the validation of existing wind provisions in the National Building Code of Canada (NBCC) for commercial roofs and submitting a code change request to the NBCC for the appropriate wind load design of edge metals. In addition, this study will contribute to the inclusion of the edge metal test protocol into the existing CAN/CSA 123.21 standard. This impact is broadened beyond Canada by proposals to the ANSI/SPRI ES-1 standard and ASCE-7 wind load document.

(a)

(b)

(c)

Figure 3: Sensor Removal Process: (a) Members involved with sensor removal (b) Extraction of pressure sensors (c) Repair and patching of insulation and membrane by Marine Roofing and Carlisle Syntec Inc

Acknowledgements

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