RESEARCH HIGHLIGHT

Technical Series 00-102

Measured Pressure Equalized Performance of an Exterior Insulation Finish System (EIFS) Specimen

INTRODUCTION

A literature review conducted by the National Research Council in 1992 to determine design guidelines for pressure equalized rainscreen (PER) walls concluded that current guidelines were not comprehensive. As a result, a research and development project was initiated to generate design guidelines for PER walls. The project has three tasks, namely, computer modelling, experimental evaluation and development of design guidelines. CMHC is jointly sponsoring the experimental evaluation task of the project with the Institute for Research in Construction (IRC). In addition, several wall system manufacturers are supplying test specimens and providing technical and practical information.

This Highlight summarizes the results of the experimental evaluation of an exterior insulation finish system supplied by Dryvit Canada Inc.

RESEARCH PROGRAM

Two specimens, each 2.44 m high by 1.20 m wide (Figure 1), were installed side by side in a steel test frame which was mounted and sealed to IRC's Dynamic Wall Test Facility (DWTF) with the air barrier facing the laboratory. Channels, 25 mm wide by 6 mm deep, machined into the back of the expanded polystyrene insulation provided the cavities of the rainscreen system. The systems were evaluated for air leakage characteristics, pressure equalization response and water penetration.

Air leakage characteristics

Air leakage through the assemblies was measured at static pressure differences ranging up to 1,000 Pa, roughly equivalent to a 150 km/h wind, or 100 kg/m^2 (20 lb/sq. ft.). Extraneous leakage and specimen perimeter leakage were first determined. The effect of leakage through the air barrier was then examined by intentionally opening 6-mm leakage holes in the air barrier. In Scenario A, one, two and three leakage holes were opened opposite the vertical channels of one of the specimens. In Scenario B, one, two and three leakage holes were opened opposite the centre of the EPS of one of the specimens.

Pressure equalization response

The pressure equalization response of the system was measured by subjecting the wall to sinusoidal pressure loadings, with varying frequencies and amplitudes. The leakage in the air barrier was also varied. Pressure taps were strategically located to record pressure differences across the air barrier at the vertical channels of the EPS, at the centre of the EPS, and across the entire specimen. The pressure difference across the rainscreen was calculated by subtracting the pressure measured across the air barrier from the pressure across the wall.

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Water penetration

Water penetration was measured under both static and dynamic pressure, with and without an intentional defect in the rainscreen, and with and without the vents open. Water was applied to the wall at a rate of 4.2 L/min/m^2 for a period of 60 minutes and any water that penetrated the wall was collected and recorded. An horizontal defect, measuring 500 mm long, 1 mm high and 3 mm deep, was cut into one of the test specimens, 300 mm from the top.

RESULTS

Air leakage

The specimen perimeter leakage was found to be less than 10% of that measured through one leakage hole. The leakage through two leakage holes was approximately equal to 0.1 L/s/m^2, which is the maximum flow rate recommended for air barriers by the Technical Guide for Air Barrier Systems published by the Canadian Construction Materials Centre.

Pressure equalization response

Pressure equalization response refers to how well the cavity pressure matches the pressure applied to the wall, in terms of both magnitude and time lag. The pressure equalization response was found to become worse as the air leakage through the air barrier increased and as the frequency of the applied pressure increased. The pressure difference across the rainscreen was also found to vary along both the height and width of the specimen; greater pressures occurred further from the vent locations, likely due to the resistance to air flow in the channels.

Water penetration

Under static conditions, the amount of water that passed through the system increased as the pressure across the specimen increased. With no pressure difference across either specimen, the amount of water through the system was approximately the same for both the defective and non-defective rainscreens. At higher pressures though, the amount of water that passed through the defective specimen was at least double that of the non-defective specimen. The amount of water that entered both specimens was significantly lower when the vents were open and the wall system could pressure equalize. The rate of water penetration increased only slightly when the air barrier system was compromised.

All the water which passed through the rainscreen was drained through the vent. No water appeared in any of the stud cavities.

IMPLICATIONS FOR THE HOUSING INDUSTRY

A wall designed to PER principles is more able to resist rain penetration, as demonstrated in this work. However, as the pressure equalization response is poorer further from the vent locations, it is important to carefully consider the position and spacing of the vent locations in the design of the wall. The results showed that some flaws in the air barrier may not significantly impact the amount of rain penetration; but, defects in the rainscreen can have significant effects. These results suggest that guidelines should be determined for the optimum spacing of vents and joints in the EIFS wall.

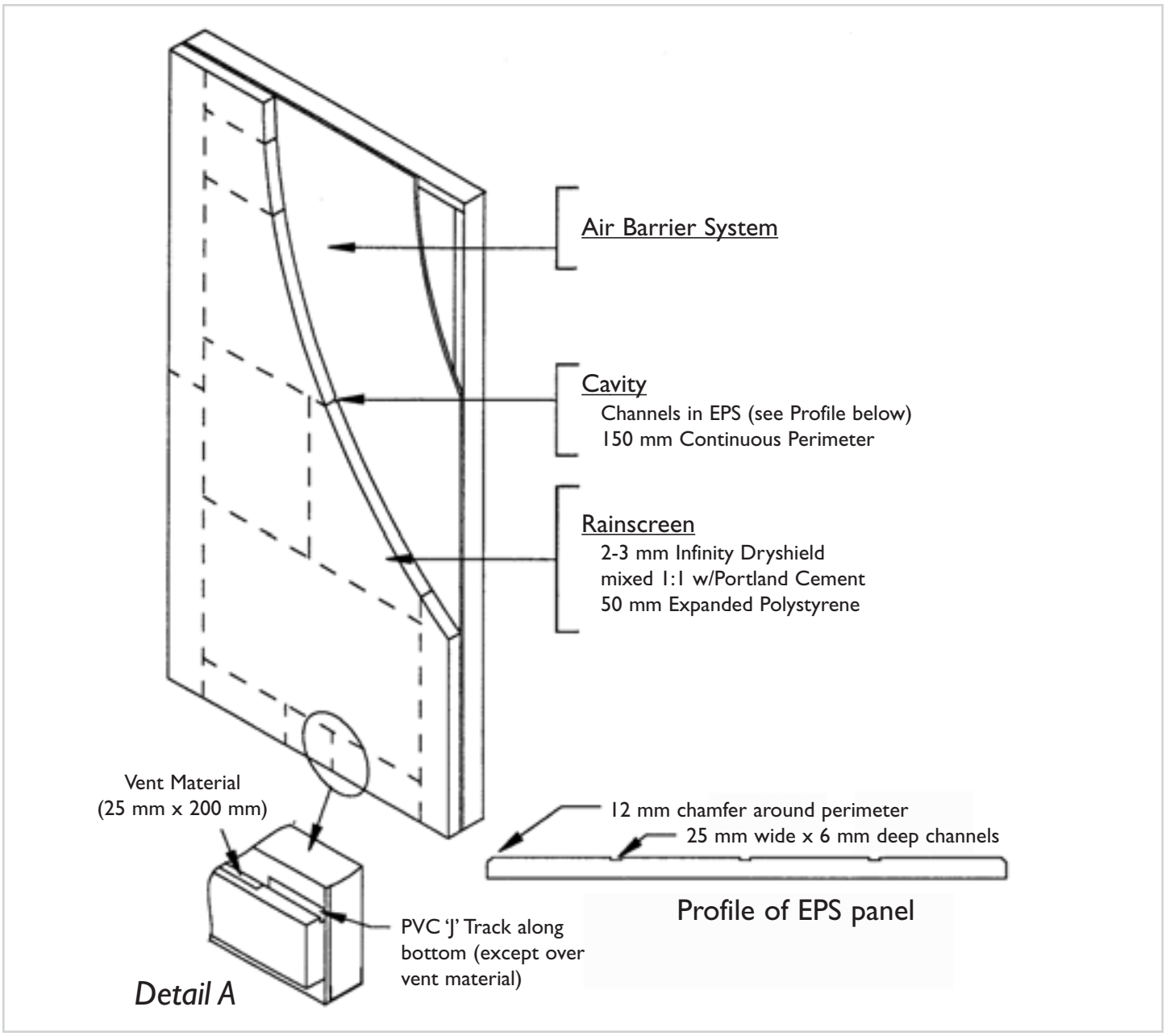

Figure 1 Details of construction of the exterior insulation and finish (EIFS) test specimens

TEST PROGRAM

Air leakage, pressure equalization and water penetration performance were measured in the DWTF. The subtasks are summarized as follows:

1. Air leakage characteristics of the specimen under various leakage configurations were measured for static pressure differences.
2. Pressure equalization response was measured at a range of frequencies for different sinusoidal loading (i.e., mean value and amplitude scenarios).
3. Water penetration was measured under both static and dynamic pressures with and without a defect in the rainscreen. The artificial horizontal defect measured 500 mm long and 1 mm wide and approximately 3 mm deep.

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Housing Research at CMHC

Under Part IX of the ***National Housing Act***, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

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