Homeowner Protection Office

Performance Monitoring of Rainscreen Wall Assemblies in Vancouver British Columbia

Project Summary

Overview
This project involves measuring and monitoring the performance of rainscreen wall assemblies within a sample of new and rehabilitated low, mid and high-rise residential buildings. It involves the instrumentation, monitoring, data collection and analysis of various aspects of wall performance relating to moisture ingress in the wall assembly. The research was carried out by the RDH Building Engineering Ltd. with funding provided by the Homeowner Protection Office, BC Housing and Canada Mortgage and Housing Corporation.

Methodology
A total of 5 buildings were monitored, all located in Vancouver (see next page). The monitoring program was designed to measure temperature, wood moisture content, relative humidity, local weather conditions including rainfall, driving rainfall and pressure differences across the walls. A continuous, automatic electronic system recorded measurements from all sensors every 15 minutes. A minimum of five wall cavities in each building was monitored; 4 at key details and 1 in the middle of the wall (east and south). Each cavity contained 4 temperature, 4 moisture content, and 2 relative humidity sensors. On the non-combustible buildings, gold leaf wetness sensors were used to detect the presence of liquid water on steel studs. To avoid power interruptions, the data acquisition system was powered by a solar-panel-charged battery.

Key Findings
The monitoring study is approximately 60% complete with data primarily available from buildings 1, 2 and 3. Preliminary findings were presented in a paper for the 9th Conference on Building Science and Technology in February 2003, and include the following:

- The moisture content in the sheathing and strapping on the wood framed buildings generally stayed below levels that can accelerate deterioration and promote fungi growth and decay. This finding indicates that rainscreen wall systems currently being utilized in the Lower Mainland can perform successfully.
- The findings also support the use of caution when utilizing exterior insulated wall assemblies with a waterproof membrane on the exterior of the sheathing, in conjunction with conventional insulation in the stud cavity. More research on this wall type is required before conclusions can be made regarding its performance.
- When remediating existing building enclosures, the mechanical ventilation strategy must consider the anticipated air and vapour tightness of the new wall assembly to ensure adequate supply and exhaust is provided in order to maintain reasonable RH levels post construction.

The data collected in the course of the research suggests:

- Overhangs reduce wetting of walls in proportion to their size and ratio to wall height.
- Condensation at the interior poly vapour retarder from inward vapour drive during hot clear days in the summer was not observed.
- Condensation from inward vapour drive was measured at the exterior sheathing following some heavy rain events in the winter and spring.
- Outward vapour drive in the winter has an effect on the moisture content of the exterior sheathing.
- Wind driven rain increases moisture content of strapping quickly but takes longer to affect sheathing. In some cases when storm duration is small, sheathing moisture content is unaffected.
- Dryer exhaust air can significantly increase the moisture content of the sheathing if it is allowed to enter behind the cladding. Cladding systems with large ventilation capacities such as vinyl siding seem to be more susceptible to this venting mechanism.

- Rainscreen cladding systems alone will not prevent wood moisture contents from reaching levels capable of supporting fungal growth if interface details allow bulk water or dryer exhaust air to infiltrate behind the exterior cladding over a prolonged period.
- Caution must be used when assessing the performance of existing buildings using moisture readings of the exterior sheathing along with the risk categories commonly used in the industry. The monitoring has shown that sheathing and strapping on all buildings with the exception of building 5 were at elevated levels for short periods during the winter. When conducting moisture content surveys, the analyst must consider the moisture regime that the building has been under for some time preceding the reading. For example a reading of 23% moisture content during a particularly wet period in February should be interpreted differently than the same reading taken in July after a period of dry weather.

Recommendations
After the determination of the basic effectiveness of the rainscreen walls, the comparative analysis of wetting and drying on the different cladding assemblies offers the best opportunity for further research and knowledge. The following are opportunities for future research utilizing the data obtained, or the monitoring system prior to decommissioning at the conclusion of the study:

- Continue a reduced frequency, long term monitoring of moisture contents. At five year intervals, period perform condition assessments of the buildings including some exploratory openings at key locations such as dryer vents to ensure that the moisture levels observed have not resulted in deterioration.
- Compare results with data from a non-rainscreen building with active water infiltration problems during the same time period.
- Perform simultaneous wetting (water testing) on all buildings (stucco, vinyl and hardboard claddings) to examine and compare wetting and drying response times.
- Research the Hygrothermal behavior of fiberglass faced gypsum sheathing.
- Correlation of driving rain to wind speed and with vertical rain accumulation.
- Determine the rate at which construction materials dry out or become wet and what environmental conditions are required for each event.
- Determine the effects of relative humidity on building materials.
- Determine how accurate real life data correlates to hygrothermal simulations such as WUFI and what parameters during simulation are critical to the analysis.
- Further investigation of Building 3 to determine the effect of the prolonged increased moisture contents on the surface of the sheathing.
- Further investigation of Building 3 to determine the cause of the increased humidity levels. Modeling of the interior environmental conditions to examine the impact of ventilation on interior humidity.
- Investigate the windowsill on building 4 to determine the source of the increased moisture content in the strapping.

In addition to the primary goal of assessing performance, the monitoring program continues to provide information on how the building envelope reacts to weather and interior environmental conditions in a real world environment.

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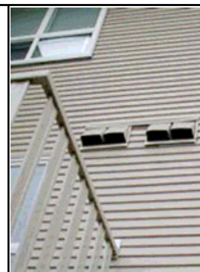
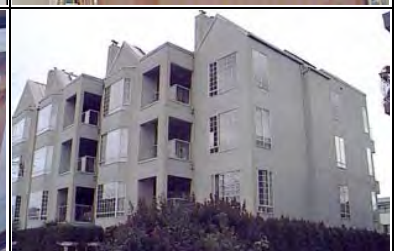
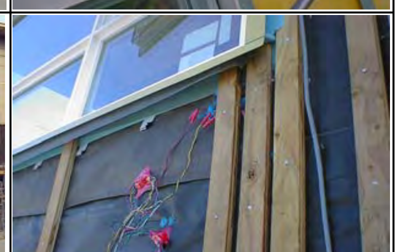
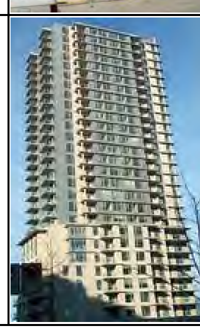
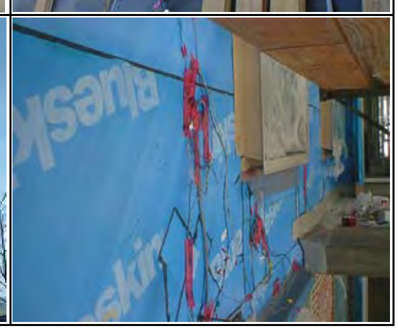
Information about the Buildings Studied

<u>Building 1</u> **Height**: 4 stories **Project Type**: New Construction **Frame Type/Sheathing**: Wood/Plywood **Insulation**: Fiberglass Batt in stud cavity **Moisture Barrier**: 2 layers of Building Paper **Cladding**: Vinyl Siding on Wood Strapping		
<u>Building 2</u> **Height**: 4 stories **Project Type**: Cladding Rehabilitation **Frame Type/Sheathing**: Wood/Plywood **Insulation**: Fiberglass Batt in stud cavity **Moisture Barrier**: Tyvek commercial wrap **Cladding**: Stucco on Wood Strapping		
<u>Building 3</u> **Height**: 6 stories **Project Type**: Cladding Rehabilitation **Frame Type/Sheathing**: Concrete/Fiberglass Faced Gypsum Board (FFGB) **Insulation**: Rigid Fiberglass on exterior of moisture barrier + Fiberglass Batt in stud cavity **Moisture Barrier**: Self Adhesive Bitumen **Cladding**: Stucco on "Z" bars		
<u>Building 4</u> **Height**: 4 stories **Project Type**: New Construction **Frame Type/Sheathing**: Wood/Plywood **Insulation**: Fiberglass Batt in Stud Cavity **Moisture Barrier**: Building Paper **Cladding**: Fiber Cement Board on Strapping		
<u>Building 5</u> **Height**: 30 stories **Project Type**: New Construction **Frame Type/Sheathing**: Concrete/Fiberglass Faced Gypsum Board (FFGB) **Insulation**: Polystyrene on exterior of moisture barrier **Moisture Barrier**: Self Adhesive Bitumen **Cladding**: Stucco on "Z" bars and Aluminum Window Wall		

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