High-Rise Building Envelope Performance

Homeowner Protection Office

Project Summary

Overview

This research project identifies factors contributing to envelope performance problems and successes in high-rise residential buildings. The study correlates building envelope performance with sources of moisture, and features of design and construction of assemblies and details. Completed in October 2001, the study was undertaken by RDH Building Engineering Ltd. with funding provided by Canada Mortgage and Housing Corporation, Homeowner Protection Office, City of Vancouver, the EIFS Council of Canada and Vancouver Condominium Services Ltd. A graphics package, available on CD, was also developed as part of the study and includes: elements of high-rise building envelopes, build sequences of key details, and photos showing symptoms of problems.

Methodology

The study involved a sample of 35 buildings ranging in height from 5 to 28 storeys, located in the coastal climate region of B.C. and built in the period since 1980. The buildings were chosen based on the availability and quantity of information to facilitate the gathering of data regarding the wall assemblies. A data collection protocol was developed for this project. The study is not statistically representative, and the findings and conclusions cannot be extrapolated as an indication of performance of the general population of high-rise buildings.

Key Findings

- Exterior moisture penetration at wall-to-wall assembly interfaces, and at wall-to-window assembly interfaces was a significant contributor to moisture problems.
- Corrosion of concealed metal components in wall assemblies including steel studs, fasteners, anchors, reinforcing mesh (stucco) represented the majority of moisture damage necessitating repairs.
- Exterior moisture penetrations at details within wall assemblies were found to be significant contributors to moisture problems – linked to the interruption in wall assembly continuity.
- Mechanical ventilation provisions in the sample of high-rise buildings were not adequately controlling interior moisture conditions.
- Most of the face sealed wall assemblies, other than mass concrete wall assemblies, were found to be damaged and involved problems.

Recommendations

Standards and guidelines

1. Better guidance is needed concerning environmental loads, such as exterior and interior design temperature and humidity conditions. In particular, there is a need to define exterior moisture exposure conditions (wind and rain), as well as a process for evaluating loads at the design stage.

2. Specific durability requirements for the building envelope should be established and reflect reasonable maintenance and renewal requirements. Durability expectations for many of the materials and components should also be clarified.

3. Guidance and standards exist for the corrosion resistance of metal components within masonry wall assemblies. Similar guidelines and standards should be developed and mandated for appropriate corrosion resistance of metal components used in all wall assemblies. They should reflect relative durability requirements for materials, components and assemblies. Further research is needed on the durability of corrosion resistant coatings in installed conditions.

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Assemblies

4. Wall assemblies should be selected and designed to reflect exposure conditions for each building, and possibly wall regions within buildings that have differing exposure conditions. Rainscreen wall assemblies should be used for the high moisture exposure situations typical of non-combustible high-rise buildings. In addition to meeting performance expectations set out in Part 5 of the National Building Code (NBC) with regard to moisture control, these assemblies should reflect reasonable durability, maintenance and renewal expectations.

5. Window assemblies should be selected and designed to reflect exposure conditions for each building, and possibly wall regions within buildings that have differing exposure conditions. Rainscreen window assemblies and sub-sill flashings should be used for the high moisture exposure situations typical of non-combustible high-rise buildings. In addition to meeting moisture control performance expectations set out in Part 5 of the NBC, these assemblies should reflect reasonable durability, maintenance and renewal expectations.

Assembly interfaces and details

6. Interfaces between assemblies and at details are the focal point for water ingress and resulting damage. Both the design and the construction of these details could be improved. Clearer durability requirements and better wall and window assemblies will likely result in improved interfaces. However, there are some specific measures that could be taken:

- Add a new module to the Architectural Institute of British Columbia's Building Envelope Education Program dealing with interface details.
- Encourage education and training of all design and construction team members with respect to assembly interfaces and details.
- Require mandatory testing of building mock-ups to confirm performance of interface details.
- Develop a design guide for assembly interfaces and details.

Mechanical

7. Using mechanical ventilation and airflow within high-rise residential buildings to control interior humidity levels requires more research and more consistent application of principles. There is a need to develop guides that integrate recent research and knowledge of airflow and pressure differences within buildings and relative levels of air tightness of interior wall and floor assemblies to arrive at appropriate ventilation strategies. The study makes some specific recommendations, which could be considered on a project-by-project basis.

Materials

8. Use of glass fibre faced gypsum board and other more moisture-resistant products should be encouraged, if not mandated, for high-rise construction. Paper-faced exterior gypsum board should not be used as exterior sheathing in high-rise building construction.

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