Composite Metal Panels as a Rehabilitation Cladding

By Marcus Dell, PEng

INITIAL ASSESSMENT

In 2012, RDH Building Science Inc. (RDH) was retained to assess the condition of the building enclosure (walls, windows, skylights, and roofing) for a residential high-rise building located in the downtown core of Vancouver (*Figure 1*). The 25-story concrete frame building was originally constructed in 1988 and had been experiencing water ingress for several years despite having had "maintenance" performed by multiple contractors. The maintenance consisted of the application of various types of sealant to the interface details and window joints, and coatings to the wall cladding.

The building was originally constructed with a barrier system exterior insulation finishing system (EIFS) assembly that did not incorporate a secondary drainage plain as is more common today. In addition, the original EIFS cladding was directly adhered to paper-faced gypsum sheathing that has limited resistance to deterioration and is therefore prone to mold growth.

The investigation consisted primarily of exploratory openings made in the exterior walls from the interior side. Sections of interior gypsum, polyethylene vapor barrier, and insulation were removed to allow visual examination of the steel studs and interior face of the exterior gypsum sheathing. Over 30 openings were made from the interior. As a general rule, it is preferred to avoid making openings into EIFS-clad wall assemblies from the exterior due to the expense of repair—particularly in the case of a high-rise building.

Water testing of the windows (using ASTM E1105, *Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference)* and skylights (AAMA 501.2, *Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems*) was also performed to confirm sources of water admission. It was discovered that water ingress had caused significant deterioration of the fasteners that secured the windows into the building, and had also caused deterioration of the gypsum sheathing on the exterior of the steel studs to which the EIFS

Figure 1 – View of building as originally constructed.

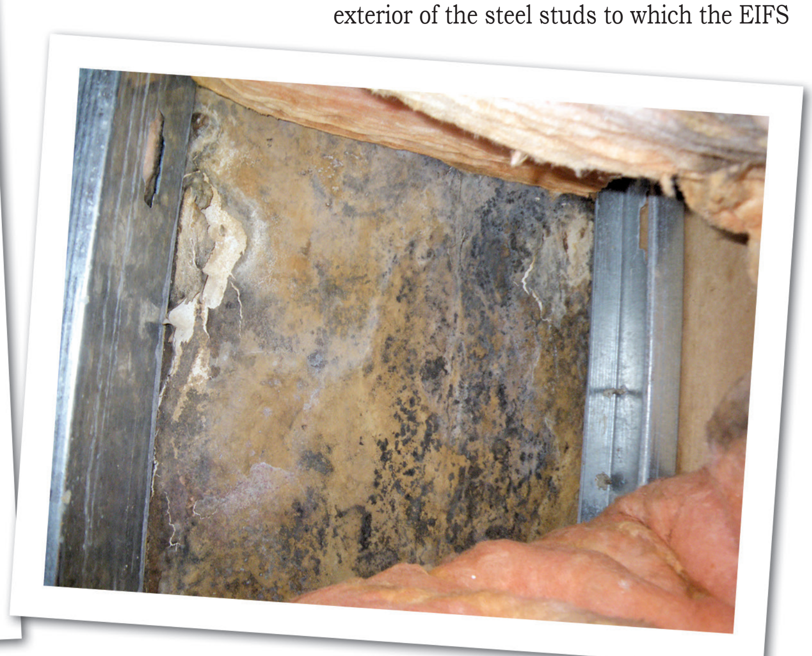

Figure 2 – Typical deterioration of gypsum sheathing to which the EIFS was adhered and corrosion on the steel studs.

Figure 4 – Typical window assembly set into EIFS cladding; as built, there was no drainage from behind the spandrel panels.

Figure 3 – Balcony-to-wall interface.

cladding was adhered (*Figure 2*). The water ingress had also resulted in corrosion of the steel studs, and consequently, loss of structural integrity of some wall areas. The deterioration of the walls was also the result of leakage at the tie-in of the wall cladding to the balcony edge, which allowed water to drain off of the balcony directly onto the cladding (*Figure 3*). *Figure 4* illustrates the typical problematic wall-to-window interface.

The floor and balcony slabs on this project are reinforced with post-tensioned cables. On previous projects, water ingress through the building enclosure has resulted in corrosion and failure of the post-tensioned cables, requiring a very expensive fix.

For all of the above reasons, it was concluded that a comprehensive building enclosure rehabilitation was required to address all of the discovered problems and to reduce the risk of water damaging the post-tensioned cables.

This article focuses on the composite metal panel wall cladding selected for the building enclosure rehabilitation.

DESIGN PHASE

The design phase is key to the success of any major rehabilitation project. In short, this is when the consultant must work closely with the owner group to develop a rehabilitation plan that will correct the water ingress and the resultant damage, while at the same time fulfilling the owner's wishes (e.g., aesthetics, energy performance, and cost).

It is prudent engineering practice to use a rainscreen assembly on high-rise buildings as a primary means of controlling water ingress. Given this primary criterion and the limitations of the existing building frame, several different cladding assemblies were considered for this project. Of the three types considered, the owners elected to proceed with the use of composite metal panels despite the higher cost as compared to rainscreen stucco and EIFS assemblies. The key deciding factors were aesthetics and reduced long-term maintenance. In general, composite metal panels have a durable, fade-resistant finish that is easy to keep clean due to its smooth texture. The modular configuration of metal panels also worked well for the existing building configuration, including detailing at the balcony-to-wall interface.

METAL PANELS

A prepainted aluminum composite metal panel product was selected for this project. The use of a composite material reduces the risk of buckling and surface deflection, both of which are key to the final aesthetics. The panels are hung from a subgirt framing system supported on extruded fiberglass spacers. The use of this type of spacer virtually eliminates thermal bridging and related degradation of thermal performance that would otherwise be caused by traditional Z-girt cladding supports.

Mineral fiber insulation was selected for use on the exterior of the air barrier. Even

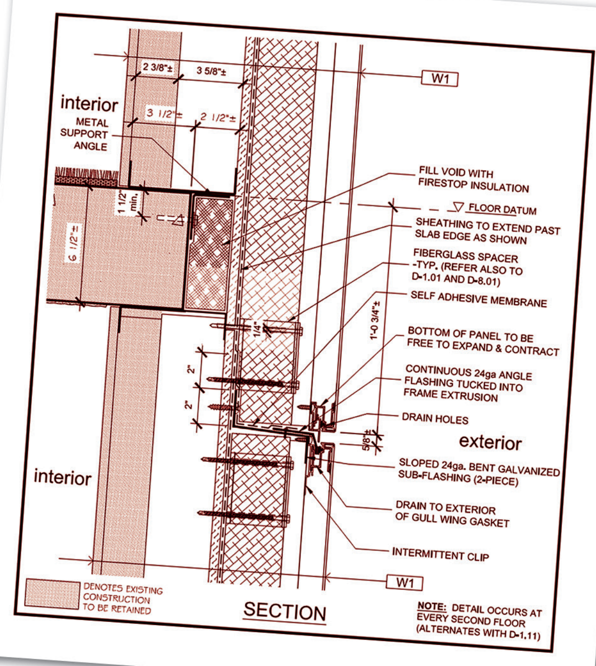

Figure 5 – Floor slab.

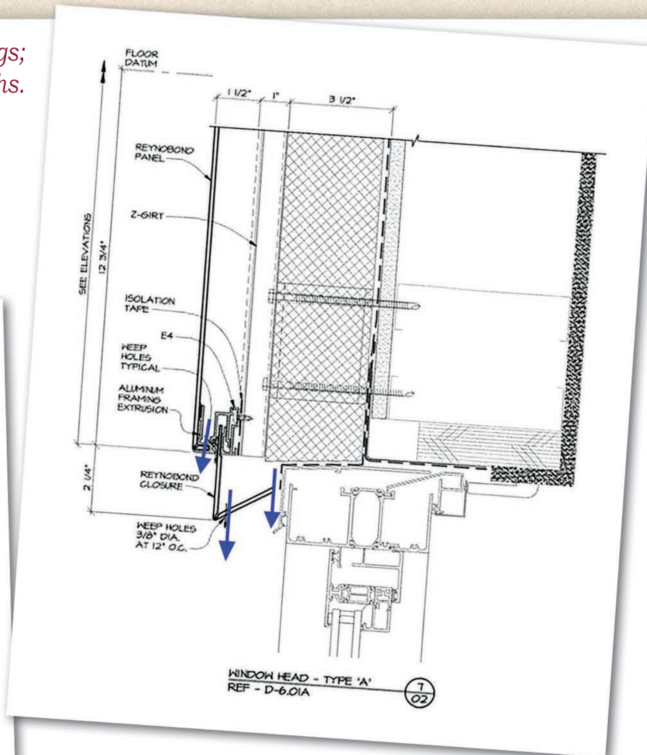

Figure 7 – Example of detail from metal panel shop drawings; blue arrows have been added to highlight the drainage paths.

Figure 6 – Wall assembly under construction.

though this type of insulation has a lower R-value than some other rigid insulation types, it easily drains any water that penetrates the panels and conforms to any irregularities in the substrate, resulting in a good fit. On previous projects, the use of rigid insulation had resulted in gaps between the insulation and the membrane drainage plane, allowing exterior air to flow behind the insulation and reducing its effectiveness. *Figure 5* is a typical cross-section detail through the slab edge, while *Figure 6* illustrates the wall assembly under construction.

Note that a cross-cavity flashing is integrated into the panel assembly to discharge any water that drains through the insulation or down the outer surface of the membrane drainage plane/air barrier. For this project, cross-cavity flashings were used at every second-floor level. This frequency was deemed to be a reasonable balance between drainage and thermal performance (the cross-cavity flashings form a thermal bridge through the continuous exterior insulation).

Shop drawings are a key component of any successful project utilizing metal panels. *Figure 7* is an example of a window head detail from the shop drawings produced for this project. Note that the window head detail incorporated drainage at three locations to ensure that water is not trapped in the assembly.

Two of the new windows were water tested (ASTM E1105) at a differential pressure of 500 Pa (10.4 psf), and large areas of the skylights were tested in general conformance with AAMA 501.2. Fortunately, the rain rack

Figure 9 – Original cladding assembly.

Figure 10 – New composite metal panels.

used for the ASTM water test was large enough to incorporate the adjacent metal panels. Flood testing of the balcony-to-wall interface was also performed (no differential pressure across the wall assembly) to confirm that water would drain out of the wall assembly at the cross-cavity flashings.

COMPLETED PROJECT

The owners are very pleased with the final aesthetics of the project. *Figure 8* shows the completed project, while *Figures 9* and *10* offer a comparison between the original cladding and the rehabilitated cladding. *Figure 11* illustrates the new building entry canopy. Importantly for the owners, the panels have remained clean and unstained since the rehabilitation was completed in 2013.

The complete cost for the project was approximately $7,500,000 (Can$), with a project timeline of 12 months from the start of mobilization on site to final completion. All of the owners resided in the building throughout the construction period.

Figure 11 – Main entrance.

Marcus Dell

Marcus Dell is a professional engineer who specializes in practical solutions to building enclosure problems. He combines his academic training with over 20 years' professional experience to offer comprehensive knowledge of the application of building science principles to North American buildings. His focus at RDH is on existing buildings and repair, renewal, and rehabilitation projects. He has published numerous papers on building envelope topics. Marcus is a member of the RCI Interface *Editorial Board and a member of the Western Canadian Chapter of RCI.*

