The Perfect (Retro)Fit: Overcoming Challenges with Curtain Wall Retrofits

By Rob Wood, P.Eng., President, C3 Polymeric

As curtain wall and window systems age, leakage and thermal problems escalate. Maintenance is no longer a viable option to extend their life, and planning for a façade retrofit commences. Crown Realty Partners (Crown), specializes in revitalizing underperforming commercial properties. The twenty-five-storey tower at 400 University Avenue in Toronto is a prime example. Constructed in 1969, it houses over 380,000 square feet of total office area. Despite a prime downtown

This twenty-five-storey tower at 400 University Avenue in Toronto used to be an underperforming commercial property but was recently revitalized thanks to a successful retrofit.

location, the appearance and performance of the building's façade were limiting its desirability to tenants.

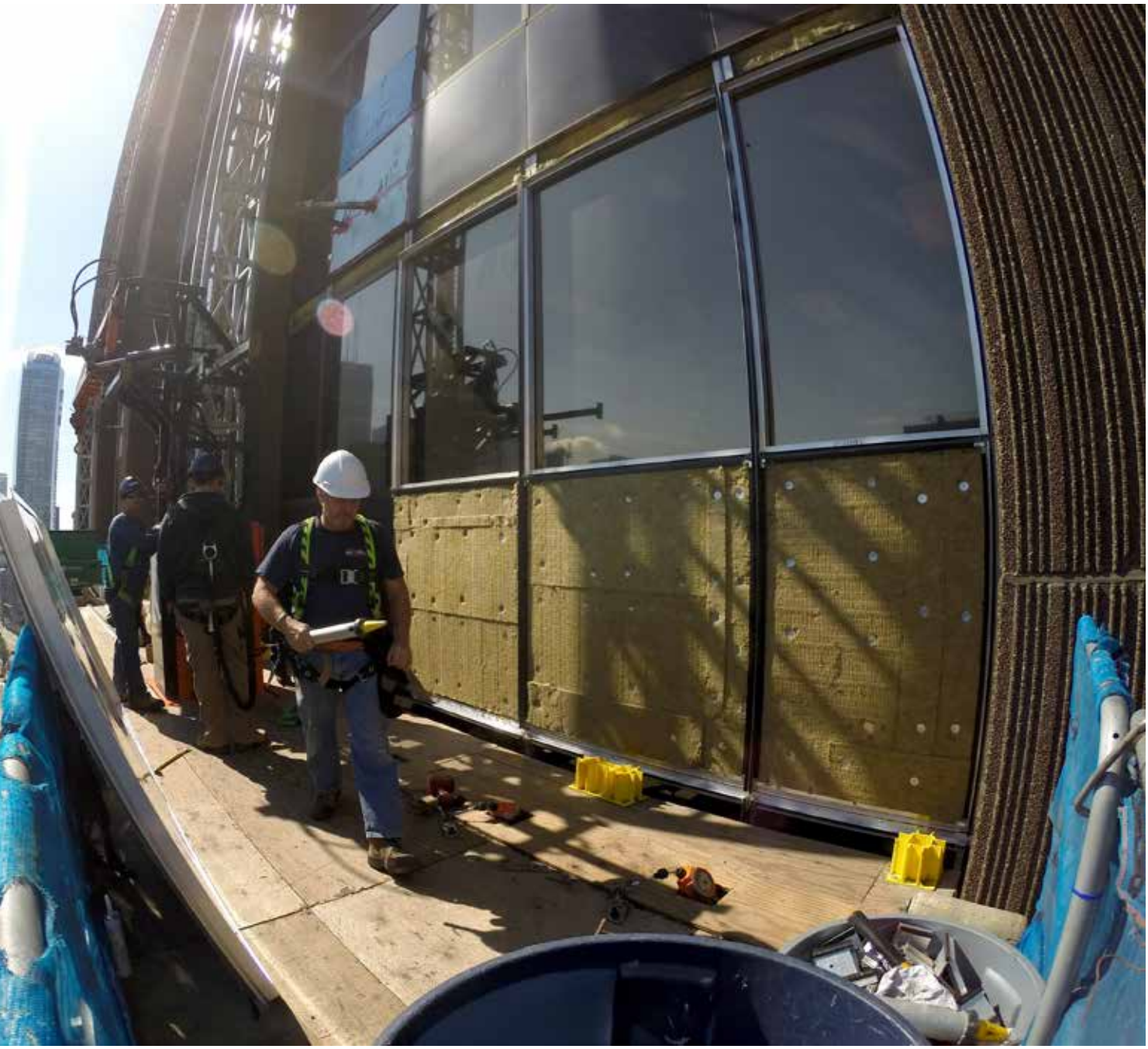
A successful retrofit starts with a clear definition of the criteria and constraints of the solution. For buildings with an aging, dated façade, owners often want to reposition the building and achieve a new, modern look. This may involve moving from a fully captured system to some combination of captured and structurally glazed components. Consideration is given to the type of insulating glazing units, spandrel units, and architectural metals to be used. Modified module sizing, including the relative amount of vision to opaque areas, may also be a criterion.

Special considerations for the type of glazing may also be identified. These could be the use of electrochromic glazing such as VIEW Dynamic Glass or SageGlass. Electrochromic glass can significantly reduce energy consumption, improve occupant comfort, and reduce or eliminate the need for interior blinds. However, it comes at a cost premium and necessitates additional interior work and investigation to determine its feasibility for use in a retrofit. Bird-friendly glass may also be required for all, or part, of the façade.

Technical criteria are generally set with the goal of achieving improvements in occupant comfort and reduction of energy consumption. A key technical criterion for many retrofits is the elimination of ongoing air and water leakage problems. These are among the most noticeable and most common problems with curtain wall and window systems. Selecting appropriate performance criteria, including the U-value of the glass and system, and the transmittance (visible light, solar), reflectance (visible in/out, solar), and solar heat gain coefficient of the new insulated glazing units (IGUs), is key to improving occupant comfort. Consideration may also be given to the condensation resistance of the system and to opportunities for adding or improving the insulation of opaque areas.

CONSIDERATION FROM CONCEPT TO COMPLETION

Analysis should consider constraints that will be present at all stages of the



Overcladding involved leaving existing frames in place and anchoring a new system to the original frames. A new insulated backpan and spandrel panel were included in the new system. The original vision glass was moved to the interior, and the interior of the original frames was overclad.

project, from concept to completion. Budgetary constraints must be identified and balanced with the need to meet technical and architectural requirements. The performance requirements described above may also impact the budget, as they will directly affect the energy savings and, in some cases, rebates that can be expected.

Most owners prefer their commercial buildings remain fully occupied throughout construction and that impact to tenants be minimized. The overall project duration and floor- or tenant-specific constraints should also be identified. These constraints may lead to some methods of retrofit being deemed unsuitable for a particular building. A designated substance survey is also beneficial at this stage. It is important that the scope of the survey includes all areas that may be impacted by the retrofit, including exterior and interior sealants, spandrel cavities, and insulation and firestopping. These areas are often not addressed in a typical designated substance survey, but are highly relevant when planning a retrofit.

Planning constraints, such as proximity to lot lines or heritage designations, that may restrict the ability to move or alter the façade system should also be identified. These constraints can directly

conflict with architectural criteria and make it considerably more difficult to meet the technical criteria.

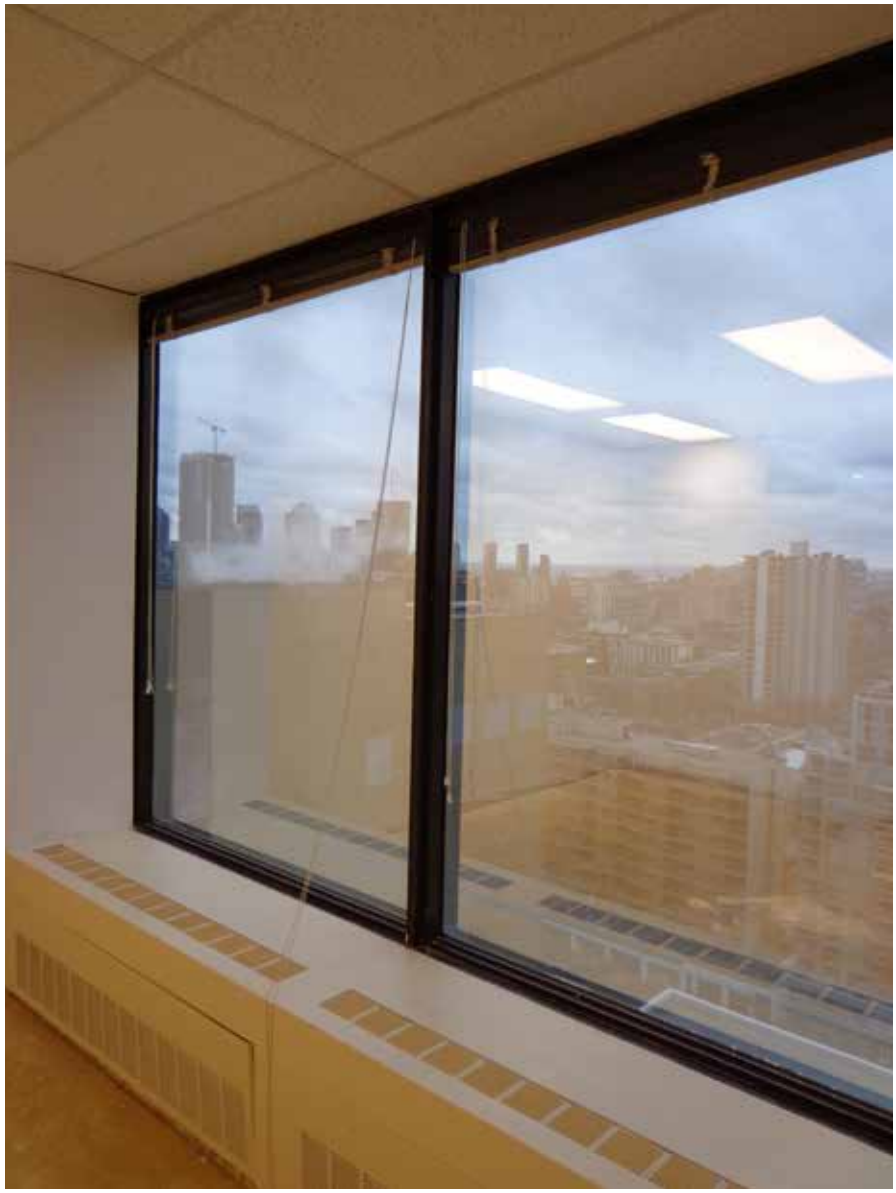
DESIGN FLAWS, FAÇADE LIMITATIONS

Having managed 400 University since 2004, Crown understood the limitations of its original façade. The façade used single glazing throughout the tower, including the ground floor. Poor detailing in the spandrel areas and the second floor soffits resulted in significant air and water penetration. While attempts had been made to repair the building, their success was limited by inherent design flaws in the façade.

As part of their purchase of the building in December 2010, Crown developed a plan to completely retrofit the façade. Recognizing the challenges of retrofitting an occupied commercial tower, Crown partnered with industry leaders C3 Buildings and Infrastructure (design, fabrication, installation), Quadrangle Architects (prime consultant, architect), and BVDA Façade Engineering (feasibility study, technical peer review) to implement the retrofit. An experienced project team is critical so they can conduct the required fieldwork and studies to determine the optimal method, given the owner's architectural, performance, and budget constraints.

DECISIONS, DECISIONS

There are three primary methods of retrofit: full replacement or recladding,



A view before the retrofit.

A view after the retrofit.

refurbishment of the existing system, and overcladding the existing system. All three options were considered for 400 University.

1. **Replacement:** This option included removal of the existing façade system and installation of a new curtain wall. It provided the best technical solution and enabled a high degree of architectural freedom; however, it was significantly more expensive than the alternatives. Further, it would have been highly disruptive to the tenants, as rotating portions of the building would have to be vacated during construction.
2. **Refurbishment:** This option included installation of new insulated glazing units (IGUs) in the existing system, and redetailing of the air seals. While this was the lowest cost alternative, it provided limited architectural flexibility and was determined to have a lower probability of effectively remedying the air and water leakage. Many of the seals could not be easily accessed for repair, and there were inherent flaws in the original design and construction.

METHOD	PROS	CONS
Refurbish	Speed, cost, tenant impact	Architectural and performance constraints
Reclad	Architectural and performance flexibility	Cost, tenant disruption, exposure of designated substances
Overclad	Minimize disruption, may be only technical feasible w, cost	Technical risk, reliance on existing structure

3. **Overcladding:** This option involved leaving the existing frames in place and anchoring a new system to the original frames. The old spandrel panels remained in place. A new insulated backpan and spandrel panel were included in the new system. The original vision glass would be moved to the interior, and the interior of the original frames was overclad.

Overcladding was selected as the optimal method of retrofit for the 400 University project. Given that this method relies on the existing structure, a detailed review of the existing window extrusions and curtain wall anchors was completed and retrofit of the anchors was included in the final scope.

FROM VISION TO REALITY

Using an iterative design process, the team developed a technically sound solution that met all of the identified criteria. The end result was a fully custom curtain wall. Sixteen aluminum and rubber extrusions were incorporated in the system and were designed to work

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specifically within the constraints of the building. The original system was used for the structural connection only and did not form part of the air seal.

The new curtain wall was installed from the exterior, prior to removal of the old vision glass. Frames, insulation, vision and spandrel glass, and pressure plates and caps were fully installed prior to removal of the old vision glass. As all of the new air seals are complete prior to any removals, the interior was never exposed to the exterior elements during construction. The interior work was limited to removal of the old glass and cladding of the frames and was completed outside of regular business hours. This method resulted in significantly less tenant disruption than either the replacement or refurbishment options.

Because the system was fully custom, the team at Quadrangle had significant flexibility to achieve their architectural vision. The primary constraint was that the module sizing had to remain as originally constructed. Although the old frames remained in place, and the only component of the existing system removed was the vision glass, it is not possible for anyone on either the interior or exterior to tell that it is not a brand new system.

The new system has resulted in annual energy savings of over 35 per cent. Building operators report that they are much better equipped to regulate the interior temperatures throughout the building, significantly improving occupant comfort. Finally, the aesthetic upgrades have been successfully leveraged to attract and retain tenants. ■

Rob Wood, P.Eng., is president of C3 Polymeric, a leading provider of curtain wall retrofits on occupied commercial buildings, and a member of The C3 Group of Companies. At C3 Polymeric, he has overseen the retrofit of five high rise office towers across Canada, including Toronto City Hall's two office towers; 400 University Avenue in Toronto; and City Centre Place and Oxford Towers in downtown Edmonton. Over the last five years, more than 15,000 vision units, spandrels, and skylights have been retrofitted under Rob's supervision.