University of Calgary MacKimmie Tower Redevelopment

Entuitive's Role: Structural Engineering Consultant

Courtesy of Klassen Photography

ENTUITIVE

The 75-Word Project Summary

As part of the University of Calgary's strategic vision towards a carbon neutral campus by 2050, U of C commissioned a retrofit of the existing 1970 MacKimmie Tower to transform it into a leading edge, high-performance, net-zero carbon building. The Tower is now 85% more energy efficient and has been recognized by the CaGBC with a provincial and national Green Building Excellence Zero Carbon Award. It serves as a model of what can be done to existing buildings.

Project Highlights

The project is unique in its high level of sustainability – not only is it a retrofit of an existing fifty-year-old library building, but the Tower is also a net-zero carbon building serving as commercial space where much of the University's administration now works in one centralized location. At time of print, the Tower is the largest net-zero carbon building project in Canada.

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A specific point of interest is the double skinned façade (interior glazing line and 4' wide interstitial space with exterior glazing), which has several innovative features, including active shading systems and fully automated operable windows both, at the inner and exterior glazing line. The automation of the windows can simply be overridden by individuals to assist in providing more refined user comfort. The system takes advantage of Calgary's extreme diurnal temperature fluctuations and performs nighttime flushes/purges after warmer days. The design was completed prior to the COVID-19 pandemic and, with the pandemic, the Tower provides a comparably safer work environment with a less risky fresh air distribution system compared to more traditional mechanical systems.

Immediately after the existing precast panels and asbestos were removed the interior glazing line was installed to ensure the building was enclosed as quickly as possible. This enabled work on the interior finishes to advance in parallel with the installation of the exterior glazing skin. As a result, the trades were able to work on the interior and exterior façade in tandem, rapidly reducing the construction schedule. In fact, the University used a phased approach to gradually allow staff to move into the new building. The building was half-occupied by U of C staff while exterior work continued.

The reuse of the fifty-year-old structural skeleton was another opportunity for innovation. Removing the weight of the heavy precast cladding and the weight of the library books made it possible to add two more floors, taking the Tower from a 12-to a 14-storey building. We also installed more efficient elevators in the existing elevator shafts, allowing the design team to reduce the elevator count by one. That freed up an existing elevator shaft to use for natural stack effect ventilation.

With considerably more efficient mechanical systems and natural ventilation, eighty percent of the pre-existing mechanical floor on the 7th level was freed, allowing for the creation of common boardrooms. This provided significant value-add to the owner – essentially adding the equivalent of an additional floor.


Courtesy of Klassen Photography

Complexity

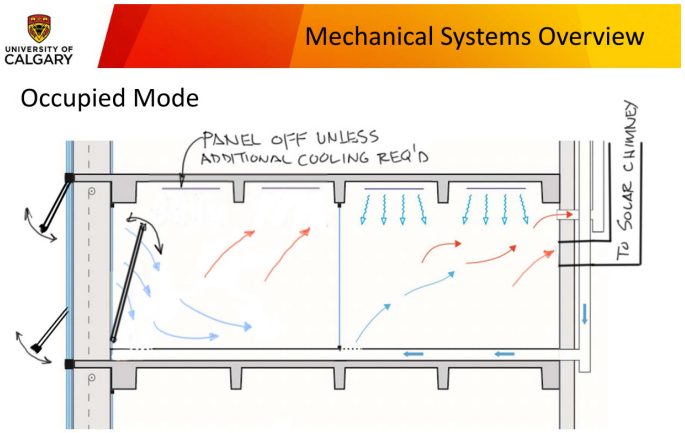
In working toward a zero-carbon building, we were faced with novel challenges that pushed us to innovate to solve them.

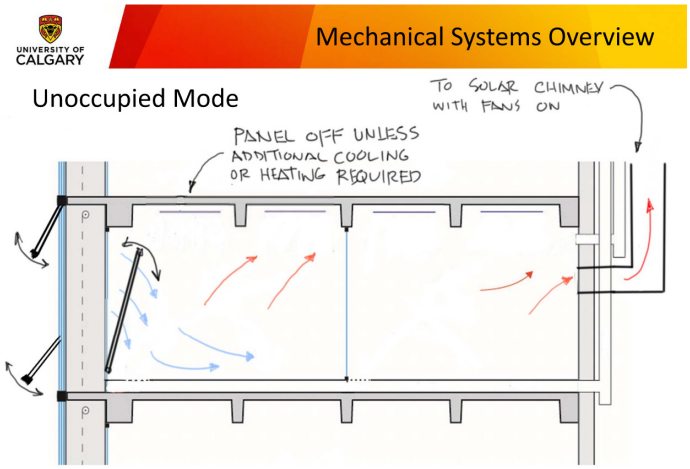
To add two new floors to the existing Tower, we completed an extensive study of the structure. We determined that removing the heavy library loads, utilizing live load reduction allowed by the current code, and removing the heavy precast panels would allow the addition without any modifications to the existing columns and lateral load resisting shear wall system.

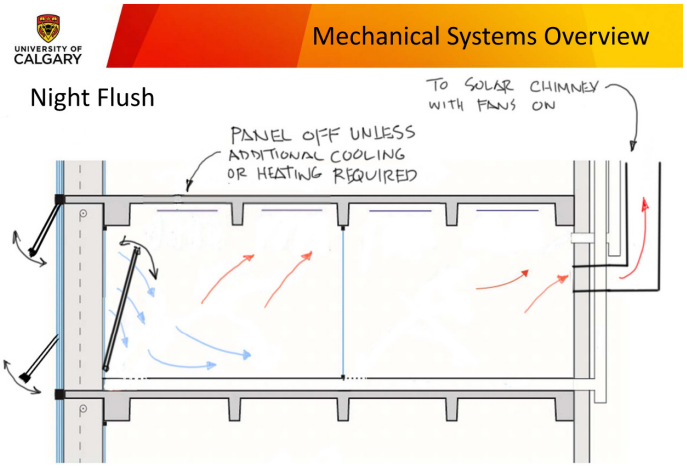
Not only did the two extra floors add space, but they also aided in creating the distinctive curved and faceted façade, giving the building a cosmetically new aesthetic. Many passersby believe that a completely new tower was constructed instead of the existing building reclad that was performed.

The addition of two-storey columns at the corners (a total of eight columns) were sloped about a vertical axis to provide a wider curvature of the glass. This assisted with the crowning of the building.

The existing concrete waffle slab posed challenges to route new mechanical, electrical, and data services within the structural floor depth. Placing the slab underneath would have resulted in undesirable finishes and would not have maximized the thermal mass properties of concrete. The solution was to add a raised access floor at every level to integrate electrical, mechanical, and sprinklers within the interstitial space to expose the existing concrete waffle slab and enable its inherent thermal mass properties facilitating more efficient heating and cooling. The services on the floor above serve the floor space below.







Social and/or Economic Benefits

The MacKimmie Tower is part of a larger redevelopment project that includes the construction of a new building. When the entire redevelopment is completed, it will offer an enhanced learning experience for students, while providing added benefits for faculty and staff. Both the Tower and the new building will use the same double skin façade and mechanical systems to enhance energy efficiency.

The Tower will be connected to the wider redevelopment project of the MacKimmie Complex, and the University, by a series of outdoor spaces and promenades, providing students, staff, and faculty alike numerous places to congregate once it is safe again to do so.

The Tower itself functions as an administrative building for the University. It has provided the U of C with the ability to consolidate its administrative function into one building, improving efficiency. Additionally, the consolidation has freed up space in several buildings that could be used for future research facilities or classrooms.

It serves as an example of what can be done with aging building stock and has been used as an example for the City of Calgary, Alberta Infrastructure, and other post-secondary institutions.

Environmental Benefits

The MacKimmie Tower is the first building in Alberta to have received the Canada Green Building Council's Zero Carbon Building Design Standard. The 40,000 square meter building is also the largest project to have received this certification to-date in Canada.

Passive design controls were used to ensure net-zero was achieved, all while minimizing energy usage and optimizing interior comfort. Other sustainable features of the building include building-integrated renewable energy generation, active and passive natural ventilation, high thermal mass construction, daylighting, and the leveraging of the University of Calgary district energy systems.


Courtesy of DIALOG

One sustainability-focused challenge was that the existing building featured an inefficient cladding system that led to poor thermal performance. The innovative double-skinned façade greatly improved thermal performance.

Photovoltaic panels will be installed at the roof level of the completed Tower and the new building will also have a PV array at the roof, along with fully integrated PV within the glazing at key locations of the façade that have maximum exposure to the sun's intensity.

Meeting Client's Needs

Over the four-year journey we were able to collaborate with the University of Calgary in creating a sustainable campus building that helps them achieve their strategic objectives. These objectives include becoming a carbon neutral campus by 2050 and becoming one of the most energy-efficient campuses in Canada. We also helped them to further cement their reputation of being a leader in sustainability and green building.

As part of this journey, we aided the U of C in repurposing an existing building, one that the government of Alberta was requesting be refurbished, and transformed an old, undesirable looking building into quite literally a shining sustainable beacon at the heart of campus.

This project was truly a positive learning experience for the owner, user groups, constructors, and consultants. It helped set the standard of what is achievable. It also enabled the client to understand the long-term cost savings that sustainable refurbishments can provide. The larger upfront investment of capital cost will help offset the operational costs significantly down the road as energy costs continue to climb.

Furthermore, being at the heart of campus, the surrounding areas are highly trafficked with over 15,000 students and faculty walking by every day and a heightened awareness of phasing and construction safety was paramount.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