2013 Canadian Consulting Engineering Awards

# Calgary Public Building Restoration

**Category:** Buildings

**Submitted by:** Stantec Consulting Ltd.

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Historic Calgary Public Building

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# Calgary Public Building Restoration



## Back to the Future

### RESTORATION CAN PRESERVE OUR HISTORY, OUR COMMUNITY, OUR ENVIRONMENT AND OUR TAX DOLLARS

The Calgary Public Building restoration constitutes a unique and quantifiable cold climate case study demonstrating that existing heritage buildings do not have to be demolished to make way for "more modern, energy efficient structures."

The City's Energy Management office was compelled to check the Calgary Public Building's energy meters when the building was first reopened after an extensive restoration. The building's energy consumption had dropped so much that it appeared, from afar, that the meters were broken! In fact, the meters were just fine. The dramatic dip in energy consumption was a direct result of our team's sustainable restoration.

Owned by The City of Calgary, this municipally designated heritage building was constructed during the depression, from 1929 through 1931. Our restoration team's challenge was creating a contemporary office space with superior indoor environmental quality and energy efficiency, while respecting the historical building aesthetics and context.

The Calgary Public Building Restoration project encompassed the top six floors and the basement of the eight-storey building, which included the transformation of one "heritage" floor with finishes and fittings authentic to, or reminiscent of, the original 1930s decor. Stantec provided mechanical engineering, energy consulting, measurement and verification, and commissioning services for the design and construction of the Calgary Public Building Restoration.

The key sustainable strategies that the team incorporated into the restoration included the following:

- High-performance, spray-applied polyurethane insulating and air barrier system installed on the interior of the existing building envelope in order to maintain the façade's heritage character while significantly decreasing the buildings heat load through improved insulation and decreased infiltration
- A second layer of new high-performance operable windows installed in the interior of the building envelope, independent from the exterior heritage windows
- Restoration of all exterior heritage windows to restore the original building's natural ventilation, and passive cooling design features
- Extensive use of daylight for illuminating the office spaces based on the existing U-shaped configuration of the building


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- Solar energy for hot water heating in the building
- Future-proofing the design so it is ready to transition to using rain water harvesting for toilet flushing, and ready to connect to the local district heating utility
- Use of chilled beams for cooling; one of the earliest installed applications in western Canada
- Digital commissioning and measurement and verification system to optimize the construction, start-up and ongoing operations of the facility
- Attained LEED for Commercial Interiors Platinum Certification

## Technical Excellence

### ENERGY EFFICIENCY AND REDUCED ENERGY AND OPERATING COSTS

Our early energy analysis indicated that a majority of the building's energy consumption was the result of air leakage through the building envelope and windows. At the recommendation of the design team, the client decided to invest in a high performance envelope and glazing to minimize the building heating and cooling loads. The result was a significant overall capital cost savings on the streamlined mechanical system, reducing energy consumption at the same time.

Stantec had extensive input into the energy characteristics of the new building envelope. By improving the building envelope and controlling ventilation and air leakage, we were able to improve, dramatically, both the indoor air quality and energy efficiency of the building. To augment these achievements we took advantage of the original design's passive building ventilation and cooling strategy. We restored its capacity to the original design specifications by reversing a number of ad-hoc modifications that had been done in the past, including the sealing of windows.

Since the exterior of the building had to remain intact, the design team implemented an innovative, high-performance building envelope "liner" that would not compromise the external façade. The liner is an internal insulation, glazing, and finishing wrap that reduced heat loss and unwanted air leakage, contributing to significant energy savings, a reduction in the size and cost of mechanical upgrades, and improved occupant comfort.

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## FUNCTIONAL SPACES THAT SUPPORT USER NEEDS AND ARE FLEXIBLE FOR FUTURE REQUIREMENTS

In order to optimize the spatial planning within the building, new plumbing lines were added to the scope of the mechanical improvements in order to service new washroom cores on several floors and provide water for the heating system. We optimized the placement of the water lines from constructability, phasing, and occupant traffic perspectives.

The team designed the building to accommodate future technologies. The design team's coordination of mechanical and electrical base building systems was key to the success of the project, given the scope of demolition and construction required to run the mechanical systems vertically within the new building envelope liner. Coordinating these systems minimized the inconvenience to building occupants during construction and provided the owner with a more flexible design for future upgrades when new funds or technologies become available.

The mechanical engineering team coordinated the installation of dual water supplies for the building's toilets and urinals, including a system option for a rainwater-harvesting cistern, which can be installed in the basement at a future date as an alternate water supply for sanitary use. In addition, we designed the heating system to accommodate a future connection to the downtown district energy system; an energy transfer station was installed to be ready for a future heating connection.

## HIGH-QUALITY INDOOR ENVIRONMENT FOR THE HEALTH AND COMFORT OF OCCUPANTS

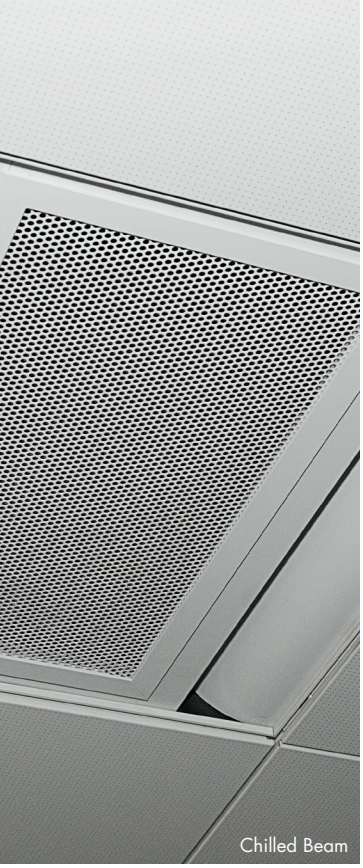
A key success of the design solution was the amount of control that it gave building occupants over temperature, air circulation, and lighting in their workspaces.

The original building had been carefully designed to accommodate natural ventilation and passive cooling through a number of features: the configuration of the building itself, the high thermal mass of the stone and concrete structure and the placement of operable windows. Over the years, the exposed thermal mass had been covered by contemporary architectural finishes, and the operable windows had been sealed shut. As a result, occupant satisfaction left much to be desired, with insufficient indoor air quality and poor thermal comfort.

Recognizing the building's inherent passive cooling design features, the mechanical design took full advantage of the thermal mass through the exposure of the unique waffle ceiling, and the use of operable windows to offset mechanical ventilation and cooling at appropriate times. We used highly efficient chilled beams with perimeter induction units to compliment the passive ventilation techniques.

*"A major design objective for the Public Building Restoration design team was to increase occupant satisfaction as measured by a reduction in the frequency and volume of requests for service calls initiated by our staff as a result of the poor indoor environmental quality in the existing facility. The City has observed a significant reduction in service calls and a welcome improvement in occupant satisfaction rates as a result of the project."*

— Russ Golightly
Project Manager,
The City of Calgary


Chilled Beam



# Advancement of Technology

## CHILLED BEAMS

Stantec's design was one of the first installations of active chilled beams in Calgary. Chilled beams are extremely quiet, eliminating fan noise typical in office buildings. They also use about one-sixth the amount of supply air as a traditional system and therefore allow smaller ductwork, leading to significant energy savings and permitting flexibility when working with the varied ceiling heights that are present in this heritage building.

Chilled beams are a more efficient means of conditioning a space; energy is moved around the building via water (hydronics) rather than via air and water can carry much more energy than air. Chilled beams work by inducing airflow across built-in heating and cooling coils to deliver conditioned air with a significantly reduced need for mechanical fans; typically only the quantity of air required for ventilation is needed to enable the chilled beams to function. Because there are no moving parts, air terminal maintenance is reduced as compared to a fan coil or variable air volume system.

## SOLAR HOT WATER

Stantec designed a solar hot water system on the roof of the building to provide enough renewable energy for the building's domestic hot water system. The solar system is all the more appealing as it enables the building's boilers to be deactivated during the warm summer months, saving maintenance and energy costs.

Rooftop solar hot water system

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## Management of Risk

### EVIDENCE-BASED DESIGN

The team used evidence-based design and life cycle cost analysis to manage cost risks for the project and to justify further investment in sustainable design and energy efficient features. Detailed energy simulations were used to evaluate the impact of various design scenarios and to estimate the rate of return on various energy conservation measures.

### REASONED DECISION MAKING

At every decision making juncture throughout the project a minimum of three very important project parameters had to be considered:

- Meets or exceeds the Standards and Guidelines for the Conservation of Historic Places in Canada
- Exemplary environmental stewardship and leadership within The City of Calgary Corporation
- Extend the life expectancy, flexibility, and adaptability of the building.

If only one or two of these parameters could be satisfied, it was considered the wrong decision for the project. Only when all three of these conditions could be satisfied was the decision made a part of the project charter. Although seemingly straightforward, at every major juncture each parameter had a competing interest with the other two parameters. By ensuring that no parameter was given sole preference over any other parameter, the project was able to incorporate very important goals from very different stakeholders in the project.

The heritage floor, where finishes and fixtures were either original to, or reminiscent of, the original 1930s building

The second layer of new high-performance operable windows, independent from exterior heritage windows.

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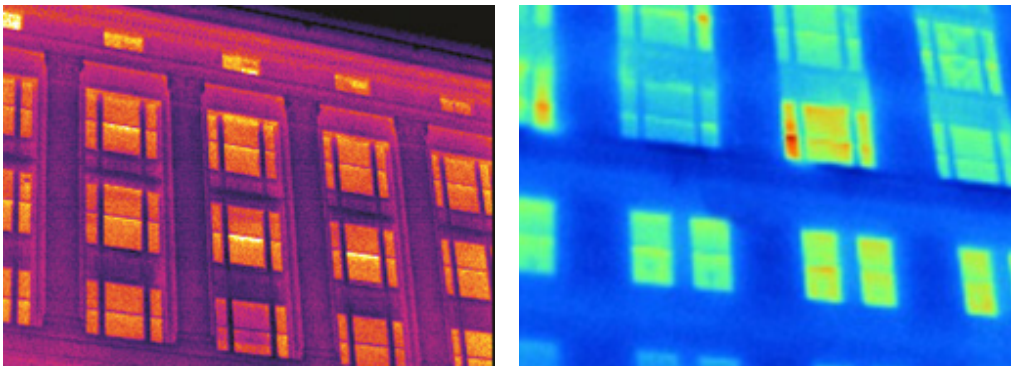
## Environmental Value

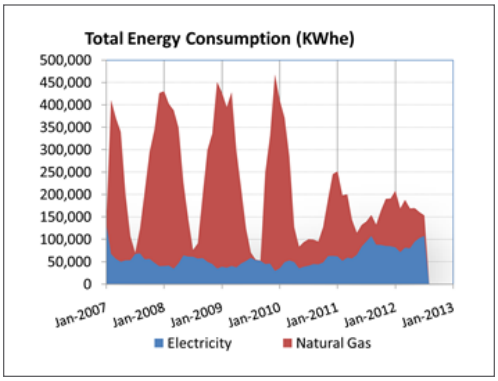
The Calgary Public Building restoration constitutes a unique and quantifiable cold climate case study demonstrating that existing heritage buildings do not have to be demolished to make way for "more modern, energy efficient structures." Heritage buildings can be successfully renovated to the highest standards of environmental stewardship without sacrificing cost, energy efficiency, or preservation standards. The Calgary Public Building has achieved Platinum certification from the CaGBC.

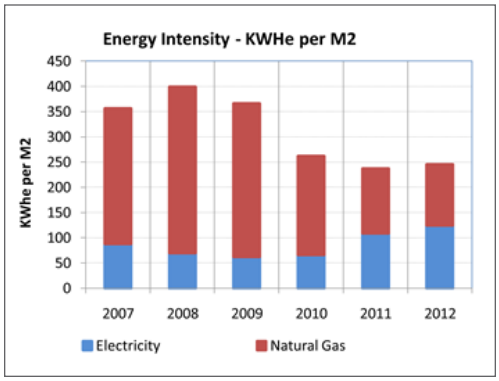
The detailed, high performance interior envelope liner retains and accentuates the heritage fabric of the building while reducing heating energy consumption by upwards of 45% and permits highly adaptable open office design because it houses the building's entire long term operating infrastructure.



Before and after thermal images for the north elevation

In the graphs below, the left illustrates the reduction in energy after the energy-related restorations were complete. The increase in electrical consumption is attributed to an increase in the number of building occupants. The right indicates the Building Energy Performance Index or BEPI number – the equivalent kilowatt hours (energy consumption) per square meter per year. A modern office building constructed to today's code would be expected to consume approximately 300 ekWh/m2-year




Chiller (CH-1) with its corresponding Stancheck barcode

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## Added Value

### MEASUREMENT AND VERIFICATION

All of the mechanical, electrical, and plumbing systems installed in the building include measurement and verification (M&V) technology. Prior to this project, the perception was that a measurement and verification system was too costly and afforded too little benefit to the building owner to be worth the additional investment. Stantec advocated the system for this application as there was extensive interest in confirming the energy savings predictions made during the design phase of the project.

Stantec's design also took advantage of recent advancements in M&V systems. The additional metering of subsystems, such as chiller efficiency, allows the building owner to quickly diagnose energy inefficiencies or inefficient occupant behaviours and make quick corrections, leading to ongoing energy optimization. The M&V system is connected to, and monitored by, The City of Calgary's automated Building Management System (BMS). The City of Calgary also has an internal energy and environmental audit group that tracks, assesses, reviews, and provides energy consumption updates through actual utility costs and bills. Information from the M&V system has been provided to the consulting team on an on-going basis and preliminary actual data demonstrates the building is currently outperforming the energy simulation predictions for the project.

### STANCHECK

Stantec also implemented their Stancheck Commissioning protocol for the project. A first with The City of Calgary, and at the time an industry-first in Canada, Stantec's digital commissioning protocol calls for barcode tags to be added to all commissioned equipment. These tags can be scanned with a tablet computer during and after construction, enabling the user to access installation, operations and maintenance, commissioning, and shop drawing data on the device, thus facilitating faster diagnosis of potential problems with the system, and speeding up repair times. As a result operational costs are minimized, energy performance is optimized, and there are fewer occupant comfort issues.

During the construction phases, the Stancheck system was instrumental in helping the construction schedule remain on track, as the consultant and owner team had real-time updates on installation and commissioning progress.

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## Degree of Difficulty

### PHASING

Our mechanical engineering team had to address specific issues as a result of the construction being phased:

- We had to install the central distribution for heating and cooling first. As a result, a mechanical infrastructure "backbone" was required at the start of the project, from which to build and carry out the floor-by-floor restorations. It was important to minimize disruption to occupants when relocating mechanical and plumbing shafts necessary to optimize the existing floor plates for workstations and environmental quality.

- The project proceeded with a phasing strategy two floors at a time, with two key interferences happening to the floor immediately below. Access was required to the base of each radiator to disconnect and cap piping. With a mixture of ceiling types in place this meant that plaster ceilings had to be cut out in many cases so that we could proceed with the work. Our design team had to work with operations and construction personnel to plan the phased demolition and construction of the restoration work for the mechanical systems.

- We designed and incorporated the new mechanical systems to work with the new and enhanced building envelope. As such, the Window, Envelope & Insulation strategy was undertaken concurrently with the start of the mechanical system upgrades. As part of this strategy, the existing radiators (the building's sole mechanical source of heat) were disconnected and removed (with the exception of the heritage floor where the radiators remain, and be supplemented with additional mechanical strategies to ensure thermal comfort standards are maintained). The new mechanical system became the building's source of heat, cooling and ventilation.

- As one of the first chilled beam installations in Calgary, our team had to work with the project stakeholders to seamlessly incorporate this new technology into the design and get buy in from the relevant trades and buildings operations staff. The installation was so successful that many projects in the region are now implementing chilled beam technology.


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## Benefit to Society

### TRIPLE BOTTOM LINE: SOCIAL RESPONSIBILITY, ENVIRONMENTAL STEWARDSHIP, ECONOMIC VIABILITY

One of the key goals set out by the Heritage Planning Authority at the City of Calgary was to create a specific heritage case study demonstrating the benefits of retrofitting and re-using heritage buildings. Specifically, the case study was intended to quantifiably demonstrate the energy savings of the preservation effort, and report back to City Council with quantifiable data. This information could then be used to support that retrofitting buildings makes economic sense and committing funding to preserving buildings is equally as reasonable or better than committing funding for new buildings. The project's high performance and energy efficient features carried a 12% construction cost premium of $1,812,500. Energy and water savings yield a nine-year simple payback on this investment, with occupant productivity and maintenance savings providing further contributions. The project truly represents a balance of people, profit, and planet.

### COMMUNITY

The owner chose to invest a significant amount of resources into the restoration project instead of building new office space in another location. Although the project does not create a new public space, it intensifies the use of an existing public space. The Calgary Public Building is immediately adjacent to Olympic Plaza, which is located in the downtown core and is a significant public space in the City. The building is located at the east end of Stephen Avenue, a designated pedestrian mall that runs through the downtown.

### TRANSFORMING CULTURAL ATTITUDES

The project showcases a rehabilitation process that resulted in the transformation of an existing heritage building into a leading edge, high performance sustainable project with equally strong heritage conservation ambitions. In Calgary specifically, it is helping transform a prevalent cultural attitude of demolishing our heritage structures and identity for more progressive and forward-looking architecture. The project's efforts are a testament to transforming the common misconception that heritage preservation, environmental stewardship, and innovative architecture are mutually exclusive initiatives.

### INFORMATION DISSEMINATION

The architectural and engineering consultants for the project continue to engage a wide audience about the results of the process, the product and the commitment and energy it takes to complete projects such as the Calgary Public Building. These initiatives include:

- Canada Green Building Council: The Calgary Public Building is scheduled to be presented at the CaGBC regional conference in Alberta in May 2013


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CATEGORY: BUILDINGS



- Winner of the 2013 Consulting Engineers of Alberta Showcase Award of Excellence for Sustainability and Award of Merit for Buildings Engineering
- Green Building & Design Magazine: April 2011 Article Publication on the Calgary Public Building and environmental stewardship in public sector projects
- Avenue Magazine: April 2011 Article Publication on the Calgary Public Building and the process of re-skinning buildings to make them more environmentally friendly
- Buildex Calgary 2010: The owner presented the Calgary Public Building and the Integrated Design Process and Project Management required to achieve high levels of environmental stewardship
- University of Calgary Sustainability Lecture Week: September 2010, Calgary Public Building featured as a case study for balancing historic preservation goals with high performance energy efficiency goals
- The Integrated Design Process used for the Calgary Public Building was highlighted as a case study in owner, consultant team and construction manager collaboration
- To date there have been three grade school tours of the Calgary Public Building lead by the owner and the Architect to educate young minds about the importance of heritage rehabilitation and environmental stewardship.

## Conclusion

The Calgary Public Building restoration exemplifies the marriage of traditional and contemporary engineering, while still being mindful of the future. The award-winning LEED Platinum project reemphasized and restored original mechanical design features such as natural ventilation, passive cooling, and thermal mass while complimenting the passive (and largely forgotten) design techniques of the 1930s era with modern technologies such as solar hot water heating, chilled beams, digital commissioning, and M&V systems. The restoration design team understood that if we did our jobs well, this would not be the end of the story for the Calgary Public Building, but merely a new chapter. Our team worked to future proof the design by incorporating design features that will readily enable a conversion to the exclusive use of rainwater harvesting for toilet flushing, and designing the heating system for easy conversion to district heating. Thanks to our efforts, the next time The City of Calgary decides it is time to go “back to the future,” the Calgary Public Building will already be prepared.