NEW HEAD OFFICE

COMMISSION DE LA CONSTRUCTION DU QUÉBEC

Canadian Consulting Engineering Awards
2014

Technical Categories
Buildings

bouthillette parizeau

advanced building solutions

An environmentally performant yet architecturally simple building!

The Commission de la construction du Québec's new head office is located right along one of the busiest highways in Québec. Its distinctive architectural design, combined with efficient yet simple systems, reflects CCQ's sustainable awareness and high-quality organization, helping to promote the image of the construction industry. BPA successfully contributed to this project by designing innovative and efficient mechanical systems, compliant with the CCQ's goal to obtain the LEED® Silver certification within budget and schedule.

HIGHLIGHTS

12,533 sq. m. – 8 floors – 600 employees

New construction and major renovation

Office building and important data center

South facade entirely made of glass (49% of the building), with heat transfer coefficients ranging between 1.7 and 2.1 W/m²°C

Triple-glazed windows with high emissivity film covers

Envelope performance RSI value: walls 3.5 (R20) and roof 6.2 (R35)

A first in North America: light-activated, antibacterial curtained ceramic facade

Chillers use R410a and R134a refrigerant (total of 380 tons) – Compliant with Kyoto Protocol with a 5.7 COP average

Heating from 2 high efficiency natural gas condensing boilers – Total capacity of 3720 MBH (ε=92%)

Energy unit intensity of 35 kBtu/sq.ft./year compared to convention building of 180 kBtu/sq.ft./year

75% heat recovery from exhaust air through a thermal wheel

Low consumption plumbing fixtures with infrared detectors – 39% reduction of potable water consumption

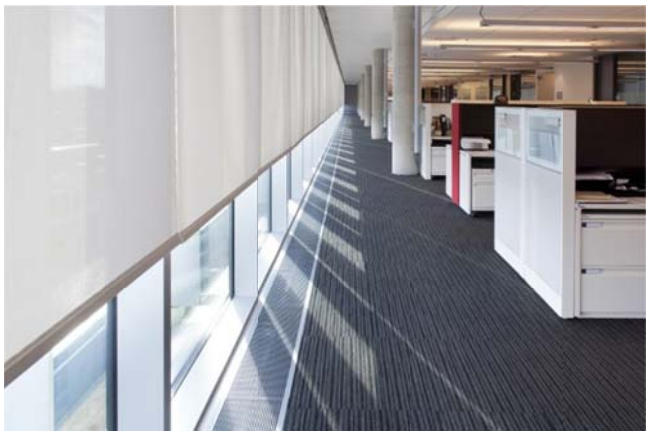
Greenhouse gas emissions decrease – 510 tons annually: equivalent to 22 medium-size houses

INNOVATION

The CCQ wished to move its head office to a new location in order to provide its employees with a modern and efficient work environment. The project consisted in a new 12,533 sq. m. building featuring eight floors of office space and a large server room. Additionally, the building located next to the new facility, accommodating the CRIQ research center, and the regional office and Montreal call center, needed a major renovation.

Below are innovative solutions as examples on why this building stands out:

- In order to capitalize on the low temperature recovered heat from the server room, a new product was used for perimeter heating which combines forced and natural convection while minimizing air movement and occupant discomfort. This equipment is used to heat the South facade glass wall (49% of the building), featuring 5.5 m high windows. The device is recessed in the floor, leaving more available space for the office furniture. It also provides efficient ventilation (εz = 1.0 as per ASHRAE standard 62.1-2007). Although manufactured in Montreal and exported internationally, this equipment installation is a first in Canada. A mock-up model was tested in a laboratory at the École de Technologie Supérieure, allowing the client and the prime consultants to assess the ventilation and noise level performances. Aerodynamic testing was performed, allowing the manufacturer to thoroughly document the product performance. The Material Resources Director at CCQ got involved in every meeting and laboratory testing session. His presence, combined with his extensive experience in the operation and maintenance fields, positively contributed to design and decision process.



- Facing the Metropolitan Expressway, the South wall features a “Hydrotect”-coated ceramic curtain whose properties allow photocatalytic decomposition of mold, bacteria and vehicles engine exhaust. The dirt is easily washed down by the rain, thus reducing maintenance costs. This material is the first in its kind to be installed in North America.

- A dedicated outdoor air system with an overall 75% efficiency heat recovery wheel was installed between outdoor airflow and general air exhaust. Treated outdoor air is then distributed into VAV ventilation systems designed to be identical on each floor in order to minimize infrastructure cost, facilitate maintenance and reduce costs for replacement parts. This flexible design allows each floor to have their own schedule while providing energy savings by reducing the operation of other HVAC systems outside working hours.

- In collaboration with the IT department, our team customized the design in order to reclaim and effectively reuse the energy produced by the data center that houses six rows of powerful computers (300 kW, 40 racks). Solution was to install in-row cooling systems which are connected to a dedicated chilled water network. Advantages are its reliability, its capacity to absorb local servers heat and the ability to adapt to supplementary servers by adding more in-row AC units. Heat rejected from the main server room helps fill building heating demands.

- The architectural design of the building represents the CCQ and construction industry values: visibility, accountability and transparency. The latter is reflected by the abundance of triple-glazed windows on the South façade of the building. An acoustical barrier was created to ensure noise reduction due to proximity of the Metropolitan Expressway.

- The 250-ton chiller (5.93 COP) with magnetic bearing compressors is paired to a conventional cooling tower which is cleverly hidden on the last floor (the executive office storey), and away from the elements.

- In order to prioritize heat recovery from the data center, the various ventilation systems were not designed to operate in a free-cooling mode. This solution was chosen according to the results of the building simulation showing significant energy savings compared to the installation of louvers on the North facade and ductwork obstruction, which would have involved additional costs.

- Each floor, divided into various zones, features occupancy sensors with dual technology (sound and motion detection). Occupancy sensors also control the temperature that can be lowered by 1°C when the room is unoccupied during normal working hours. This represents significant savings on an annual basis while going unnoticed by the occupants. Their comfort is never compromised.

- Design of the floor layout was carefully planned by locating the closed offices near the central core. All of the closed offices benefit from a great view on the open surrounding spaces and windows.

- In order to decrease solar radiation generated heat, sunshades garnish the exterior facade and photo-electric controlled blinds maximize natural lighting while reducing energy consumption. Blind operation is programmed according to brightness, scheduling, occupancy, etc.

The CCQ representatives and employees are proud of their new facility. The BPA team is also proud to have been a part of this ambitious project that resulted in a high performance building that will shine on the Montreal scene for many years!

COMPLEXITY

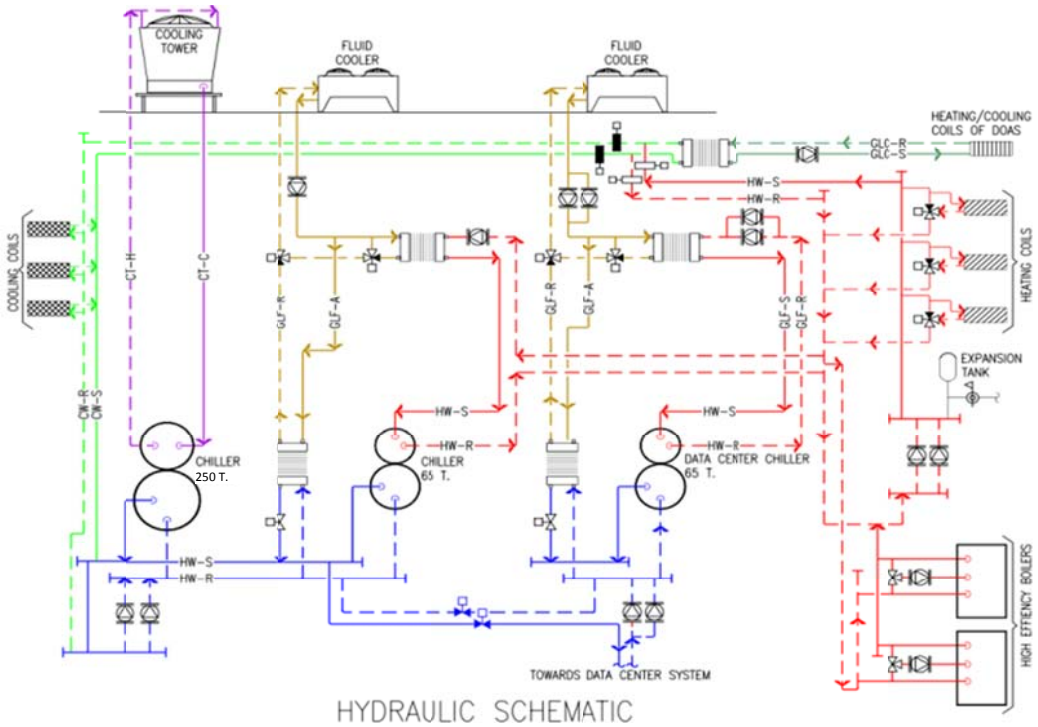
This project included several technical and operational elements of complexity.

- Since the schedule was tight and the plumbing contractor was not designated, the MEP engineers had to play the role of the contractor which required additional expertise to precisely coordinate the location of sleeves and openings for the various services into the structure. As a result, the implementation methods had to be anticipated early in the project.

- The construction was carried out in phases with a limited budget and within a tight schedule due to non-renewal of several leases.

- While the new building was erected, the existing building was being renovated to accommodate the new services. Rigorous survey was carried out in other to minimize the cost and to limit interventions since the building was still occupied during the interventions.

- Server room which provides critical and essential service, required triple redundancy of the HVAC&R equipment. The server room uses one of two independent and identical chilled water networks with a 65-ton chiller (3.6 COP and 4-step modulation), variable speed pumps and a fluid cooler. These two networks use the 250-ton main chiller for the building as back-up. As a last resort, two 4-inch chilled water fittings are designed to accommodate a rental chiller. However, in order to optimize the infrastructure costs, the main chilled water network is designed to also use the backup 65-ton chiller when not required for the data center. The fluid coolers were selected with an added capacity of 25% to compensate any fan malfunction.



HYDRAULIC SCHEMATIC

- Responsible resource management requires energy recovery during mid-season and winter. A set of control valves intercepts the heat rejection loop, which is re-injected into the heating network. A heat plate exchanger is installed, allowing to by-pass chiller operation where heat is released directly to the fluid cooler via the in-row cooling devices. Therefore, supply and return temperatures are determined by the heat recovery used for the heating network of the entire building. If the two 65-ton chillers break down at the same time, a control sequence was programmed to transfer the data center load to the 250-ton chiller designed for the building load requirements. As a last resort, 2 4-inch chilled water fittings are designed to support a rental chiller. Due to critical operations of the data center, the configuration of the HVAC&R services and the selection of the equipment allow for continuity of services.

- A building energy simulation was required not only for LEED® certification but also to reinforce the comprehension of the building profile and to help determine which measure needs to be controlled at what time. Because of the limited budget, the simulation helped optimize the system capacities and reduce operating costs.

- Integration of every heat recovery loop to optimize energy consumption.

- During the renovation of the existing building, the presence of mold within the envelope was discovered. A delay in construction has been avoided by framing interior walls and using temporary services. These measures helped to continue work without any health issues for the workers.

Finally, the use of an integrated design process allowed us to easily and successfully get through these challenges. The result: a fully functional, easy to operate building, with refined architecture, using simple technology and equipment available on the market.

SOCIAL AND ECONOMIC BENEFITS

The Commission de la construction du Québec (CCQ) is the organization that applies the laws and regulations providing a legal framework for the construction business. Considering the controversy over the industry, it was extremely important for the client to implement a project that would be a model with regard to governance, community involvement, and standards compliance. The client is thrilled with the results: the team achieved all of the goals, the construction was finished on schedule, and the cost per square foot is lower than in the private industry. Moreover, a high energy efficiency building means lower costs, thus good news for the construction workers and employers who finance the organization.

Additionally, the CCQ put in place several incentives for employees who chose alternative means of transportation (carpool, public transport, bicycle). Those means will most certainly contribute to reduce the impacts of motor vehicle traffic in the CCQ offices area.

The project was presented to Ahuntsic-Cartierville borough's Consultative Committee of Urban Planning, and was the object of recommendations and conditions, which were complied with by the CCQ. Those conditions related to, among other things, the new building facing, the landscaping, the pedestrian circulation and the parking areas.

Globally, the CCQ was committed and succeeded to integrate the project in the most harmonious way possible into the area, maintaining the bicycle path and improving the visible aesthetics.

ENVIRONMENTAL BENEFITS

BPA roped in its expertise to create a high energy efficiency building (Silver LEED® certification). Among the 40 points submitted to Canada Green Building Council's rating system, 15 credits were under BPA's responsibility. 8 of those 15 credits were attributed to energy performance only. These reductions were achieved without the use of major technologies such as geothermal heat pumps, solar or wind energy. Only simple, but efficient measures were implemented. Below are the environment benefits:

- Use of high efficiency condensing boilers, heat recovery from exhaust air and mostly, heat generated by the server room.

- Careful selection of lighting fixtures ensured by a density reduction of 61% and visual comfort increased in the light spectrum in order to reduce occupant eyestrain.

- Low consumption plumbing fixtures with infrared detectors (39% reduction in potable water consumption).

- Motion and CO_2 detectors throughout the building controlling the quantity of outdoor air to be supplied based on occupancy. Overall, 50 CO_2 sensors are installed in high-density locations. The amount of outdoor air is adjusted according to the readings and the limits regarding the Clothing level (clo) and the Metabolic rate (met) (range from 0.5 clo in summer to 1.0 clo in winter; range from 1.0 met to 1.4 met), as recommended by Appendix C of ASHRAE Standard 62.1-2007 and by ASHRAE Standard 55-2004). A differential of 650 ppm was programmed in the operation system to make sure that the ASHRAE Standard limit is never reached. Several sensors are installed for temperature and humidity control so levels are according to ASHRAE Standard 55-2004.

- Addition of silencers, vibration isolators and floating slab to eliminate vibration transmittal and reduce sound levels of the cooling tower and chillers located on the top floor beside the executive offices.

- A semi-underground parking lot, which is naturally ventilated, therefore eliminating heating and operating charges.
- Intelligent centralized control system maximises the efficiency of each energy measure at a precise moment and for a critical situation.
- The owner was also concerned with preserving the integrity of the site, maintaining the bike path and by improving the visible aesthetics.

All of this allowed for a 55% reduction of energy consumption, compared to the Model National Energy Code of Canada for Building (MNECB) reference building.

Also, a simulation revealed an annual energy reduction of 6 150 MBTU and resulted in an annual savings of $94,374.

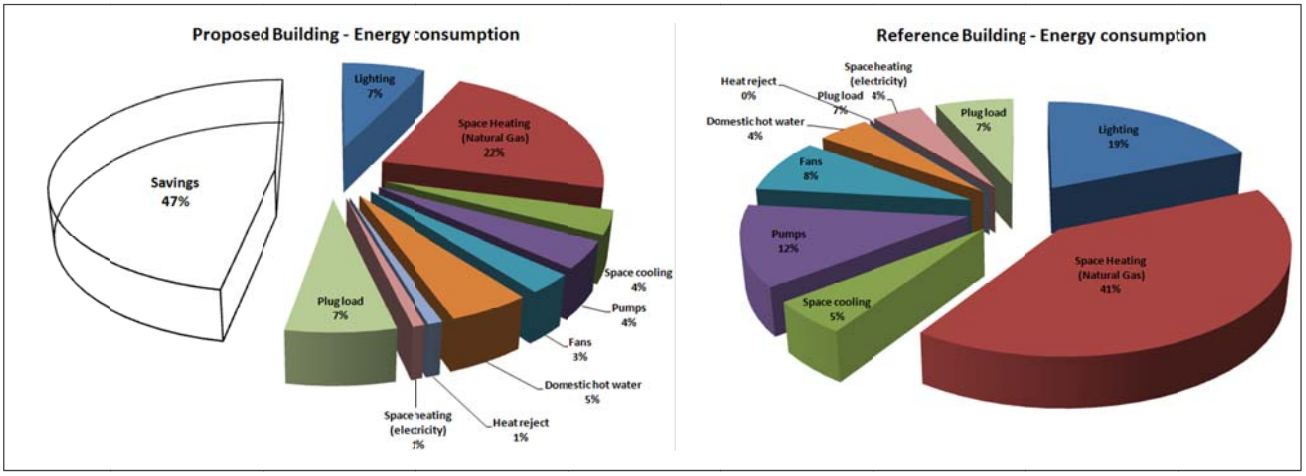


TABLE: ENERGY BILL INVOICES		
Period	**Natural Gas (m^3)**	**Electricity (kWh)**
January 2013	8647	262800
February 2013	5320	244800
March 2013	5175	226800
April 2013	3135	246000
May 2013	1795	211200
June 2013	1873	243000
July 2013	1509	219600
August 2013	1405	220800
September 2013	2202	226800
October 2013	4079	225600
November 2013	11510	228600
December 2013	8077	228600
TOTAL	**54727**	**2784600**

MEETING CLIENT'S NEEDS

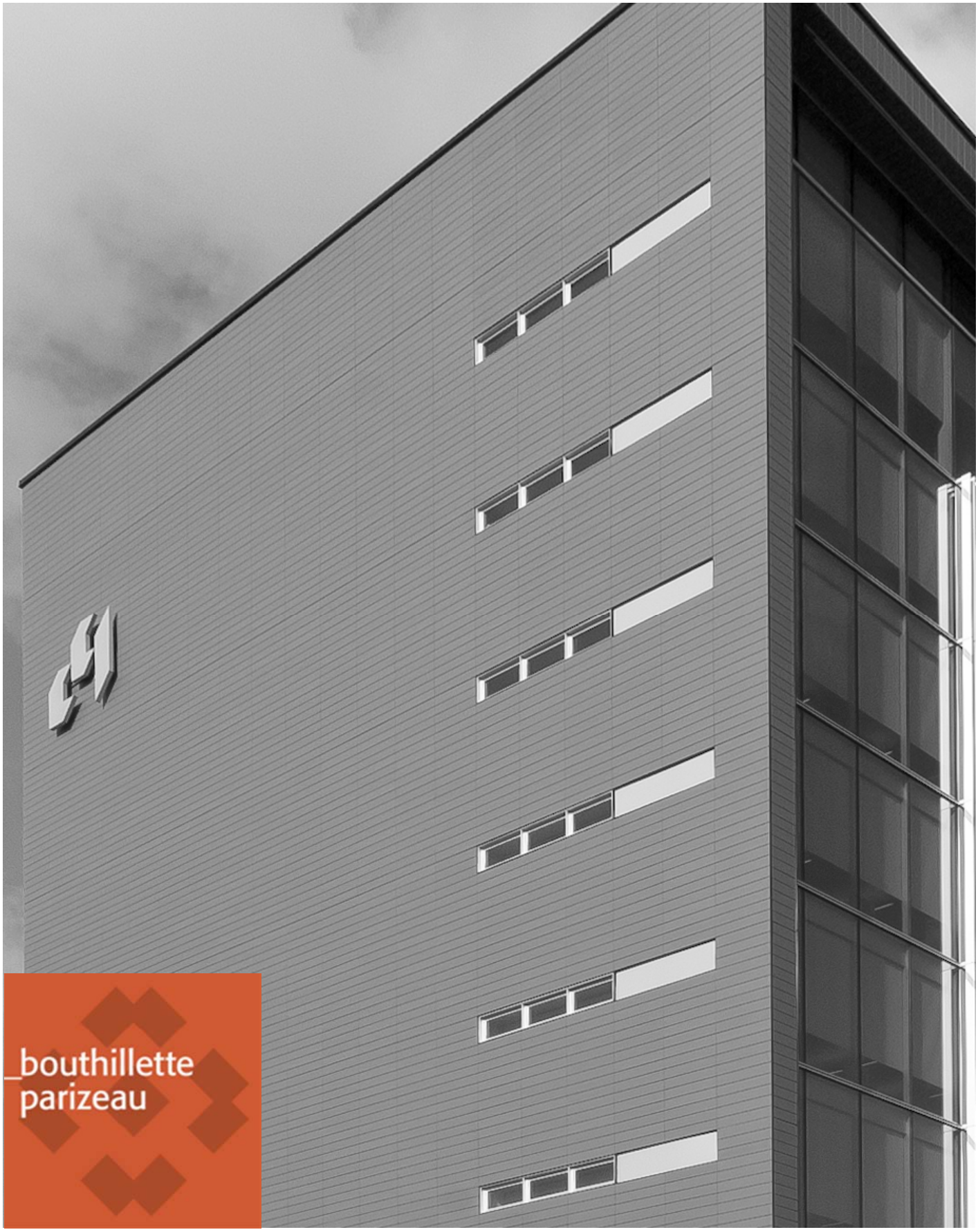
Right from the beginning of the project, the CCQ representatives expressed their needs regarding integrated design process, easy maintenance, LEED® certification and budget-schedule compliance. They also wished to promote good business practice.

The owner's involvement throughout the project ensured that all of his requirements were met. It also allowed him to express his opinions and concerns while contributing to all of the strategies, decisions, and budget allocation for each discipline.

The client required his building to be equipped with high efficiency systems. A clever design allowed for a reduction of 510 tons of greenhouse gas emission and an energy cost reduction of 48% compared to the Model National Energy Code of Canada for Building (MNECB). Other than high efficiency equipment, ease of access, operation and maintenance were also a priority for the client. By locating each system within the building and away from harsh winter conditions, the client requirements were met. The simplicity of the system allows the owner to fully understand the operation and to ensure optimal building performance.

The owner has also benefited from the involvement of the commissioning agent which allowed him to follow and validate any changes that were made while ensuring that all requirements were respected.

With a total budget of 37 million$ (which is less than the anticipated budget of 40 million$), an 18-month design phase and a 13-month construction phase (exactly on schedule), the client proved that it is possible to build such an exemplary yet simple building within a limited budget and timeframe, contributing to valorize the construction industry.



_bouthillette
parizeau

9825, rue Verville, Montréal (Québec) H3L 3E1 | (514) 383-3747 | (514) 383-8760_téléc. | www.bpa.ca