Manitoba Hydro, the province’s sole energy provider, began planning for a new, energy-efficient headquarters in 2002. The design team soon realized that the extreme climate of Winnipeg, Manitoba, actually provided a rich opportunity for harnessing the abundant solar and wind energy to operate the building using more passive systems.

The program called for a 690,000 square foot building on a full block in downtown Winnipeg to accommodate 1,800 employees. One goal was to reduce energy consumption 60% below Canada’s Model National Energy Code Building (MNECB). Manitoba Hydro also wanted to create a landmark building with signature architecture that contributes to the revitalization of downtown Winnipeg. However, the primary purpose of the building was to create a healthy, supportive workplace for Manitoba Hydro’s employees.

Winnipeg’s extreme climate was initially perceived as a challenge to the energy reduction goals. The city’s temperature annually ranges from –35°C (–31°F) in the winter to +35°C (95°F) in the summer. However, Winnipeg also receives more sunlight than most major Canadian cities, and has an unusual abundance of strong southerly winds. The building team realized that the climate challenge actually presented an opportunity to reduce energy use and create a healthy workplace.

**Project Charter**
Manitoba Hydro mandated the project be designed, developed and delivered using a formal integrated design process (IDP). An essential first step of the IDP is to determine the project charter. The project charter clarifies the project goals and is continually referenced for every major design decision. Manitoba Hydro’s project charter contained six core goals.

1. To create a supportive workplace environment for the employees of Manitoba Hydro;
2. To create an energy-efficient design; 60% reduction in energy consumption from the MNECB;
3. To create a design that achieves a LEED Gold certification;
4. To develop signature architecture integrated throughout the building at different scales from street level to the roof;
5. Urban design—to achieve a high level of urban integration to revitalize the downtown;
6. To achieve a cost-effective building design solution that has measurable benefits to Manitoba Hydro in terms of comfort, operations, and maintenance.

**Design Charettes**
The design charrette is a critical tool in the IDP to advance integrated thinking and solutions. Fifteen building form options were generated for evaluation and testing and three options were selected for detailed development and analysis to test passive efficiencies.

**MANITOBA HYDRO PLACE**

**Case Study**

**Harnessing Climate**

*By Bruce Kuwabara, Thomas Auer, Tom Akerstream, Glen Klym*

With Mark Pauls, Kael Opie and John Peterson

Edited by Amanda Sebris

Architecture is a powerful reflection of civilization. It is the responsibility of every architect to make buildings that enrich the world, not deplete it. A building that thinks and breathes on its own serves both as a function of civilization as well as a contributing member within it.

— Bruce Kuwabara

**Building at a Glance**

<table>
<thead>
<tr>
<th>Distinctions/Awards</th>
<th>Manitoba Hydro Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009 Council on Tall Buildings and Urban Habitat</td>
<td>Best Tall Building (Americas)</td>
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<tr>
<td>2010 Royal Architectural Institute of Canada Urban Design Award</td>
<td>2010 American Institute of Architects COTE Award</td>
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<td>2010 Engineers Canada Award</td>
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</tbody>
</table>

| Total Cost | $283 million CDN |
| Cost Per Square Foot | $400 CDN |

| Owner | Manitoba Hydro |
| Principal Use | Corporate Head Office |
| Location | Winnipeg, Canada |
| Gross Square Footage | 823,535 |
| Conditioned Space | 695,241 |

| Cost Per Square Foot | $283 million CDN |
| Substantial Completion | Fall 2009 |

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daylighting, and climatic impact through computational fluid dynamics, wind analysis and energy modeling. The final solution is a hybrid of formal process and serendipity. The energy consultant rotated one of the splayed tower schemes to position the stacked atriums due south to capture Winnipeg’s abundant sunlight during the winter and strong southerly winds. It was dubbed the “Solar Tower” and became the preferred option.

The tower form itself functions as a passive solar collector. The east and west office lofts are splayed open at the south end and separated by winter gardens that maximize solar heat gain. The lofts meet at the north end of the tower, reducing direct northern exposure and minimizing heat losses.

**Double Façades**

A glass tower in Winnipeg’s extreme climate was ironically logical. When it is extremely cold, it is also very sunny, ideal for solar gains. The reduction in heating demand for Manitoba Hydro Place is largely due to a high performance double façade curtain wall design.

Above: Atria at the north end of the tower collect exhaust air from adjacent floors. Dampers at the chimney intake are used to balance the stack effect throughout the tower height. This exhaust plenum doubles as a break space for employees.

Left: The Public Galleria connects the streets through the entire city block, creating a public pedestrian thoroughway. The galleria also hosts farmers markets and charity events.

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**LG MULTI V III: INNOVATION THAT OUTPERFORMS**

LG reaches a whole new level of HAC with Multi V III. It boasts a 20 HP capacity with fewer units, saving valuable space. It also supports an incredible 1000m+ piping length, making it perfect for high-rise buildings. And with SPEED COP, LG Multi V III delivers more cooling capacity per unit and less energy consumption.

**LONGER PIPING**

1000m

**HIGHER EFFICIENCY**

COP 4.58

**BIGGER CAPACITY**

20HP

LG Multi V III’s wide louveres maximize the heat transfer rate by creating air paths. Uniform-Distributor optimizes heating and cooling performance.
and outdoor views. By introducing buffer façades on the east-west faces, and by expanding the south façade buffer zones to act as winter gardens, excellent daylighting and views can be maintained while also supporting energy efficiency.

The double façades are the most apparent example of the climatically responsive approach used to make Manitoba Hydro Place energy efficient. The east and west façades operate in three main modes. In the winter, the façade is sealed tight and acts as a solar collector. Without the assistance of active heating, the interstitial space regularly reaches 20°C (68°F)—even with outdoor temperatures below −25°C (−13°F). This significantly reduces heat losses through the envelope.

In the summer, hundreds of operable windows on the outer (double-glazed) façade open and allow wind and convective air patterns to ventilate the double façade. Automated louver blades within the curtain wall control glare and heat gain. This ensures that cooling demands are not increased by the façade.

During the shoulder seasons, the outer façade is opened and employees are asked to open the manually operated windows on the inner curtain wall. The outer façade is controlled automatically based on indoor and outdoor conditions, including outside and interstitial air temperature, humidity, light levels, and wind speed. The modulating curtain wall is a visible example of the climatic-responsive approach at Manitoba Hydro Place, and has become an iconic image of downtown Winnipeg.

**Lungs** of the Building

The three stacked, six-story high winter gardens—large, unconditioned spatial volumes—are unique in the context of hermetically sealed North American office buildings. They are the “lungs” of the building and responsible for providing 100% fresh air every day throughout the year.

In the winter, fan coils fill the winter garden with outside air preheated to 5°C (41°F). The expansive south-facing curtain wall (more than 400 m² [4300 ft²] in area) allows Winnipeg’s abundant winter sun to provide the remaining sensible heat. Humidification is provided by a 24 m (79 ft) tall water curtain composed of mylar ribbons. The ribbons maximize water feature surface area to encourage moisture exchange, and water is heated to 32°C (90°F) for humidification.

In the summer, the winter garden fan coils are disabled, and operable vents bring fresh air into the building. Sun-tracking louver blinds are used to manage solar heating, and the temperature of the water feature is dropped to 10°C (50°F) for dehumidification. Throughout the year, natural stack effect distributes fresh air.
Displacement ventilation is used to efficiently and effectively distribute fresh air. An “air highway” directs fresh air under the raised floor from south to north along the office lofts. The air, slightly cooler than space temperature, spills out of floor level vents to flood the office space. Stale air is naturally drawn towards the north end of the office, driven by buoyancy forces and the pull of the solar chimney. The solar chimney passively exhausts the air in the summer. In the winter, fans at the base of the solar chimney draw exhaust air down to both ventilate the parking garage and recover exhaust heat.

Thermal Comfort

Heating and cooling is achieved primarily through the use of active radiant slabs. More than 180 miles of plastic tubing is embedded in the concrete, and slab temperatures are modulated between 20°C and 23°C (68°F and 73°F) to maintain comfort throughout the year. The thermal mass of the all-concrete building also minimizes temperature fluctuations throughout the occupied hours, and allows heating and cooling systems to be turned off on evenings and weekends.

The passive design features combined with the efficient heating supply system, including a ground-source heat pump, exhaust air heat recovery, and condensing boilers, reduce energy use for heating to only 28 kWh/m² (3 kWh/ft²) annually. This is a significant drop from an annual typical heating load of 250 kWh/m².
BUILDING SYSTEMS OVERVIEW

HIGH PERFORMING BUILDINGS

Building Systems Overview

MNECB Reference Building

For common areas, feature lighting is programmed based on outdoor light levels. Currently, the lighting energy is reduced by 44% from the MNECB reference building. This is expected to drop further as recent sequence changes tying exterior and common area architectural lighting to outdoor light sensors are reflected in metered data.

Building Management System (BMS)

The building management system (BMS) uses prevailing conditions (temperatures, radiation, wind, precipitation) for real-time integration of heating, cooling, and other information.

LESSONS LEARNED

Office Acoustics

Manitoba Hydro Place shows that energy efficiency can be complementary to a high-quality indoor environment. For example, the glass double façade is critical to the energy concept for the building, but also offers occupants good daylighting, access to views, and personal control of natural ventilation.

Double façade in a cold climate

Manitoba Hydro Place is among the first large-scale implementations of a double façade in a cold climate. This is a technology still viewed largely with a degree of skepticism in North America. The double façade at Manitoba Hydro Place was studied extensively prior to implementation, using computational fluid dynamics, several mock-ups and many thermal models. The analysis led to several unique characteristics.

Commissioning Challenges

Unique commissioning challenges are associated with a building that responds to the climate. The biodynamic nature of Manitoba Hydro Place means that the building responds very differently to Winnipeg's four distinct seasons. As such, there are building sequences that only can be tested during a brief seasonal window once a year. An entire year may be required for system commissioning.

The lighting system proved to be the most difficult system for commissioning. The office lighting system, while elegant in its form and functionality as an energy-saving device, provides little feedback to building operators. All other building components provide a wealth of real-time information that can be used to troubleshoot problems and optimize sequences. The lighting system, however, only allows one-way communication to the device. Ideally, future generations of integrated lighting systems will include feedback from the daylight sensor of each fixture, real-time energy data and other information.

LEARNING OBJECTIVES

The building management system (BMS) uses prevailing conditions (temperatures, radiation, wind, precipitation) for real-time integration of heating, cooling, and other information.

Optimization Stage

Manitoba Hydro is committed to ongoing study and optimization of Manitoba Hydro Place. Since occupancy and the end of the commissioning phase, building sequences and setpoints have been regularly updated. Examples of the more significant sequence changes from the original design include:

- Incorporating outdoor humidity into the natural ventilation sequence to ensure that the building enters dehumidification when appropriate.
- Modifying geothermal field pumps to control speed as a function of return temperature from the field (instead of a pressure setting).
- Increasing radiant slab zoning resolution to reflect different solar gains at north and south tips of the office tower.
- Using low-temperature heating water supplied by the ground-source heat pump to displace the high-temperature system from the condensing boilers in the shouler seasons.

BUILDING TEAM

Client: Manitoba Hydro
Architects: Kwabara Payne McKenna Blumberg (design architects), Smith Carter Architects and Engineers (executive architects), Prairie Architects (associate architects)

Energy and Climate

Transsolar Energietechnik GmbH

Contractor: PCL Constructors Canada

Structural Engineer: Cioskol Kijigon/Halvorson Yolles

Mechanical & Electrical Engineer: Earth Tech Canada

Lighting Design: Pivotall Lighting Design

Landscape Design: Hilderman Thomas Frank Cram, Phillips Faragvaq Smallenberg

For further information, please visit the building management system (BMS) at http://www.manitobahydroplace.com.

© Brian Christie
architecture and the individual systems for comfort and efficiency.

Two on-site weather stations collect climate data, which is manipulated using building sequences into commands for various control points (operable windows, shade positions, slab temperatures, etc.). These sequences are continually optimized as improved occupant comfort and energy savings are identified. For example, a nighttime building flush program was implemented when it was observed that downtown Winnipeg often has sufficient daily temperature swings in the summer.

The BMS is also used for verifying and optimizing energy targets and for observing building performance in close detail. Several hundred meters monitor lighting, plug loads, water heating, pump and fan energy and hydronic loads, among others. These metering points are a small portion of the more than 25,000 control and observation points in the BMS.

Human Factor
Creating a supportive workplace for employees was always the primary goal of Manitoba Hydro Place. Personal control and natural light were large factors in the increased perception of comfort.

At Manitoba Hydro Place every employee has access to outdoor views and receives natural light for 80% of normal office hours. They are able to control exterior blinds, and dim light fixtures from their computer, and have access to operate windows for comfort control.

Excellent indoor air quality is another feature. Carbon dioxide is monitored at multiple locations on every floor, and typically peaks between 200 to 300 ppm above outdoor levels throughout the occupied hours.

In addition, Manitoba Hydro Place encourages sustainable commuting options for employees. Underground bicycle storage areas and show- ers have made cycling an attractive option for 10% (and growing) of employees in the summer. The building’s carefully selected site is in the hub of Winnipeg’s spoke-based transit layout, and more than 60% of employees take public transit to work.

The creation of a supportive, inspiring and healthy workplace ultimately eclipses energy and productivity by valuing community and civic pride.

City Building and Community
The building form, orientation and massing capitalize on Winnipeg’s extreme climate energy potential while simultaneously creating a new public destination for the city. The solar chimney marks the main entrance at the north and a large canopy at the south mitigates gusting winds. The siting of the south end of the building on a 21° angle to face due south resulted in an open space for a new public park. Inside, the public galleria serves as both a sheltered pedestrian route through the block and an indoor event/gathering space.

Conclusion
Manitoba Hydro Place successfully delivered on the goals set out in its project charter. It has led to a new wave of development in downtown Winnipeg, it has achieved new levels of sustainability for an office tower of its size (expected to be the largest LEED Platinum office tower in Canada [pending]) and reduced energy consumption by more than 60%. In the end, however, the quality of space is the building’s primary achievement.

The office tower is situated on a three-story podium scaled to the surrounding area. The tower has been shifted from the street grid to face exact south and maximize passive solar heating.

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