Green Buildings & Green Interiors

Manitoba Hydro Place

ENVS-664-660 Sustainable Design
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Jongpil Park

Background

Manitoba Hydro, the primary energy utility in the province of Manitoba, set ambitious five goals for its new headquarters, including energy efficiency, urban revitalization, signature architecture, cost effectiveness and a supportive workplace. After many sites are reviewed, the site on Winnipeg's main street, Portage Avenue, was strategically selected for its proximity to the city's transit system and a network of raised walkways that connects buildings in the downtown core. The 695,742 square foot, 22-story office tower occupies a full block in the center of Winnipeg, a city that is well known for its extreme climate and a downtown in recovery from severe economic downturn in the late 20th century. The relocation of over 2,000 employees from 15 suburban offices to the downtown signifies the corporation's shift to a collaborative culture and a commitment to provide the community with a signature architectural image. The form and massing directly respond to the extreme climate. The design visibly shows Manitoba Hydro's commitment to environmentally responsible practices, achieving an unprecedented 64.9% energy savings by utilizing maximum passive solar, wind, and geothermal energy. The Manitoba Hydro Place is targeting less than 100 $kWh/m^2/a$ compared to 400 $kWh/m^2/a$ for a typical large scale North American office tower located in a more temperate climate.

Extreme Climate

Located in the geographic center of North America, Winnipeg is one of the coldest large cities in the world with a population over 500,000. Temperatures fluctuate from -35 ºF with the wind chill factor in the winter months to +95ºF with the humidex during the summer months. During winter months, the city receives abundant sunlight and strong Southerly winds, which provided the Integrated Design Process (IDP) an opportunity to harness passive wind and solar energies for heating, cooling, ventilation, and reduced reliance on artificial lighting.

Integrated Design Process (IDP) & Integrated Design Team (IDP)

Manitoba Hydro determined the new building would be realized through an Integrated Design Process (IDP) modeled on the successful C-2000 program developed by Natural Resources Canada (NRCan) a department of the Canadian federal government. The IDP is a simple, process-based solution to the complexities inherent in contemporary architecture. The IDP considers diversity of ideas and approaches within a holistic method that acts to harmonize design elements related to energy, materials, site, climate, construction, economics, culture and society. One of the first tasks in the formal IDP was to build the Integrated Design Team (IDT) comprising the corporation, design architects, architects of record, energy engineers, building system engineers, cost estimators, and project contractors. Among eight competitors, KPMB Architects, under the design leadership of Bruce Kuwabara and project direction of Luigi LaRocca, was selected as Design Architect. KPMB participated in the selection of the other consultants for the IDT, including Smith Carter Architects and Engineers for Executive Architects, Transsolar ClimateEngineering for energy engineers, PCL for Construction Management, and Hanscomb as Costing/Quantity Surveyors.

Design Charettes –

KPMB Architects led the design charettes, generating fifteen concepts with related presentation materials, including models and renderings. Each of these fifteen concepts was evaluated against a checklist based on the goals of the project charter and then modeled by Transsolar for thermal comfort, day lighting and energy consumption. From the fifteen, three options were selected for refinement. The final scheme was resolved during Charette 4 by rotating the model of the "Comfort Tower", which enables to capture Winnipeg's abundant winter sunlight and strong southerly winds. In this way the "Comfort Tower" became the preferred scheme through all levels of evaluation and review.

Sustainable Sites & Water Conservation

Manitoba Hydro Place occupies a previously underutilized site, formerly occupied by several vacant buildings, which were carefully deconstructed, with 95% of the components either recycled or reused. For example, old-growth Douglas fir beams were milled and reused in the new building for soffits and benches. The site had been designated a brownfield, so soil remediation was required to remove patches of hydrocarbon contaminants.

Two significant public spaces were created to enrich the downtown: an outdoor park (Fig. 1) in the south portion of the site and a publicly accessible, three-story-high Public Galleria (Fig. 2). Galleria runs the full length of the podium base to connect the north and south entrances and provide a new interior, barrier-free gathering space that can accommodate over 1,000 occupants for concerts, farmer's and Christmas markets, and special events.

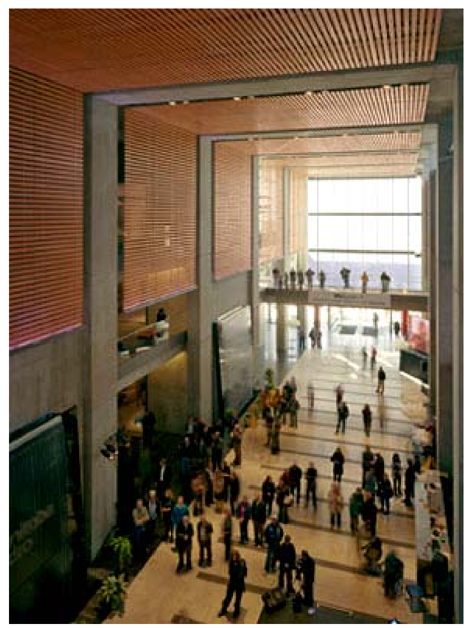
Fig. 2 Galleria


Fig.1 Outdoor Park

Green roofs cover the podium roof, providing a dramatic increase in landscaping compared to the hard-surface parking lots and tar roofs of the original site. Thus, the green roof reduces stormwater runoff and provides additional thermal insulation. All green roofs employ native plant species, irrigated by rainfall or, during drought conditions, by condensate collected from the building's mechanical equipment. Waterless urinals and low-flow toilets and sinks are used throughout the building.

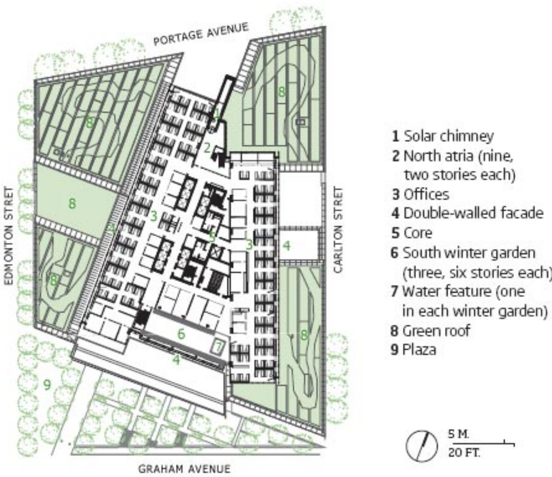

Fig. 3 Plan

How Manitoba Hydro Place Works

Every part of the building relates to the whole. The towers converge at the building's north end to minimize north-facing surface area as shown on the plan(Fig. 3). To maximize solar and wind exposure, the towers splay open to the south. At the pointed north end, a solar chimney runs continuously from the ground level to several stories beyond the roof. Three south-facing, stacked six-story winter gardens form the short side of the triangle.

This orientation allows Winnipeg's prevailing southern winds to naturally ventilate the structure. In winter, fresh air enters each winter garden through louvers in its south-facing, double-walled facade. Here the air is heated by the sun and humidified by the water features: 280 tensioned mylar ribbons(Fig. 5) that carry water from the ceiling to the floor. If necessary, air picks up additional heat from fan-coil units, then feeds the underfloor displacement-ventilation systems. It is also tempered by radiant ceilings heated by alcohol-based fluid. This heat is supplied in turn by chillers, whose source is a bank of 280, 400-foot deep geothermal wells drilled beneath the building. Air moves horizontally through the offices, finally reaching the solar chimney at the north end of the

Fig. 4 Airflow diagram

building through any one of nine two-story atria. In winter the air is drawn downward through the solar chimney into heat-recovery units, then warms the parking garage beneath the building. The building's double-walled facades consist of two low-iron glass curtain walls, separated by a three-foot-wide air buffer. It holds in heat by preventing thermal bridging from the interior to the exterior.

In the summer much of the process is reversed. Water running down the mylar ribbon is now chilled to the point that it can dehumidify fresh air entering the winter garden. If necessary, additional cooling may be added before the air enters the underfloor displacement-ventilation system. Heat is also absorbed by the radiant ceilings, extracted by the chiller, then sent into the geothermal wells, warming the soil around them until heat is needed in the winter. As in winter, air flows from south to north, although now the stack-effect draws it upward and out the top of the solar chimney. To ensure that cool night air does not interrupt the stack effect, the sun's heat is stored in 632 pipes filled with 17 tons of sand installed behind glass at the top of the chimney.

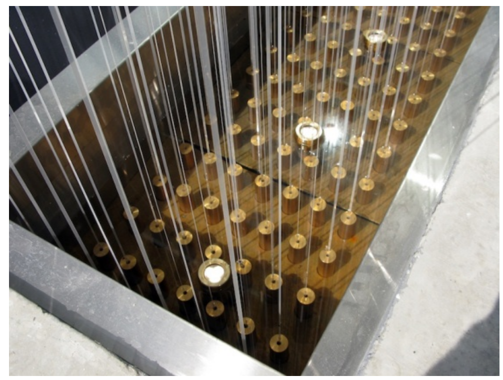

Fig. 5 Water feature, mylar ribbon

Indoor Environmental Quality

Typically, power for artificial lighting can represent 20 to 40% of a building's total power use. Through careful building orientation and design, this demand can be substantially reduced, and at the same time dramatically increase the quality of the space.

The variety of design solutions to get more daylight into the deeper interior were applied because simulation by Transsolar (fig. 6) demonstrates that the daylight can't reach enough into the interior. An unusual floor plate configuration ensures light reaches all the way to the core of the building. Floor-plate depths are kept shallow, with terraces and atria cutting strategically into the building and ensuring that all occupants have access to natural light. The slightly higher than average floor to floor heights (4m), in combination with a shaped slab edge step at the East and West double skin facades open the typical office loft to let light penetrate deeper into the space. In addition, open workstations

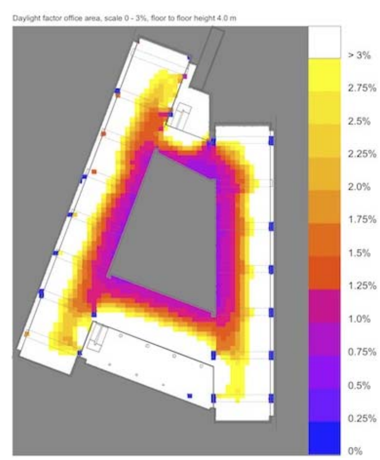

Fig. 6 daylight simulation

and demountable partition allow exterior daylight to penetrate to the interior as shown on the above section (Fig 7).

East and west tower facades are double-glazed with motorized windows on the exterior and single-glazed with manually operable, hopper-style windows on the interior. Large-format automated louvers within the double façade open and close throughout the day to minimize solar gain and glare. Louver blades at the top act as a light shelf, bouncing additional light onto the white ceiling.

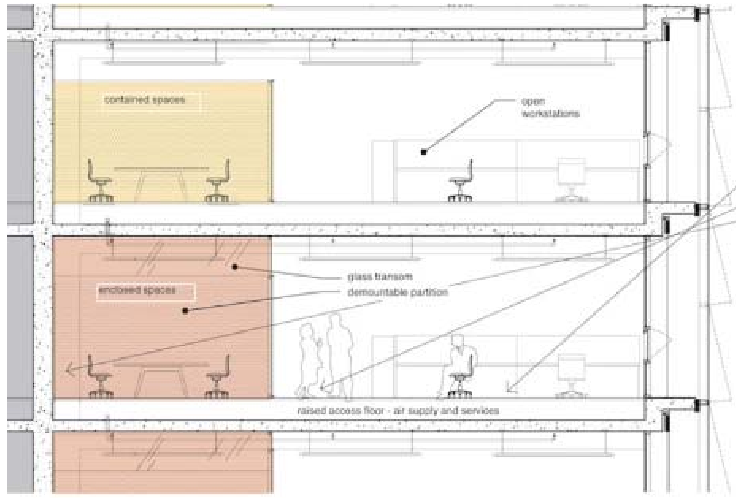

Fig. 7 Section

Direct/indirect T5 HO fixtures are dimmable, equipped with daylighting and occupancy sensors, and are individually adjustable from the central building management system.

Urban Revitalization and Transportation

Manitoba Hydro is as invested in creating a supportive workplace and revitalizing Winnipeg's downtown as it is in achieving energy savings and signature architecture. The building connects to the city's elevated sheltered pedestrian network. In the former head office, located in the suburbs of Winnipeg, 95% of the employees drove to work alone. Over 95% of the bus routes pass this address, including routes to suburban Winnipeg where 80% of Manitoba Hydro employees live. In anticipation of the transition, Manitoba Hydro secured a number of parking stalls downtown. At the same time, it created various incentives, including corporate participation in the Transit EcoPass program to encourage employee use of public transit. Six months after moving into the new building, more than 68% of relocated employees are taking public transit. Qualitatively, employees are reporting that they are enjoying time gained to read and socialize with colleagues instead of driving.

Leasing opportunities in the base building are limited in an effort to stimulate the support of local businesses, and to encourage staff to experience their city. Restaurants and bars are already reporting a tremendous increase in revenue as a result of the influx of over 1600 Hydro employees to the area.

Post-Occupancy and Commissioning

Still ahead is the challenge to commission the building and to educate the staff, building operators and maintenance people. Manitoba Hydro is conducting a thorough workplace study to evaluate how the design impacts employee productivity. Along with their Facilities group, Transsolar has been engaged to monitor and analyze the building's performance over the years.

LEED rating & Awards

Documentation and submission processes for the LEED program needed to achieve the project's Platinum rating.

2010 AIA/COTE Top Ten Green Projects Award

2010 Sustainable Architecture & Building Magazine Award, Project Winner

2009 CTBUH Best Tall Building Award - Americas

2008 IBS Award, Highly Commended

2006 MIPIM Architectural Review Awards - Commended for Innovation

2006 Canadian Architect Award of Excellence

Conclusion

To achieve design innovation at such scale and ambition, an exceptional client is needed. Manitoba Hydro had a clear vision and understanding of the implications for design, construction, and management. The result is a testament to a committed client, an integrated design and construction team, and skilful project management. It exemplifies the IDP for achieving ambitious environmental and energy conservation objectives. The open, collaborative forum of the workshops and charettes drew out the best creative and innovative thinking and facilitated pragmatic decision-making. Manitoba Hydro sets a precedent for environmentally responsive large scale building design and urban revitalization.

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