Canadian Building Performance Evaluation Project

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This project summarizes the lessons learned from building performance evaluations of nine Canadian green buildings using a standardised framework and key performance indicators.

MMM Group Office, Kitchener, ON

Manitoba Hydro Place, Winnipeg, MB

Surrey District and Education and Conference Centre, Surrey, BC

Canal Building, Ottawa, ON

The aim of this project was to better understand the operational performance of Canadian green buildings and identify lessons for their owners, design teams and the construction industry. The project investigated the "performance gap" by documenting the differences between predicted and measured performance and compared this with benchmarks for "typical" performance of similar buildings. The investigation included energy, water, indoor environment, site, materials, and economic issues.

Key Performance Indicators (KPIs) were developed and data was collected for each project. A summary of the findings and lessons for each building is presented on the adjacent posters. The project was initiated by **iiSBE Canada** with development of protocol and building performance evaluations conducted by researchers from the **University of British Columbia, University of Manitoba** and **Ryerson University**, and sponsored by **Stantec** and the **Natural Sciences and Engineering Research Council** (NSERC).

Building Data

Nine buildings across Canada were selected for this study. Five are academic buildings at universities or colleges, three are private or public office buildings, and one is a community building. All were built or had undergone a major renovation in the last ten years. In each case the client had set "green" objectives for better than typical level of performance in areas such as energy use, water use and indoor environment. The buildings range in size from 1,900 m^2 to 64,500 m^2 of net conditioned floor area. Construction costs vary from \$1,950 per m^2 to \$6,150 per m^2. A variety of established, new and innovative technologies were used.

Key Lessons

Some initial findings from the project include:

- **Actual building occupancy can be very difficult to determine if not monitored and recorded on an ongoing basis.**
- **Building occupancy often changes significantly from the original design assumptions, which can have significant impact on performance.**
- **Acoustic performance, particularly speech privacy, is a consistent concern for occupants.**
- **Occupants seem to be satisfied with levels of daylight above accepted lighting guidance standards.**
- **It was difficult to find a correlation between implementation of an Integrated Design Process (IDP) and performance outcomes.**
- **Exemplary performance appeared to be directly related to the building management and operational staff.**
- **Ongoing commissioning was also instrumental in sustaining or improving the performance of several projects.**
- **Sub-metering is important for building operators in terms of monitoring, maintaining and improving the performance of their buildings, and for effective performance evaluation.**
- **Occupant surveys were useful to identify trends and provide a perspective on building performance that is not available by direct measurement.**
- **To carry out effective BPEs it is important that better documentation of design assumptions, and provision for collecting performance data for later use, be considered at the design stage.**

Building	Owner	Type	Net floor area (m^2)	ASHRAE Climate Zone	Const. cost ($/$m^2$)	Type
MMM Group office	MMM Group	Office	1,897 m^2	6	\$2,900	New build
Manitoba Hydro Place	Manitoba Hydro	Office	64,590 m^2	7	\$4,284	New build
Surrey District and Education Centre	Surrey Board of Education	Office	11,421 m^2	5	\$2,500	New build
Canal Building	Carleton University	Academic	7,310 m^2	6	\$4,160	New build
Ron Joyce Center	McMaster University	Academic	9,338 m^2	5	\$1,980	New build
Roblin Centre	Red River College	Academic	19,208 m^2	7	\$1,950	Adaptive re-use & new build
Jim Pattison Centre of Excellence	Okanagen College	Academic	6,780 m^2	5	\$4,000	New build
Centre for Interactive Research on Sustainability	University of British Columbia	Academic	5,500 m^2	5	\$6,150	New build
Alice Turner Library	City of Saskatoon	Community	2,070 m^2	7	\$1,620	New build addition

Research Methodology

Building performance evaluation (BPE) is a process to investigate and analyse how a building is operating, compare it to benchmarks, learn design lessons, and identify problems or concerns that need to be addressed. This research focused on assessing the following: occupancy issues, energy use, water use, economic factors, indoor environment, site issues, and materials issues. Key performance indicators (KPIs) were collected for:

- Predicted performance at the design stage (based on design stage modeling and green rating submissions).
- Actual building performance over a minimum of two years of operation.
- Reference values for typical buildings of similar use in the region.

This was used to identify the difference between actual & predicted performance. The work required the research teams to collect both quantitative and qualitative data from various sources.

- Metered data for energy and water use was collected for each building from utility bills or sub-meters.
- Greenhouse gas (GHG) emissions were calculated using provincial carbon intensity factors.
- Spot measurements for indoor environment conditions were taken in a selection of typical work spaces in each building when occupied. These included: light levels, temperature, relative humidity, background noise levels, CO_2 & particulate concentrations.
- An occupant survey was carried out to investigate the occupants' satisfaction with the building indoor environment. Occupants provided scores of 1 to 7 for their perceptions of a range of building characteristics.
- Interviews were carried out with the design team and the building manager.
- Observations were made during building visits to provide supporting information.

Ron Joyce Center, Burlington, ON

Roblin Centre, Winnipeg, MB

Jim Pattison Centre of Excellence in Sustainable Building Technologies, Penticton, BC

Centre for Interactive Research on Sustainability, Vancouver, BC

Alice Turner Branch Library, Saskatoon, SK

For more information see: *iisbecanada.ca/sb-14*