INTEGRATED DESIGN CHARRETTE REPORT

COMMERCE COURT WEST
401 RICHMOND

Metro Toronto Convention Centre
December 2, 2003

By

Sustainable Buildings Canada

INTRODUCTION

On December 2, 2003, Sustainable Buildings Canada (SBC) hosted a 1-day Design Charrette focused on providing energy efficiency and environmental assessments for two existing buildings: GWL's Commerce Court West office tower and 401 Richmond - a renovated historic building. The Charrette attracted more than 50 participants, representing architects, engineers, educators, building operators and a variety of technology specialists.

With key funding support from Enbridge, NRCan, and Ozz Corp, the Charrette attempted to demonstrate that superior environmental building operations, including retrofits can be developed through the integrated design process.

Design Charrettes typically focus on new buildings and use the "integrated design process" to create more environmentally friendly and robust designs. The integrated design process is a method used to challenge designers to consider new strategies and products, in this case, for more sustainable multi-unit housing.

- An integrated team formed early at the concept stage, can maximize the potential benefits. This is when concepts can change easily as new ideas are considered.
- An integrated team includes members with diverse expertise and experience to inform the process including property managers, energy simulators, costing experts, energy efficiency experts, envelope specialists, municipal engineers and planners and alternative energy specialists along with the design team members. These team members work together to achieve a higher performance, value added building. This multi-disciplinary relationship should continue throughout the design and construction phases.

For this Charrette, the same process was applied to the two existing buildings. Three teams were assigned to the Commerce Court tower while two teams were assigned to the 4012 Richmond historic building. Each team consisted of approximately 10 core members, with floating experts and guests circulating among the teams.

Sustainable Buildings Canada is pleased to provide the following report and wishes to thank all those involved in making this important event happen. In particular, our core funders – NRCan, Enbridge, and Ozz Utilities, the building owners – GWL and 401 Richmond, the facilitators and modelers for the day, and finally the staff at the City of Toronto who assisted in the logistical details. Thank you to all

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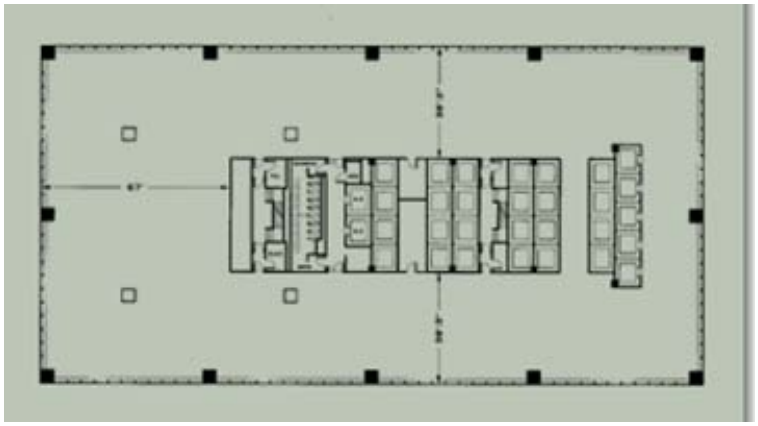
BUILDING DESCRIPTION

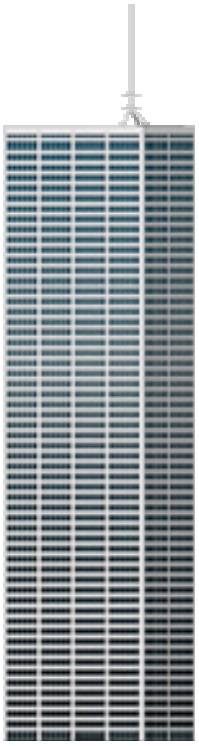
Commerce Court West is a 57 storey, 125,883 m² skyscraper located on 199 Bay Street. There are 3 underground parking levels. The building was designed by I.M. Pei Cobb Freed & Partners and constructed for the Canadian Imperial Bank of Commerce in 1972. It has 1.4 mil. SF of net leasable area with typical floor plate of 24,000SF. The building was last upgraded in 1993. The major tenant is CIBC. It has approximately 6000 occupants and is open six days a week for approximately 16 hours a day. The building is owned by GWL Realty Advisers and managed by Steven Sorensen.

The original main branch is located right next to it and is now known as Commerce Court North. Commerce Court West was considered to be the tallest office building in Toronto until the construction of First Canadian Place in 1975.

The building is part of several landmark structures that make up the financial district in Toronto. It is probably the simplest building in the area with a very open ground level comprised of glass walls almost 2 stories high. The building itself is set back from the street to create a platform in front of the entrance that maximizes public access. With the glass wall on the ground floor, the platform seems to extend all the way inside the building, creating continuity with the exterior features. The floors above have horizontal bands of glass alternating with bands of steel.

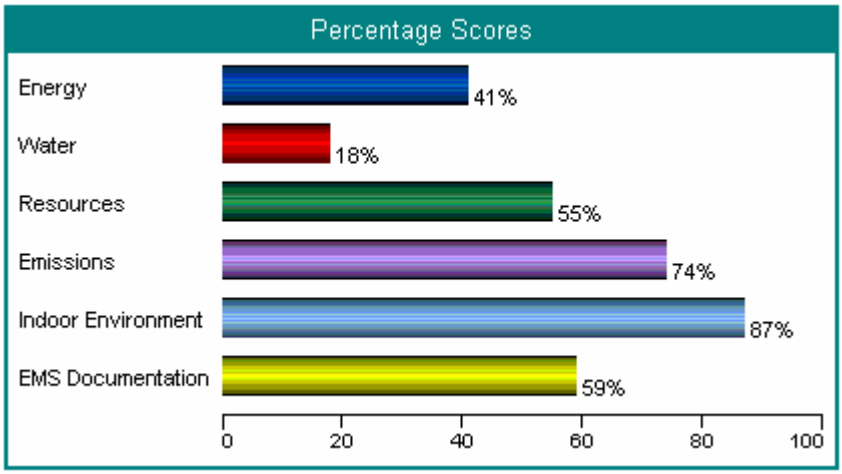
The building has energy efficient building automation and lighting and state of the art heating air-conditioning and ventilation system with 6 to 12 complete changes of processed filtered air per hour and 2 complete changes of fresh air per hour. The building is heated by steam.





CURRENT PERFORMANCE

The Green Globes assessment tool was used to benchmark current building performance.



Based on the scores for each module, Commerce Court scored 56% overall.

3 GREEN GLOBES

The goal of the charrette is to work out design measures to improve the building performance, using the Green Globes score as an indicator.

DESIGN TEAM 1 RESULTS

Team 1 was facilitated by Bob Bach. The team focused on energy efficiency while also dealing with issues of, building envelope, water and waste and devised a strategy for each.

ENERGY EFFICIENCY MEASURES

The team has identified the following opportunities and estimated W/ft² savings per measure:

MEASURE	CURRENT W/FT²	PROJECTED W/FT²
Lighting	1.40	
T8 & electrical ballast		0.85
T5 & daylighting control – dimmable perimeter		0.60
HVAC	0.95	
High-efficiency chiller VSD fans and pumps High-efficiency motors Deep lake water cooling		0.55

HVAC

- Install high efficiency chillers (eliminate existing CFCs).
- Install variable speed drives on fans & pumps.

- Install high efficiency motors.
- Consider deep lake water cooling to reduce air conditioning requirements.

Controls

- Scheduling ventilation air & VAV terminal fans.
- Scheduling lighting.

Lighting and daylighting

- Install lighting controls to avoid energy wastage.
- Insall T5 and T8 fixtures with electronic ballasts.
- Install daylighting controls (including dimmable ballasts).

Other energy efficiency measures

- Install variable speed drives on booster pumps
- Install high-efficiency boilers

ENVELOPE

- Apply solar film on the south and west faces to harness solar energy.
- Solve infiltration and air balance problems.

RENEWABLE ENERGY SOURCES

Team 1 considered the potential of implementing alternative sources of energy at Commerce Court:

i. Photovoltaics – costly at this time, long payback

ii. Active solar – perhaps DHW

iii. Wind – not yet ready for primetime, possible

iv. On-site generation-requires resolution of some electrical connection issues.

WATER

Domestic

- Install low flow fixtures (6L toilets, waterless urinals, etc.).
- Eliminate once through cooling – use chilled water loop.

WASTE

i. Current building waste diversion is approximately 70 %. Management includes separation, recycling and compost of:

- Paper & cardboard
- Cans/bottles/plastic
- Organics (food court)

Set a waste reduction target for diverting an additional 2% waste per year. Consider attaining 85% diversion.

ii. Control retailers.

iii. Involve the dock manager.

iv. Communicate with larger tenants and initiate an overall building waste management strategy.

- Meet with large tenants on a daily basis
- Create a "green team" to design and manage a waste reduction strategy

POTENTIAL SAVINGS AND PAYBACK

Team 1 produced the following table to estimate the cost, savings and paybacks of implementing the proposed measures.

	Utility cost ($)	Potential savings ($)	Cumulative savings ($)	Percent	Capital cost ($)	Payback
Base	4,562,000					
T8	4,409,000	153,000	153,000	3%	1,000,000	6.54
Daylighting	4,375,300	33,700	186,700	4%	75,000	2.23
HE chillers	4,082,400	292,900	479,600	11%	830,000	2.83
VSD	3,969,300	113,100	592,700	13%	340,000	3.01
Solar film	3,902,300	67,000	659,700	14%	2,000,000	29.85
Infiltration	3,878,000	24,300	684,000	15%	500,000	20.58
Scheduling	3,333,700	544,300	1,228,300	27%	630,000	1.16
T5	3,278,558	55,142	1,283,442	28%	1,000,000	18.13

DESIGN TEAM 2 RESULTS

Team 2 was facilitated by Ed Lowans. The team identified three possible goals:

1. best working environment
2. best payback
3. lowest environmental impact and highest Green Globes score

Below are the solutions proposed by Team 2 for each of the problem areas identified during the charrette.

ENERGY EFFICIENCY MEASURES

Big issue: law firms in the building operate for 24 hours a day, which impacts the whole system operation

Recommended measures:

1. consider GFX heat recovery from DHW (food court and restaurant)
2. consider heat recovery from cash machines
3. Consider district cooling
4. Consider having major tenants purchase green power and aim to have other tenants follow

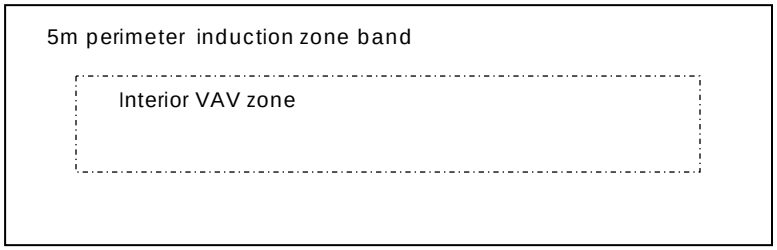
ENVIRONMENTAL CONTROLS

1. Currently, cost of individual controls is high
2. Metering BTUs is a likely, more cost-favourable option
3. Zone-control by tenants includes several benefits:
    - 76°F to 78°F = 2.1% electricity savings
    - 70°F to 68°F = 13% steam savings
    - Total savings potential ranges from $275,000 to $5,000,000
    - Reduced tenant complaints
    - Improved team performance

Zone HVAC control

16 zones are proposed per 2400 m^2 floor area. With 50 people per floor each zone would consist of 15 people.

Open control-quasi form of group control-floor negotiation
Closed control -group by group



LIGHTING AND DAYLIGHTING

Recommended measures:

1. install tenant zone-control
    - estimated 5% reduction in lighting demand = 673,000 kWh saved per year $40,500 saved per year
    - photo sensors = estimated $48,000 saved per year
2. install horizontal blinds/controllable blinds
    - increase occupant awareness
    - allow for more occupant control
3. improve lighting maintenance
    - landlord administered
    - includes ongoing light replacement
4. consider Digital Addressable Lighting Interface (DALI) lighting
    - DALI system enables sub-group relamping (caution group relamping may no longer be advisable)
    - evaluate potential of T5 direct/indirect (self-contained fixture)eliminates ceiling disturbance heat cleaning and in addition avoids lenses or egg crates and specify 24000 hour life low mercury DALI

Lighting retrofit implementation strategy

a. Improve task lighting.

b. Install high frequency ballasts.

c. Install 1 control per floor (existing condition generally).

d. Upgrade to multi-control when changes are being made.

e. Implement re-ballasting.

RESOURCES

The resources issues considered for improvement included:

- Waste Reduction and Recycling
- Site

Recommended measures:

1. increase waste diversion rate over 3 years
2. set final waste diversion goal at 80% based on improving wet waste management
3. check if wet waste is being composted
4. install high reflectivity roofs to reduce the heat island effect
5. consider alternative ice melters for improved IEQ and reduced impact on structure

EMISSIONS, POLLUTION REDUCTION

The emissions issues considered for improvement included:

- Air Emissions
- Ozone Depletion
- Water Effluents
- Hazardous Materials
- Hazardous Products and WHMIS

1. Implement a continuous program to increase heating efficiency with lower emissions and reduced refrigerant impact
2. Establish documenting for emission credits and water evaporation credit (via cooling towers)
3. Return condensate to Enwave (hardness, chemical content and temperature)
4. Establish organic/IPM specifications for pest control and indoor/outdoor landscape

INDOOR ENVIRONMENT

The indoor environment issues considered for improvement included:

- IAQ
- Lighting
- Noise

Recommended measures:

1. Install spill containment units for DHW tanks located over mission critical or high risk spaces such as computer rooms, executive offices, etc.
2. For DHW use stainless steel tanks, and schedule regular maintenance including anode changes and residue removal from the bottom of the tanks.
3. Review orphan plumbing and bacterial contamination potential.

4. Change to MERV air filter designations.
5. Send CO sensors out for testing.
6. Pre-cool the building (Note: the building cannot be dehumidified without mechanical cooling).
7. System should respond to outside air temperature and adjust start and stop times accordingly (longer flush on Mondays).
8. VAV system should respond to solar loads.
9. Consider room temperature catalyst for spot or building VOC reduction (painting, new carpets, etc.) and reduce use of activated carbon.
10. Use smoke pencil to trace ventilation (short circuiting).
11. Schedule steam cleaning of the carpets during the winter time when both the heating and the ventilation are on, to avoid moisture problems.
12. Cleaning and maintenance vacuums should be HEPA filter equipped.
13. Improve BAS system feedback information.
14. For noise concerns, consider legal vs. code requirements for sound proofing.

ENVIRONMENTAL MANAGEMENT SYSTEM

Tenant awareness

Set sustainability goals and water conservation targets for:

a. groups on floor
b. floor by floor
c. tenant by tenant

Ecopolicy

An ecopolicy should be established which includes the following mandates:

1. The preferential use of post-consumer recycled materials,
2. A commitment to reduce, recycle, reuse, and compost,
3. A behavioural change in the building tenants and occupants,
4. Pesticide, herbicide and pest control specifications,
5. The minimization of transportation in the CBD: train/telecommuting/bike/walk
6. The minimization of light pollution,
7. The preferential selection of certified materials, and
8. A purchasing policy for cleaning chemicals in the building.
9. Improve green procurement (create specifications for the building and tenants)

DESIGN TEAM 3 RESULTS

Team 3 was facilitated by Chris Jalkotzy. The team identified 3 possible goals to achieve:

1. best working environment
2. best strategy with no extra cost/best strategy with 2 year payback

3. lowest environmental impact, highest Green Globes score

Using the Green Globes score, Team 3 benchmarked the current building performance and generated the recommendations according to the following scenarios:.

IAQ	**Baseline score: 87%**
No personal control of ventilation	Scenario 1
Documented procedure for ensuring high IAQ	Scenario 1, 2
Lighting	**Baseline score: 47%**
Task lighting	Scenario 1
High frequency lighting	Scenario 1
Internal/external ballasts	Scenario 2
Re-ballasting	Scenario 2
Regular maintenance/cleaning	Scenario 2
Noise	**Baseline score: 100%**
Induction units, white noise	
EMS	**Baseline score: 59%**
Water conservation	Scenario 1, 2
Environmental purchasing, policy	Scenario 1, 2
Tenant Awareness	**Baseline score: 59%**
Information	Scenario 1

LIGHTING

To improve the overall lighting condition in the building:

- Improve task lighting
- Install high frequency electronic ballasts
- Install horizontal blinds control
- Schedule regular maintenance and cleaning of fixtures
- Apply personal lighting controls
- Move to zone control by tenants for energy improvement and improved control of work environment
- Improve maintenance procedures and documentation

The estimated energy savings for a 5% reduction in lighting energy is $40,500 annually. Daylighting control through photo sensors in perimeter spaces has a further potential of $48,000 in annual savings.

ENVIRONMENTAL MANAGEMENT SYSTEM

i. To improve water conservation, design a hands-free washroom.

ii. Implement an environmental purchasing policy (consider off-gassing, cleaning products, etc.)

TENANT AWARENESS

i. Personal HVAC controls are the best option but the highest cost.

ii. Consider "occupant commissioning."

iii. Consider HVAC zone control by tenant agreement (warmer in summer and cooler in winter) – fosters team building and cohesion.

iv. Allow employee self-selection of workspace locations.

v. Add BTU-metering with energy performance targets for tenant awareness and ownership of space/energy use.

Possible benefits – savings of 2% of electrical energy for cooling and 13% of steam purchased for heating (for 2°F temperature relaxation).

ECOLOGICAL POLICY

Team 3 recommended that the landlord facilitate the development of an "ecological policy" for the tenants. The key points to include are:

i. Preferential selection of recycled and certified materials.

ii. Composting, recycling and overall waste reduction.

iii. Control and reduction of chemicals used in facility including cleaners, pesticides, etc.

iv. Improved public transportation: further enhancement of transit use, more bicycle storage and change room facilities, telecommuting options, etc.

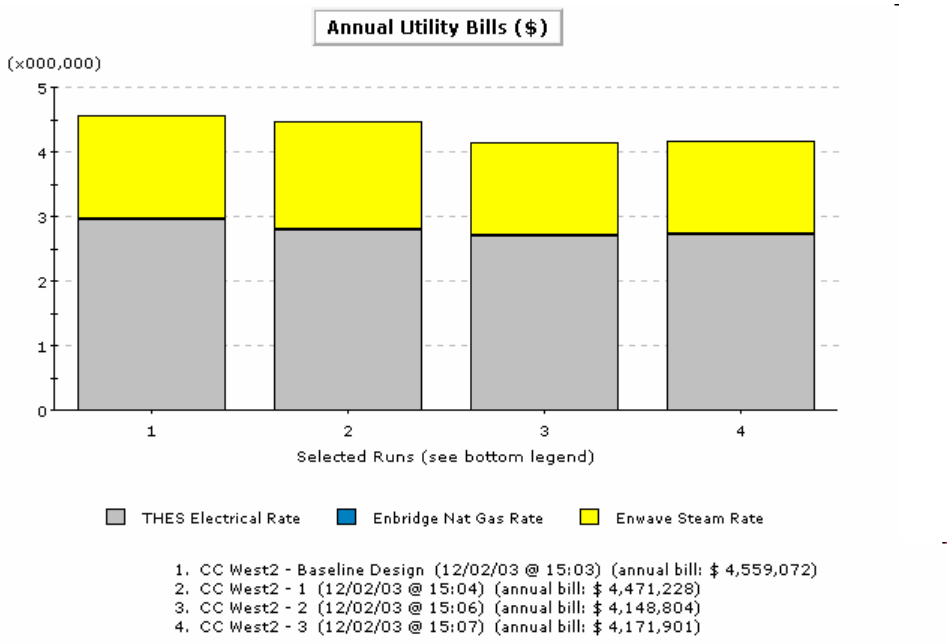
The key for overall building improvement is tenant involvement as a partner with the landlord.

IAQ ISSUES

i. Add personal controls – HVAC zonal strategy.

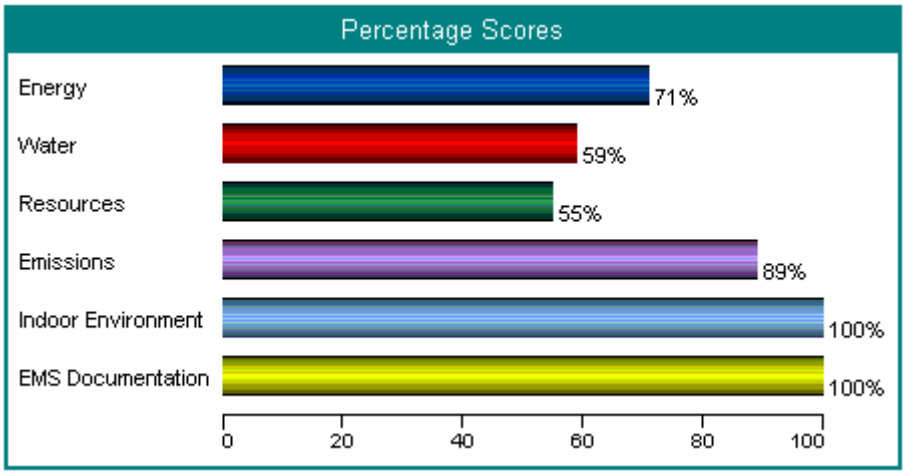
ii. Document a procedure for ensuring good IAQ.

UTILITY COST PERFORMANCE



PROJECTED PERFORMANCE

Based on the overall recommendations of the charrette, the Green Globes tool was used to re-assess the building.



The projected final performance of Commerce Court was 80% overall.

4 GREEN GLOBES

401 RICHMOND

401 Richmond Street West is a 4 storey, 200,000 square foot building – an early 20th century agglomeration of warehouses. The building was built in 5 stages starting in 1899 and ending in the 1930s. It has undergone a number of renovations over time; however, the main features and characteristics of the building have been maintained. A thorough energy audit of the building has not yet been completed. The total electricity consumption per year is approximately 2 million kWh, at an average of 28 to 36 equivalent kWh per office.

The building is converted for use by small businesses. It has approximately 120 tenanted spaces with an average of two occupants and is open seven days a week for approximately 15 hours a day. The tenants are mainly artists and there is great importance placed on keeping building rents low.

The building is owned by 401 Richmond Ltd. and managed by Mike Moody.

ENVELOPE

The building is of solid walls brick construction build-up ply roof, last retrofitted 8 years ago. There are 600 original, single glazed, wood, double hung windows. These are being carefully maintained by the building staff. Overheating is partially reduced by vegetated green roof.

LIGHTING

There are various lighting systems in use throughout the building. The majority of the indoor lighting systems use fluorescent luminaires with incandescent sources and task lighting in tenants' areas. The majority of the fluorescent luminaires have 34-watt T12 energy-saving lamps with standard electromagnetic ballasts. The typical conditions of the luminaires vary widely from average to poor. The exit signs use fluorescent lamps.

HEATING

The building has a bigger heating load than electrical load. Its phased construction means that the building has no core – each phase has an external thermal zone. As a result, the southern part of building is considerably cooler than the northern part in winter and tenants heat and cool their spaces correspondingly. Furthermore, the single glazed windows provide little insulation.

MECHANICAL SYSTEMS

Most floors in the building are not mechanically ventilated and they depend on opening windows for ventilation. There are many original, hot water radiators with a manual control valve.

The existing mechanical HVAC system in the building consists of the following:

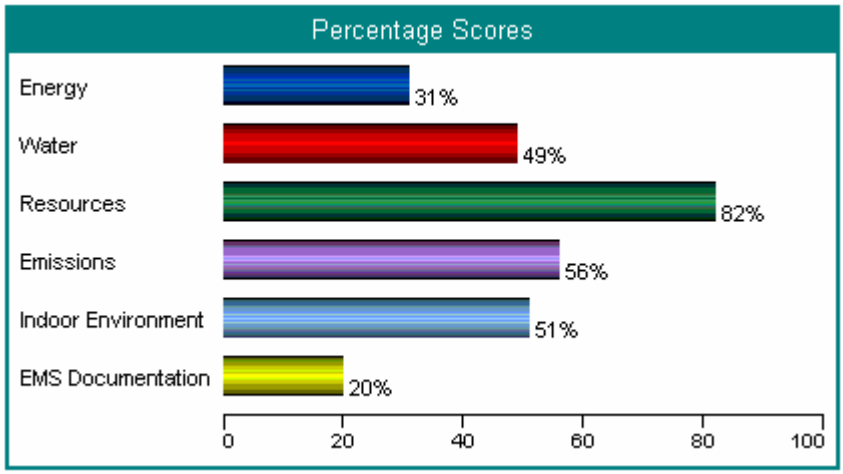
- 1 12,540,000 BTU Napanee steam boiler in the basement
- 3 MightyTherm Teledyne Lars 180,000 BTU boilers in a new 4th floor boiler room
- 7 rooftop mounted York A/C units serving the fourth floor.

HOT WATER

Domestic hot water (DHW) is heated by 270 L 4500 W electrical water heaters. The building has some hot-water saving devices such as water conserving faucets.

CURRENT PERFORMANCE

The Green Globes assessment tool was used to benchmark current building performance.



Based on the scores for each module, 401 Richmond achieved an overall score of 45%.

2 GREEN GLOBES

The goal of the charrette is to work out design measures to improve the building performance, using the Green Globes score as an indicator.

DESIGN TEAM RESULTS

Teams 4 and 5 started the charrette by working together to outline the current building condition and determine key problem areas. The teams were lead and facilitated by Jiri Skopek and Mark Mitchell. The team also included the building owner, Margie Zeidler, the building manager, Mike Moody.

The first task was to identify features and aspects of the building which were most important to its character. This included:

- **Window preservation:** the 600 windows of 401 Richmond are single glazed, double hung, character-defining windows in wooden frames. They are maintained by Mike Moody. Despite their lower thermal performance, their preservation is vital.
- **Rent issues:** the building tenants, for the most part, are members of the arts industry and appreciate the low rent costs and prime location of 401 Richmond.

- **Community aspects:** there is a strong community-based approach to building management and operation. The tenants are very much involved with and aware of the building programme.
- **Air-conditioning:** the art galleries in the building currently use air-conditioning to protect the artwork and for the comfort of visitors. Air-conditioning is not provided by the building – tenants are responsible for the operation and maintenance of their own units.

Based on these requirements and the goal to improve the overall Green Globes score, the teams identified key problem areas upon which to focus their ideas.

ENVELOPE: WINDOWS

i. Conduct a thermographic analysis of the building to determine the heat loss.

ii. All 600 windows do not need to be openable. A certain number of them should be permanently sealed to minimize air leakage and avoid unnecessary openings. Enough windows should be openable for adequate cross-ventilation. Magnetic windows are a good non-permanent option.

iii. The heritage aspect of the windows should be preserved – stay away from vinyl products, and use copper or brass instead. Determine an insulative value and an air leakage target to achieve.

iv. The material that is currently used for weatherstripping should be changed from the current product to Schlaegal. Anderson PulleySeal (or another similar product) should be used for pulley windows to reduce air infiltration. A reversible fill should also be used for insulated pulley windows.

v. Building automated controls should be implemented so that the ventilation system responds to open windows.

ENVELOPE: WALLS AND ROOF

i. Insulate cable conduits, piping holes, elevator shafts, and all other openings in the envelope.

ii. Re-roof final section of the roof (two sections have already been completed) and assess the possibility of adding insulation in the roof. Adding insulation could affect the natural breathing of the building therefore, if solar gain and heat loss are great, a reverse membrane system should be considered.

iii. Upgrade the existing green roof to a fully extensive green roof covering the entire building roof area.

HEATING

ii. Zone the building to control the amount of steam going to the radiators on different faces of building (i.e. north vs. south face). Install unitary heat pumps which provide units with air conditioning and a way of getting heat from south to north side in addition to using steam.

iii. If the building cannot be zoned, install a heat recovery system.

iv. Since tenant-metering is not entirely feasible, implement an Energy Efficiency Task Force to engage tenants in energy conservation. Consider building-wide targets and set up a fund with the money saved from lowered energy costs.

v. Add ivy on south walls, automated shutters, overhangs, bring daylighting into buildings, shade roof.

vi. Join the 4-storey and 3-storey sections of the courtyard with glass to create an openable-atrium and to create a quasi-core for the building. Consider the manufacturer called "OpenAir" : half of the roof retracts so that the courtyard is comfortable during the summer months. The atrium would be a good fresh air intake during the winter months.

LIGHTING AND DAYLIGHTING

i. Install skylights with diffusers.

ii. Based on the Daylight Penetration Rule, no lighting should be required in the hallways. Install occupancy or daylight sensors, or lumen-based controls.

MECHANICAL SYSTEMS

iii. An energy audit is critical to develop a full baseline profile before designing a retrofit project. Consider going through the Energy Innovators Office to assist with the planning and implementation processes (financially). The audit could also provide awareness programs for tenants and staff.

iv. Mechanical controls should be implemented to avoid the need for manual boiler control. This would also reduce the wear-and-tear on the boilers since constant turning 'on' and shutting 'off' drastically affects overall efficiency and the boiler lifecycle. (This also indicates that the boiler is oversized since it should be running flat out all winter rather than on and off all the time.)

v. Boilers should be zone-controlled through a Building Automation System. This might be complicated due to the numerous risers (i.e. 2 north faces, 2 south faces etc.) but the atrium could relieve this problem by establishing a quasi-core. About 25% of the gas currently consumed could be saved ($25,000/year) through automated and zone controls.

vi. The single large boiler should be replaced with several smaller, high-efficiency ones so that only those required are turned 'on'.

vii. Cogeneration should be considered to be applied to the steam generation to reduce the electrical demand. (Due to minimal off-hours electrical use and minimal summer heating, the cogeneration payback might not be financially viable).

viii. Convert the steam pipe system to a waterloop or GSHP system. This would contribute to an A/C supply which would ultimately change the entire building system since windows would be totally sealed, a mechanical ventilation system and humidity controls would be installed, plus the IAQ and noise issues due to the open windows would be eliminated.

ix. Sub-meter energy use rather than tenant-based metering. Use a lighting logger, or appliance metering to see where there is wastage.

WATER

ii. An extensive water audit should be done to identify leakage issues, monitor consumption, and single out major uses.

iii. Retrofit often-used toilets with 6L tanks. (This measure cannot be implemented across the board because of pressure issues in the piping.) For less often-used toilets, retrofit with

two-stage flushes. Install waterless urinals. Investigate the opportunity of 401 Richmond qualifying for the City of Toronto Toilet Replacement Program.

iv. Recycle grey water, rain water, and black water with a living machine/biofiltration system. Plant native and drought-tolerant plants in the courtyard and on the roof. Use a solar-powered pumping system for collection system. Use reclaimed water for watering plants.

v. Rain water should be collected at the roof level to avoid pumping requirements. Consider treating grey water and pumping it to the roof for use in the garden.

vi. Investigate the opportunity of getting a rebate or cost-savings from the City because of the green roof and water reclamation.

vii. Install solar DHW heaters on the roof.

IAQ ISSUES

i. Implement an environmental purchasing policy for products used in operation and maintenance (paints, sealants etc.).

ii. Select indoor plants which are drought-tolerant and good air filters.

RESULTS

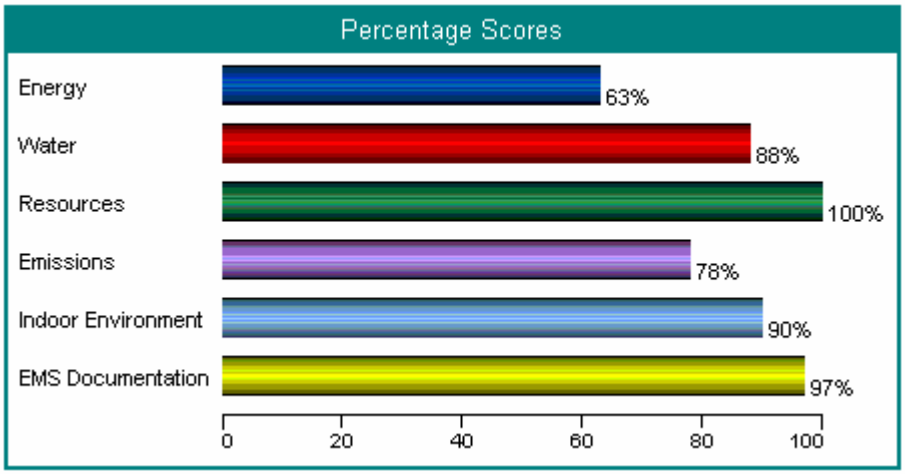
ESTIMATED SAVINGS

- $15,000 from a properly sized boiler, controls
- $10,000 from better sealing
- $20,000 from a lighting retrofit
- $20,000 from constructing an atrium

TOTAL SAVINGS: $65,000/annum

PROJECT PERFORMANCE

Based on the recommendations of the charrette, the Green Globes tool was used to re-assess the building.



The projected final performance of the building achieved a score of 80% overall.

4 GREEN GLOBES