INTEGRATED DESIGN CHARRETTE REPORT

JUNE 3, 2003

MINTO MIDTOWN
METRO LABEL PRINTING

Toronto City Hall
June 3, 2003

By

Sustainable Buildings Canada

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INTRODUCTION

On June 3, 2003, Sustainable Buildings Canada (SBC) hosted a 1-day Design Charrette focused on providing alternative design scenarios for two projects: Minto's Midtown – Yonge and Eglinton project and Metro Label's printing facility in Scarborough. The Charrette attracted more than 100 participants, representing architects, engineers, educators, city planners and a variety of technology specialists.

With key funding support from Minto and Metro Label, Enbridge, NRCan, CMHC, the Canadian Energy Efficiency Alliance, Direct Energy and Ozz Corp, the Charrette attempted to demonstrate that superior environmental design alternatives can be developed through the integrated design process.

Design Charrettes 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, three teams were assigned to Minto's project while two teams were assigned to the Metro Label project. Each team consisted of approximately 15 core members, with floating experts and guests circulating among the teams.

Minto's Midtown Project consists of two towers – 53 and 37 storeys connected by a common area "bridge". Construction is expected to start later this year. The Charrette used the completed architectural drawings and plans for as a way of identifying sustainable design considerations for the development.

Metro Label is planning on building a new 100,000 sq. ft. printing facility on a site in Scarborough. Planning activities have only just been initiated with preliminary site drawings developed. As such, most details regarding the structure of the building, including final configuration and orientation have not been resolved. The Metro Label integrated design teams used the LEED™ software as part of their approach to the design.

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, CMHC, Enbridge, Ozz Utilities and Direct Energy, the building owner/developers – Minto Urban Communities and Metro Label, the facilitators and modelers for the day, and finally the staff at the City of Toronto who not only provided an excellent venue, but also went overboard in covering all the logistical details. Thank you to all.

LIST OF ATTENDEES

Abush	Joshua	Joshua Four Ltd	abushj@yahoo.com
Adams	Peter	Morrison Hershfield Ltd	padams@morrisonhershfield.com
Akhavi	Shervin	ECD Energy and Environment Canada	xshervin@web.ca
Andrew	Brian	WZMH Architects	bandrew@wzmh.com
Applegath	Craig	Dunlop Architects	xapplegath@dunloparchitects.com
Bach	Bob	Engineering Interface	bbach@ameresco.com
Belusa	Fred	Belnor Engineering Inc.	fbelusa@belnor.com
Blanchard	Carl	WZMH Architects	
Blazevski	Bob	Minto Urban Communities	b.blazevski@minto.com
Bourassa	Nam	Minto Urban Communities	n.bourassa@minto.com
Brydon	Larry	OZZ Corporation	lbrydon@ozzcorp.com
Carpenter	Steve	Enermodal	scarpenter@enermodal.com
Chadwick	Terry	Enbridge	terry.chadwick@enbridge.com
Cheung	Casey		casey_cheung@hotmail.com
Chiarelli	Mario	OZZ Engineering	mchiarelli@ozzcorp.com
Clark	Christie	Kinectrics Inc	Christie.Clark@kinectrics.com
Clark	Jim	NRCan	jclark@nrcan.gc.ca
Cox	Ian		ianmcox@canada.com
Craig	Barry	CMHC	b.craig@sympatico.ca
Creighton	Paul	Morrison Hershfield corp	pcreighton@morrisonhershfield.com
Cullinan	Anna	NRCan	acullina@nrcan.gc.ca
D'Angelo	Peter	Mariah Energy Corp	pdangelo@mariahpower.com
Dhaliwal	Kiran	Minto Urban Communities	kirand@minto.com
Dickson	Donna	Pearl Earth Sciences Corp	ddickson@pearlearth.com
Dunn	Chris		chris_dunn@sympatico.ca
Etherington	Ross		ross@inovativedesign.ca
Feistner	Heinrich	City of Toronto	hfeistne@toronto.ca
Ferguson	John	Hidi Rae Consulting Engineers	johnf@hidi.com
Fraser	Marion	Sustainable Buildings Canada	mfraser@rogers.com
Freedman	Robert	City of Toronto	
Foster	Stephanie	CH2MHill	sfoster@ch2m.com
Fountain	Brain	GreenSim	bfountain@canada.com
Gaffney	Annette	Minto Urban Communities	annetteg@minto.com
Glasspool	James	Enbridge	james.glasspool@enbridge.com
Glickman	Mel	WZMH Architects	mglickman@wzmh.com
Gupta	Suneel	Energy Advantage	suneel.gupta@energyadvantage.com
Hart	Lenard	Clean Air Foundation	lhart@summerhillgroup.com
Hartley	Mark	Mark Hartley Landscape Architects	markh@on.aibn.com
Hewitt	David	Jacques Whitford Env Ltd	dhewittt@jacqueswhitford.com
Hu	Songyang	Toronto Hydro Energy Services	shu@torontohydro.com
Jarolimek	Jitka	Sustainable Edge	jjarolimek@s-edge.com
Joakim	Christian		christianjoakim@hotmail.com
Kolbasenko	Tom	Young and Wright Architects	tkolbasenko@ywarch.ca
Knight	Rob	Ted Handy and Associates	rob@thandyarchitect.on.ca
Lamanque	Michel	NRCan	mlamanqu@nrcan.gc.ca
Leitch	Paul	Direct Energy	paul.leitch@na.cnetrica.com
Liefhebber	Martin	Martin Liefhebber Arch	martin.liefhebber@on.aibn.com
Levitt	Sheldon	Quadrangle Architects Ltd	slevitt@quadrangle.ca
Lucuik	Mark	Morrison Hershfield	mlucuik@morrisonhershfield.com
Lubun	Michael	NRCan	mlubun@nrcan.gc.ca

Lum	Patrick	Optimira Controls	plum@optimira.com
Macmurdo	Jason	RJMcKee Engineering	jasonm@rjmeng.com
Marchant	Michel	Toronto Hydro Energy Services	mmarchant@torontohydro.com
Martyn	Rabi	City of Toronto	rmartyn@toronto.ca
Mather	David	Enermodal	dmather@enermodal.com
Maybank	Herb	Herb Maybank	
McMurdo	Jason	RJ McKee Engineering Ltd	jasonm@rjmeng.com
Merhaj	Christine	City of Toronto	cmerhaj@toronto.ca
Morris	Richard	City of Toronto	rmorris@toronto.ca
Morrison	Andrew	Caneta Energy	caneta@compuserve.com
Motamedi	Farid	Farid Motamedi Architect Inc.	fmarch@attglobal.net
Nervick	Chuck	Direct Energy Business Services	chuck.nervick@na.centrica.com
Norrie	John	Intellimeter	jgnorrie@hotmail.com
Olin-Chapman	Stephanie	Minto Urban Communities	
Parker	Michelle	Enbridge	michelle.parker@enbridge.com
Peterson	Brad		edc@sentex.net
Ponessa	Tom	Living Environments	ponessa@sympatico.ca
Pope	Stephen	NRCan	spope@nrcan.gc.ca
Pride	Andrew	Minto Urban Communities	apride@minto.com
Ridsdale	Cameron	Cement Association of Canada	ridsdale@cement.ca
Ronchka	Richard	OZZ Energy	
Segal	Julian	Hidi Rae Consulting Engineers	
Sawatsky	Bob	RENOVA Consultants	
Scott	Graeme	Jacques Whitford Env Ltd	gscott@jacqueswhitford.com
Scott	Lyle	Minto Urban Communities	lscott@minto.com
Sharp	Sheena	Young and Wright Architects	ssharp@ywarch.ca
Silverio	John	Ameresco	jsilverio@ameresco.com
Simpson	Jack	Toronto Hydro Energy Services	simpson@torontohydro.com
Singleton	Michael	Sustainable Buildings Canada	mike-singleton@rogers.com
Skopek	Jiri	ECD Energy and Environment Canada	jiriskopek@sympatico.ca
Stein	Gerald	Zeidler Grinnell Partnership	
Tamblyn	Tom	Riverside Innovation	tomtamblyn@sympatico.ca
Tanner	Mathew	ECD Energy and Environment Canada	jiriskopek@sympatico.ca
Uhera	Nestor	City of Toronto	nuhera@toronto.ca
Warren	John	City of Toronto	jwarren@toronto.ca
Watson	Robb	Sunlite Insulating Glass Mfg	Robb@sunlite-ig.com
Weir	Jeff	Earth Energy Utility Corp	jweir@eeutility.com
Whelpley	Mike	OZZ Corporation	
Wilson	Keith	Owens Corning Canada	keith.wilson@owenscorning.com
Williams	Keith	Aecon Buildings	kwilliams@aecon.com
Woods	Brian	Hidi Rae Consulting Engineers	brianw@hidi.com
Wong	Dathe	Dunlop Architects	dwong@dunloparchitects.com
Wong	Nelson	Nelson Wong Arch	nelsonw@spidercom.net
Young	Wally	Enbridge	walter.young@enbridge.com
Yousef	Nabila	OZZ / DeTech	yes@interlog.com

MINTO MIDTOWN BUILDING(S)

DESCRIPTION OF THE BUILDINGS

Minto Midtown: The Minto Midtown project is a 2-building condominium project located near the intersections of Yonge and Eglinton. It features a 52 story and a 37 storey glass tower, oriented north-south on Yonge St. The basic elements are as follows:

- two towers – 53 and 37 stories
- 900 suites
- ~ 900,000 sq feet (gross)
- 825 car underground parking garage
- Year round heating & cooling

- Recreational facility.

Baseline modeling in EE4-CBIP was provided by Mr. Brian Fountain of GreenSim. The baseline modeling indicated that the project as currently designed was expected to operate at an energy performance level close to the MNECB reference building.

Metro Label Printing Facility: A new industrial building to house a label printing operation located in Scarborough, Ontario, the building will consist of a manufacturing and warehousing area (110,000 ft^2), and a two-storey office area (20,000 ft^2). The plant normally operates two shifts per day, Monday to Friday. Key features include:

- 15 printing presses, plus quality control equipment and other support equipment. The presses use a number of different types of inks, including ultra-violet (UV) drying, water-based, and solvent-based.
- Approximately 33,000 cfm of make-up air (of which 27,000 cfm is due to the manufacturing process).
- Equipment consumes approximately 4,000 kWh of electricity during each production day.
- Plant is fully air-conditioned, with a cooling set-point temperature of 23°C. The plant is also fully heated, with a set-point temperature of 21°C.
- Approximately 55% of floor area for manufacturing (60,500 ft^2), 30% for storage/warehousing (33,000 ft^2), and 15% for shipping and receiving (16,500 ft^2). The shipping and receiving area of the plant has ten overhead doors. The floor-to-ceiling clearance height in the plant is 24 feet.

Baseline modeling was provided by Enermodal. The modeling focused on laying the groundwork for a LEED™ assessment.

DESIGN TEAMS AND SCENARIOS

Minto Midtown: There were three basic scenarios – a CBIP energy efficiency scenario, a C-2000 scenario and an open-ended High Performance scenario.

Minto CBIP Scenario – Design Team 1
The team operated on the basis that the building form has been determined. Elements that cannot be changed by the team are listed below. All other elements could be changed. Energy efficiency to meet CBIP, a high level of occupant comfort, and water efficiency were the goals.
Fixed Elements:
1. Building shape and orientation.
2. Window placement and general appearance of the building (e.g. ratio of fenestration: gross wall area)

Suggested Optional Elements:
1. Materials (make up of glass, pre-cast, etc.), and insulation values.
2. Mechanical systems including in-suite ventilation.
3. Lighting in the common areas (and some potential in-suite innovations).
4. Garage lighting & ventilation.
5. Roofing material and water retention.
6. Mechanical systems for Recreation facility.
7. Corridor ventilation/pressurization.

8. High efficiency appliances

Minto C-2000 Performance Scenario – Design Team 2

This scenario involved meeting the C-2000 Guidelines. C-2000 buildings are expected to consume 45% less than the energy of a MURB building built to the energy efficiency design standard MNECB. Because the standard is an overall performance target, designers have the opportunity to use a wide variety of technologies and products to meet this goal.

C-2000 buildings adhere to strict indoor environment guidelines on air quality, room-by-room ventilation, noise, humidity control and occupant comfort. Other environmental impact criteria will include limits on solid waste, emissions and water consumption. The environmental implications of the energy they consume is another consideration.

Fixed Elements:
1. Building shape and orientation.
2. Window placement and general appearance of the building (e.g. ratio of fenestration: gross wall area)

Suggested Optional Elements:
1. Materials (make up of glass, precast, etc.), and insulation values.
2. Mechanical systems including in-suite ventilation.
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6. Mechanical systems for Recreation facility.
7. Corridor ventilation/pressurization.
8. High efficiency appliances

Minto High Environmental Performance – Design Team 3

This is a scenario where optimum environmental performance is the goal, including energy efficiency, water and waste-water minimization, consideration of renewables, etc. The number of suites and the total floor space are fixed. All other elements can be modified.

To ensure that all energy and environmental issues are covered in an integrated manner, the participants were encouraged to refer to the Green Globes questionnaire. The On-line Green Globes Design assessment: http://www.greenglobes.com/nbalpha/ was used to evaluate the Team's results.

MINTO DESIGN TEAM 1 RESULTS

Team 1 was led and facilitated by Bob Bach, and Brian Fountain was the EE4 modeller. Team members included: Michel Lamanque, Mark Lucuik, Casey Cheung, Anna Cullinan, Paul Leitch, Keith Williams, Patrick Lum, Suneel Gupta, Tom Tamblyn, Keith Wilson, Brian Woods, Chuck Nervick and Rabi Martyn.

Team 1 was charged with a CBIP scenario and took the approach of examining the building by its various elements: envelope, water systems, mechanical, electrical etc. The key discussion points and outcomes are as follows:

Introduction:

- The Minto residential development is design to CBIP standards.
  - It is currently sitting at 25% better than CBIP standards.
  - The goal is to reach 35% better than CBIP standards.

- The view is the selling point of the development, and at no cost is the view to be tampered with.

- Windows are still being sourced and tested.
  - U value 6.7 is the heat loss on glass edge.
  - Aluminum extrusion, insulated glass.
  - 3rd floor up 72% glazing fixed and cannot be changed.
  - 15% operable balcony door.
  - Major source of heat loss.
  - Tower is 70% glass.
  - Floor to ceiling windows.
  - Can be tinted, but is stressed that the view cannot be diminished.

- Walls are rated at a R12.3 ~ to 0.08 is the U value.
- Balconies are a great area of energy loss.
- Total area of balconies is 3.5% in the south building.
- Building is pre-cast concrete (walls).
- Steel studs.
- Insulation in transition areas, i.e. Balconies.
  - Want to bring this area above code.
- Mechanical Systems.
  - 65 CFM is the per suite goal.
  - Controlled by occupants.
    - HRV systems.
    - 3 speed variable fans.
    - Heat return vents, washroom fans, dryers, and kitchen.
  - To equalize with suites, they would like the corridor fans run at 30% or less.
  - 30 CFM heat exchangers.
  - 50 CFM toilet vacuum (lights off), 100 CFM (lights on).
  - 120 CFM Fume-hood.

- HVAC systems.
  - 30 CFM of fresh air – exhaust 30 CFM running through a heat exchanger.
  - 4 pipe, coil systems.
  - 3 plants.
  - Condensing and non-condensing.
  - Water chillers, cooling coils.
  - VAV variable speed drives.

- HRV systems.
  - 3 speed fans (controlled)
  - Fans in bathrooms, kitchens.

- Talked about flow rates between suites and corridors.
- Equalization of pressure a must.

- Fans are time controlled.
- No central exhaust, only controlled through suites.
- Kitchen would like to use but there are issues of grease,
    - Talked about restaurant uses, but was cut off.

- Possible places to look at.
    - Pool ventilation.
    - Parking exhausts fans.

- Lighting.
    - Sensors for all public places
    - Emergency lighting will be maintained.
    - Temp and energy sensors in suites, when occupants are out for a certain amount of time, the environmental controls will bring the temp down by 2 degrees.

- **The group was split into smaller groups.**
    - HVAC group.
    - Lighting group.
    - Building Envelope group.
    - Ventilation group.

- Groups were asked to come up with solutions, factoring cost and savings, etc.

HVAC

- Smaller load, smaller system, means less consumption.
- Air-handling units, AHUS.
    - Pressure equalization.
    - Elevators, garbage chute, garage, pool, retail.
    - Suites balanced by corridor fan.
- Boiler.
    - Increase numbers to allow digital series / cascade effect.
    - Pre-heat water via GFX solar (pre-boiler).
    - Water loop heat-pumps, retail area heat-exchangers.
    - Grey water, as a source for heat.
    - Pool water, heat pump as a possible source.
    - Condenser tower cooling.

- BAS – Building Automation Systems.
    - Energy counter for suites.

- Mechanical upgrades.
    - 60,000 CFM to 22,000 CFM corridor space.
    - $250,000 in capital yields $85,000 in savings per year.
    - Smaller plants, chiller and heater means less energy consumption.
    - HVAC upgrades give an 8% savings for corridors.
    - In-suite metering, with occupant viewing.
        - Give feedback so that persons are aware of their energy consumption habits.
        - Will impact and show validity for ones efforts.

    - Waterless urinals.

  - Dual flush toilets.
  - White water, grey water, and black water can also be considered.

- HRV units deliver 30 CFM of 65 CFM of the required venting / suite.
- Diminishes the reliance on corridor air.
- Concentric duct heat exchange.
  - For dryer, and kitchen.

Envelope

- South and west walls will reflect solar heat.
- North and east walls will absorb solar heat.
- Upgrade to Low-E windows
    - Heat mirror glass, with tints.
    - Tinting on south and west.
    - No tinting on north and east.
  - Envelope yielded a 12% upgrade.

- Lighting.
  - Must maintain at least 1 foot candles at all times.
    - Emergency lights.
    - Stairwells.
  - Public access areas, halls, storage, garage.
    - Must maintain at least 5 foot candles.
    - Max is 45 foot candles.

- Lighting in suite do not have to follow codes.
- Corridors and public areas are MNECB.
- 35 watt per square meter.
- Parking and shop areas can be looked at.
  - Shops binding lease agreement can govern the amount of power allowable for use.
  - Jewelry shops, Shoppers, etc.

- Garage 36,000 square feet.
  - One light sensor / 1000 square feet, to turn lights on when area is in use.
  - 3 on / 3 off florescent lighting.
  - 50 sensors for garage area.
  - $35 for reg. ballast florescent lighting / unit.
  - $55 for electronic ballast florescent lighting / unit.
  - $145 for florescent dimmer unit / unit.
  - Storage areas will also be outfitted.

- Lighting Figures.
  - $25,000 in capital yields $21,000 in saving / year.

Major Conclusions for Team 1

Team 1 demonstrated that energy efficiency improvements are possible using market available equipment. Table 1 provides the EE4 simulation results for a variety of improvements. If all improvements were made, the total technical potential is approximately 30% better than MNECB.

Description	Electr MBTU	Nat. Gas MBTU	Total MBTU	Energy Cost	% of MNECB	Energy cost reduction $	Incr savings %	Incr savings $	EI kWh/ft²	K-cost $
Reference	36,766	40,722	77,488	$ 1,286,081					16.11	
Starting	35,113	36,141	71,254	$ 1,224,552	92.0%	$61,529			14.82	
isolated suite vent	34,756	30,376	65,132	$ 1,139,077	84.1%	$147,004	7.9%	$85,475	13.54	$250 k
building envelope	34,877	21,331	56,208	$ 1,046,192	72.5%	$239,889	11.5%	$92,885	11.69	$55k
improved lighting	33,645	21,784	55,429	$ 1,025,183	71.5%	$260,898	1.0%	$21,009	11.53	$25k
mechanical upgrades	33,789	21,270	55,059	$ 1,024,125	71.1%	$261,956	0.5%	$1,058	11.45	
water htg upgrades	33,789	19,024	52,813	$ 1,008,754	68.2%	$277,327	2.9%	$15,371	10.98	

MINTO DESIGN TEAM 2 RESULTS

Team 2 was led and facilitated by Nelson Wong. Stephen Pope provided modeling support. Team members included: Peter D'Angelo, Terry Chadwick, Chris Dunn, Nam Bourassa, Jitka Jarolimek, Rob Knight, Barry Craig, Fred Belusa, John Norrie, Mel Glickman and Jason MacMurdo.

Team 2 was charged with designing a building to meet the C-2000 standard. Although the site itself was predetermined, there were no design or cost constraints given to Team 2. However, the team did focus on creating a design that is both practical and feasible.

Parameters

1. cannot change amount or location of glass
2. cannot change orientation of buildings
3. desire to keep three buildings (North Tower, South Tower, Podium) as separate systems for metering purposes
4. Connected to Toronto Hydro
5. Suites individually metered for domestic water not gas
6. Fresh air → corridor pressurization system
   a. Keeps odours in suites
   b. Cost effective
   c. Not best method for providing fresh air to suites

C2000 Design considerations

- Bias on fabric of building
- CBIP allows for lighting improvements
- Based on installed capacity, no credit for changing set points in occupant suites (ie. temperature set point etc.) as C2000 focuses on building system and energy reduction in central plant
- No credit for shading from adjacent buildings (for C2000 compliance building is assumed to have no shade from other buildings)

Current Building

- Building is currently 6.2% lower than MNECB
- Target is 45%

Current HVAC system

- Electrical centrifugal chillers – working fluid to be defined
- VFD Drive on chiller
- Open induced draft
- Constant volume primary system
- Constant volume ventilation system that delivers temperate air in summer and winter but unseasonably cool air in fall/spring
- Operable windows in all suites
- Approximately 8' of glass (floor to ceiling) in all suites

Current Stormwater management

- Currently buildings retain some stormwater on roofs of two towers
- Held in 2 storage chambers (approximately 1.5 m^3 each)

Potential Ways to attain C2000 Compliance (See Modeling and Results below)

Green Roof/Vertical Gardens

- Vertical gardens → vegetation grown on walls of buildings to help reduce space heating and cooling loads
  - Not suited to this project because one of the selling features of this building is the views of each suite
  - Vertical vegetation will cover the glass areas thus running counter to clients wishes
- Green Roofs → vegetation grown on roof of building to reduce space heating and cooling loads

Window Improvements

- Different glazings on different sides of building
- Promote shading
- Vertical blinds – reflective on one side black on other (no C2000 credit as it is an energy management solution)
- Film on windows
- Given that view is a selling point and that glass MUST remain as floor to ceiling and it is desired to reach C2000 compliance client will have to pay a premium for high performance windows → one of the few features of envelope that can be altered
  - Double glazed 7525 Kawneer
  - Low e
  - Argon filled
  - Edgetech spacer
  - Applied in a curtain wall system
- Using the above window system improved building to 8% lower than MNECB
- To improve acoustics (ie. soundproofing interior from exterior) it is desirable to use panes of 2 different thicknesses(1/4" & 1/8") instead of two panes of the same thickness
  - A good alternative to triple glazing
- Second Iteration of window enhancements
  - 7550 Kawneer Unit
  - Triple glazed
  - 2 low e coatings
  - 2 insulating spacers
  - shading coefficient = approx 0.3
- results in approximately 27% less energy than MNECB
- Cost: approximately $14 Million
- Could potentially apply the expensive window system to one specific side of the building in order to reduce costs (North side may not require this window system)

Sealing Building

- No credit for reducing infiltration however it was recognized among the group that it would reduce energy use significantly
- Infiltration is highly quantifiable however C2000 does not currently give credit (one of current problems with C2000)
- Curtain wall system used to ensure high level of sealing between interior and exterior environment
- Suites could be sealed effectively however it is difficult to conceive of a "sealed" elevator shaft

    - Significant stack effect

Centralized Exhaust System

- Can recover heat from kitchen and bathroom fans instead of exhausting those directly to exterior
- Could potentially preheat domestic water

Demand Control Ventilation

- Use occupancy sensor
- CO_2 sensor not practical because will take a long time to trigger if a person is not a heavy breather
- VFDs on corridor units

Podium Level

- Currently has limestone walls with punch windows
- Podium uses a heat pump system
- Lighting seems high (3.5 W/ft2)
    - It is high due to fact that it is retail space and lighting demands are high
    - Look to reduce lighting levels through dimmable ballasts
    - Reasonable to reduce lighting levels to 2.5 W/ft2
- Insulation @ podium level currently R16 (just slightly above the code)
    - Increase insulation at the cost of increasing the thickness of the walls by 1"
    - New R value is R17

Individual Suite Metering

- Low time use
- Promotes energy lifestyle changes by occupants
- Energy reduction potential of 0-35%
- Not a C2000 initiative because it is an energy management solution to individual suites

Wastewater retention

- Use of grey water for urinals, WCs etc.

Blue Sky Ideas

- PV Cells on roof → expensive
- Wind turbine on roof → operating under certain height restrictions therefore adding the wind turbine to the top would cut back on number of suites that could be sold due to a necessary reduction in tower height to accommodate wind turbine
- Waste power turbine

Minto Midtown C-2000 Simulation Summary

Prepared by:
Mr. Stephen Pope, Natural Resources Canada, CANMET Energy Technology Centre Buildings Group, Commercial Buildings Section

Base model "Minto2"

Proposed energy consumption 75,173, 136 MJ vs. reference at 81,750,064 MJ.

The base case building energy consumption is 8.1% below the MNECB/CBIP reference. The target for improvement is 45.1% below the MNECB/CBIP reference (MURB target).

Reference building energy consumption by proportion, ranked in order of importance is:

1. SPACE HEAT 41.1%
2. VENT FANS 14.7%
3. AREA LIGHTS 13.1%
4. DOMHOT WATER 11.5%
5. MISC EQUIPMT 6.6%
6. PUMPS & MISC 6.4%
7. SPACE COOL 4.7%
8. HEAT REJECT 1.9%

Space heating in residential buildings tends to be dominated by skin (exterior) loads. However, a condition of the review was that the fenestration to wall ratio (averaged at 66%) was to remain constant. In addition, the mechanical systems were well designed using an efficient approach (fan coils) and high efficiency boilers. Accordingly, envelope improvements were the first energy conservation measures modelled.

(It must be noted that in a discussion on the effects of combining energy efficiency measures, the energy simulator misinterpreted some results and overestimated the importance of cooling to the overall project. Considerable time was spent discussing cooling measures that did not reach a resolution.)

Measures Modelled (base case 8.1% < MNECB/CBIP, energy target 50.1% < MNECB/CBIP).

1. Wall upgrade to R20 (RSI 3.5) throughout entire complex (using base case windows):
   Result: 17.5% < MNECB/CBIP
   (this strategy was not considered all that realistic)

2. Base model with actual windows specified (U = 2.27 W/m^2degC, SHGC = .50):
   Result: 17.3% < MNECB/CBIP

3. Base model with high performance double glazing (Kawneer 7525 curtainwall frame with double glazed IGU [CLR, 13 mm warm-edge spacer, argon gas fill, LE, e = 0.03], U_{window} = 1.75 W/m^2degC, SHGC = .63)
   Result: 19.0% < MNECB/CBIP

4. Base model with high performance triple glazing (Kawneer 7550 curtainwall frame with triple glazed IGU [CLR, 13 mm warm-edge spacer, argon gas fill, LE e = 0.03, 13 mm warm-edge spacer, argon gas fill, LE e = 0.03] U_{window} = 0.85 W/m^2degC, SHGC = .29).
   Result: 27.6% < MNECB/CBIP
   (although this was the first measure to get the project over any energy threshold an estimated cost for this curtain wall configuration was made at $14.0 M)

5. Base model with high performance double glazing as (3) and RSI 3.5 upgrade to all walls.
   Result: 19.7% < MNECB/CBIP

A second test of wall upgrades was made doubling the initial upgrade value to give a wall with RSI 7.0 supporting a fenestration to wall ratio of 66%.

6. Base model with high performance double glazing as (3) and RSI 7.0 upgrade to all walls.
   Result: 20.2% < MNECB/CBIP
   (clearly the law of diminishing returns for insulation in walls starts to cut in around RSI 3.0)

As envelope upgrades on their own were not sufficient lighting in the podium was reviewed. 90% of the lights in service spaces were put on occupancy sensors. Corridor spaces (and the parking garage) were placed on a bi-level occupancy control. All spaces reduced connected lighting power by 15% and Retail spaces in the podium employed continuous dimming over 25% of the space run by daylighting sensors. Lighting energy reductions on their own produced the following results:

7. Base model with lighting modifications to parking, retail podium and common spaces in towers:
   Result: 8.5% < MNECB/CBIP

It is common with lighting efficiency measures that the electricity saved from the lights also represents a reduction in heat to the space, which must be compensated by increases to the heating energy in the space, especially when the building envelope is weak. To ensure that the lighting improvements were not neutralized by additional heating energy the exterior walls of the podium were increased in thermal resistance to RSI 3.5.

8. Base model with lighting modifications to garage, retail podium and common spaces in towers plus envelope upgrade to RSI 3.5 (R-20) in podium:
   Result: 8.8% < MNECB/CBIP

9. Base model with actual specified windows, lighting modifications to garage, retail podium and common spaces in towers plus envelope upgrade to RSI 3.5 (R-20) in podium:
   Result: 17.9% < MNECB/CBIP

As no one system was going to provide the necessary energy use reduction, combinations of measures were attempted.

10. Base model with high performance triple glazing (4), lighting modifications to garage, retail podium and common spaces in towers plus envelope upgrade to RSI 3.5 (R-20) in podium (8):
    Result: 28.4% < MNECB/CBIP

11. Base model with high performance triple glazing (4), lighting modifications to garage, retail podium and common spaces in towers (7) plus envelope upgrade to RSI 3.5 (R-20) in all walls (1):
    Result: 28.5% < MNECB/CBIP

Based on model 11 the overall energy consumption is 61,912,998 MJ vs. 86,613,008 MJ for the reference. Proposed building energy consumption by proportion, ranked in order of importance is:

Proposed building energy use			
End Use	Percent of Total	Electricity (MJ)	Natural Gas (MJ)
SPACE HEAT	28.2%	0.0	17,483,330.0
VENT FANS	18.3%	11,317,480.0	0.0
AREA LIGHTS	17.4%	10,776,340.0	0.0
DOMHOT WATER	13.7%	0.0	8,464,713.0
MISC EQUIPMT	8.7%	5,410,432.0	0.0
SPACE COOL	4.8%	2,980,427.0	0.0
PUMPS & MISC	8.0%	4,956,441.0	0.0
HEAT REJECT	0.9%	523,835.	0.0
Energy Totals by type		35,964,955.0	25,948,043.0

There are a number of energy saving measures that could not be modelled using the EE4.CBIP package. Specifically, the group wanted to take advantage of heat recovery from waste water, and the improved air tightness of a true curtainwall system as opposed to the originally specified window walls.

Studies on a waste water heat recovery systems known as GFX have demonstrated a 20% savings on hot water heating energy. Taking advantage of this saving would reduce the natural gas consumption of model 11 by 1,692,942.0 MJ, lowering the total to 24,255,510.0 MJ.

Studies on air tightness suggest that up to 25% of space heating loads can be shed when infiltration is reduced by half. This could reduce the heating load by 4,370,832.0 MJ. Taking advantage of the air tightness credit in addition to the GFX credit could reduce the natural gas consumption of model 11 to 19,884,269.0 MJ, and cutting the total proposed building energy use to 55,849,224.0 MJ.

The very low energy requirement for heat rejection suggests that further study on alternative methods of heat rejection would be fruitful at this point. If possible, the energy use of the whole category could be transferred to a water feature or other non-electrical demand method.

With proper design and integration the additional measures could improve the percentage performance with respect to the reference to 35.5% lower than the MNECB/CBIP reference. Unfortunately, this level of performance has been reached at considerable expense (although no credit has been calculated for the reduction in heating plant size, or electrical transformers and distribution), and is still well short of the C-2000 target

Charrette model – end result. 35.5% <MNECB/CBIP

Epilogue – further investigations

Following the charrette sessions some additional modelling was performed to check the impact of fenestration-to-wall ratios. As a starting position model 11 was run modified to use the high performance double glazed system (3). The result was only a 20.2% reduction on the MNECB/CBIP reference.

12. Base model with high performance triple glazing (4) modified to have a 40% fenestration to wall ratio, lighting modifications to garage, retail podium and common spaces in towers (7) plus envelope upgrade to RSI 3.5 (R-20) in all walls (1):
    Result: 27.7% < MNECB/CBIP

Repeating the earlier test of superinsulated envelopes produced a similar result:

13. Base model with high performance triple glazing (4) modified to have a 40% fenestration to wall ratio, lighting modifications to garage, retail podium and common spaces in towers (7) plus envelope upgrade to RSI 7 (R-39.75) in all walls (6 sim):
    Result: 28.2% < MNECB/CBIP

With the higher insulation level present an investigation was made regarding the boiler size. Boiler size was reduced from 1,360 kW to 1,100 kW and the efficiency was adjusted to the maximum condensing boiler position of 94%. The system was also modelled as being a modulating system at 10 levels.

14. Base model with high performance triple glazing (4) modified to have a 40% fenestration to wall ratio, lighting modifications to garage, retail podium and common spaces in towers (7) plus envelope upgrade to RSI 7 (R-39.75) in all walls (6 sim), plus downsized condensing boilers:
    Result: 30.8% < MNECB/CBIP

The cost effectiveness of the benefits in model 14 is not the best. An investigation of the ability of high performance double glazing to deliver sufficient envelope thermal values was made. Model 14 was given high performance double glazing (3) with all other elements remaining.

15. Base model with high performance double glazing (3) modified to have a 40% fenestration to wall ratio, lighting modifications to garage, retail podium and common spaces in towers (7) plus envelope upgrade to RSI 7 (R-39.75) in all walls (6 sim), plus reduce capacity, higher efficiency boiler (14):
    Result: 28.1% < MNECB/CBIP

It was desirable to reduce the level of tower insulation to a more manageable point. RSI 4.5 was taken as a target. The reduced boiler capacity proved to be insufficient unless the projecting balconies were constructed in a fashion thermally isolated from the floor slabs.

16. Model (15) with high performance double glazing (3) modified to 40% fenestration to wall ratio, plus lighting modifications to garage, retail podium and common spaces in towers (7) plus envelope upgrade to RSI 3.5 (R-20) in podium walls (1), and RSI 4.5 (R-25.5) in tower walls, plus reduce capacity, higher efficiency boiler (14), plus thermally decoupled balconies:
    Result: 28.4% < MNECB/CBIP

At this point the level of detail has increased such that the designers should be involved in the discussions. To close off the investigations a final model was prepared.

17. Model 16 was modified to show high performance triple glazing in the podium shop windows (only), and the water heating fuel was switched to electricity to make a quick estimate of the potential for heat pump domestic water heating. Not accounting for heat pumps with DHOW the results were as follows:
    Result: 28.0% < MNECB/CBIP

Proposed building energy use			
End Use	Percent of Total	Electricity (MJ)	Natural Gas (MJ)
SPACE HEAT	29.1%	0.0	16,694,250.0
VENT FANS	19.7%	11,315,790.0	0.0
AREA LIGHTS	18.8%	10,776,340.0	0.0
DOMHOT WATER	11.4%	6,535,121.0	0.0
MISC EQUIPMT	9.5%	5,410,432.0	0.0
SPACE COOL	5.7%	3,236,384.0	0.0
PUMPS & MISC	4.8%	2,771,104.0	0.0
HEAT REJECT	1.0%	563,927.	0.0
Energy Totals by type		40,609,098.0	16,694,250.0

A heat pump water heater with a COP of 3.0 should produce a three-fold decrease in the electricity used for water heating. This would reduce the energy use for water heating by 4,356,747 MJ. Using the earlier factor for GFX heat recovery on the adjusted DHOW load would produce an additional 435,674. MJ savings annually, however this may not be sufficient to support the installation of the technology.

Returning to the earlier projected savings for heating due to the use of curtain wall over window wall giving better air tightness, an additional 4,174,356 MJ could be saved.

The projected combined air tightness and electricity savings for the proposed building would give an energy use of 36,252,351. MJ of electricity and 12,519,894. MJ of natural gas. The total energy use of 48,772,245. MJ compared to the reference building at 79,635,880. MJ gives a 38.8% improvement over the MNECB/CBIP performance level.

Additional manipulation of envelope values, review of the fan efficiencies for ventilation and inclusion of the savings arising from energy efficient appliances (impacting the Misc. Equipment category) should be able to bring the building performance to the desired C-2000 level of a minimum 45% improvement on the MNECB/CBIP reference.

MINTO DESIGN TEAM 3 RESULTS

Team 3 was led and facilitated by Martin Liefhebber, and Mike Lubun was the EE4 modeller. Team members included: Sheldon Levitt, Wally Young, Michelle Parker, Robb Watson, Songyang Hu, Peter Adams, Shervin Akhavi, Matthew Tanner, Jeff weir, Jiri Skopek and Christian Joakim.

Team 3 was charged with the challenge of designing a building to the "highest environmental performance". Team 3 used both the EE4 modeling software for its energy modeling and the Green Globes™ environmental assessment to undertake a broader environmental assessment of the building. The EE4 modeling report and results are integrated with the Green Globes™ assessment report.

General Discussion

Energy Saving Ideas

1. *Options Concerning Parking Spaces*
    a. Reduce number of spaces by approximately 50%, which will free up land, both above and below ground, for other uses that include
        i. Water storage (e.g. cistern) of grey water, storm water, etc. to be used in irrigation, heat recovery, etc.
        ii. Incorporate natural lighting and natural ventilation into the parking scheme, bearing in mind that the garage must provide vehicles with protection from the elements and it must also provide an appropriate level of safety for the vehicle owners.
        iii. Use of motion-sensitive lights in the parking areas.
        iv. Exploit the geothermal potential of the extra space (water quality is near P2 levels).
        v. Look into "thermo-active" foundations (please refer to examples in European buildings).
        vi. Promote use of nearby subway as well as other options that include Autoshare programs, car-pooling, increased prices for the parking spaces that are available (i.e. deterrent to owning a car) walking, bicycling, etc.
    b. Other considerations
        i. Construction cost and time.
        ii. Payback period.
        iii. Noise problems associated with parking ventilation, etc.
        iv. Safety issues associated with lighting and exposure to the elements.

2. *Options Concerning Windows*
    a. High level of thermal resistance, i.e. use appropriate glazing, coating, thickness, insulating gas, etc. for each side of the building.

b. Optimize day-lighting and solar gain effects while making appropriate considerations for occupant comfort level, thermal lag effects of radiant heat transfer, seasonal variations, and diurnal variations.
c. Employ external shading devices (e.g. awnings) that are tailored to the window orientation, the 24-hour sunlight distribution, and the seasonal variations of Toronto's temperate climate.
d. Use PV cells or some other type of solar collector, either roof top or in conjunction with the upper surface of the awnings, to generate electricity that could be used by the building for simple appliance needs.

3. *Energy Options*
   a. On-site electrolysis-based hydrogen fuel cell that uses grey water, storm water, etc. to generate energy for the building
   b. Co-generation or tri-generation techniques, which have been proven successful in other buildings in the Toronto area.
   c. Exploit the energy potential associated with the height of the building (e.g. miniature hydro power plant).
   d. Employ a solar wall (50% solar electric and 50% solar thermal energy) or trombe wall, bearing in mind that occupant lifestyle and comfort issues are significant, i.e. highly desirable to be able to have operable windows.
   e. Exploit the thermal mass of the concrete floors in conjunction with solar gain to produce radiant thermal lag effects that can be used for space heating at night.
   f. Heat recovery from waste water using the GFX system.
   g. Heat recovery and space heating options using a central + in-suite ventilation hybrid system developed by Minto.

4. *Waste Management Issues*
   a. Creation of incentives to bridge the significant gap between the recycling practices of MURBs and single-family homes.
   b. Sorting issues – manual disposal and separation at the source (i.e. higher occupant participation) vs. three-chute system currently in Minto's plans.
   c. Composting options that can be used in conjunction with balcony gardens, green roof applications, and total site green-space.
   d. "Green box" plans vs. wet garbage chute.
   e. Note: the chute option prevailed generally because of the historical trend in the attitude of the occupants to recycling and waste management.

5. *Miscellaneous Ideas*
   a. Rooftop greenhouse-café option, which has the potential to decrease heat loss through the rooftop and will serve as a hub of social activity for the occupants.
   b. Strategically placed trees that serve many functions, some of which include shading, noise blockage (especially at the street level), and reduction in the urban heat island effect (a welcome effect, especially for people who don't own air-conditioned cars and choose to travel on foot, by bike, or by subway – i.e., this strategy also ties in with the previous recommendation of parking space reduction).

c. Eliminate thermal bridging and any potential fin effects that are associated with balconies and other similar protrusions. This is a relatively simple method of reducing heat loss by approximately 5%. The elimination of thermal bridging will also reduce mold growth and condensation problems at the window-wall interface, which can have serious structural and health consequences.
d. Use metered appliances, etc. at the suite level so that the end users, i.e. the occupants, realize the amount of energy they use.
e. Minimize air leakage (infiltration and exfiltration) across the building envelope through a high level of quality control throughout the life cycle of the building.
f. Provide appropriate furnishing, flooring materials, and wall colours that maximize solar thermal absorption and minimize the embodied energy of the building.

The Green Globes model results are provided in the next section. The building achieved a rating of 4 out of a possible 5 Green Globes. An excellent rating!

Green Globes Design

Green Leaf™ Eco-Rating Program

Project:	**Sustainable Design Charrette** **MintoMidtown Condominium Project, Team 3**
Owner:	**Minto Urban Communities**
Date:	**June 03, 2003**
Ref. No:	**06-001**

ECD Energy and Environment Canada Ltd.
Tel: 416 699 6671
Fax: 416 699 9250
E-mail: skopen@interlog.com

Table of Contents

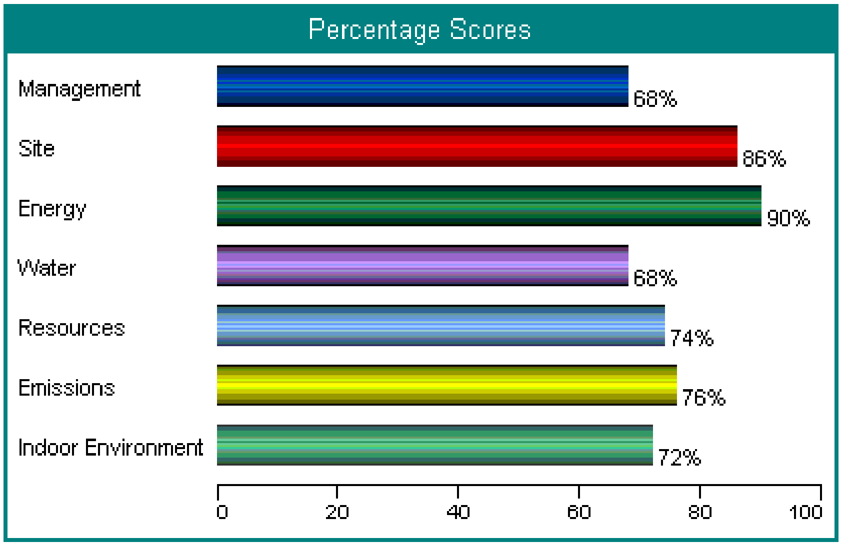
INTRODUCTION

Design team 3 of the Charrette was led by Martin Liefhebber as the facilitator and Mike Lubun as the energy simulator. The team was tasked with designing a building to the “highest environmental performance” and challenged to redesign the MintoMidtown Condominium Project in order to improve its overall energy and environmental performance. To ensure that all energy and environmental issues are covered in an integrated manner, the participants were encouraged to refer to the Green Globes questionnaire and the on-line *Green Globes Design*[1] assessment was used to evaluate the team’s results. Although the site itself was predetermined, there were no design or cost constraints given to Team 3. However, the team did focus on creating a design that is both practical and feasible.

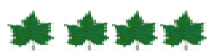
The buildings will have year round heating and cooling via a two pipe fan coil system linked to high performance chillers and boilers. The two pipe fan coil eliminates simultaneous heating and cooling associated with the more conventional four pipe fan coil distribution systems. The two pipe system will be either distributing heated or chilled water at one point in time, therefore thermal mass, controls and thermal swings have to be more seriously considered in the design to avoid zones of unsatisfactory comfort. facilities have also been incorporated in the design.

Percentage of points achieved by Minto Midtown for each module:

[1] Green Globes Design: http://www.greenglobes.com/nbalpha/.



The Team 3 MintoMidtown Project achieved an overall score of 80%. Team 3 used the Green Globes checklist as a means of addressing all the aspects of the sustainable design in a comprehensive manner.

RATING: 

Four Green Leafs

Section A: PROJECT MANAGEMENT POLICIES AND PRACTICES

This section evaluates the extent to which an integrated design process and a team approach are being used to generate design solutions that will meet the needs identified in previous stages, as well as the purchasing policy and the commissioning plan.

The MintoMidtown Team 3 achieved a score of 68% on the Green Globes™ rating scale for its integrated design process, integration of environmental purchasing and commissioning plan. The score largely reflects the fact that issues, such as green procurement, were not within the scope of this particular exercise due to time constraints.

A.1 Integrated Design Process

Highlights

The Integrated Design Charrette provided a forum to encourage future design and construction ideas for the developer and for a future phase of the MintoMidtown Project. The use of an integrated design process for the building design concept was accomplished by a full day of brainstorming.

The design process used a team approach, consisting of members from a range of disciplines, including: a facilitator, energy simulator, developer, three architects, educator and electrical engineer. Several experts in specific fields, including: water and acoustic issues were also available for consultation. They were able to provide the design team with immediate feedback and ideas and this contributed greatly to the quality and practicality of the team's work. This not only created a design experience that was seemingly real, but also valuable and enjoyable. For example, the group explored possible urban design issues and discussed them with Minto representatives.

Since the aim of the Charrette was to design a green, healthy building, green design facilitation was used to support green integration at the concept design stage.

A.2 Integration of Environmental Purchasing

Team 3 did not discuss the integration of environmental purchasing. The following issues would normally need to be addressed.

Opportunities for Improvement

Establish criteria for green procurement. Stipulate that suppliers must be asked to provide information on the environmental characteristics of their products. Indicate that water efficiency and energy efficiency are to be key issues when selecting new plumbing equipment and new mechanical equipment, respectively. Reputable materials specifications guides should be consulted for major elements.

A.3 Commissioning Plan - Documentation

Highlights

As part of the Charrette process, Team 3 produced a basis for the Design Concept Report.

Section B: SITE

This section evaluates design strategies for optimal use of the site based on information gathered during the Site Analysis Stage, and in response to the requirements set out at the Project Initiation Stage and further outlined in the Programming Stage.

Minto Midtown achieved a score of 86% on the Green Globes™ rating scale for site design and measures to minimize the impact of the building on the site and/or the site enhancement.

B.1 Analysis of Development Area

Highlights

The original design team has collected and analysed site data for topography, geology, soils, water features, drainage, vegetation as well as previous land use, and applied the results to the development of the site plan.

The site is an existing serviced site. The MintoMidtown project is not contributing to urban sprawl by focusing development in an existing urban area.

Increasing density along the transportation corridors will increase the viability of public transport.

B.2 Development of Strategies to Minimize Ecological Impact

Highlights

The design concept proposes the integration of native planting and landscape naturalization.

There was a discussion of strategies to avoid creating heat islands. Roof gardens, trellis façade systems and green roofs were considered.

Opportunities for Improvement

Team 3 failed to discuss exterior lighting. Integrate lighting strategies that will avoid disturbing the nocturnal environment. Reduce the night sky glow by choosing exterior light fixtures designed to minimize light trespass and light pollution.

B.3 Integration and Enhancement of Watershed Features

Highlights

Site grading will be used to increase infiltration, reduce run-off and divert water from the building. Team 3 recommended:

- minimizing the impact/footprint, and maximizing greenspace
- minimizing hardscapes, and where this is unavoidable, using permeable , pervious surface paving materials
- using vegetation to maximize the total amount of water consumed by plants
- Strategically placed trees that serve many functions, some of which include shading, noise blockage (especially at the street level), and reduction of the urban heat island effect (a welcome effect, especially for people who don't own air-conditioned cars and choose to travel on foot, by bike, or by subway – i.e., this strategy also ties in with the recommendation to reduce the number of parking spaces).
- landscaping the site to divert water away from the building
  - parking garage cistern tank to collect rain water to be used as a cooling tower supplement, source of landscaping water and a possible source of non-potable water (car wash, urinals)

In addition, the design proposes that rainwater be captured from impervious areas for groundwater recharge and reuse in the building. The large underground water tank would either replace an existing floor in the parking garage or a number of spaces within the parking garage.

B.4 Strategies to Enhance Site Ecology

Opportunities for Improvement

Consult with the Landscape Architect for advice on ways to improve the native habitat based on slope, soil type, and local regulations, and incorporate this into the Design Concept.

Section C: ENERGY

Building systems such as HVAC, lighting and heating of water use large amounts of energy. Energy is an important environmental parameter because it relates directly to climate change and global warming as well as a variety of air emissions. These include sulphur dioxide and oxides of nitrogen, which produce acid rain; as well as hydrocarbons and airborne particles. There is also a direct relationship between energy savings and cost savings.

MintoMidtown Team 3 achieved a score of 90% on the Green Globes™ rating scale for energy efficiency. This represents the weighted integration of the sub-scores for: modelling and simulation of the building energy performance, energy demand minimization strategies, integration of energy-efficient systems, integration of renewable energy sources, and planning energy-efficient transportation.

C.1 Modelling and simulation of building energy performance; establishing an energy target

MintoMidtown Team 3 achieved a sub-score of 100% for its energy consumption, based on the inputted projected energy performance of 160 ekWh per gross square meter per year.

As a comparison, the expected annual energy use of the building, as calculated by the Commercial Building Incentive Program (CBIP) Screening Tool, is 81,750,100MJ (173 ekWh per gross square metre per year). The projected energy savings of the proposed design as compared to the same building constructed to the Model National Energy Code for Building reference conditions are 7.5%. (Note that savings of 25% or greater suggest that the project may qualify for a CBIP incentive grant.) Carbon dioxide (CO_2) emissions savings, based on CBIP Screening Tool estimates are expected to be 556,000 kg. The breakdown of the energy used in the proposed design and the corresponding reference building is shown in the following table:

Highlights

Led by energy simulator Mike Lubun, the group applied several design measures to improve the energy performance. Among those analysed include a change in the type of window used, and changes to the balconies to reduce thermal bridging.

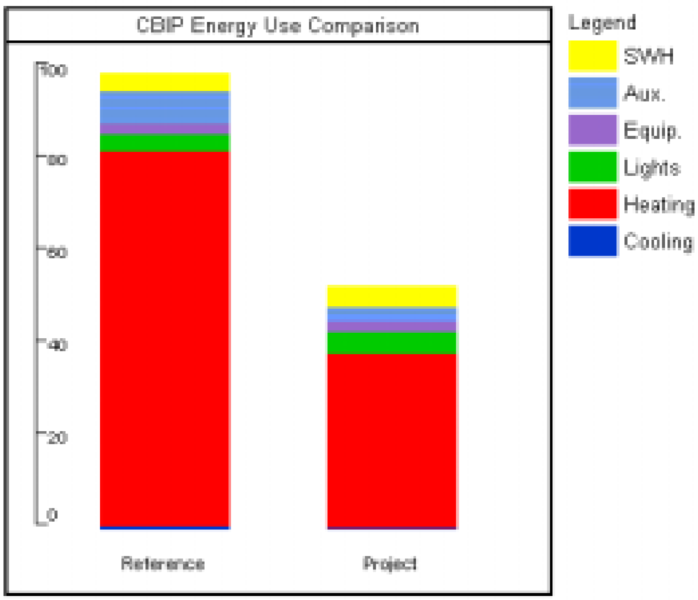
Energy Usage: Proposed Design and Reference Building

PROPOSED: ALL PLANTS ENERGY	ENERGY TYPE:	ELECTRICITY	NATURAL-GAS	TOTAL
	SITE UNITS:	KWH	THERM	EKWH/M2
	CATEGORY OF USE			
	AREA LIGHTS	3185579.	0.	24.33
	MISC EQUIPMT	1502542.	0.	11.47
	SPACE HEAT	0.	281183.	62.91
	SPACE COOL	907019.	0.	6.93
	HEAT REJECT	162151.	0.	1.24
	PUMPS & MISC	1377399.	0.	10.52
	VENT FANS	3153242.	0.	24.08
	DOMHOT WATER	0.	80230.	17.95
	TOTAL	10287932.	361413.	159.42

REFERENCE: ALL PLANTS ENERGY	ENERGY TYPE:	ELECTRICITY	NATURAL-GAS	TOTAL
	SITE UNITS:	KWH	THERM	EKWH/M2
	CATEGORY OF USE			
	AREA LIGHTS	2982598.	0.	22.77
	MISC EQUIPMT	1502542.	0.	11.47
	SPACE HEAT	0.	318574.	71.28
	SPACE COOL	1066293.	0.	8.14
	HEAT REJECT	438123.	0.	3.35
	PUMPS & MISC	1450070.	0.	11.07
	VENT FANS	3332721.	0.	25.45
	DOMHOT WATER	0.	88645.	19.83
	TOTAL	10772346.	407219.	173.37

The major energy usage was space heating , as expected, followed by ventilation and fan coil fan energy. The EE4/DOE simulation which generated this output, also indicated excessive envelope glazing; 63% of the façade was covered in glass, compared to a maximum of 40% fenestration to wall ratio in the reference design (CBIP rules). This requires the glazing selected to offer substantial overall thermal performance (insulation, shading, light transmission). This is one of the critical factors why Midtown is only 7.5% more efficient than the MNECB reference in spite of a good envelope, and high efficiency chillers and boilers.

Figure: Annual energy use comparison between the reference building and the current design:



CBIP Energy Use Comparison

C.2 Energy Demand Minimization Strategies

The use of energy in buildings impacts on the environment through the consumption of non-renewable resources and by contributing to global pollution through greenhouse gas emissions. The reduction of this impact and improved comfort conditions start with the space planning of the building and consideration of microclimatic conditions. The Model National Energy Code for buildings sets out the design requirements for improving the energy performance of buildings, focusing on both the building envelope and the building systems and equipment.

MintoMidtown Team 3 achieved a sub-score of 80% based on a review of space optimization, response to microclimate and topography, daylighting and design features of the building envelope that would be expected to affect the building's energy use and hence its carbon dioxide emissions.

Highlights

Space optimization

The design team proposes the optimization of space use to maximize energy efficiency. This was done by incorporating spaces, that can accommodate more than one function into the design.

The design concept accommodates the potential to phase construction. By planning to build in phases, only parts of the project that are really needed at a given time are constructed.

Response to microclimate and topography

Both buildings allow for natural ventilation via operable windows, however air pollutants from street traffic along west face of the buildings may be a problem, thus mechanical ventilation will be needed. Also, the design of multiple orientation units promotes the occurrence of cross-flow ventilation.

Daylighting

The heights of both towers allow for a majority of the building to maximize opportunities for daylighting. By placing the taller tower to the North and the shorter tower to the South, the amount of shading imposed on each other is minimized.

The design proposes that the window sizing and placement are being designed to optimize energy-savings and maximize daylighting.

Design Team 3 proposed that window glazing be used to optimize energy-savings and daylighting. A suggestion was made that the current glazing of windows be replaced with windows of high level of thermal resistance, i.e. use appropriate glazing, coating, thickness, insulating gas, etc. for each side of the building. Heat mirror glazing (U=1.4 W/m2-C) glazing, and improved low emmissivity coatings for windows that face Nouth were suggested. The North, Northeast and Northwest windows contained a 0.58 low e softcoat, whereas the east, west and southern orientations contained a 0.4 low e softcoat. The heat mirror glazing with orientation specific low e coatings was applied to the entire 23,100 m2 of glazing in the complex. This was simulated to have a 10,540,000 MJ of annual energy (15% savings on total energy) and $100,000 annually on utilities. Unfortunately it appears that the payback (greater than 1-5years) may not be economical.

The design proposes that shading devices be integrated to minimize overheating and glare. Shading of the higher floors is figured to be accomplished by overhanging balconies.

Integration of occupancy sensors in both the stairwells and corridors are proposed in the design. Team 3 discussed the opportunity to also include them in the parking garage.

Occupancy sensors controlled all of the corridor lighting and 50% of the parking garage lighting. This measure resulted in a savings of 298750 MJ of energy (0.4% total energy savings) and utility savings of $6900. The savings would have been higher if the garage was not heated or only partially heated, as the garage heating requirements increased due to the reduced internal heat gains from lighting energy.

Optimization of building envelope

The design proposes the use of building form and thermal massing to minimize heat loss through the building envelope. Team 3 decided to increase south facing glazing. Balconies are to be designed to reduce thermal bridging.

The design explores material selection strategies to respond to ambient conditions, including wind, precipitation and other environmental forces, which would meet or exceed the performance requirements of the *Model National Energy Code for Buildings*.

The design proposes a continuous air barrier. Air leakage (infiltration and exfiltration) across the building envelope will be minimized through a high level of quality control throughout the life cycle of the building. The design already incorporates the CBIP infiltration maximum tolerance of 0.25 L/sec per m2 of above grade envelope area.

A green roof was proposed which would provide increased insulation (R40-45). A rooftop greenhouse-café option, which has the potential to decrease heat loss through the rooftop and serve as a hub of social activity for the occupants was also discussed.

Energy metering

The design provides for interval metering or sub-metering of major energy uses.

Opportunities for Improvement

Response to microclimate and topography

Develop options for using site features and configuring the occupied spaces and openings to maximize passive solar gains. Consider the possibility of flipping the north tower plan to provide better sun exposure for single units.

Perform wind and snow control studies for areas where this could be a problem. Develop a site plan showing possible strategies to minimize the exposure to wind and the accumulation of snow.

Daylighting

Explore strategies to bring natural light deeper into occupied spaces while avoiding sunlight falling directly on occupants. Consider the window size to interior space ratio. In residential applications, avoid deep, unlit spaces.

Employ external shading devices (e.g. awnings) that are tailored to the window orientation, the 24-hour sunlight distribution, and the seasonal variations of Toronto's temperate climate. Another type of shading could be provided by planting, possibly under a landscape contract. An exterior trellis system could incorporate a watering system supplied from rainwater that is collected and stored on the top of the building.

Incorporate natural lighting and natural ventilation into the parking scheme, bearing in mind that the garage must protect vehicles from the elements and provide an appropriate level of safety for the vehicle owners.

Optimization of building envelope

Investigate the use of "thermo-active" foundations, precast absorber piles that are used to absorb thermal energy from the ground for heating purposes and/or to dissipate the heat extracted from buildings into the ground for cooling purposes. At the same time, these piles form an inherent part of the structural design of the building.

Exploit the thermal mass of the concrete floors in conjunction with solar gain to produce radiant thermal lag effects that can be used for space heating at night. This could be in a form of thermoactive ceilings, water-filled pipe circuits embedded in the concrete ceilings and used to transport cooling/heating energy into the interiors of the building.

Eliminate thermal bridging and any potential fin effects that are associated with balconies and other similar protrusions. This is a relatively simple method of reducing heat loss by approximately 5%. The elimination of thermal bridging will also reduce mold growth and condensation problems at the window-wall interface, which can have serious structural and health consequences.

Consider strategies such as material selection, insulation and measures to ensure sealing, to prevent the penetration of groundwater or driven rain into the building.

Energy metering

Use metered appliances, etc. at the suite level so that the end users, i.e. the occupants, realize the amount of energy they use.

C.3 Integration of Energy-Efficient Systems

Building systems such as HVAC, lighting and heating of water use large amounts of energy. The Model National Energy Code for buildings sets out the design requirements for improving the energy performance of buildings, focusing on both the building envelope and the building systems and equipment.

Team 3 achieved a sub-score of 92% based on a review of individual design features of the building services that would be expected to affect the building's energy use and hence its carbon dioxide emissions.

Highlights

The design proposes the integration of the following lighting features:

- high efficiency lamps
- luminaires with electronic ballasts
- appropriate personal lighting controls
- use of motion-sensitive lights in the parking areas.

High efficiency condensing boilers and centrifual or scroll chillers will be used. The boilers and chillers are also multi-staging type to provide optimal output related to outdoor air temperature and load conditions. This relates the boiler and chiller output to the desired load, eliminating cycling effects.

Design Team 3 discussed the possibility for co-generation (electricity and heat), as well as tri-generation (electricity, heating and cooling), which have been proven successful in other buildings in the Toronto area. While this measure can prove cost-effective, it is not considered as a measure eligible under CBIP, as the current program does not credit nor penalize the energy source for electrical generation, except for direct renewables.

The design proposes the integration of the following:

- variable speed drives on variable air volume distribution systems
- energy-efficient motors

The use of variable speed drives on all heating, cooling and condensor loops, air handling equipment and the use of high efficiency motors will reduce pump energy by 64% (852,000 kWh savings) with a potential savings of $67,500 annually on electrical use.

The integration of building automation systems (BAS) is proposed. Team 3 investigated CO2 ventilation control for the corridor and non-residential spaces, including retail spaces (excluding the parking garage). The demand control ventilation was limited to the 3 hour reduction in the fan and occupancy schedules (7 am, 7 & 8 pm hour reductions). This measure applied to the corridors, lobbies, exercise and retail spaces resulted in a savings of 800,000 kWh annually or $42,000 per year.

The design provides for the integration of hot water saving devices, including low-flow aerators on faucets and showerheads. The design was assumed to install low flow showerhead rated at 9.5 L/min and hot water faucets rated at 8.3 L/min (MNECB minimum requirements). Team 3 suggested that further improvements in low flow and sensor faucets are available to reduce showerhead discharge to 7.5 L/min and faucet discharge to 6 L/min. This measure was applied in all residential suites and in the exercise locker room. The resulting savings were 1,428,900 MJ or 400,000 kWh annual which reduced hot water costs by $14,250 per annum. This would result in further water and sewage cost savings

Heat recovery and space heating options are proposed using a central, in-suite ventilation hybrid system developed by Minto. The in-suite ventilation system provides a balanced air handling system incorporating heat recovery. Heat recovery is via the bathroom exhaust system only, and is limited to the air requirements of the suites. A central pressurized corridor system is also installed to provide corridor ventilation and a portion of the in-suite ventilation that is not provided by the in suite heat recovery ventilator. This is necessary as the suites contain laundry facilities which exhaust air directly, which must be provided by the corridor ventilation system. The in-suite heat recovery ventilation is not capable of providing a constant ventilation rate plus an intermittent supply air necessary for laundry operation. This can only be achieved via a separate dedicated air supply for the in-suite laundry systems with advanced controls to avoid a pressurized corridor system. The corridor pressurization system is not provided with heat recovery, therefore the effective heat recovery effectiveness for the entire air handling system is 18% for the residential towers. The lobbies, retail podiums, exercise rooms, parking garage and lounge areas are not equipped with any heat recovery devices

Strategies are being developed to integrate high efficiency elevators in the building.

Opportunities for Improvement

Other energy-saving systems or measures are proposed including:

- a GFX greywater heat recovery system which will save 28% of the hot water load
- garage ventilation via stack effect, reducing the need for mechanical ventilation (modelled at 10,000 L/sec fresh air, and assuming a 11 kW supply fan interlocked with an exhaust fan and CO controls). The savings would result from the elimination of the supply fan and replaced with a CO activated outdoor air damper system, and building exhaust would flow through the parking garage for pressurization effects (saving two 11 kW fans, operating at 25% of the time throughout the day)
- garage heating via waste heat rejected from the building through corridor, lobby, retail, lounge and exercise room exhaust air that has not been used for in-suite ventilation air (screening tool analysis of heating load of parking garage)
- exploitation of the energy potential associated with the height of the building and descending waste and rain water from upper stories through energy production via turbine (e.g. miniature hydro power plant).
- on-site electrolysis-based hydrogen fuel cell that uses grey water, storm water, etc. to generate energy for the building

C.4 Integration of Renewable Energy Sources

Renewable energy sources are those that produce electricity or thermal energy without depleting resources or producing greenhouse gas. They include solar, wind, water, earth and biomass power, and energy from waste.

MintoMidtown Team 3 received a sub-score of 50% for integration of renewable energy sources.

The following energy systems are being considered:

- active solar-heating. This would involve installing solarwall on the East facing sides of the buildings. 500 m^2 of solarwall, 20000 L/sec airflow, cost = $378,000, savings = $21,000/yr, payback = 18 yrs. The solarwall would only provide a portion of the ventilation air preheating, as the entire complex requires 525,000 L/sec of ventilation air. The solarwall could only provide enough ventilation preheating to 40 C for the north tower corridor ventilation requirement. The maximum usable output of the solarwall would be 1,107,000 MJ of ventilation air preheating.
- photovoltaic panels. Reduce curtain-wall elements, and replacement them with PV on the south spandrel panels (2800 m^2), cost = $3.3 million, savings =126,000 kWh, payback = 13.5 yrs. The photovoltaic panels would be a commercially available poly-chrystalline type with a conversion efficiency of 11.1%, and an overall efficiency of 10% (1% inverter and line losses). The entire project would require 280 one square meter modules capable of 100W of 24 V output. Zero storage of generated power would be installed as 94% of the electrical power generated would be immediately consumed on-site.

Opportunities for Improvement

Explore strategies to integrate other renewable energy systems, such as wind energy and biomass, into the design.
Employ a solar wall (50% solar electric and 50% solar thermal energy) or trombe wall, bearing in mind that occupant lifestyle and comfort issues are significant, i.e. highly desirable to be able to have operable windows.

Investigate the scope and amount of renewable energy that can be supplied either directly or indirectly to the buildings.

The following is a summary of the energy measures quantified for consideration:

	Annual Usage	Annual Cost	Savings MJ	Savings %
Reference Building	81,750,064 MJ	$1,286,081		
Proposed Design	75,173,136 MJ	$1,206,524	6,576,923	8
Incremental Savings (MJ & %) versus the initial proposed design				
Measure 1:				
High Performance Windows (U=1.4, low E)			10,538,843	12.9

Measure 2:		
Occupancy sensors: corridor & garage	298,744	0.4
Measure 3:		
Cooling Tower replaced with Garage Cistern Coil	547,308	0.67
Measure 4:		
Garage Ventilation via stack/natural ventilation	173,443	0.21
Measure 5:		
Garage Heating via Building Non-Suite Exhaust Air	2,524,750	3.1
Measure 6;		
Variable Speed pumps and variable speed air handler drives	3,067,192	3.75
Measure 7:		
Demand Control Ventilation for corridors, lounge, and retail	2,872,643	3.5
Measure 8:		
Low flow showerheads and faucets (20% improvement)	1,428,867	1.75
Measure 9:		
Grey Water Heat Recovery Device on waste hot water	1,438,325	1.76
Measure 10:		
Solarwall Ventilation Air Preheating	1,107,000	1.35
Measure 11:		
Photovoltaic Generation	453,600	0.55
Total Measures:	24,450,700	30.0

Since the original design was already 8% better than the MNECB reference, the high performance design is now 38% better than the MNECB reference equivalent.

C.5 Planning Energy-Efficient Transportation

A daily journey totaling as little as 5 miles by car can, over one year, emit as much CO_2 as that emitted to provide heat, light and power for a person in an office.

MintoMidtown Team 3 received a sub-score of 100% for facilitating alternatives to automobile commuting.

Highlights

Public transport

The site design will integrate the following features to reduce automotive commuting:

- good access to public transport
- features promoting shared vehicle transport (car-pooling). By reducing the number of parking spaces by 50 %, promote use of nearby subway as well as other options that include Autoshare programs, car-pooling, increased prices for the parking spaces that are available (i.e. deterrent to owning a car) walking, bicycling, etc.

Cycling facilities

The design proposes secure, sheltered and accessible bicycle storage. Also, temporary bicycle parking outside the building will be provided. This will encourage shorter trips within Toronto to be made by bike.

Section D: WATER

This section calls for the development of strategies to conserve treated water and minimize the need for off-site treatment of water.

MintoMidtown Team 3 achieved 68% on the Green Globes™ rating scale for water consumption and measures to minimize water use.

D.1 Meeting a Water Performance Target

Opportunities for Improvement

Design Team 3 estimates the water performance target for the building to be less than 150 m^3/apartment/year. This target is based on the integration of water-conserving features and strategies.

D.2 Water Conserving Strategies

Highlights

Strategies to minimize consumption of potable water

The following water fixtures are being considered:

- dual flow rate toilet technology (less than 6 L)
- water-saving fixtures on faucets (7.5 L /min) and showerheads (9.0 L/min.)
- Energy Star appliances (dishwashers, washing machines)

The Team felt that the design could further reduce hot water by utilizing advanced low flow devices for hot water faucets (6 L/min), and ultra saving low flow showerheads (7.5 L/min). These commercially available devices are 20% more conserving than the MNECB minimum standard.

The design proposes the incorporation of both hot and cold water metering at the suite level.

Strategies to minimize water for cooling towers

Team 3 proposes that an onsite water storage tank(e.g. cistern) be used to collect storm water, grey water, etc. to be used for cooling, irrigation, heat recovery, etc..

Strategies to minimize water for irrigation

Design Team 3 addresses the principles of xeriscaping with integration of native, drought-resistant species into the landscape.

A rainwater irrigation system is being considered. An onsite storage tank would be used for storage.

Opportunities for Improvement

Strategies to minimize water for cooling towers

Where applicable select air-cooled towers or consider desiccant cooling.

Strategies to reduce off-site treatment of water

Evaluate how graywater technologies could be integrated into the design.

Section E: RESOURCES, BUILDING MATERIALS AND SOLID WASTE

This section evaluates strategies and design approaches, material selection and construction systems that use fewer resources, or enable materials to be reused or recycled. The design of facilities for storing recyclable waste is also considered.

MintoMidtown Team 3 achieved a score of 74% on the Green Globes™ rating scale for managing resources through waste reduction and site stewardship.

E.1 Integration of Systems and Materials with Low Environmental Impact

Highlights

A preliminary lifecycle assessment using Athena was performed to compare the environmental burden and embodied energy effects of the following: foundation and floor assembly, structural systems (column and beam combinations) and walls, and roof assembly materials.

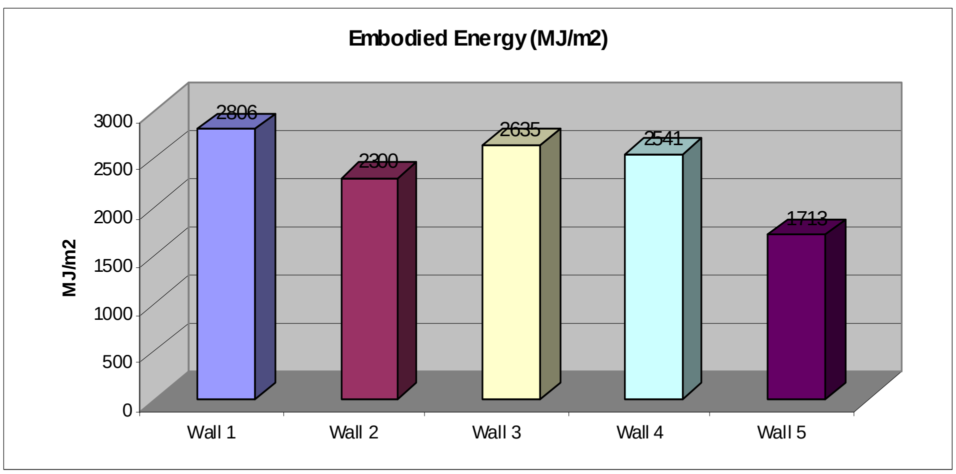


Fig. Comparison study of embodied energy of wall materials. (The current suggested curtain wall specification is represented by the wall type 4).

Appropriate furnishing, flooring materials, and wall colours that maximize solar thermal absorption and minimize the embodied energy of the building were discussed.

E.2 Strategies to Minimize the Use of Non-Renewable Resources

Highlights

The design concept recommends the incorporation of building materials that contain recycled content.

The design proposes the incorporation of durable, low-maintenance building materials and components, particularly in areas likely to experience high levels of wear and tear.

Opportunities for Improvement

Research local sources to assess the availability of construction & demolition (C&D) waste for use in the project. Avoid products that contain hazardous materials or that do not meet current performance standards.

Investigate the availability of locally manufactured materials. Use a lifecycle analysis (LCA) to determine the trade-offs between local products that have a lower environmental impact due to transportation and those that are from renewable sources or those that promote efficient use of materials and construction methods.

Investigate the sources of certified lumber and timber panel, and avoid the use of tropical hardwoods.

E.3 Strategies to Reuse Parts of the Existing Building

N/A

E.4 Design Strategies for Building Adaptability

Opportunities for Improvement

Explore strategies to accommodate future growth or alterations of the facility, with respect to the footprint, façades, floor to floor height and column spacing, spatial definition, mechanical systems, components and finishes.

E.5 Design Strategies for Building Dissassembly

Opportunities for Improvement

Explore systems that are fastened in such a way as to facilitate disassembly, thereby avoiding their destruction and allowing the components to be reused when the building is demolished.

E.6 Strategies to Reduce, Reuse and Recycle Demolition Waste

Highlights

Reducing the number of parking spaces by approximately 50%, will reduce the amount of excavation and hence the amount of soil disposal. The energy needed for ground excavation will be reduced.

A construction, demolition and renovation waste management plan is proposed.

E.7 Facilities for Recycling and Composting

Highlights

The design proposes facilities for future occupants to handle and store consumer recyclables. Sorting issues include: manual disposal and separation at the source (i.e. higher occupant participation) vs. three-chute system currently in Minto's plans. The chute option prevailed generally because of the historical trend in the attitude of the occupants to recycling and waste management.

Opportunities for Improvement

Provision of facilities to collect organic waste to be composed. Team 3 discussed the opportunity of composting food-wastes onsite, used in conjunction with balcony gardens, green roof applications, and total site green-space. However, due to minimal garden space, composting offsite was thought to be a better option.

Create incentives to bridge the significant gap between the recycling practices of MURBs and single-family homes.

Section F: EMISSIONS, EFFLUENTS AND OTHER IMPACTS

This section evaluates strategies to avoid or minimize air emissions, ozone-depleting substances, effluents, pesticides, and hazardous materials. Note that it is assumed that halon-containing materials will not be introduced into the building.

MintoMidtown achieved 76% on the Green Globes™ rating scale for emissions, effluents and other environmental impacts.

F.1 Strategies to Minimize Air Emissions

Highlights

The design proposes the use of condensing boilers with low-NOx burner technology.

F.2 Strategies to Avoid Ozone-Depleting Refrigerants

Highlights

The design proposes the use of high efficiency chillers, most likely using HFC refrigerant with ozone-depleting potential zero.

Opportunities for Improvement

Cooling and air-conditioning solutions, which do not use ozone-depleting substances (ODS) or potent industrial greenhouse gases (e.g. PIGGs-HFCs, PFCs and SF6) should be combined with passive solutions (e.g. shading, insulation, building orientation, natural and forced ventilation) which will serve to reduce the cooling load. Consider evaporative cooling, natural ventilation, free cooling, ground water cooling, ice/slurry storage or hybrid ventilation as alternatives to reduce the need for ODS refrigerants. Improvements in the building envelope, advanced glazing, combined with non-refrigerant cooling techniques will minimize the use of high electricity refrigerant mechanical cooling systems.

F.3 Strategies to Control Surface Run-Off and Prevent Sewer Contamination

Highlights

Design measures will be taken to prevent sewer contamination.

There will be measures to prevent stormwater run-off from the roof from entering public utilities.

F.4 Pollution Reduction Strategies

Highlights

Strategies for integrated pest management

There are design features to promote integrated pest management.

Strategies for proper storage and control of hazardous materials

The design provides proper storage of hazardous materials.

Section G: INDOOR ENVIRONMENT

This section evaluates the strategies that are being used to ensure that the indoor environment is healthy and comfortable, in terms of providing a high level of indoor air quality, effective lighting, thermal comfort and suitable acoustic conditions.

MintoMidtown Team 3 achieved 72% on the Green Globes™ rating scale for indoor environment and measures to provide healthy, productive and comfortable environment.

G.1 Strategies for Effective Ventilation

Highlights

The design proposes that air intakes be positioned so that they are far from sources of pollution and prevent recirculation. The openings will be protected.

The suggested ventilation system provides sufficient ventilation rates in accordance with ANSI/ASHRAE 62-1999. An in-suite ventilation system provides ventilation air and direct air supply for dryer and bathroom high speed exhaust.

The design recommends an adequate ventilation system for enclosed parking garages. Team 3 discussed the use of natural ventilation and a chute to create a thermal stack with a fan-induced system to ensure CO exhaust. This would eliminate or reduce the need for a parking garage fan.

The intended control systems will allow ventilation rates to be adjusted to meet varying needs throughout the building. Demand control ventilation via zone CO2 sensors will control reduce air requirements and subsequent heating and cooling loads when CO2 level are below 1000 ppm . TEAM only investigated the demand control ventilation benefits applied to non-residential spaces in the complex (excluding the parking garage).

The design will allow occupants to have personal control over the ventilation rates.

The design provides for easy access for cleaning and inspecting air filters.

Opportunities for Improvement

Investigate the ventilation effectiveness and determine the amount of fresh air that need to be admitted.

Investigate non-venting dryers.

Select ventilation systems that minimize pollution in the ventilation air path. If internal duct insulation must be used in ducted returns within the building, it should meet the Underwriters Laboratories (UL) 181 and ASTM C 1071 standards.

G.2 Strategies for the Source Control of Indoor Pollutants

Highlights

There are design measures for controlling moisture build-up in the building and to prevent the growth of mould.

The air-handling units will be easily accessible for regular maintenance and drainage.

The design and proposed placement of the wet cooling towers will help to avoid the risk of *Legionella*.

The hot water design will help to avoid the occurrence of *Legionella*.

G.3 Strategies to Optimize Lighting

Highlights

<u>Lighting design</u>

The design proposes electronic ballasts fitted to luminaires.

Measures to minimize glare will be integrated.

The proposed lighting concept follows the guidelines outlined in the *ISNEA Lighting Handbook for Lighting Levels* with regards to the selection of lighting levels for specific tasks.

The local lighting controls will be adjustable to meet requirements relating to room occupancy, circulation space, and daylighting.

Opportunities for Improvement

Daylighting

Use an integrated, sequenced approach to design a lighting system.

The daylighting design must be completed before planning artificial lighting in order to minimize the electric lighting that is needed.

Explore various options in the daylighting design arising from the form and orientation of the building. Make a selection based on modelling.

Design the floor plan depths and heights to optimize daylighting and views.

Calculate the percentage of the floor plan that would receive the most direct daylight based on various floor plan design options.

For critical spaces, calculate the daylight factor for different times of the year for clear-sky and overcast conditions. Use various energy-efficient lighting and daylighting design strategies to maximize the daylight where necessary. Aim for an average daylight factor of 5%, in 80% of work areas, for a well day-lit work place. For a partially day-lit workplace or a living/dining area in a typical dwelling unit, aim for at least 2%.

G.4 Strategies for Thermal Comfort

Highlights

Based on thermal evaluation for critical spaces the thermal conditions will meet ASHRAE 55.

G.5 Strategies for Acoustic Comfort

Highlights

The design plan includes strategies to zone acoustically sensitive occupancies far from undesirable external noise sources.

Design strategies are being developed to control noise transmission from the site through the building envelope.

Design strategies exist to achieve reverberation control/acoustic absorbency, consistent with speech intelligibility requirements.

Opportunities for Improvement

Consider the acoustic performance of the structural elements of the building. Use sound attenuation strategies to suit occupancy requirements.

Acoustically zone the building interior to achieve the required levels of privacy and minimize occupancy-related acoustic problems.

Plan the layout, size and shapes of the ductworks and acoustically zone the building to minimize noise from mechanical systems and equipment.

METRO LABEL DESIGN TEAMS 4 AND 5 RESULTS

A new industrial building to house a label printing operation is to be built in Scarborough, Ontario. The building will consist of a manufacturing and warehousing area (110,000 ft^2), and a two-storey office area (20,000 ft^2). The manufacturing plant normally operates two shifts per day, Monday to Friday. The regular business hours for the office are 7:30 am to 7:00 pm, Monday to Friday.

The manufacturing operation currently consists of 15 printing presses, plus quality control equipment and other support equipment. (The machinery is to be moved to the new plant from an existing location.) The presses use a number of different types of inks, including ultra-violet (UV) drying, water-based, and solvent-based. The plant requires approximately 33,000 cfm of make-up air (of which 27,000 cfm is due to the manufacturing process). The manufacturing equipment consumes approximately 4,000 kWh of electricity during each production day. The process requires that the plant be fully air-conditioned, with a cooling set-point temperature of 23°C. The plant is also fully heated, with a set-point temperature of 21°C. The floor area of the plant consists of approximately 55% for manufacturing (60,500 ft^2), 30% for storage/warehousing (33,000 ft^2), and 15% for shipping and receiving (16,500 ft^2). The shipping and receiving area of the plant has ten overhead doors. The floor-to-ceiling clearance height in the plant is 24 feet.

In order to demonstrate their commitment to the environment, the owner has expressed interest in achieving a building that meets the requirements of the IBIP and LEED programs. The owner also desires to maintain good indoor air quality in the building, and has expressed interest in humidity control for the plant in the summer.

Design Scenarios

There were two design scenarios for the Metro Label Building. One team will focus on building systems and energy performance. The other team will focus on site considerations, building materials, and water issues. For both teams, the building location, orientation, and general shape will be fixed, as a site plan has already been submitted for approval.

Building System and Energy Efficiency – Design Team 1

This team discussed measures for maximizing building and process energy savings in accordance with IBIP. IBIP requires that a combination of building and process energy efficiency measures be implemented in order to achieve an energy savings of 25% of the annual energy use of a reference building. This team attempted to achieve as many relevant LEED credits as are technically and economically feasible.

Site, Materials, and Water Issues – Design Team 2

This group will discussed sustainable design of the project with particular emphasis on site development, water efficiency, and material usage. This team attempted to achieve as many relevant LEED credits as are technically and economically feasible.

Teams 4 and 5 decided to amalgamate their efforts in certain areas to maximize the integrated design process opportunity. While part of the session did break away into two teams, the results presented at the end of the day and highlighted here represent the joint efforts of the two teams.

The teams used the LEED software, with modeling provided by Enermodal to track and estimate environmental performance.

A number of challenges were identified:

- no cash for frills
- innovation – cost with no reward?
- contractors don't understand

Metro Label Printing – important features and considerations

- 130, 000 sq. ft.
- humidity and temperature must be controlled in manufacturing facility
- IBIP and CBIP earned a total 25% savings
- lighting costs in manufacturing facility
- high ventilation
- how can we improve energy use?
- energy efficiency is only part of it
- resource efficiency
- environmental respect and responsibility
- community respect and responsibility
- 20,000 sq. ft. of office space
- 33,000 CFM – outdoor air
- heat of machines
- venting
- 40% machines
- 20% lighting
- 13% heating
- 8% cooling
- A/C to 23° but not dehumidified
- nothing on existing property
- R14 office
- R14 Manufacturing
- R20 Roof
- 50 foot candles for manufacturing facility
- can you burm all the way around the walls
- owner wants to showcase that he is environmentally friendly
- how do we lower lighting costs
- skylights
- windows on south facing walls
- sink the building into the ground
- orient the saw tooth roof to face the sun
- white or light grey concrete reduces heat
- paint inside with white ceramic paint because it increases the R value

- what is the view from HWY 401
- the façade of the building acts as marketing
- green roof between saw tooth roofing
- concern of rain and snow build up
- not a problem with current technology
- green roof has 35 year life expectancy
- the printing company vents the building to get rid of heat rather than getting rid of odors from printing inks
- does the ceiling need to be 24 feet tall?
- can the office space be incorporated into the square footprint of the facility to reduce its overall footprint
- the company wants to have an environmental presence, the example of umbra was given
- the idea of having a windmill. They'd be known as the company with the windmill
- 3 story office is to be incorporated into warehouse with a green rooftop
- the issue of noise between the manufacturing facility and offices is said to not be a problem with acoustic control

Transportation

- bus' available? Assume that there are buses near by you can reduce number of cars and parking spots.
- try and get 5% of employees to ride bikes to work
- have bike racks, that requires showering and changing facilities
- you save money when you replace a parking spot with a shower and change facilities
- its cheaper to install the facilities than to have the parking spot
- company wants 160 parking spots at new facilities
- why? There are 60 employees. At shift change you have 120 possible cars.
- alternate parking could be natural parking
- the issue is our climate and snow removal

- storm water runoff from parking lot contains many bad things for the environment that eventually seep through the ground and into the water table
- we want to collect the storm water runoff and naturally filter it in a front entrance cistern
- use as greywater system
- storm water runoff used as irrigation
- can't be used for irrigation as its bad for the environment
- want to store the parking runoff water in a front door marsh or pond that gets treated by the plants
- -if the pond were on the south side it would be better because of the sun
- debating between a highly reflective roof and a green roof. The cost difference?
- there should be a light coloured concrete in the loading area
- trees in the parking lot to reduce heat
- permeable pavers are not an option due to climate
- thought about a black water recycling unit. Like the one at the body shop
- going to have waterless urinals
- low flow fixtures
- its not cost effective to have a living wall
- if salvaged materials are used you can save 40%-60%
- the materials used would have recycled content
- use recycled concrete for back fill

- Athena, cradle to grave analysis

The groups identified a consideration with the LEED approach: it doesn't take into account the surrounding properties

Presentation of the building is critical

- Functional
- Sustainable
- Advertisement for the company
- $50/sq. ft.
- light in building, saw tooth
- pull office into building
- pull the roof up to gain more light
- water from parking lot to go into engineered wetlands
- provide max amount of shade reduces heat
- light coloured concrete = less heat
- green roof
- self sustainable plants surrounding building
- hearty indigenous plants
- reduces operating costs for someone to come a mow lawn (fuel and pay)
- collect rain water from roof and put in a cistern for flushing toilets
- salvaged building materials
- building materials with 20-40% post-consumer materials
- low VOC materials will be used (adhesives and paints)
- innovation: Athena change bay size to embody more energy

Energy Base Proposed Heating 37,200 8,314 Process energy recovery + better envelope
Cooling 22,902 13,019 Dessicant dehumidification + cooling tower
Fans 30,023 19,367 Gas-fired radiant heating
Lighting 56,313 46,977 Daylighting
Process 117,924 117,924 -
Other 20,099 20,099 -
Total 284,461 225,699 Cost savings = $58,762
Energy Cost Reduction (excluding process energy) = 65%

With theses results, and incorporating the environmental performance improvements, the Metro Label building could achieve the LEED Gold Rating