INTEGRATED DESIGN CHARRETTE REPORT

TRIDEL CIRCA PROJECT

Markham Hilton Suites Hotel
April 23, 2003

by
Sustainable Buildings Canada

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INTRODUCTION

On April 23, 2003, Sustainable Buildings Canada (SBC) hosted a 1-day Design Charrette focused on providing alternative design scenarios for Tridel's Circa Project in downtown Markham. The Charrette attracted more than 60 participants, representing architects, engineers, educators, city planners and a variety of technology specialists. With key support from Tridel, Enbridge, NRCan, CMHC, the Canadian Energy Efficiency Alliance 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.

?? Tridel's Circa Project is a two-Phase project with construction on the first Phase scheduled to commence later this year. The Charrette used the completed architectural drawings and plans for Phase I as a way of identifying sustainable design considerations for Phase II.

LIST OF ATTENDEES

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Simon Hong	City of Markham	

DESCRIPTION OF THE BUILDING

The Tridel Circa project is a 2-phase condominium project located in downtown Markham. It features a terraced design, 16 stories at the highest point and 390 suites. The basic elements are as follows:

- ?? 390 suites
- ?? 450,000 sq feet (gross)
- ?? 585 car underground parking garage
- ?? Terraced design (16 floors at highest point)
- ?? 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 MNEC reference building.

DESIGN TEAMS AND SCENARIOS

There were two basic scenarios – a CBIP energy efficiency scenario and an open-ended High Performance scenario.

CBIP Scenario – Design Teams 1 and 3

These teams 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. Design Team 1 operated under the assumption that the building will be heated and cooled with district energy (no electricity generation). Design Team 3 operated under the assumption that the building will be heated and cooled with a conventional system(s).

Fixed Elements:

1. Perimeter, building envelope and orientation.
2. Window placement and general appearance of the building (e.g. fenestration-to-wall ratio)
3. Appliance package (Energy Star refrigerators)

Suggested Optional Elements:

1. Materials (glazing characteristics, precast, etc.), and insulation levels.
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 pressurization.

High Environmental Performance – Design Teams 2 and 4

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 were fixed. All other elements could be modified.

DESIGN TEAM 1 RESULTS

Team 1 was led and facilitated by Bob Bach, and Jack Simpson was the EE4 modeller. Team members included: Pal Ahuja, Rudy Zugec, Noel Cheeseman, Joshua Abush, Philip Ju, Andrew Basso and Susan Clinesmith.

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. Each element is presented in the order of the examination below.

Envelope
A number of envelope improvements were considered, with the team ultimately arriving at the following five:
– IRMA roof R40 (original R22)
– Precast conc. sandwich panel wall R24 (original R14)
– Glass R5, SHGC .32 effective (original R2, SHGC .39)
– Thermal break cantilevered balcony

Water
Team 1 also identified a variety of water saving measures:
– Low flow fixtures
– Water saving appliances (energy star rated)
– Heat recovery GFX from grey water
– Suite water sub-metering
– Grey water & rainwater cistern c/w treatment
– Solar domestic hot water preheat panels
– Site irrigation with recovered water
– Automated pool blanket & insulated liner

Mechanical system improvements and measures included:
– HRV makeup air + variable speed drives
– WSHP suites, make-up air and domestic hot water
– Heat recovery GFX from grey water
– Heat recovery from condensor water to domestic hot water

Based on these suggested measure improvements, Team 1 modelled and presented a series of scenarios:

Case 1: Basic

Case	Electricity	Natural Gas	Total MJ	$ energy
Proposed	14801621	13943587	28745208	$430,672
Reference	13648421	14379672	28028093	$414,530
Difference	-1153200	436085	-717115	$(16,142)
% change	-8.4%	3.0%	-2.5%	-3.9%

Case 2: HRV Makeup air – sensible and latent @65% + Variable Speed Drive

Case	Electricity	Natural Gas	Total MJ	$ energy
Proposed	14464813	7525884	21990697	$360,790
Reference	13648421	14379672	28028093	$414,530
Difference	-816392	6853788	6037396	$53,740
% change	-6.0%	47.7%	21.5%	13%

Case 3: Water Loop Heat Pump, Heat Recovery Ventilator, Make-up Air

Case	Electricity	Natural Gas	Total MJ	$ energy
Proposed	15424377	5312727	20737104	$358,753
Reference	14217740	14402206	28619946	$425,715
Difference	-1206637	9089479	7882842	$66,961
% change	-8.5%	63.1%	15.7%	15.7%

Note that the incremental cost associated with Case 3 is estimated at $400,000 and that the project would be eligible for a design incentive of $133,922 (CBIP maximum is $60,000).

Case 4: Case 3 plus R5 glazing

Case	Electricity	Natural Gas	Total MJ	$ energy
Proposed	15248514	3793685	19042199	$340,273
Reference	13716895	14949287	28666182	$422,009
Difference	-1531619	11155602	9623983	$81,736
% change	-11.2%	74.6%	-33.6%	19.4%

Note that the incremental cost associated with Case 4 is estimated at $1,150,000 and that the project would be eligible for a design incentive of $163,472 (CBIP maximum is $60,000).

Case 5: Case 4 plus R40 Roof and R24 Walls

Case	Electricity	Natural Gas	Total MJ	$ energy
Proposed	15261924	3396298	18658222	$336,717
Reference	13716895	14949287	28666182	$422,009
Difference	-1545029	11552989	10007960	$85,292
% change	-11.3%	77.3%	34.9%	20.2%

Note that the incremental cost associated with Case 5 is estimated at $1,520,000 and that the project would be eligible for a design incentive of $170,584 (CBIP maximum is $60,000).

DESIGN TEAM 2 RESULTS

Team 2 was led and facilitated by Neil Munro and Mike Lubun was the EE4 modeller. Matthew Tanner provided a concurrent Green globes assessment. Team members included: Bill Humber, Andrew Morrison, Paul Heleno, Peter Rowles, Colin McGugan, Doug Hart, Dinesh Jain, Matthew Tanner and Simon Hung.

Team 2 was charged with designing a building to the "highest environmental performance": a redesign of the Circa Condominium building in order to improve its overall energy and environmental performance. 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. All members of the team were able to spend a significant amount of time working with the team. 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. For example, the group found it interesting to learn of both the environmental benefits and financial setbacks of photovoltaics. From this information, a group decision was made not to incorporate them into the design.

Team 2 started with the initial energy use estimates derived from the baseline modeling:

- lighting 1.8 kWh/ft2/yr
- appliances 1.5 kWh/ft2/yr
- heat rejection 0.25 kWh/ft2/yr
- pumps 1.26 kWh/ft2/yr
- fans 2.0 kWh/ft2/yr
- DHW 1.8 kWh/ft2/yr
- cooling 1 kWh/ft2/yr
- heating 9 kWh/ft2/yr

TOTAL 18.63 ekWh/ft2/yr

GOAL: 50% Reduction

A series of energy reduction options were examine. These included:

1. High heating loads required attention via envelope insulation, improved glazing performance and building orientation
2. Photovoltaic considered but $1000/m2 installed cost (200 watts or $5/watt would result in a 15-20 year payback
3. Solarwall for ventilation air heating only marginally considered
4. Replacement of curtainwall with a high performance type curtainwall (Kawneer 7500 series or Visionwall product) was considered, but rejected due to high costs
5. Replacement of curtainwall with precast insulated wall and punched windows rather than floor to ceiling glass was considered but rejected due to architectural considerations
6. Storm water system acting as a cooling tower or cooling water pre-cooling was considered

Further refinements and options were identified as part of the 50% improvement goal:

1. Orientation Change:
   Rotate Building by 90 degrees leaving all windows/wall components as is
   Impact: 18.43 ekWh/ft2/yr total energy use (negligible savings)

2. Improve windows to double glazed operable with softcoat low E and argon fill on thermally broken frames (U=1.79, SC = 0.44)
   Impact: 17.76 ekWh/ft2/yr total energy use

3. Reduce Window to Wall Ratio to 41% from 53%
   Replaced 27% of the window area with precast walls
   Impact: 17.52 ekWh/ft2/yr total energy use

4. Increasing Insulation within Precast Panels to effective RSI 3.52 by adding 38 mm rigid insulation sheathing and altering the cavity insulation to high density batts:
   This was rejected due to the small area of precast area, high cost of insulation, precast/curtainwall thickness matching, and high payback

5. In-suite heat recovery ventilation systems were considered, but difficulty in modelling the units (due to the zoning of the file and the grouping of the suites) dismissed this notion. The in-suite units, would require unit servicing, increase noise and only allow bathroom, laundry heat recovery. The option of a central heat recovery system was deemed more practical and cost-effective.

6. Make-up Air Unit with Central ducted exhaust from all suites and corridors (balanced), with 60% effective heat recovery and increased static pressure due to central exhaust
   Calculation: 390 suites with 2 bathroom exhausts at 25 watts each
   Exhaust airflow equivalent power = 19500 watts
   Entered Static Pressure = 871.5 pascals,
   Calculated supply fan power = 22077 Watts
   New Static Pressure: 41577 = (13.9333 x SP) / 0.55
   41577 = supply + return power (watts)
   13.933 = return airflow (m3/sec)
   0.55 = fan/motor combined efficiency
   Impact: 13.38 ekWh/ft2/yr total energy use

7. Reduce Supply Air Fan by 6 hours during night. This involved changing the fan schedule, such that make-up air heating is not required
   Impact: There are a very small savings, as the make-up air is required to provide ventilation air during occupancy and a resulting heating load was transferred from the make-up air unit to the suite fan coils

8. Ground Source Heat Pump with Gas Fired Make-up Air Unit
   - constant 10 C water source temperature (vertical well)
   - average heating COP = 3.8, average cooling COP = 3.5
   - flow rate 180 L/sec, fixed speed pump 5.6 C temp. differential

   Impact: 10.94 ekWh/ft2/yr total energy use

9. GFX Grey Water Heat Recovery
   28% reduction measured in hot water usage (CBIP allowance)
   Heat recovery applied to domestic water heating energy only as reuse of grey water for toilet flushing has not been modelled
   787,496 kWh/yr hot water use reduced to 566,996 kWh
   Impact: 10.5 ekWh/ft2/yr

10. Heating/Cooling Capacities only were optimized
    Zone original heating capacities were manually resized due to measures 1-9 by running the EE4 sizing report (airflows were not optimized due to lack of time)
    Impact: 10.32 ekWh/ft2/yr

11. Storm Water/Cistern Replacement of Cooling Tower
    Ground source heat pump will dissipate loop heating during the cooling season via a coil in a cistern or storm water collection system that has been appropriately sized to maintain Heat rejection 51,576 kWh/yr reduced to 0 kWh with adequate system
    Impact: 10.2 ekWh/ft2/yr

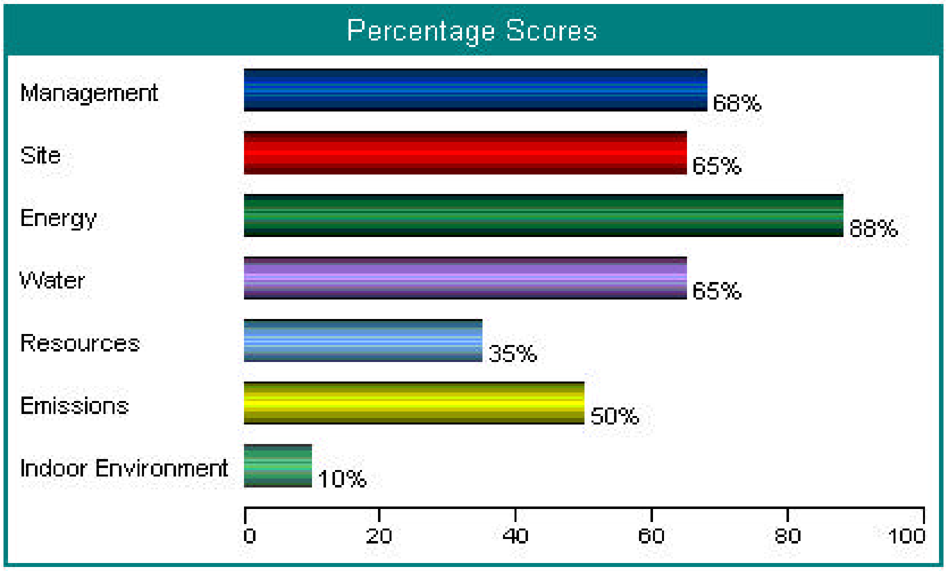
Summing all of these measures results in a total energy reduction of 45% compared to MNECB reference building

Team also considered but did not model a number of other measures/improvements and recommends that these be considered in the final planning:

1. Distributed Systems for lounge, exercise room
2. Variable speed pumps and fan drives
3. Parking garage air handling systems and C0 exhaust control
4. CO2 controls on ventilation air
5. In-suite metering (energy and water)
6. Fixture Lighting (in-suite, common spaces)
7. Natural ventilation via operable windows and redesign of suite layouts
8. Water conservation (hot and cold)
9. Daylighting potential
10. GSHP loop heat dissipation to domestic water heating
11. Window shading (blinds, overhangs, fixed shading, ground vegetation)
12. Redesign of building to allow optimal fenestration and natural ventilation
13. Thermal massing

Team 2 also made use of the Green Globes Environmental Assessment Tool as a checklist for ensuring all pertinent environmental considerations were covered. Subsequently, Mr. Jiri Skopek generated a Green Globes report based on the information developed in the session. Appendix A provides the Green Globes results for the Circa project. The following table summarizes the point achieved in each module:

Percentage of points achieved by Circa Condominium for each module:



The Team 2 Circa Condominium alternative achieved an overall score of 57%. The relatively low score of the design is mainly due to fact that Charrette Team 2 could not address all of the aspects of the assessment, particularly the Indoor Environment, due partially to time constraints. See Appendix for the full Green Globes Report.

RATING: 

Three Green Globes

DESIGN TEAM 3 RESULTS

Team 3 was led and facilitated by Victor Heinrichs, and John Silverio was the EE4 modeller. Team members included: Doug Cane, Bruce Tempeny, Robb Watson, Sunil Gupta, Danny Tito, David Katz, Ravi Mann, Gerry McCabe, Richard Damecour.

Team 3 began with an examination of potential savings by major building component. These included:

Window glazing:

- ?? 2 Options: 1-Standard (low e argon), R4 value, 6mil. Glass
- ?? laminated glass is more efficient
- ?? frame can reduce the r value of the glass
- ?? curtain wall gives better r values
- ?? 1 in depth insulated
- ?? base: R2/R4 R8. Use R12
- ?? 2-2 ½ times more expensive, however anticipate 15%-25% more expensive on whole window
- ?? Curtain wall R5-R7:

Suggested upgrades to window represent 11% improvement.

Precast R14 Concrete Mineral fiber loose file

- ?? Gypsom sheeting.
- ?? Can't really implement this without more insulation.
- ?? Could select a better material.
- ?? Can reduce window/glass covering by 10%

Suggested upgrades to concrete including polycurenate result in 1% improvement

Heating

- ?? individually vented through the wall. Fresh air through the wall.
- ?? Central system means you need to increase CFM X4
- ?? One scenario HRV insuite
- ?? Currently central boiler with central chiller.
- ?? Change the boilers to high efficiency condensing (89% eff.)

Suggested upgrades to heating system results in 5% improvement

Chillers

- ?? Upgrade chillers – 2 screw chillers with COP of 6
- ?? Approximate cost of 2 Screw Chillers $67 000

Suggested upgrades to chillers result in 8% improvement

Variable Speed Drives and Pumps

- ?? Circulating pumps
- ?? Pumps.

Pumps.	Heating	$4000
	Water	$7500
		$11500

?? 2 Speed make up air: $66000
?? hot VAC $115500
?? VSD fan $15,000

Suggested upgrades to pumps and drives result in 1.5% improvement

Variable Speed Drive on Corridor Make-up air
?? Expected savings should be approx 1.5%

The following table provides savings and cost estimates for the various measures

Option	Percent of Ref Case	Savings (%)	Cost Premium
Heat Mirror Glazing	89%	11%	$320,000
Poly Insulation in precast wall	88%	1%	$10,000
Condensing boilers	83%	5%	$39,000
Screw Chillers (COP=6)	75%	8%	$67,000
VSD on heating and CLG circ pumps	73.5%	1.5%	$11,500
VSD on corridor make-up air	72%	1.5%	$15,000

The total cost for the upgrades would be $462,500, with anticipated savings of $88,400. The building has energy performance characteristics 28% higher than MNECB and CBIP eligibility of $60,000. The payback period is 4.4 years.

A number of other measures and options were considered but not modeled. These include:
?? High Pressure Sodium lights in the garage
?? Energy efficiency light (eg. Compact fluorescents) in corridors & common areas
?? double flush 6 litre toilets is for water savings
?? metering the water – GFX drain gains another possibility heat recovery from shower water/ drain water.
?? Front load washer – high eff. Dishwasher
?? White roof instead of black provides great energy savings. (Colour is key to the load).
?? Comfort and quality issues including indoor air quality, acoustics and comfort.

DESIGN TEAM 4 RESULTS

Team 4 was led and facilitated by Richard Williams, and Brian Fountain was the EE4 modeller. Jiri Skopek provided a concurrent Green Globes assessment. Team members included: Jiri Skopek, Dean Jordan, Maria Cinquino, Ted Handy and Heinz Vogt.

Team 4 defined its mission statement as : "Develop a set of principles for sustainable development of highrise condominium development." With this mission statement in hand, Team 4 undertook an examination of the specifics of the Tridel project.

Key considerations included:

?? orientation,
?? form/massing,
?? unit type,
?? neighbourhood,
?? accessability,
?? energy efficiency,
?? innovative technology,
?? design recognition,
?? and indoor air quality.

Further design principles were also identified:

?? Minimize impact/footprint,
?? maximize greenspace,
?? Variety of building types (tower & lowrise),
?? Community involvement in design
?? Maximize energy efficiency
?? Accessibility
?? Noise Control
?? Water Conservation
?? Indoor Air Quality

Each component was examined with the aim of increasing environmental performance:

Building Form

?? Lower corners, with higher tower(s)
?? Re-oriented to more East-West orientation (0.4% energy reduction)
?? Through ventilation rather than central corridor
?? Issue with highway along south face – influences ventilation & glazing

Urban Design Guidelines

?? Height restriction – airport & clock tower
?? Massing to South-East corner
?? Pedestrian friendly
?? Visual "city centre" look/streetscape

Design Summary

Tower
- ?? Optimized orientation
- ?? South - shading / daylight
- ?? North – daylight / insulation
- ?? Simple building form

Low-rise
- ?? Urban design – streetscape
- ?? Through-ventilation
- ?? Thermal chimneys
- ?? Articulated façade
- ?? Passive daylight & shading opportunity

Unit Design Consideration

- ?? Solar Buffer - Glazing of balconies to create summer space
- ?? Decreasing window to wall ratio (1.7% energy reduction)
- ?? Multiple orientation units – promotes cross-flow ventilation
- ?? Shallower North units than South (improve unit daylighting)
- ?? Glass wall on North corridor
- ?? Metering of suite energy
- ?? Barrier-free design of bathrooms
- ?? Use of stairwells as community spaces

Building Envelope

- ?? Increase south facing glazing, reduce
- ?? Reduce curtain-wall elements
- ?? Balconies – reduce thermal bridging
- ?? High fly-ash content concrete

Indoor air Quality and Ventilation

- ?? Crossflow ventilation – through units rather than central corridor allows natural ventilation and improved occupant control
- ?? Dedicated suite ventilation rather than corridor pressurization – (central vs. individual suites)
- ?? Heat recovery & free-cooling (15 – 20% energy savings potential)
- ?? Maintain corridor pressurization with corridor units

Central Plant

?? Increase heating system delta-T and use condensing boilers

?? Heat pump mechanical allow transfer of heat from South to North suites – adds maintenance
?? Ground source heat pumps (further investigation)

Water considerations

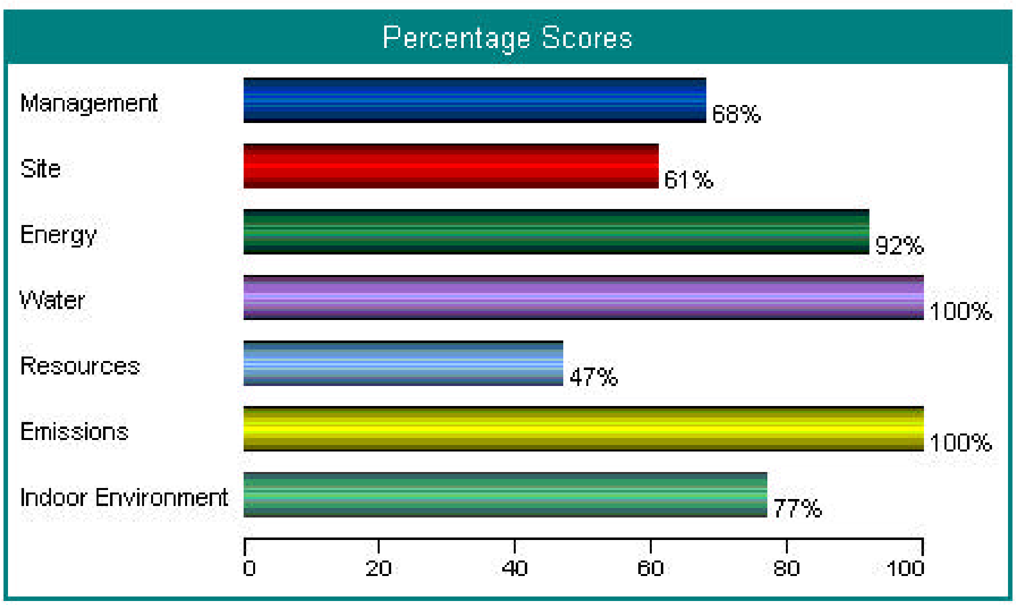
?? Metering of water at suite level
?? Dual flow rate toilet technology (target below 6 l/flush)
?? Energy Star appliances (dishwashers, washing machines)
?? Storm water retention combined with grey water for irrigation & non-contact water uses

Renewables

?? Solar Wall
?? PV – expensive – small as statement rather than for ecomomics at this point
?? PV's as part of window assembly to reduce window to wall ratio
?? Solar pool heating (2-½ yr payback)

As indicated, all of these considerations were integrated into the Green Globes framework and a complete assessment was undertaken. EE4 model results were not presented by Team 4. As such, the Green Globes results are presented below in their entirety as part of Team 4's final report.

Percentage of points achieved by Circa Condominium for each module:



The Team 4 Circa Condominium alternative achieved an overall score of 81%. Team 4 used the Green Globes checklist as a means of addressing all the aspects of the sustainable design in a comprehensive manner.

RATING: Four Green Globes

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.

Team 4 Circa Condominium 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 no, 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 Circa Condominium. The use of an integrated design process for both site selection and 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 the urban design issues and discussed them with the Markham planning official.

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 4 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 4 produced a basis for the Design Concept Report and established design criteria to meet the functional and operational requirements of the building.

Opportunities for Improvement

Prepare Basis of Design documentation in the Design Concept Report. Document the primary assumptions to guide design decisions and provide a narrative description of the building systems. Explain how the design intent goals will be achieved.

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.

Team 4 Circa Condominium achieved a score of 61% 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. The score largely reflects the time limitation for accessing and analyzing the results of site studies

B.1 Analysis of Development Area

Although the importance of analysis of the development area was discussed within Team 4, the Charrette did not provide enough time for an actual study to be done. It was not possible to collect all pertinent site analysis data for topography, geology, soils, water features, drainage, vegetation as well as previous land use and apply the site analysis results to the development of the site plan.

Highlights

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

Opportunities for Improvement

Circa Condominium is being built on a new greenfield site, which is approximately 19 acres in size. For future projects, Tridel should consider construction on an existing serviced site. Where appropriate, consider a compact and dense development of no less than 2,500 m^2/ha (60,000 ft^2/acre) (i.e. two-storey inner city development).

The site should be verified as not being a wetland or a wildlife corridor. Avoid locating buildings within or close to ecologically sensitive areas. Portions of the site that are wetland, wildlife corridors, agricultural land, parkland, or areas notable for their scenic beauty, should be fully protected. Conduct an environmental assessment where appropriate.

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 and green roof were considered, particularly for the lower podium of the proposed design. The discussion focused on many advantages of the green roof including increased insulation (R40-45).

The design proposes exterior lighting that avoids glare, light trespass and night sky glow.

Opportunities for Improvement

Develop design strategies that minimize the disturbance of undeveloped areas of the site. Minimize the area of the site for the building, parking, and access roads, and locate new buildings on previously disturbed parts of the site. Preserve significant trees and natural slopes to maintain the existing direction of groundwater flow. Prepare a drainage and erosion control plan. Map all the existing site vegetation.

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 4 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
- landscaping the site to divert water away from the building

In addition, the design proposes that rainwater be captured from impervious areas for groundwater recharge and reuse in the building. It was proposed that a large underground water tank be created which will be used also as a heat sink for building cooling as well as reservoir for irrigation.

B.4 Strategies to Enhance Site Ecology

Highlights

Team 4 developed strategies to enhance the site's natural features which include:

- appropriate site drainage and water retention through pervious surfacing materials
- avoidance of heat islands green roof.

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 directly relates 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.

Team 4 achieved a score of 92% 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.

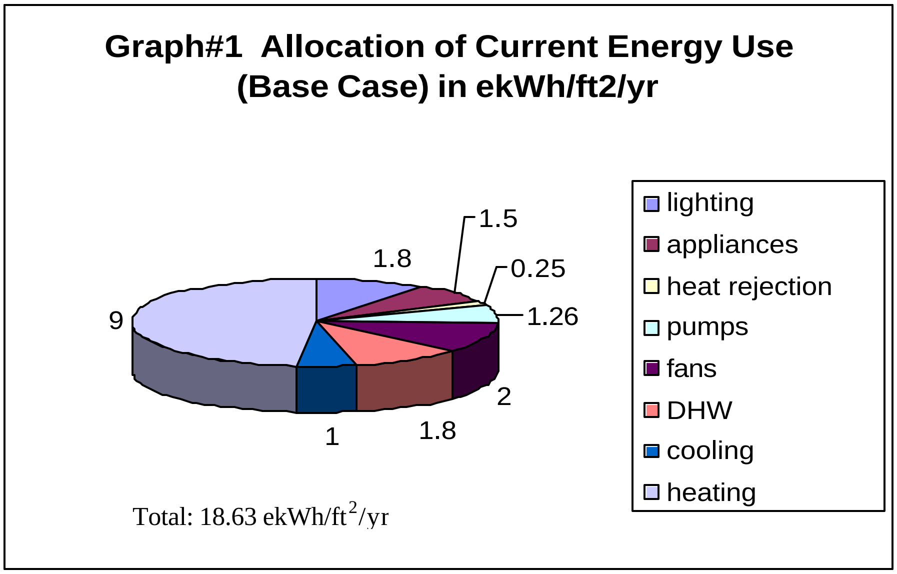
C.1 Modelling and simulation of building energy performance; establishing an energy target

Team 4 achieved a sub-score of 90% for its energy consumption, based on the inputted projected energy performance of 110 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 7,660 GJ (51 ekWh per gross square metre per year). The projected energy savings as compared to the reference project are 78.3%. (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 calculations, are expected to be 1,439,795 kg/year.

Highlights

The group applied several design measures to improve the energy performance. The ee4 simulation model was used to quantify the energy impacts of some of these design changes. Among those was the east west orientation of the tower which yielded an improvement of 0.4% in the energy performance. This simulation projected a total energy use of 18.63 ekWh/ft^2/yr. The allocation of this energy total is displayed in graph #1 below.



Graph#1 Allocation of Current Energy Use (Base Case) in ekWh/ft2/yr

A number of design features and energy reduction options were considered and analyzed. These included:

1. Re-orientation of the tower to more East-West orientation (0.4% energy reduction).
2. Through or cross-flow ventilation rather than central corridor ventilation on lower units.
3. Stack housing units (e.g. 2 story units) to promote cross-flow ventilation
4. Maximising unit daylighting and R-value insulation on the north facades
5. Use of thermal chimneys on low rise units.
6. Maximising shading opportunities on south and west elevations. Use of Solar Buffer
7. Glazing of balconies to create summer space-units
8. Glazed stair landings on the North
9. Decreasing window-to-wall ratio (to match reference building of 40% glazing) (1.7% energy reduction)
10. Design of shallower units on North rather than South to improve unit daylighting.
11. Increase of south facing glazing.
12. Reduction of thermal bridging on balconies. Dedicated suite ventilation rather than corridor pressurization – (central vs. individual suites).
14. Heat recovery & free-cooling (15 – 20% energy savings potential).
15. Increase of heating system delta-T and use of condensing boilers.
16. Use of heat pump to allow transfer of heat from South to North suites. (note there is a disadvantage in terms of added maintenance).
17. Storm water system acting as a cooling tower.
18. Consideration of ground source heat pumps, Solar Wall (further investigation).
19. Use of PV's as part of window assembly to reduce window-to-wall ratio.
20. Solar pool heating (2-½ yr payback).

The proposed solutions were developed using an integrated design process that considered a wide range of factors such as the site's microclimate, space optimization, the integration of energy- efficient systems and transportation.
Through the integration of five specific measures, the buildings energy input was reduced to 10.2 ekWh/ft^2/yr, which is a 45% reduction of the base case. These measures were:

1. Orientation change (0.4% energy reduction).
2. Reduce Window to Wall Ratio (1.7% energy reduction).
3. Heat recovery & free-cooling (15 – 20% energy savings potential).
4. Use of a Ground Source Heat Pump with Gas Fired Make-up Air Unit.
5. Solar pool heating (2-½ yr payback).

Some of these energy reduction measures that were discussed in greater detail further in this section.

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's systems and equipment.

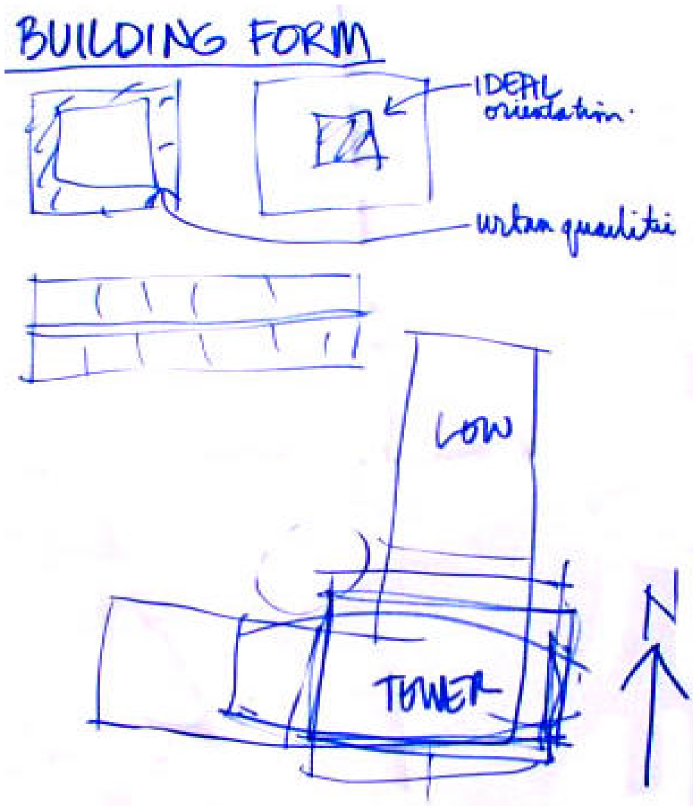
Circa Condominium achieved a sub-score of 95% based on a review of space optimization, response to microclimate and topography, daylighting and design features of the building envelope that would be expected to affect the building's energy use and hence its carbon dioxide emissions.

Highlights

Space optimization

The design team proposes the optimization of space use to maximize energy efficiency. Much discussion has focused on the urban form of the project. A courtyard solution uses the site most efficiently, maximizes building density and has inherent pedestrian friendly, urban design streetscape qualities that are consistent with the visual "city centre". However, a point tower is a more efficient "machine" for living. It also provides a better opportunity for orientation, minimizes impact/footprint and maximizes green space. As a compromise, team decided to combine a perimeter site development juxtaposed with a tower, thereby allowing for a variety of building types (tower & low rise).

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.

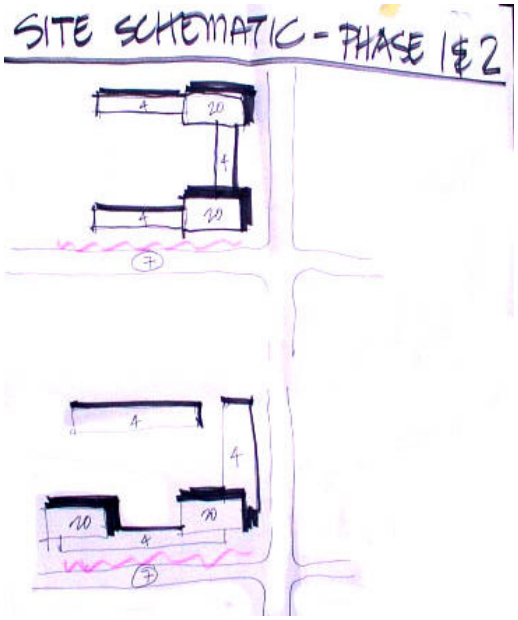


Response to microclimate and topography

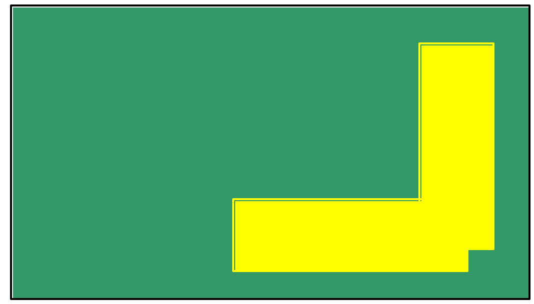
Design Team 4 wanted spaces and openings to be configured to optimize passive solar gains. They had to take into account considerations such as the height restriction, imposed by Markham airport and the influence that the highway, located along the south perimeter of the development, which affect decisions regarding ventilation and glazing. The solution that Design Team 4 arrived at was to re-orient to more East-West orientation - resulting in a 0.4% energy reduction and adopting a simple building form, including a lower 4 storey podium with a higher 20 storey tower.

The design recommends that the building form, occupied spaces and fenestration be coordinated to allow natural or hybrid ventilation. Staked units – promote cross-flow ventilation. Shallower north units as compared to south-orientated units improve daylighting.

By decreasing the height of the podium, the design team assumed the use of operable windows would be a more practical suggestion. The podiums allow for through ventilation rather than central corridor ventilation. Thermal chimney solutions were also considered.

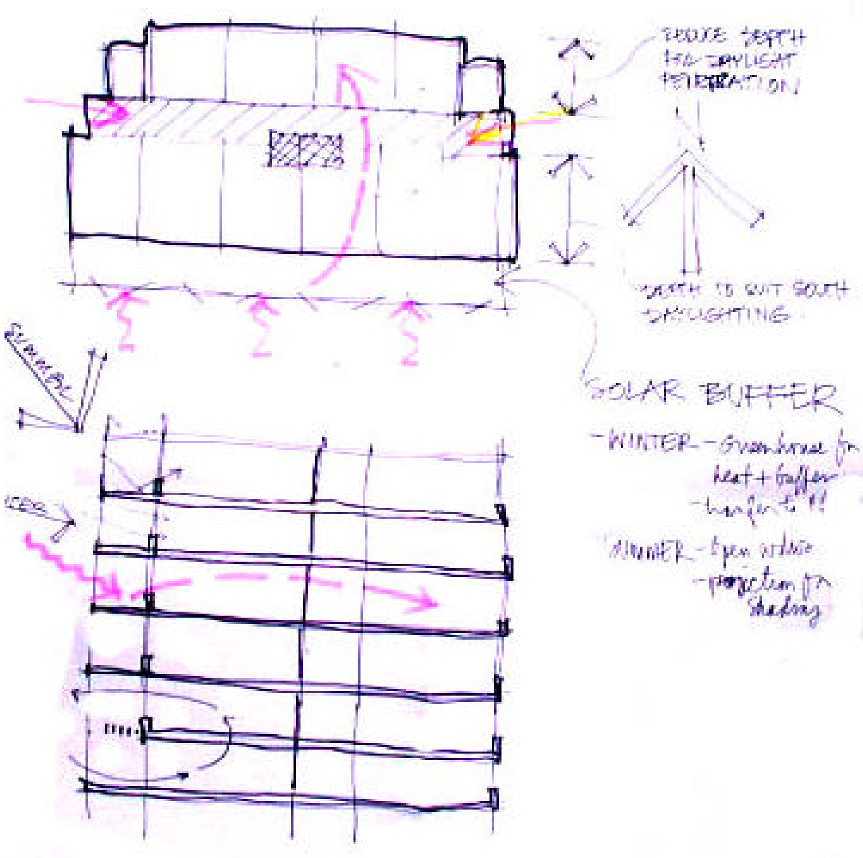


Proposed sketch scheme



Building
Site

Original Design



Proposed tower design

Daylighting

The building will be located and oriented to save energy by maximizing opportunities for daylighting, while at the same time minimizing thermal loss and addressing cooling requirements. The corridor side of the unit is to receive daylight from the generously lit corridors through upper corridor windows. The design proposes that south shading devices and articulated façade are to be integrated to minimize overheating and glare. Shading of the higher floors is figured to be accomplished by overhanging balconies. Use of "Heat mirror" glass was considered.

Optimization of building envelope

The design proposes the use of building form and thermal massing to minimize heat loss through the building envelope. Team 4 decided to increase south facing glazing, and reduce curtain-wall elements. Balconies are to be designed to reduce thermal bridging.

The design proposes additional north insulation and a temperate zone created by glazed north corridor spaces. A green roof was also proposed for the lower part of the podium

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*.

Measures are being proposed to prevent groundwater or driven rain from penetrating into the building and a continuous air barrier.

Energy metering

Design Team 4 concluded that monitoring the energy used by tenants is important, as sub-metering can help to raise awareness regarding reduction of energy use.

Opportunities for Improvement

Optimization of building envelope

Choose the appropriate U-value for windows depending on the building function, orientation and the climate. For buildings that would benefit from passive solar-heating, explore glazing strategies to optimize solar heat gain.

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 4 achieved a sub-score of 76% 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

High efficiency boilers will be used. The team suggested increasing heating system delta-T and the use of condensing boilers

The design proposes the integration of the following:
- ?? variable speed drives on variable air volume distribution systems
- ?? energy-efficient motors

The integration of building automation systems (BAS) is proposed.

Other energy-saving systems or measures are proposed including:
- ?? heat recovery systems & free-cooling,
- ?? dedicated suite ventilation rather than corridor pressurization – (central vs. individual suites),
- ?? ground source heat pumps (subject to further investigation),
- ?? heat pump to allow transfer of heat from South to North suites,
- ?? crossflow ventilation – through units rather than central corridor to allow natural ventilation and improved occupant control

Opportunities for Improvement

Explore the feasibility of integrating co-generation at the building or district scale.

Explore opportunities to include hot water savings devices.

Explore measures for reducing the dependence on elevators, either through building morphology or circulation patterns that promote the use of ramps and stairs. Investigate the possibility of using gearless elevators with reduced energy consumption.

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.

Team 4 received a sub-score of 100% for integration of renewable energy sources.

The following energy systems are being considered:

- active solar pool-heating and Solar Wall
- photovoltaic panels as part of window assembly to reduce window-to-wall ratio. While PVs are expensive, they are a statement of environmental leadership at this point in time

Opportunities for Improvement

Explore strategies to integrate other renewable energy systems, such as wind energy, into the design.

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

C.5 Planning Energy-Efficient Transportation

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

Team 4 achieved 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).

Cycling facilities

The design team proposes secure, sheltered and accessible bicycle storage. This will encourage shorter trips within Markham 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.

Team 4 achieved 100% on the Green Globes™ rating scale for water consumption and measures to minimize water use.

D.1 Meeting a Water Performance Target

Design Team 4 estimates the water performance target for the building to be less than 50 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 design proposes sub-metering of water consumption at the suite level.

The following water fixtures were considered:

- low flush toilets (less than 6 L) or dual flow rate toilet technology (target below 6 l/flush)
- water saving fixtures on faucets (7.5 L/min.) and shower heads (9.0 L/min.)
- other water saving Energy Star appliances (dishwashers, horizontally loaded washing machines)

Strategies to minimize water for cooling towers

Team 4 proposes a stormwater storage tank to replace the need for cooling towers.

Strategies to minimize water for irrigation

The design addresses the principles of xeriscaping with the integration of native, drought-resistant species into the landscape.

Storm water retention combined with greywater for irrigation & non-contact water uses were also considered.

Strategies to reduce off-site treatment of water

Team 4 addressed the possibility of a separate system for the supply of graywater.

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.

Team 4 achieved a score of 47% 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

Design team 4 proposed the use of high fly-ash content concrete to reduce the environmental burden and embodied energy effects of the construction materials.

Opportunities for Improvement

Conduct a preliminary research and evaluation of building materials generically, such as concrete, steel, and wood. Explore the environmental effects of different design options or material mixes.

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

Highlights

The design proposes the incorporation of reused building materials and components.

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

The utilization of locally manufactured materials is proposed for the project.

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.

The design stipulates that tropical hardwoods be avoided and solid lumber and timber panel products originate from certified or sustainable sources.

E.3 Strategies to Reuse Parts of the Existing Building

N/A

E.4 Design Strategies for Building Adaptability

Highlights

Design features to facilitate building adaptability were considered.

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 Reuse and Recycle Demolition Waste

Highlights

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.

Design Team 4 proposes that facilities to compost organic waste be located on site.

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.

Team 4 achieved 100% on the Green Globes™ rating scale for emissions, effluents and other environmental impacts.

F.1 Strategies to Minimize Air Emissions

Highlights

Low-NOx burner technology was investigated.
District energy system using cogeneration linked to absorbtion cooling was available for this project.

F.2 Strategies to Avoid Ozone-Depleting Refrigerants

Highlights

A large part of the ODS reduction strategy of Team 4 is to reduce the cooling load by design. It is proposed to use large gray water tank as a heat store and reject the heat through piping under the garage These measures are envisaged to be sufficient to reduce the cooling load sufficiently that only a small amount of cooling would be required, for which a non CFC-process, such a gas cooling could be applied.

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

Highlights

Design measures will be taken to prevent sewer contamination.

Measures to prevent stormwater run-off from the roof from entering public utilities include provision of an onsite storage tank to collect all stormwater and use it for cooling.

F.4 Pollution Reduction Strategies

Highlights

Compliant storage tanks

Storage tanks will comply with applicable guidelines and local requirements.

Strategies for integrated pest management

Use of hardy, naturally pest-resistant local plants will 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.

Team 4 Circa development achieved 77% on the Green Globes™ rating scale for indoor environment and the 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.

A strategy for effectively delivering ventilation was developed. Cross ventilation, rather than central corridor ventilation would be provided for lower podium units. This allows natural ventilation and improved occupant control.
Dedicated suite ventilation rather than corridor pressurization – (central vs. individual suites) is proposed for the tower units.

The design recommends an adequate ventilation system for enclosed parking garages.

The design will provide for easy access for cleaning and inspecting air filters.

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

The design proposes local exhausts for areas where contaminants are likely to be centrally generated.

G.3 Strategies to Optimize Lighting

Highlights

Daylighting

The orientation and visual access of the building are being considered in terms of daylighting potential.

Lighting design

The design proposes that electronic ballasts be fitted to luminaires.

Measures to minimize glare will be integrated. (See previous discussion.)

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:

- ?? 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 typical dwelling unit, aim for at least 2%.

Lighting design

Calculate luminance levels for the building spaces based on ANSI/IES and IESNA recommended practice and integrate these into the design.

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

There are design measures to achieve desired vibration control and prevent noise transmission throughout the building.

There are design measures, such as zoning or isolating certain spaces, to achieve the required acoustic privacy and minimize the potential for occupancy-related acoustic problems.

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

The design proposes measures to mitigate acoustic problems associated with noise and vibrations from mechanical equipment and plumbing systems.

Opportunities for Improvement

Where undesirable noise originates on the site, integrate noise attenuation in the design of building envelope.
Consider use of dissimilar thickess of glazing to reduce noise transmission through fenestration resonance.

G.6 Occupants' and Dwelling Unit Criteria

Highlights

Community involvement and use of stairwells as community spaces were considered in design.

Accessibility and barrier-free design of bathrooms were considered in design.

Green Globes

The Green Globes Rating Program was designed to evaluate and rate the energy and environmental performance of buildings. The goal of the program is to guide environmental performance integration in the design of the buildings as well as to identify opportunities to save energy and water, reduce waste and prevent water, air and land pollution in the management and operation, based upon the key elements of eco-efficiency. The Program involves a graduated rating system designed to recognize buildings that are committed to improving their environmental performance. In general, the designations reflect the following objectives for each eco-rating level:

- **1 Green Globe**: To participate in the Green Globes Rating Program, a project or facility must have identified and initiated some measures to improve the environmental performance such as energy use reduction strategies, water conservation steps, waste reduction, etc. A key component should be commitment to a set of guiding environmental principles.
- **2 Green Globes**: This designation indicates that the project or facility has moved beyond awareness and commitment to sound environmental practices, and has demonstrated good progress in reducing environmental impacts of its design and operations.
- **3 Green Globes**: This designation indicates excellent progress in achieving eco-efficiency results through current best practices in all areas of a project design or facility's operations and management.
- **4 Green Globes**: This designation indicates national industry leadership in terms of eco-efficiency design, practices and management commitment to continuous improvement and industry leadership.
- **5 Green Globes**: This designation is reserved for select projects or facilities, which are serving as world leaders in eco-efficient design, and are continually introducing policies and improved practices that can be adopted by others.

APPENDIX A

GREEN GLOBES REPORT

TEAM 2

Green Globes Design

Green Leaf™ Eco-Rating Program

Project: **Sustainable Design Charrette**
Circa Condominium, Team 2

Owner: **Tridel**

Date: **April 23, 2003**

Ref. No: **02-011**

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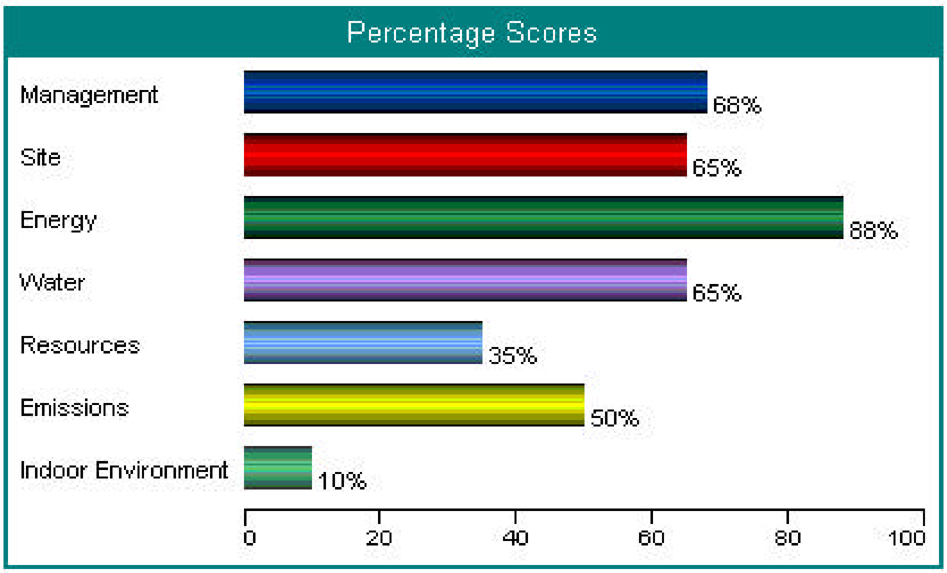
INTRODUCTION

Team 2 of the Charrette was led by Neil Munro as the facilitator and Mike Lubun as the energy simulator. The team was charged with designing a building to the "highest environmental performance". and challenged to redesign the Circa Condominium building in order to improve its overall energy and environmental performance. 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.

Percentage of points achieved by Circa Condominium for each module:



The Team 2 Circa Condominium alternative achieved an overall score of 57%. The relatively low score of the design is mainly due to fact that Charrette Team 2 could not address all of the aspects of the assessment, particularly the Indoor Environment, due partially to time constraints.

RATING:

Three Green Globes

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.

Circa Condominium achieved a score of 68% on the Green Globes™ rating scale for its integrated design process, integration of environmental purchasing and commissioning plan.

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 Circa Condominium. The use of an integrated design process for both site selection and 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, architect and mechanical engineer. The teams also consisted of several experts in specific fields, including: cost estimation, civil engineering/envelope consulting, renewable energy, property management and acoustic issues. All members of the team were able to spend a significant amount of time working with the team. 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 found it interesting to learn of both the environmental benefits and financial setbacks of photovoltaics. From this information, a group decision was made not to incorporate them into the design.

The idea behind the Charette was to design a green, healthy building. Thus Green design facilitation was used to support green integration.

A.2 Integration of Environmental Purchasing

Team 2 did not discuss the integration of environmental purchasing. The following issues needed 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 2 produced a basis for the Design Concept Report and established design criteria to meet the functional and operational requirements of the building.

Opportunities for Improvement

Prepare Basis of Design documentation in the Design Concept Report. Document the primary assumptions to guide design decisions and provide a narrative description of the building systems. Explain how the design intent goals will be achieved.

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.

Circa Condominium achieved a score of 65% 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

Although the importance of analysis of the development area was discussed within Team 2, the Charrette did not provide enough time for an actual study to be done. It was impossible to collect all pertinent site analysis data for topography, geology, soils, water features, drainage, vegetation as well as previous land use and apply the site analysis results to the development of the site plan.

Highlights

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

Opportunities for Improvement

Circa Condominium is being built on a new greenfield site, which is approximately 19 acres in size. For future projects, Tridel should consider construction on an existing serviced site. Where appropriate, consider a compact and dense development of no less than 2,500 m²/ha (60,000 ft²/acre) (i.e. two-storey inner city development).

The site should be verified as not being a wetland or a wildlife corridor. Avoid locating buildings within or close to ecologically sensitive areas. Portions of the site that are wetland, wildlife corridors, agricultural land, parkland, or areas notable for their scenic beauty, should be fully protected. Conduct an environmental assessment where appropriate.

B.2 Development of Strategies to Minimize Ecological Impact

Highlights

The design recommends that undeveloped areas on the site, that is areas which will not be build upon or used for parking or access roads, remain undisturbed. Team 2 discussed the preservation of certain land to be utilized as garden and parkland areas. Where possible, significant flora and natural slopes will be maintained in order to sustain the existing direction of groundwater flow.

The design concept proposes the integration of native planting and landscape naturalization. Native grasses and plants will be considered in the landscaping practices, and lawn area will be kept to a minimum. This will help minimize or eliminate the need for supplemental irrigation.

There are strategies to avoid creating heat islands. Team 2 discussed the use of trees on the property for shading impermeable surfaces. Roof spaces and terraces were also strongly suggested to be shaded via construction of a green roof.

Opportunities for Improvement

Team 2 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 2 made suggestions such as:

- minimizing hardscapes and the use of permeable , pervious surface paving materials
- integrating storage area ponds, where water can seep into the ground
- using vegetation to maximize the total amount of water consumed by plants
- landscaping the site to divert water away from the building

The design proposes that rainwater be captured from impervious areas for groundwater recharge and reuse in the building. It was thought that a human-engineered pond will provide a convenient and attractive reservoir for irrigation.

B.4 Strategies to Enhance Site Ecology

Highlights

Team 2 developed strategies to enhance the site's natural features which include:

- prevention of soil erosion;
- creating of habitat (pond, gardens);
- appropriate site drainage and water retention; and
- avoidance of heat islands.

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.

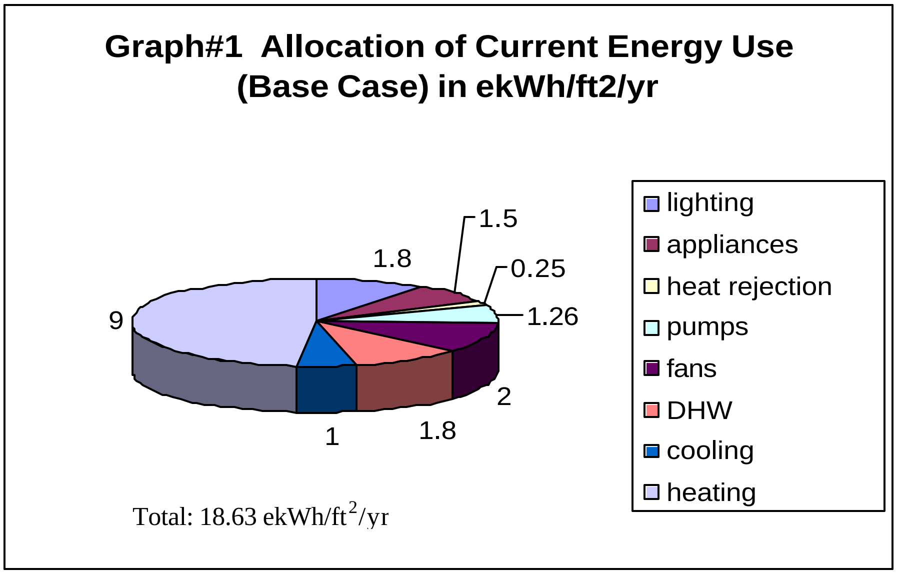
Circa Condominium achieved a score of 88% on the Green Globes™ rating scale for energy efficiency. This represents the weighted integration of the sub-scores for: modelling and simulation of the building energy performance, energy demand minimization strategies, integration of energy-efficient systems, integration of renewable energy sources, and planning energy-efficient transportation.

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

Circa Condominium achieved a sub-score of 100% for its energy consumption, based on the inputted projected energy performance of 10.2 ekWh per gross square feet 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 16,696 GJ (102 ekWh per gross square metre per year). The projected energy savings as compared to the reference project are 56.0%. (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 calculations, are expected to be 7,018,707 kg.

Highlights

Lead by the energy simulator Mike Lubun, the group decided to review an existing energy simulation that had been done for a preexisting design for Circa Condominium. This simulation projected a total energy use of 18.63 ekWh/ft^2/yr. The allocation of this energy total is displayed in graph #1 below.



As a team, a goal of a 50 % reduction in the building's energy use was sought to be achieved. A number of reduction energy reduction options were analyzed. These included:

1. High heating loads required attention via envelope insulation, improved glazing performance and building orientation.
2. Photovoltaics considered but $1000/m2 installed cost (200 watts or $5/watt would result in a 15-20 year payback.
3. Solarwall for ventilation air heating only marginally considered.
4. Replacement of curtainwall with a high performance type curtainwall (Kawneer 7500 series or Visionwall product) was considered, but rejected due to high costs.
5. Replacement of curtainwall with precast insulated wall and punched windows rather than floor to ceiling glass was considered but rejected due to architectural considerations.
6. Storm water system acting as a cooling tower or cooling water pre-cooling was considered.

The proposed solutions were developed using an integrated design process that considered a wide range of factors such as the site's microclimate, space optimization, the integration of energy- efficient systems and transportation. Through the integration of nine specific measures, the buildings energy input was reduced to 10.2 ekWh/ft^2/yr, which is a 45% reduction of the base case. These measures were:

6. Orientation change.
7. Improve windows.
8. Reduce Window to Wall Ratio.
9. In-suite heat recovery ventilation systems were considered, but difficulty in modelling the units (due to the zoning of the file and the grouping of the suites) dismissed this notion. The in-suite units, would require unit servicing, increase noise and only allow bathroom, laundry heat recovery. The option of a central heat recovery system was deemed more practical and cost-effective.

10. Make-up Air Unit with Central ducted exhaust from all suites and corridors (balanced), with 60% effective heat recovery and an increased static pressure due to central exhaust.
11. Reduce Supply Air Fan by 6 hours during night.
12. Use of a Ground Source Heat Pump with Gas Fired Make-up Air Unit.
13. Use GFX Grey Water Heat Recovery.
14. Heating/Cooling Capacities only were optimized.

Some of these energy reduction measures will be discussed in greater detail further on in the energy section.

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.

Circa Condominium achieved a sub-score of 73% 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

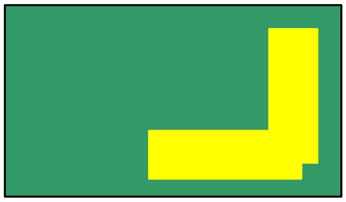
Space optimization

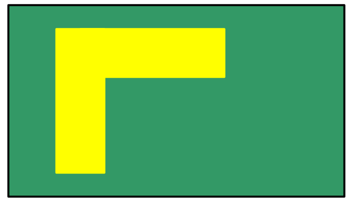
The design team proposes the optimization of space use to maximize energy efficiency. This was done by incorporating spaces, that can accommodate more than one function into the design.

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

Design team 2 proposes that spaces and openings be configured to optimize passive solar gains. The idea of rotating the building by 270 degrees leaving all windows/wall components unchanged, created a energy savings of 0.2 ekWh/ft2/yr.



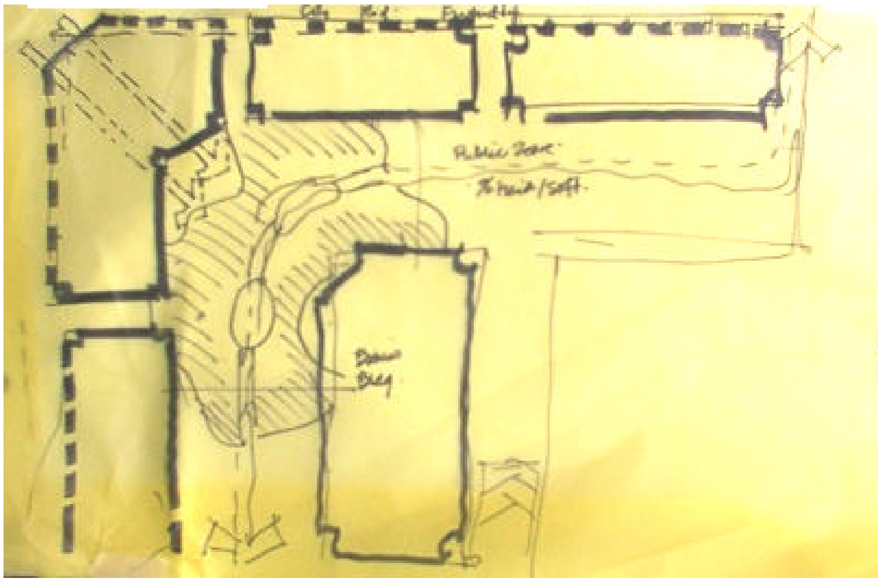


Building

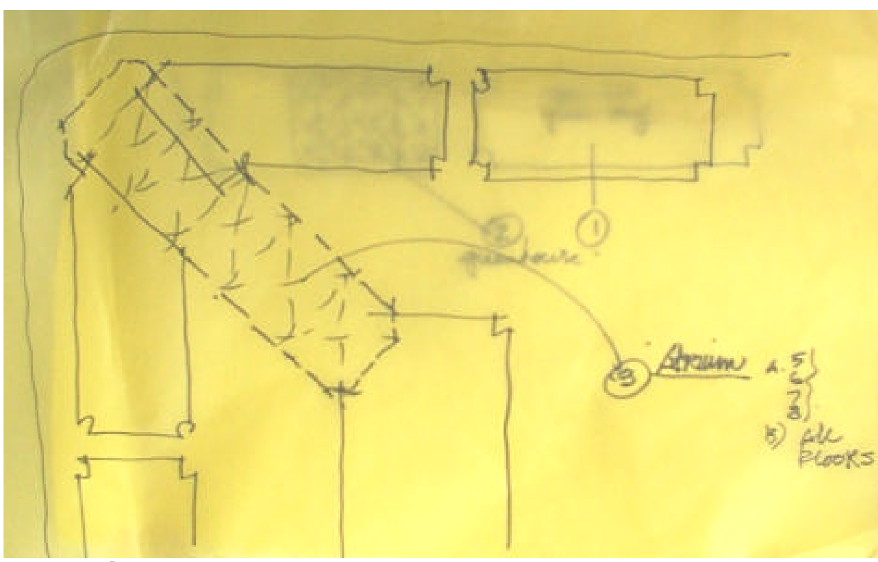
Site

Original Design

Rotated 270 degrees



Proposed sketch scheme



Proposed atrium connection

The design proposes that the building be configured to minimize snow deposition and thermal loss due to wind. This is done by not changing the orientation of the building, but adding an extra section to the Northwest area of the building.

The design recommends that the building form, occupied spaces and fenestration be coordinated to allow natural or hybrid ventilation. By decreasing the height of the building, the design team assumed the use of operable windows would be a more practical suggestion.

Daylighting

The building will be located and oriented to maximize opportunities for daylighting.

The design proposes that window glazing be used to optimize energy-savings and daylighting. One of the design team's energy reducing measures was to improve windows to double glazed with softcoat low E and argon fill on thermally broken frames (U=1.79, SC = 0.44).

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

Optimization of building envelope

The design proposes the use of building form and thermal massing to minimize heat loss through the building envelope. Team 2 decided to reduce the window-to-wall ratio to 41% from 53%, and replaced 27% of the window area with precast walls. Energy simulation suggested that this would help to minimize energy loss through the envelope.

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*.

Measures are being proposed to prevent groundwater or driven rain from penetrating into the building.

Energy metering

Design Team 2 concluded that monitoring the energy used by tenants is a must, as sub-metering can help to raise awareness regarding reduction of energy use.

Opportunities for Improvement

Daylighting

Explore strategies to bring natural light deeper into occupied spaces while avoiding sunlight falling directly on occupants or worktops. In residential applications, avoid deep, unlit spaces.

Optimization of building envelope

Choose the appropriate U-value for windows depending on the building function, orientation and the climate. For buildings that would benefit from passive solar-heating, explore glazing strategies to optimize solar heat gain.

Ensure that the design provides for a continuous air barrier.

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.
Circa Condominium achieved a sub-score of 22% 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 replacement of the purchased hot/chilled water system (via a nearby cogen plant) with an on-site ground source heat pump system using deep ground water as the heating/cooling fluid. The heat pump system would pump ground water at a deep water temperature of 10 C^{o} at a calculated flow rate of 180 litres/second in a closed loop system. The water would then be conditioned to a heating delivery temperature of 38 - 41 C^{o} via at 3.8 COP compressor during the heating season. During the cooling season, the already chilled water may only require 1-2 C^{o} of additional cooling via the compressor. Temperature resets and flow controls will further reduce the compressor operating times thereby saving electricity. The ground source heat pump provides a high efficiency combination heating/cooling system that takes advantage of a constant temperature source (deep ground water). The ground source heat pump could be integrated within a potable water heating loop to provide low cost potable water heating. This was not investigated.

The design team concluded that variable speed drives in variable volume air distribution systems should be used as well as variable speed pumps for fluid distribution systems in addition to energy efficient motors.

The team also proposed a GFX drainwater heat recovery system, whereby heat from discharged hot water showers, sinks, and laundry equipments is captured and used to preheat City cold water prior to entering a hot water boiler. This is estimated to save approximately 28% of the energy required to heat potable water. The team also proposed low flow water usage appliances and also considered grey water recovery systems."

Opportunities for Improvement

Consider integrating the following lighting features:

- High-efficacy T-8 or T-5 fluorescent lamps with electronic ballasts. Use the efficiency rating (LER) to compare different styles and models. Use luminaires that accommodate compact fluorescent lamps and high-intensity discharge lamps.
- Task lighting in combination with overall ambient lighting.
- The integration of separate lighting controls for small functional spaces, and/or devices such as occupancy sensors, motion detectors, and daylighting controls.

Determine the space requirements and zone areas for different hours of occupancy and loads.

The Designer should decide which building systems should be controlled and integrated and at what level of complexity, and then choose the BAS accordingly.

Explore opportunities to include hot water savings devices, and assess the economics of the proposed installations.

Explore measures for reducing the dependence on elevators, either through building morphology or circulation patterns that promote the use of ramps and stairs. Investigate the possibility of using gearless elevators with reduced energy consumption.

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.

Circa Condominium received a sub-score of 50% for integration of renewable energy sources.

The following energy systems are being considered:

- photovoltaic panels were considered, however due to a high payback period (15-20 years) they were rejected from the design.

Opportunities for Improvement

Explore strategies to integrate, where appropriate, the following renewable energy systems into the design:

- Solar-heating systems

- ?? High efficiency, low emissions biomass combustion systems
- ?? Wind energy systems

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

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.

Circa Condominium 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. Design Team 2 also suggests a covered, and potentially heated, bus shelter be provided.
- ???features promoting shared vehicle transport (car-pooling) will be affected by increasing the number of suites from 390 to 500, while keeping the number of parking spaces constant at 585. This will encourage carpooling by reducing the number of parking spaces per suite.

Cycling facilities

The design team proposes secure, sheltered and accessible bicycle storage. Also, temporary bicycle parking outside the building will be provided. This will encourage shorter trips within the Markham 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.

Circa Condominium achieved 65% 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 2 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:

? ? ???low flush toilets (less than 6 L)

? ? ? water saving fixtures on faucets (7.5 L/min.) and shower heads (9.0 L/min.)

Strategies to minimize water for cooling towers

Team 2 proposes an on-site pond to replace the need for cooling towers.

Strategies to minimize water for irrigation

A rainwater irrigation system is being considered. The pond will be used for storage.

Strategies to reduce off-site treatment of water

Team 2 did discuss the possibility of a separate system for the supply of graywater.

Strategies to minimize consumption of potable water

Depending on the uses and quantities of water consumed in the building, determine the extent to which water needs to be metered and address this in the design concept. As with electricity meters, water meters need to be accommodated in an appropriate enclosure and location, usually in the basement. If the intention is to connect water metering to a BAS, an appropriate conduit needs to be provided.

Integrate water saving devices such as:

?? other appropriate water-saving fixtures or appliances

Strategies to minimize water for irrigation

Integrate native, drought-resistant species into the landscape.

Strategies to reduce off-site treatment of water

Where appropriate, develop design strategies and select appropriate systems based on the facility's program, occupants and site, for alternative waste treatment such as manufactured bio-filters, peat moss drain fields, wetlands, consolidated systems or composting toilets. For wetland systems, identify design requirements based on users, the facility's capacity, the pollutants to be removed from the water, the area and detention time necessary for thorough treatment, vegetation and aquatic life survival requirements, and aesthetics.

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. Circa Condominium achieved a score of 35% 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

Design team 2 did compare the environmental burden and embodied energy effects of the envelope assembly materials (cladding, windows etc.).

Opportunities for Improvement

Conduct a preliminary research and evaluation of building materials generically, such as concrete, steel, and wood. Explore the environmental effects of different design options or material mixes.

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

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.

Research recyclable materials such as aluminum, steel, glass, carpet, and ceiling tile. Survey manufacturers to obtain information on the recycled-content of their product or material.

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.

Identify parts of the building that are likely to experience high levels of wear, tear and exposure to weathering forces, accidents and vandalism, and design them to be durable. Select materials with low maintenance requirements.

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

Highlights

By approaching the design as a terraced building, Team 2 is considering possible building adaptability for future use.

E.5 Design Strategies for Building Dissassembly

Highlights

Design options are being considered to facilitate building disassembly.

E.6 Strategies to Reuse and Recycle Demolition Waste

Opportunities for Improvement

Ensure that a waste audit and a construction, demolition and renovation waste management plan have been prepared before any work begins.

E.7 Facilities for Recycling and Composting

Highlights

The design proposes facilities for future occupants to handle and store consumer recyclables.

Design Team 2 proposes that facilities to compost organic waste is be located on site. Both the roof and garden areas of the building are both being considered.

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.

Circa Condominium achieved 50% on the Green Globes™ rating scale for emissions, effluents and other environmental impacts.

F.1 Strategies to Minimize Air Emissions

Design Team 2 proposes Ground Source Heating Pumps instead of boilers, therefore air emissions from boilers are not an issue.

F.2 Strategies to Avoid Ozone-Depleting Refrigerants

Team 2 proposes the building to be cooled using ground source chilled water, thus no refrigerants are likely to be used.

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

Highlights

There will be measures to prevent stormwater run-off from the roof from entering public utilities. The onsite pond will collect all stormwater.

Opportunities for Improvement

Review the sources of effluent contamination and include in the design, measures to either intercept contaminants before they run off into sewers or waterways, or to treat the contaminated water on-site.

F.4 Pollution Reduction Strategies

Highlights

Compliant storage tanks

Storage tanks will comply with federal guidelines and local requirements.

Opportunities for Improvement

Strategies for integrated pest management

Avoid architectural/structural perforations and openings that could allow pests to enter and plan proper storage facilities to protect garbage and kitchen waste from pests. Outdoors, select native, pest-resistant vegetation and integrate it into the landscaping.

Strategies for proper storage and control of hazardous materials

Consider design elements that will minimize the future need for toxic commercial cleaners, oils, surface coatings, water softeners, biocides, glycol, herbicides and indoor pesticides. Plan for designated storage areas with outside venting. Evaluate various structural containment measures to prevent spills from entering the drains.

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.
Circa Condominium achieved 10% on the Green Globes™ rating scale for indoor environment and the measures to provide healthy, productive and comfortable environment.

G.1 Strategies for Effective Ventilation

Highlights

The design team did consider operable windows to encourage natural ventilation and team also considered suite layouts differently to induce natural air movement.

Opportunities for Improvement

Determine where the air intakes would best be positioned. Consider wind direction. Where pollution is unavoidable, consider measures to remove pollutants from the air supply.

Gauge the ventilation effectiveness and determine the amount of fresh air that needs to be admitted. 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.

Based on the parking capacity of the garage and the predicted emissions, design an adequate ventilation system for enclosed parking garages.

Investigate and evaluate available technologies for personal environmental controls and integrate the selected option into the design.

Design an appropriate filtration system and ensure easy access to the air-handling units. Also, provide easy access for cleaning and inspecting filters.

G.2 Strategies for the Source Control of Indoor Pollutants

Opportunities for Improvement

Note areas which have a high moisture potential, especially as a result of thermal bridging and capillary action and those areas where exhaust for moist air should be provided such as bathrooms, laundry areas etc.

Provide easy and convenient access to Air Handling Units (AHUs) for regular inspection and maintenance, in the building design plan.

If humidification is to be integrated in the design, consider the use of steam humidification provided from an independent source rather than from the boilers.

If cooling towers are to be used evaluate options for their design and positioning to minimize the risk of *Legionella*.

Consider the demand patterns for hot water and estimate bulk storage volumes and recovery rates to match. Design the domestic hot water system with features that will help minimize the risk of *Legionella*, including measures to ensure that water can be heated to high temperatures for pasteurization, and can be kept at a uniform temperature.

Design the system so that it can be readily accessed for draining, dismantling and cleaning, and to avoid dead-legs and long runs. Consider using point-of-use heaters.

If smoking is to be allowed, consider the options to avoid smoke infiltration throughout the building. Provide exhaust at source to remove chemical contaminants in smoking areas as well as chemical storage areas, photocopying stations or workshops, or areas where there are fossil fuel burners.

G.3 Strategies to Optimize Lighting

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 typical dwelling unit, aim for at least 2%.

Lighting design

Consider the using electronic ballasts.

Consider shading options; particularly in the vicinity of windows orientated more southerly than NE or NW.

Calculate luminance levels for the building spaces based on ANSI/IES and IESNA recommended practice and integrate these into the design.

G.4 Strategies for Thermal Comfort

Opportunities for Improvement

Consider conducting a thermal comfort evaluation, particularly in the design of naturally ventilated buildings.

G.5 Strategies for Acoustic Comfort

Highlights

There are design measures to achieve desired vibration control and prevent noise transmission throughout the building.

There are design measures, such as zoning or isolating certain spaces, to achieve the required acoustic privacy and minimize the potential for occupancy-related acoustic problems.

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

The design proposes measures to mitigate acoustic problems associated with noise and vibrations from mechanical equipment and plumbing systems.

Opportunities for Improvement

Develop strategies to acoustically zone building spaces so as to maximize the distances between noise sources and acoustically sensitive areas.

Where undesirable noise originates on the site, integrate noise attenuation in the design of building envelope.

Notes:

Due to time constraints, a number of features could not be easily determined from the modeling, however Team 2 noted them as being essential to the integrated design process:

1. Conversion to operable windows (would require a manual window by window change in the file).
2. In-suite ventilation (would require generating a system per suite or group of suites manually in the file).
3. Thermal storage (requires a DOE2 calculation, additional 2-3 hours of time).
4. Heat pump water heaters or per suite water heating (2-3 hours of DOE2 work)
5. In-suite metering and in-suite energy use (8 hours of DOE2 preparation and calculations).

Team 2 Members:

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