BURROWS BUILDING
PARADISE LAKE, ONTARIO

CHARLES SIMON ARCHITECT

Helena Vamberger
M. Arch Candidate
University of Waterloo
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# QUICK FACTS

<table>
<thead>
<tr>
<th>Building Name</th>
<th>The Burrows Building, formerly the Earth Residence</th>
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<tbody>
<tr>
<td>City</td>
<td>Paradise Lake, Ontario</td>
</tr>
<tr>
<td>Year of Construction</td>
<td>Completed in Spring 1995</td>
</tr>
<tr>
<td>Architect</td>
<td>Charles Simon Architect</td>
</tr>
<tr>
<td>Consultants</td>
<td>Allen Associates</td>
</tr>
<tr>
<td>Owner/User Group</td>
<td>YMCA of Kitchener-Waterloo</td>
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<tr>
<td><strong>Program</strong></td>
<td>Year-round dormitory for 40 people</td>
</tr>
<tr>
<td><strong>Gross Area</strong></td>
<td>3,600 square feet (335m²)</td>
</tr>
<tr>
<td><strong>Climate</strong></td>
<td>Cold-humid continental climate with harsh winters and warm summers</td>
</tr>
<tr>
<td><strong>Site Conditions</strong></td>
<td>Located on 77 partially wooded acres of former agricultural land, with 20 acres considered environmentally sensitive</td>
</tr>
<tr>
<td><strong>Aesthetics</strong></td>
<td>Designed to blend with the surrounding environment by using materials such as heavy timber construction for principal structural elements</td>
</tr>
<tr>
<td><strong>Structural System</strong></td>
<td>Concrete retaining walls and wood post-and-beam construction</td>
</tr>
<tr>
<td><strong>Mechanical System</strong></td>
<td>Active: Central wood-fired masonry heater; Passive: concrete masonry walls absorb solar radiation</td>
</tr>
<tr>
<td><strong>Special Construction</strong></td>
<td>North wall buried into adjacent hill; masonry heater heats building; located “off the grid”</td>
</tr>
<tr>
<td><strong>Day-lighting</strong></td>
<td>Glazing oriented for optimal solar gain; clerestory windows light bedrooms</td>
</tr>
<tr>
<td><strong>Shading</strong></td>
<td>Exterior trellis with solar panels shades south-facing glazing</td>
</tr>
<tr>
<td><strong>Ventilation</strong></td>
<td>Operable windows aid cross ventilation and induce the stack effect</td>
</tr>
<tr>
<td><strong>Acoustics</strong></td>
<td>No specific treatment, however all walls and floors are well insulated</td>
</tr>
<tr>
<td><strong>User Controls</strong></td>
<td>Designed primarily to be “low tech,” user friendly and educational</td>
</tr>
<tr>
<td><strong>LEED Rating</strong></td>
<td>Gold - 46 points</td>
</tr>
<tr>
<td><strong>Cost of Construction</strong></td>
<td>$350,000</td>
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</table>
ENVIROMENTAL RESPONSIBILITY BY EXAMPLE

The idea for the YMCA Environmental Learning centre took shape in the early 1990s. The Kitchener-Waterloo YMCA was looking to develop their summer camp located on seventy-seven acres of partially wooded land on Paradise Lake near Waterloo, Ontario. They hired local architect Charles Simon to consult them on the development and programming of the site. Simon’s master plan included the expansion of the existing summer camp program to include exercises in environmental responsibility. The final result bore the idea of the YMCA Environmental Learning Centre where groups of children and adults could learn to live in an environmentally responsible way.1 The YMCA liked the master plan so much that they hired Simon to follow up the proposal with two architectural projects for the camp. As a result, the two buildings created by Simon now constitute the core of the YMCA’s Learning Centre.

The Solarium Building is the Learning Centre’s principal building. Considered the heart of the camp facilities, it houses offices for camp administration, the principal instruction and seminar room and a demonstration waste-water purifying “garden” known as the Living Machine. The second building, the Burrows Building, is considered the soul of the Learning camp; it was designed as a team effort where the site and the available materials exercised as much influence as the client and the architect. The process of design development focused on two key factors: sensitivity to the local environment and the need to occupy the building year-round.2 Consequently the building’s architectural elements and environmental systems had to be in synch to ensure the success of the project.

Completed in the spring of 1995, the Burrows Building can accommodate overnight stay for up to forty individuals throughout the entire year. The building’s
design and environmental systems are primarily low-tech, with high-tech features added as back-up. Low-tech features include a wood-fired masonry heater as the only active heat source, a passive heat-gain concrete masonry wall, a green roof, a solar hot water heater, and a fan-shaped plan that allows for efficient heat and light distribution and effective passive ventilation of the building. High-tech features include photovoltaic panels, a wind turbine, composting toilets and a grey-water filtration system. The residence also houses a stationary exercise bike that literally plugs into the building to supply additional energy using human pedal power. The Burrows Building relies upon the integration of many elements for the success of its design. From careful siting and material selection to shading devices and passive heating strategies, the dormitory stands as testament to the ideals of both the architect and client. Unlike other buildings of its kind, the Burrows Building embodies the teachings of the YMCA Learning Centre, and demonstrates them by example.

SITE CONSIDERATIONS

The YMCA Environmental Learning Centre is located fifteen minutes north of Waterloo, Ontario on seventy-seven acres of heavily wooded land beside Paradise Lake. Approximately twenty acres of the site are considered environmentally sensitive, while much of the site is already devoted to summer camp use. Surrounded on four sides by functional farms, the site’s rolling topography was formerly used for agriculture; however today Learning Centre activities now make use of the entire site.

Like the other buildings on the site, the Burrows Building is located away from environmentally sensitive ground. The location was selected according to environmental requirements: the building would be best located where it could be
built into a hill, yet disturb as little of the surrounding land as possible. The architect found the ideal location for the dormitory in a small south-facing clearing in the woods located on a hill on the northern end of the site.\(^3\)

In siting the building, the architect was careful to ensure the residence fit well into the landscape; not only does the building respect the original clearing and surrounding wooded area, but by partially interring the building it becomes a smooth continuation of the hill. The topography of the entire site slopes gradually towards the South. By locating the Burrows Building to the north end of the site, the residence is afforded views of the entire summer camp. From the main sitting area there is a view of the Solarium Building to the south and Paradise Lake to the east. On the north, east and west sides the building is protected by dense woods, while the clearing to the south of the building opens onto a grassy plane. The Burrows Building is approached from the east of the site along a tree-lined path. Although the building is located on the highest elevation of the site, because of the architect’s endeavour to minimize the impact on the surrounding environment, the building is inconspicuous and tucked away. The weathered exterior wood cladding compliments the heavy timber construction as well as the neighbouring forest. During the summer months the building blends in with the adjacent woods, while in the winter it contrasts the snow similarly to the leafless trees surrounding it.\(^4\)

**PROGRAMMATIC REQUIREMENTS**

The Burrows Building provides overnight accommodation for up to forty guests attending the YMCA Environmental Learning Centre educational camp sessions. The majority of its 3,600 square feet is concentrated on one floor with a small basement underneath the west side [see Burrows Building Main Floor...](image)
BURROWS BUILDING MAIN FLOOR PLAN

1. ENTRANCE AND HALLWAY
2. SMALL ASSEMBLY/BIKE ROOM
3. WASHROOMS
4. MASONRY HEATER
5. STORAGE
6. BEDROOMS
7. MAIN GATHERING SPACE
Plan]. Divided by a hallway, the floor plan of the building is a combination of two concentric semicircles that house different programmatic elements. The smallest semicircle dominates the southern façade of the building and houses the building’s public spaces. It focuses around a sitting area that contains the wood masonry heater as its focal point. The largest semicircle is nestled into the adjacent hill, and houses the building’s private spaces. The bedrooms are located within this second circle off of the principal sitting space. Although the bedrooms benefit from the radiant heat provided by the masonry heater, they have a higher degree of privacy due to their separation.

The building is approached from the east through a covered entrance. The entrance is flanked on either side by washrooms separated between men and women. The entrance vestibule leads toward a small assembly space and two generous storage closets. One of the closets is used for storing janitorial equipment while the other houses both the firewood and implements used for the masonry stove. The small assembly space adjacent to the entrance was once used for growing plants. Currently, it functions as little more than the location of the stationary bike used for generating back-up pedal-power electricity. According to the YMCA camp organizers however, the space and bike become quite useful if any of the guests have too much energy to spare.

The hallway from the front assembly bike-room continues in a slow curve between the concrete masonry wall of the bedrooms and the side of the masonry wood stove. The hallway culminates in the building’s main sitting area that faces south. The sitting area is entirely glazed with operable triple-glazed, low-E, argon-filled windows that overlook the meadow clearing beneath the hill and the Solarium building in the distance. Beyond the south façade on the exterior of the building, a wooden trellis fitted with photovoltaic panels provides shade and moderates heat gain during the summer months. The main room also has
The ceiling of the main room is sloped to provide lighting in the bedrooms [see Burrows Building North-South Section]. The glulam beams that comprise the building’s structure are left exposed in the main room, filling the space with the warm colours provided by the wood. Other than the commanding view to the south, the focal point of the main room is the wood-fired masonry stove. Located on the eastern part of the main space, the masonry heater delineates the entrance bike-room space from the main sitting area. When the building was constructed, the masonry heater was the largest in North America. The heater is the principal heat source for the building. Secondary heat gain comes from solar radiation that is collected in the concrete masonry walls via south-facing glazing; however the masonry heater alone is sufficient to provide enough heat for the entire building. Heat distribution is maximized with help from the curvilinear plan of the building; while the intermediate and northern walls help retain the heat within the space.

The second semicircle in plan delineates the building’s private spaces of bedrooms and bathrooms. In total, there are eight bedrooms: four rooms have enough bunks for six people, while the rest have sleeping space for four. Located on the north side of the building, the bedrooms are divided from the public spaces by a passive heat-gain concrete masonry wall. The dividing wall is made out of two layers of rough cut white masonry blocks and has a dual purpose: it stores heat from the masonry heater and sun, and aids daylighting of the main sitting space by reflecting sunlight with its light-coloured surface. In contrast to the dual function of the concrete masonry wall, the bedroom areas are designed for the sole purpose of sleeping, and consequently contain no furniture other than beds.
BURROWS BUILDING SECTION NORTH-SOUTH

1. MAIN SITTING AREA
2. BEDROOM
3. EXTERIOR TRELLIS
4. SOLAR PANEL
The exterior walls of the bedrooms are buried beneath the adjacent hill to the north. Grass cover extends from the hill to form a sod roof that covers the sleeping quarters and the east bathroom. The roof of the bedrooms slopes towards the north so as to provide space for south-facing clerestory windows. These windows provide light and ventilation in the sleeping area. The bedroom windows are operable and ventilate the rooms using the stack effect; during the summer months cool air enters from the hallway and the main room causing warm air to collect and exit the building through the windows at the top of the bedroom space.

The basement service area is located on the west side of the building. Apart from its entrance, the service area is completely interred in the adjacent hill. Overall the basement represents a fraction of the floor space provided above. The service area houses the many components required for the high-tech systems used in the building; it stores the stationary bike when it is not in use, the composting toilet and water filtration systems as well as battery storage for both the photovoltaics and pedal bike systems.

The programming of the spaces is also separated according to environmental strategies. The interior of the building is separated horizontally: the first floor houses mostly low-tech environmental strategies whereas the basement holds the body of the high-tech environmental systems. In contrast, on the exterior of the building the low-tech and high-tech systems are combined. Solar hot-water panels are located on an elevated clearing along the sod roof, and a wooden trellis combined with photovoltaics moderates heat gain along the south façade and provides power for the building.

In a similar manner, the methods used for the heating and cooling of specific spaces lend legibility to the floor plan. Low-tech environmental strategies such
as solar gain, active and passive heating as well as the interring of specific spaces indicate public and private spaces very clearly. Solar light and heat gain along with the masonry wood heater directly heat the main room, indicating it as a public space. The bedrooms are heated indirectly through long-term heat radiation that emanates from the public space, indicating that bedrooms are private.

ELEMENTS OF SUSTAINABLE DESIGN

The materials used in the Burrows Building were selected according to specific criteria: they had to be low in embodied energy, reusable or recyclable, available locally, and adaptable in respect to the skills of the local builders involved in the project. The construction of the building employed mainly local manpower, including many people from neighbouring farms.

Wherever possible the architect specified wood post-and-beam construction instead of concrete structural elements. Due to the extra energy required to produce concrete, only the interred retaining walls on the north side of the building are made out of concrete. The concrete used in the Burrows Building is made in part from reused materials. Half of the aggregate used in the concrete mixture came from 40-year-old sidewalks and foundations from a nearby site. One of the only other elements of the building with a high embodied energy is the concrete-masonry wall that separates the main sitting area from the bedrooms.

The majority of the materials selected for the building were either produced or reclaimed from local sources. Almost ninety-percent of wood used in the residence came from demolished buildings such as the Seagram Distillery Building in nearby Breslau. Other environmentally responsible materials include the

Above: Detail of the wood used on the ceiling of the main sitting room. Below: Detail of the south-facade exterior trellis with integrated photovoltaic panels.
glulam beams used in the main sitting area, latex paint on the interior and carpet made from the recycled plastic bottle caps. Like the materials, the finishes used are environmentally sensitive as well; exterior wooden surfaces are treated with a vegetable based wood finish, while interior wood is treated with acrylic, water-based varnishes.\(^6\)

The heating and cooling of the building are designed to work with daily and seasonal natural temperature cycles. Since there is only one source of active heating, the system is very adjustable and thereby negates the need for a separate cooling system. The secondary source of heating – solar heat gain – is mediated by the strategic positioning of window openings, the wooden trellis and the photovoltaic panels. Both the panels and the trellis shade the interior during the summer while in the winter they allow the sun to reach the internal passive heat masonry wall. Because of the moderation of the interior climate by exterior architectural features such as the wooden trellis, the cooling of the interior is accomplished through passive means. In addition to the north wall that helps stabilize the ambient temperature, cross ventilation that uses the clerestory windows to induce the stack effect and are sufficient to cool the building. There are no blinds or shades installed on the interior of the building to help moderate the amount of daylight that enters the building. This choice was very conscious on the part of the architect: because the space is used primarily at night for sleeping, there is no need for daytime control of light levels.

Water used in the Burrows Building is provided by a well located on the site. All of the grey and black water produced in the residence goes through either the Clivus Multrum composting toilets or Waterloo Biofilter water treatment system.\(^6\)

The residence managers have discovered however that neither the composting toilet nor water filtration systems are used to their full potential; the toilets produce only one wheelbarrow full of compost annually while the sponges in
the water filtration system often dry up. In addition to other water conservation strategies, the land surrounding the building has not been landscaped. Left in its natural state, the landscaping does not require watering.

The design of the Burrows Building is very specific to the local site and climatic conditions. Despite this, there are many elements of its design that could be integrated into buildings in cold, temperate, and even hot-humid climates. Buildings constructed in hot climates could gain from partial interment in order to benefit from the heat-moderating qualities of earth cover. Interior cooling can also be accomplished through the use of shading devices combined with natural ventilation as provided by the clerestory windows in the bedrooms. These and other elements such as the photovoltaic cells and the solar water heater could also benefit buildings in hot, as well as cold and temperate, climates.

THERMAL ENVIRONMENTAL STRATEGIES

The predominant environmental strategies used in the Burrows Building are passive rather than active. Passive heating and ventilation as well as the solar orientation of the building are the most important factors in the design of the building. The focus on passive strategies allows the light and heat that enter the building to be used to their fullest potential. The sun is used for a multitude of purposes; from the heating of interior spaces and water, to daylighting and the delineation of private versus public spaces. Active elements such as the wood masonry heater are used in conjunction with passive components such as heat gain through solar radiation. The building relies upon passive elements to maintain the ambient temperature, including the passive concrete masonry wall that divides the sitting space from the bedrooms. The concrete masonry wall collects heat during the day and reradiates it at night to warm the bedrooms and
The masonry heater is the only active heat source in the building. Relying on a small, intense fire, it is stoked twice daily with wood from nearby farms.

The active heat source for the Burrows Building is the masonry wood heater. The design for the heater is based on traditional masonry heaters used in Northern European dwellings. Also known as Kachelofen, Grundofens, Varaava Takka, tile stoves, ceramic stoves or Finnish fireplaces, historically they were used as kitchen wood-fired stoves. Developed between 1500 and 1800, the stoves were used in both peasant and wealthy homes. They ranged from simple white-washed clay stoves to ornate, tile-clad masterpieces. Traditionally, these stoves were located in the centre of the dwelling, and fired twice daily for two purposes: the preparation of meals and the heating of the building. Because of their sheer size, at night the stoves served as additional beds; however their use was reserved for the elderly or ailing members of the family.

There are three basic components to the masonry heater: a firebox, a large masonry mass, and a multi-baffled flue passageway. The firebox and flue are lined with firebrick, refractory concrete or similar materials capable of handling hot temperatures. Depending on the stove, the fire box can reach temperatures in excess of 2000°F – or 1,093°C. The large masonry mass absorbs the heat from both the fire and the smoke that travels through its passageways. The masonry mass retains the heat and releases it slowly over the course of the next twelve hours into the ambient space. In contrast to a typical English fireplace where heat from the fire and smoke is lost up the chimney, the baffled flue passageway allows for heat to stay within the masonry mass long enough for it to be absorbed.
The masonry heater in the Burrows building takes advantage of the innate benefits of this centuries-old technology. Radiant heat – like that of the sun – is more comfortable than heat from a forced air system. It maintains humidity levels and will not create a draft. The heater is more energy efficient than a regular wood stove or fireplace. It retains 90% of the heat produced in the fire, compared to only 60% in regular wood stoves and 10% in fireplaces. The fire produced in the masonry heater is clean burning; it emits very little air pollution in the form of fine particulates and smoke. The harmful gases, compounds and tars associated with wood fires are burned in the firebox, creating heat not pollution. On average a masonry heater produces one eighth of the emissions produced by a common fireplace - 2.8gm/kg of emissions compared to 24gm/kg. In addition, the masonry heater also requires less fuel than a typical wood stove or fireplace. Although the heater in the Burrows building relies upon wood from surrounding farms, other heaters can be designed to use any type of solid fuel, including pellets or even compost.

Despite all of the benefits of masonry heaters, there are some disadvantages as well. The masonry heaters cannot provide heat quickly from a “cold start” in the same way a fireplace can; they require hours of burning in order to warm the ambient space. Unlike gas furnaces and other common heating systems employed in residential buildings, the masonry heater requires daily maintenance. In cold weather it needs to be stoked twice daily to ensure that the building stays warm. The construction of masonry heaters is also quite complicated. In 1998, the Masonry Heater Association of America introduced a rigorous certification program for masons wanting to specialize in the technology. Although the heaters are currently advertised as do-it-yourself kits, the assembly of the heater requires experienced professional help. Another disadvantage to the heater is the up-front investment. Masonry heaters are long term investments compared to other residential heating systems; however this was not a concern in the
In combining active and passive systems to meet year-round heating and cooling needs, the Burrows Building is exemplary in the integration of its building systems. The active and passive systems can function independently of each other, however together they maximize the performance of the building. Although their integration and operation may seem complex, the systems function using a combination of century old techniques and new technology. For this reason, the residence is very adaptable: because the building is built “off” of the energy grid, in worse case scenarios the Burrows Building will be unaffected by future energy crises. At the same time, the building still permits flexibility for the addition of future technological elements. Since the basic building systems work without relying upon high-tech systems or external energy resources, technological elements can be easily replaced – or removed – without diminishing the building’s overall performance. The building’s caretakers have noticed that during normal weather conditions, the building operates perfectly using only passive systems. Together however, the high-tech and low-tech systems are so efficient that the building generates more energy than it needs. Within the near future, the YMCA hopes that it will be able to sell some the surplus energy back to the power grid to help fund the maintenance of the building and its year-round camp activities.

CONSTRUCTION DETAILS

The architect was careful that the wall, floor and roof assemblies maximized their insulating values. Simon aimed to achieve R-values of over R-30 for each of the assemblies, however was surprised by certain assemblies that performed better than their estimated value. In the case of the north retaining wall, it was...
able to surpass its estimated R-value because of the earth cover: it did not lose as much heat as it normally would have if it were exposed to air.\(^{13}\)

In contrast to special features such as the north retaining wall, the construction of the rest of the building does not differ much from a typical residential building. The architect specified conventional building methods and materials that in turn saved time and expense compared to the use of new materials and technologies. No specialized, extraordinary products were used in the construction of the building with the exception of the sealant used in the south-facing glazing.\(^{14}\)

In terms of construction however, the Burrows Building is set apart in two ways: first, by the emphasis placed on high insulation values that surpass building code requirements; and second, the careful and appropriate application of materials and construction technologies for all building assemblies as they relate to specific requirements.

Ironically, despite the low-tech approach used for heating the building that is based on hundreds of years of traditional vernacular building, the mechanical systems used in the Burrows Building are not considered “conventional.” Unlike the construction of the typical contemporary residential or institutional building,

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**WALL ASSEMBLY**
- WOOD FASCIA
- 16x140 mm CEDAR SIDING
- 13 mm PLYWOOD SHEATHING
- ALUM. WINDOW SECTION AFFIXED TO u/s OF WOOD DECK ABOVE
- 2x89 mm BATT INSUL. TYPE 1 (R-25)
- 6 mil POLY VAPOUR BARRIER
- 13 mm G.W.B. LET INTO REBATED WOOD TRIM, TOP & BOTTOM

**ROOF ASSEMBLY (METAL ROOF)**
- MRT-L STANDING SEAM METAL ROOF
- PANELS ON THERMRO Z-CLIPS
- 2x75 mm SEMI-RIGID INSUL. TYPE 4 (R-28)
- 47 mil EPDM ROOF MEMBRANE, LOOSE LAID INSTALLATION
- 13 mm FIBREBOARD SHEATHING
- ROOF BEAMS

**WOOD TRELLIS (CEDAR)**
- 2-38x89 mm TOP CHORDS SPANNED 100 APART W/STEEL ANCHOR C.L. @ WALL AND BEAM
- 9 mm THREADED RODS @ 300 O.C.
- 150 mm DIA. COLUMN @ 2750 O.C.

**EXTERIOR DECK**
- 36x140 mm CEDAR DECK BOARDS W/ 6-10 mm SPACING AND 2% SLOPE
- 38x235 mm JOISTS @ 600 O.C.
- 38x235 mm BEAMS @ 2400 O.C. ON 200mm DIA. CONCRETE FOOTINGS
SOD ROOF ASSEMBLY
- 150-200 mm SOIL/PLANT MIX
- DRAINAGE MEMBRANE W/ FILTER CLOTH
- 2x75 mm RIGID INSUL. (R-30)
- 60mil HREPDM ROOF MEMBRANE (LOOSE LAID)
- 13 mm FIBREBOARD SHEATHING
- 38x89 mm WOOD DECK
- 200 mm GLUELAM ROOF BEAMS

PARAPET CONSTRUCTION
- PREFIN. METAL CAP FLASHING
- EPDM ROOF MEMBRANE FULLY ADHEARED TO FRONT EDGE OF PARAPET
- 16 mm PLYWOOD SHEATHING
- 38x89 mm WOOD FRAMING @ 400 o.c.
- 16 mm PLYWOOD SOFFIT

FLAT ROOF ASSEMBLY
- 75 mm GRAVEL BALLAST
- 2x75 mm RIGID INSULATION (R-30)
- 6 mm H.D. EPDM ROOF MEMBRANE (LOOSE LAID)
- 16 mm PLYWOOD SHEATHING
- 38x184 mm WOOD JOISTS @ 400 o.c.
- 200 mm DUCT SPACE
- 19 mm WOOD FURRING
- POLY VAPOUR BARRIER
- 13 mm G.W.B.

RETAINING WALL
- 2x75 mm RIGID INSULATION (TYPE 2 R-30)
- 1500 BELOW GRADE AND SINGLE LAYER TO FOOTING
- PEEL & STICK WATERPROOF MEMBRANE
- 200 mm C.I.P. CONCRETE WALL
there is no air conditioning system. The cooling and ventilation of the building is done through passive means as opposed to active mechanical systems. In a similar manner, the building’s energy requirements are met using the sun and wind through photovoltaic panels and a wind turbine. The Windseeker-500 wind turbine provides an hourly output of 24 Volts – or 500 Watts. The rest of the building’s energy requirements are met through the photovoltaic panels. Similarly to its electrical needs, instead of using a typical hot water heater or gas-fired boiler, the Burrows Building relies upon solar energy to heat its water. Surplus energy from the photovoltaic panels, wind turbine or stationary bike is stored in batteries in the basement of the building to provide energy in times of extreme weather conditions. The mechanical systems also include the composting toilet and water filtration systems that are uncommon in institutional buildings.\textsuperscript{15} It is clear that despite the use of low-tech, commonplace methods and materials, the Burrows building is anything but “conventional.”

**LEADERSHIP IN ENERGY EFFICIENT DESIGN**

The estimated LEED rating for the Burrows Building is based on version 2.1 of the certification system. The building was constructed prior to the creation of the rating system; however it receives an estimated 46 out of 69 possible points which qualifies the building for Gold status. Although the rating system seems biased toward urban redevelopment projects, the Burrows Building exceeds environmental standards even for buildings constructed under the conscious use of the LEED programme. As such it becomes a useful tool in order to quantifiably compare the sustainability of the Burrows Building to others of its type.

**Sustainable Sites:**
Careful siting and the integration of the building into the landscape achieved the majority of the points in this category. Due to low site disturbance, and the location of the building away from the lake, marshy land and other sensitive ground, the building was able to earn points for siting and storm water management. The natural landscaping and sod roof slow rain water run off, as well as reduce the effects of heat-islanding. Because the building is constructed off of the grid, one-hundred percent of its storm water is treated on the site. External light pollution is also minimized due to the few exterior lights on the building. The only points lost in this category were due to its rural location. For this reason, the building could not gain points for the redevelopment of a brown-field site, the reclamation of any part of an existing structure, nor could it implement measures for accessibility via means of mass transportation. Because of its remote location, it is assumed that YMCA camp participants will arrive by charter bus. This however also reduced the amount of parking otherwise needed for a dormitory type building, and accordingly gained the building an additional point.
Water Efficiency:
The naturalized landscaping and innovative water treatment system earned the Burrows Building full points in this category. The water consumption in the building is also minimized by the use of composting toilets – by at least thirty percent over a typical dormitory building.

Energy and Atmosphere:
The Burrows Building receives high marks for optimized energy performance. Since the building employs natural or energy efficient strategies for heating, cooling and lighting its spaces, the building achieves a fifty-percent energy savings over that of ASHRAE standards. Because the ventilation and cooling of the building is achieved by passive means, the building does not have an air-handling unit. Without a typical mechanized HVAC system or chiller, the building helps reduce ozone depletion because it does not require coolant for its systems. Similarly, energy requirements are met through renewable resources; thus the photovoltaic panels and wind turbine earned the building additional points as well.

Materials and Resources:
The careful redirection of construction waste for reuse, and the use of reclaimed wood and concrete aggregate from demolished buildings, and the use of materials with recycled content such as the carpet, allowed the Burrows Building to gain many points in this category. The building lost points however, because the architect did not specify certified wood, nor use proven rapidly renewable materials.

Indoor Environment Quality:
The burrows building excelled in this category due to the thought put into the heating and ventilation of the building. By relying on passive means to air the
building, the ventilation system exceeds the standards set out by LEED for both air-exchange rate and controllability. Also, there is very little indoor light pollution from artificial sources since the building is nearly one-hundred percent day lit. The use of natural materials, sealants, adhesives and finishes minimizes the off-gassing in the building and helps maintain the indoor air quality. The building lost points however because the only permanent monitoring system in the building is a carbon-monoxide detector – an essential instrument in a building heated by a wood masonry stove.

**Innovation in Design Process:**
Like many buildings evaluated by the LEED accreditation system, the Burrows Building achieved only one point in this category for educational benefit. This category seems to be the most difficult to excel in, unless the building is innovative in many different aspects. Unfortunately, like many other categories, points are lost up front for buildings designed without the guidance of a LEED accredited professional. It seems slightly unfair to use the system for buildings designed prior to the implementation of LEED, however the Burrows Building is very successful overall.

**CONCLUDING THOUGHTS**

The Burrows Building was constructed as part of a participatory learning environment designed to teach people about environmentally responsible living through example. The building successfully displays many different environmentally sustainable techniques and strategies for manipulating the quality of architectural space. As part of the building programme, the residence is designed to operate in a user-friendly way. The design relies on passive heating and cooling while active mechanical systems support, but do not dominate the functioning of the building. Overall the Burrows Building stands out in terms of design considerations, environmental systems and construction. In doing so, it demonstrates that environmentally conscious design can use primarily low-tech passive systems and centuries-old building techniques in order to be exemplary of environmentally sustainable design in North America.
ENDNOTES

1. Charles Simon, personal interview.
2. Charles Simon, personal interview.
3. Charles Simon, personal interview.
4. Charles Simon, personal interview.
7. Callum McKee, personal interview.
8. Chimney Keepers Website.
11. Temp-Cast Masonry Heaters website.
13. Charles Simon, personal interview.
14. Callum McKee, personal interview.

IMAGES

Burrows All images graciously supplied by Professor Terri Meyer-Boake of the University of Waterloo.
Page 16 Masonry heater schematics and tile-clad example from Biofire website.
Page 17 Cook-stove masonry heater from Woodmasonry.com; Rod Zander’s Baker’s oven masonry heater and Gimme-Shelter cottage-style heater from the Masonry Heater Association of America Image Gallery; contemporary white, fireplace-style heater from Biofire website.

DRAWINGS

Page 4 Burrows Building Main Floor Plan based on plans supplied by Charles Simon Architect, modified by author and Kate Harrison
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Page 17 Reconstructed wall section of bedrooms based on drawings supplied by Charles Simon Architect, redrawn by author

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