ARCH 684: Advanced Studies in Canadian Sustainable Design
Winter 2003

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Burrows Building – Earth Residence, YMCA Environmental Learning Centre Paradise Lake, Ontario

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Quick-Facts:	
Building Name	The Earth Residence renamed The Burrows Residence, The YMCA Environmental Learning Centre
City	Paradise Lake, Waterloo
Country	Canada
Year of Construction	1994/95
Architect	Charles Simon Architect Inc.
Consultants	Allen Associates
Program	A year round residence for forty residents and a part of The YMCA Environmental Learning Centre
Gross Area	3,600 s.f.
Owner/User Group	The YMCA of Kitchener-Waterloo
Climate	Cold humid continental climate with harsh winters and warm summers
Special Site Conditions	Located “off-grid” on seventy seven partially wooded acres with twenty acres environmentally sensitive
Aesthetics	Designed to blend with the nature.
Structural System	Concrete retaining walls and a wood post and beam construction.
Mechanical System	A central masonry wood heater.
Special Construction	The north wall buried into the hill. Much of the wood in the building is reused timber and siding.
Daylighting	South oriented glazed surfaces and clerestory windows in the sleeping rooms.
Shading	A trellis at the south glazed surfaces.
Acoustics	Not of a special concern, but all walls and floors well insulated.
Ventilation	Ventilation is low-tech: operable windows and cross ventilation with a stack effect.

Adaptability	Design specific to the site with adaptable elements.
User Controls	Designed to be “low tech” and user friendly.
Estimated LEED rating	53 points (GOLD)
Budget	About $350,000.00
Cost of Constructions	Not available
Annual Maintenance Cost	Not available
Special Circumstances	Designed close to environmentally sensitive area and situated “off-grid”.

Paradise Lake aerial view

Introduction

The idea for the YMCA Environmental Learning centre was born in early 90's. The Kitchener-Waterloo YMCA was looking to develop their summer camp at Paradise Lake, Waterloo. They hired Charles Simon Architect Inc. as a consultant to consult them on the development and program of the area. The master plan included development of the program of the existing summer camp as an exercise in environmental responsibility. The final result bore the idea of The YMCA Environmental Learning Centre where groups of kids (and adults) would come and learn how to live in an environmentally responsible way.[1]

The Kitchener-Waterloo YMCA liked a potential in this proposal so much that they hired the same architect to follow up with the proposal. The Burrows Residence was designed as a team effort where the client, the architect, the site and the available materials all influenced each other. The process of the design development included the sensitivity to the environment and the building was constructed to be inhabitable year round.[2]

The YMCA Learning Centre consists of two buildings. The Solarium Building houses the offices, the seminar room and the green machine. The other building is The Earth Residence that was renamed by YMCA into The Burrows Residence. This building is designed for year round overnight stay for up to forty individuals. The Earth Residence was completed first in spring of 1994 and it is a showcase for the assembly buildings built off of the energy grid.

The Earth Residence building is a low-tech design with the high-tech features added as a back-up. The low technology features are a masonry wood heater as the only source active heat, a passive heat masonry wall, the green roof, a solar water heater, a solar oriented design that also allows for a good stack effect cross ventilation and the curvilinear fan shaped design that allows for the sufficient heat and light distribution. The high technology features are the photovoltaic panels on the south façade, the wind turbine, the composting toilets and the water filtration system. The residence also houses a bike for the additional human pedal power and batteries for the storage of the additional energy.

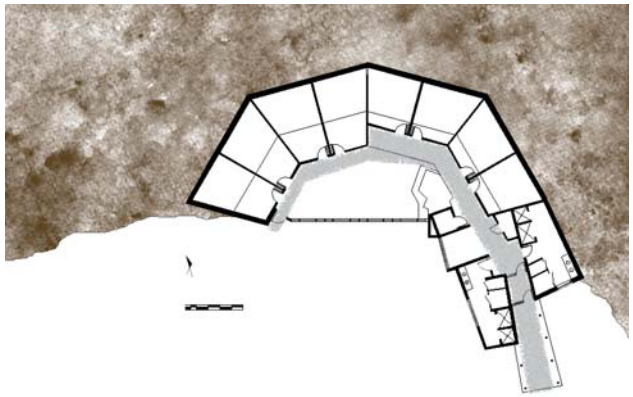
Aesthetically the design of the Burrows Residence was to contribute to the environment rather than contrast it. Therefore the building exterior is nestled into the south exposure slope with exterior wood cladding left to age with the seasons. In addition the building is surrounded by a thick forest and colour wise it blends in the surrounding during summer months.[3]

Front view of The Burrows residence

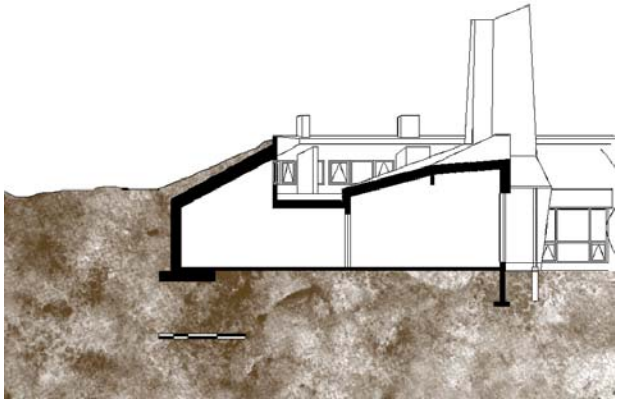
Program

The Burrows Residence provides an overnight stay for up to forty guests that come to The YMCA Environmental Learning Centre for the educational camp sessions. Most of the building area of three thousand and six hundred square feet is on the first floor with a small basement underneath the west side. The floor plan of the building is a combination of two fan shaped spaces, the south one in the front and the back one on the north side, with the hallway connecting them both. The hallway also acts as a transitional space between the south public spaces and the north private rooms.

The Burrows Residence is approached from the east through the covered entrance. The entrance is flanked on both sides by the washrooms. The entrance vestibule leads toward an assembly room that used to house plants and is now days sometimes used for the generating the electricity by human pedal power. It apparently becomes quite useful if any of the guests have too much energy to spare. In the same area there are also two storage closets, one for storing the janitorial equipment and other one used for storage of the wood and the masonry stove's implements.



First floor plan with indicated hallway.

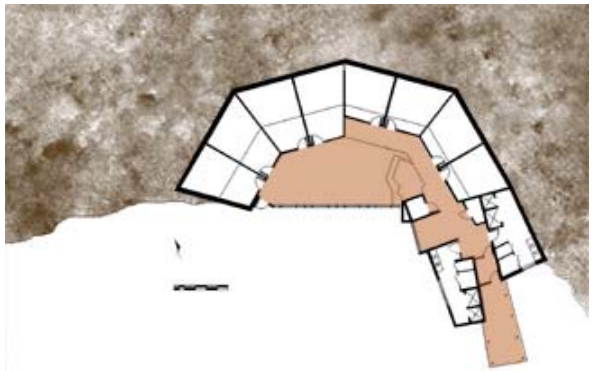


Cross section through the main room and sleeping room.

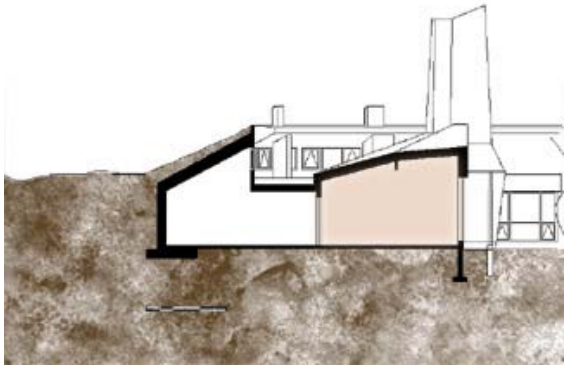
The hallway from the front assembly room continues in a slow curve between the masonry heat wall and the back of the big masonry wood stove and culminates in a main assembly living room. The main room has large triple glazed low-E argon filled windows with operable openings at the bottom part facing south and overlooking the lower ground with the Solarium building in a distance. In front of the room is the wooden trellis that provides shade during summer months. The room also has a secondary exit on the west side that leads to the outside earth terrace.

The ceiling of the main room is sloped to provide the back rooms with the access to light. The roof is hold up by large glue-lam beams and the post and beam construction. The focal point of the main room beside the view is the indoor masonry wood stove. The masonry heater is so far the largest one build in North America and it is located on the eastern part of the main space thus delineating the entrance spaces from the inside assembly area. The heater is the only heat source for the whole building. Since the design of the residence is curvilinear with the heat source in the centre, with large

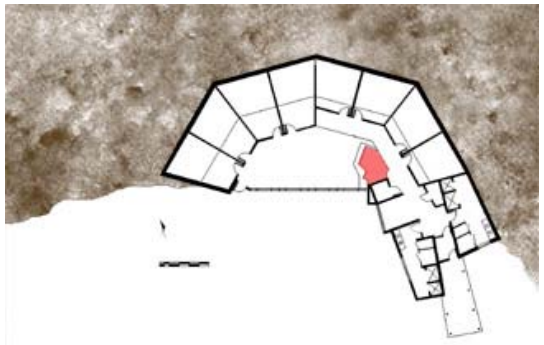
glazed south surfaces, masonry intermediate wall and subterranean north wall, the building only heat source is enough to heat all of the spaces sufficiently. The masonry wood heater is fuelled twice daily, usually in the morning and again at night, with dry wood from nearby farms.



First floor public space



Section through public space



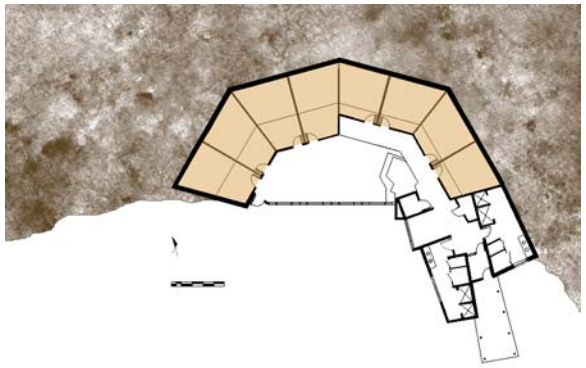
Plan showing location of masonry heater.

The main room view with south windows.

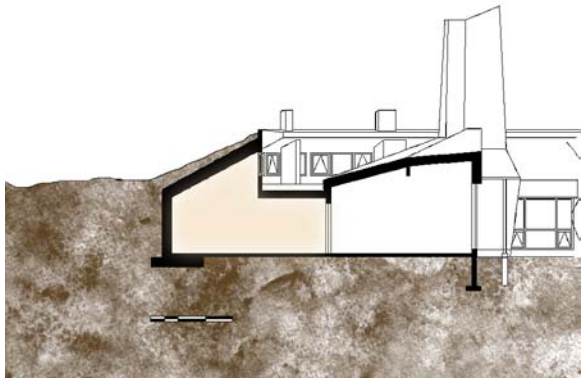
The glue-lam beams for ceiling.

The masonry heater in the main room.

The back curve of the plan indicates private spaces in form of the rest rooms with bunk beds. There are eight rooms all together all built into the hillside. Four of them house three bunk beds for six persons, while the rest house two bunk beds. The rooms are divided from the public area by a passive heat masonry wall that. The passive heat wall is made out of two layers of rough cut white masonry blocks and it has dual purpose of storing the heat from the masonry heater and sun, as well as reflecting the light due to its light surface. The rooms are designed only for the resting purposes; therefore they do not contain any other furniture but beds. The exterior walls of the rums are subterranean and the grass cover extends to the green roof that covers the sleeping quarters and the east bathroom. The roof is sloped towards north so there is space for openings on the south where the only windows for the rooms are. The windows are all operable and the ventilation act on the stack affect, where during summer the cooler air enters from the hallway or the main rooms through the door and the hot air, is directed via the sloped roof upwards toward the windows.



The private resting quarters.



Cross section indicating the resting rooms.

The masonry wall.

Inside of the rest room.

Inside of the bedroom.

The window in the bedroom.

The basement floor is built on the west side of the building and is pretty much subterranean except for the entrance. It houses the bike for human pedal power, the composting toilet system, the system for filtration of the water and the batteries for the storage of the electricity.

The program was designed with the selected environmental strategies in mind. According to that classification the program is divided horizontally. The space above the first floor slab is the seat of mostly low-tech environmental strategies with the solar water heating panels positioned on the elevated clearing behind the green roof. The basement floor houses the main body of high tech environmental system with the storage batteries.
On the whole the interior was designed to implement the passive heat and solar gain with the high-tech system supporting it. Therefore the caretakers are noticing that in the normal weather conditions they are generating more energy than they need, which they are hoping to sell back to the energy grid.

The low-tech environmental strategies solar gain, active and passive heat source and subterranean north wall indicate public and private spaces very clearly. The solar light and heat gain along with the active masonry wood heater is active in the main room that is delineated as the active space. The bedrooms are the recipients of passive heat gain through the passive masonry wall and with the smaller amount of light indicate a resting space. In addition the subterranean north wall helps with the fluctuation of the temperature in the bedrooms, which is also beneficial for the sleeping area, since the earth keeps the rooms cooler in the summer and warmer in the winter.

Site

The YMCA Environmental Learning Centre is located on seventy-seven acres of heavily wooded land beside The Paradise Lake. About twenty acres of the site are environmentally sensitive while some of it has already been used as a YMCA summer camp. The whole site is situated on rolling land that used to be used for farming and is surrounded by large farms.

The Burrows Residence is not built on environmentally sensitive ground, as chosen by the architect while he was researching the location. The architect was looking for a south facing clearing close to the forest, preferably on the hill side where he could built a buried building. This area was close to perfect since it met the above-mentioned requirements.[4]

The space delineated for the new Environmental Learning centre is at the north of the summer campgrounds. The ground is sloping slightly and the area of the Solarium has been chosen closer to the entrance to the site. The site for the residence has been chosen by the architect in the small clearing on the south-facing hill north of the Solarium building. The clearing on the site had views toward the solarium building on the south, to the entrance path on the west and to the Paradise Lake on the east. The area is protected from the north by a dense forest, the marshy south-west plane and large trees on the east side. The approach to the site is from the east along large trees growing closer to the lake.

The building fits into the site and it respects the original clearing and the wooded area. Since the building is oriented south it also follows the original orientation of the south facing clearing. Since the north façade of the building is subterranean

the ground protects the residence and the disruption of the sloped hill is diminished by burmed north wall. The grassed land also continues onto the roof, so the whole design in section is continuation of the hill.
The design of the Burrows Residence is specific to the site, however the elements of the design could be incorporated into the buildings in the temperate and cold climates. The hot climate would benefit with inclusion of the subterranean walls to keep the temperature of interior cooler. The use of shading devices as well as the photovoltaic cells and the solar water heater would fit well into design for the hot and arid climate.

Sustainable Design

The materials selected for The Earth Residence were selected according to the amount of embodied energy, the reusability, the recyclability, the local availability, the environmental impact locally and internationally, and the adaptability of the material in respect to local builders involved in the project. The project employed a lot of local manpower and quite a few very from neighbouring farms. The materials selected were local, especially the wood that came from demolished buildings and there were no special new products involved except for the sealant in the south windows.[5]

Wherever possible the design used a wooden post and beam construction, due to the energy required to produce the concrete. Therefore only retaining walls at the back of the building are made from concrete. The concrete used is partially made from reused materials, since half of the gravel used came from the 40-year old sidewalks, foundations and slabs from a nearby site. The passive masonry wall is another element of the building with significant embodied energy content. Close to 90% of wood used in the residence came from the demolished buildings, such as Breslau Seagram Distillery building. The other components of structure were the glue-lam wooden beams that are prominent in the main room roof

construction and recycled carpet in the main room that is made from the recycled plastic bottle caps. The finishing materials are like wise environmentally friendly. Exterior wooden surfaces were treated with vegetable based wood finish and interior is painted with latex paint and wood is covered with acrylic water based varnishes.[6]

The building is designed to work with the nature cycles and also with the temperature cycle of night and day. Since there is only one source of the easily adjustable active heat, the building does not need to be cooled down. The solar heat gain is cut down by the strategic positioning of the window openings and the wooden trellis with photovoltaic panels. Both the panels and the trellis shade the interior during summer while allowing sun to reach the internal passive heat masonry wall. The cooling of the interior is not a big concern since the heating process is adjustable. In addition the north wall is acting as a temperature stabilizer and as a passive cooling strategy while the cross ventilation and the stack effect are taking on the active cooling role.

Water that The Earth Residence uses is provided from the water source on the grounds and all the water that is used in the building goes either through the composting toilet system or the water filtration system. The management has discovered though, that both systems are not used to their fullest, since the composting toilets produce about a wheelbarrow of compost annually and the sponges in the water filtration have been known to dry up.[7] The grounds around the building have nor been landscaped and are left in their natural state, so they require no additional water.

Environmental Controls

The environmental controls implemented into the design for the Earth Residence are the solar heat gain, the solar orientation, the active and passive heat strategy, the passive ventilation. The focus is on passive strategies so that the light and heat accumulated is used to the fullest potential. The passive solar heat strategy is used to heat the water for the residence, for the lighting and delineating the interiors into active and non-active spaces, and for the passive solar heat gain. The active heat in form of the masonry wooden heater is used to heat the whole building in addition to solar heat gain of the main room. The passive heat masonry wall collects the heat from both sources and releases it during night into the sleeping rooms. The subterranean north walls contain and stabilize the temperature of the spaces. Therefore the heat generated is used by the building and its inhabitants rather than heating up the exterior.

The masonry wooden heater is designed on the precedents of the masonry heaters used in the European peasant buildings. The heaters are traditionally placed close to the middle of the building and fired up twice daily. Those heaters were usually used as a kitchen fire stove and as the additional bed, where the top of the stove provided a space for old or sick member of the family. The Masonry heater in The Burrows residence is likewise heated twice daily with dry wood logs coming from nearby farms. However that masonry heater is not used for cooking or healing purposes.

Construction

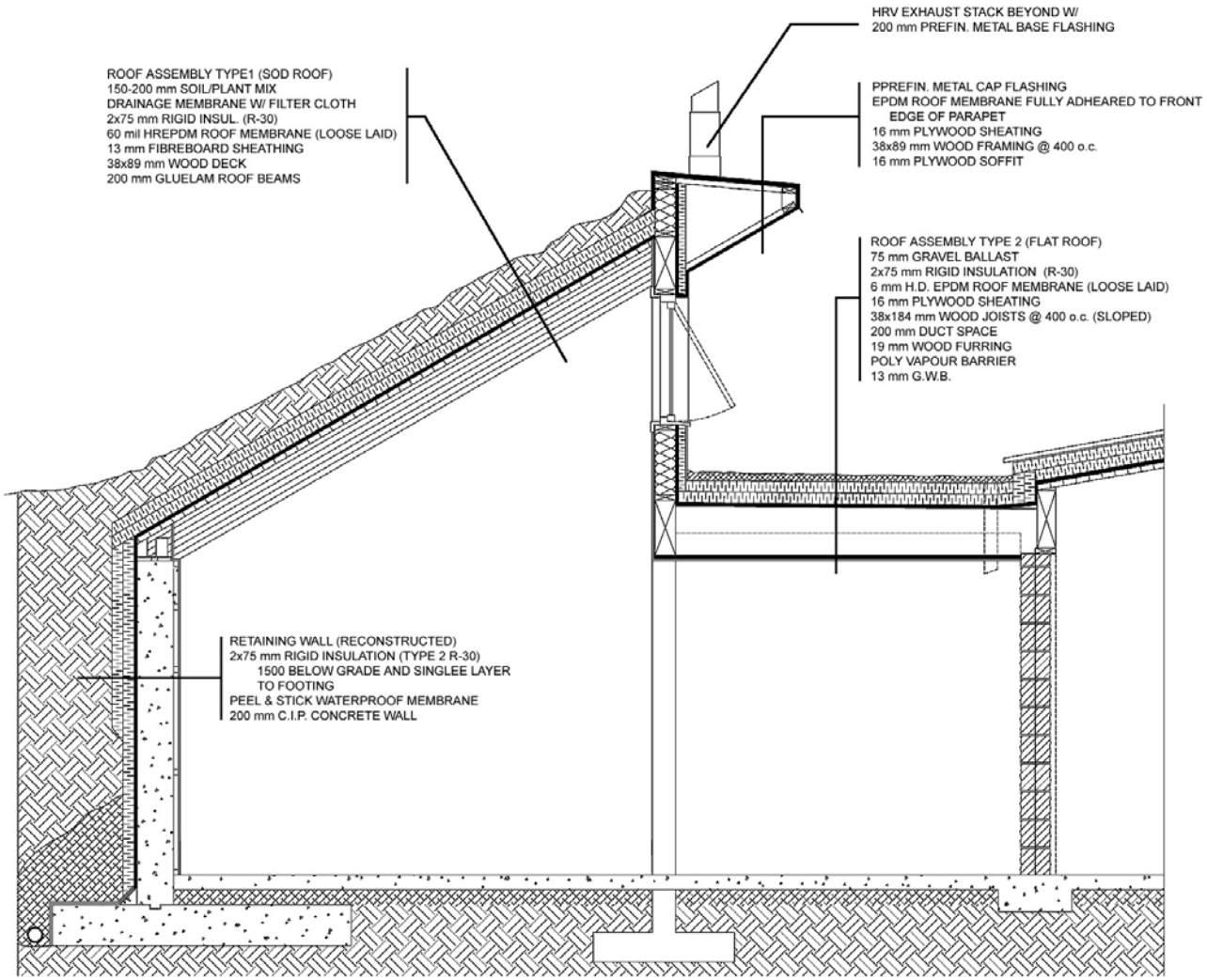
The Burrows Residence was built in 1994 with local building force. The construction of the building is based on the post and beam method with the concrete block wall system added only when needed. Quite a bit of wood used for beams and

columns came from the demolished buildings and the local farms. As such the building minimizes the embodied energy of the materials.

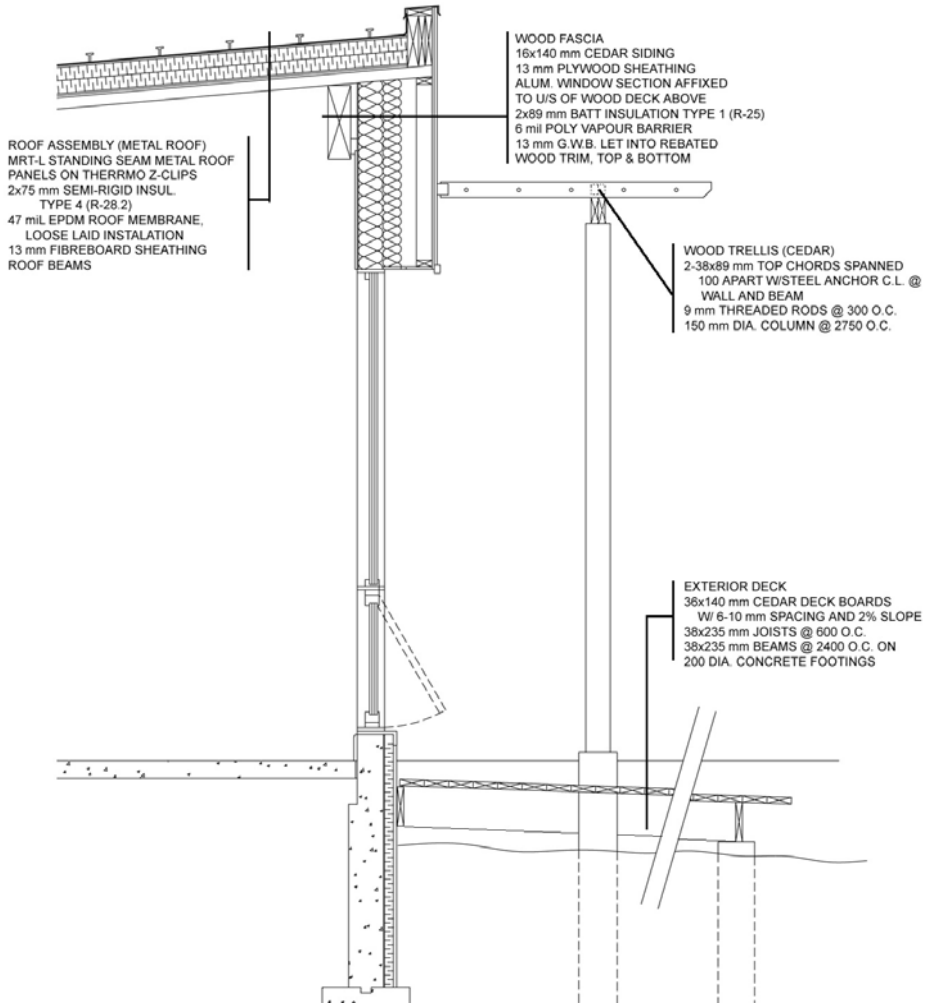
The R-value of the retaining walls is estimated to be around R-31, the sod roof or the Roof Assembly Type I is estimated to be R-34 and the metal roof or the Roof Assembly Type III is R-30. The design of the envelope tried to incorporate the high R-values for each part of the envelope, therefore most of the walls, the roof structures and the floors are well insulated and they all carry the insulation value of R-30 or more. In addition the subterranean walls perform better then their estimated value, since they are not loosing as much heat as they would exposed to air.

The rest of the construction of the building does not differ a lot from a typical residence that would be built as a summer camp. The conventional building methods were employed and none of the materials was at the time new to the building industry. What sets the building apart from other buildings in structural view is the overall insulation value that is higher then code demands and the use of the appropriate wall, roof and floor assemblies for the intended space.

On the other hand the mechanical systems are not as “traditional”. There is no air conditioning, since the aeration, the cooling and the air intake is based on the passive ventilation strategy. The energy is harvested from the sun and the wind in form of the photovoltaic panels and the wind machine. The wind turbines used is The Windseeker 500 a turbine that requires a minimum wind speed of five mph and has an output of 24 Volts or 500 Watts per hour. In addition the water is heated through the solar water heater, rather then an electric or gas boiler. The kinetic energy is added through the use of human pedal power and the excess of the energy is stored in the building. The mechanical system also includes the water filtration system that is so far uncommon in the institutional buildings and the composting toilet system.[8]



Sectional detail of a 6-bed sleeping quarters.



Sectional detail of the main room glazed surface.

The R-values calculated as per reconstructed details:

Roof assembly Type I (without added earth insulation value)	R 34
Retaining Wall (without the earth insulation value added)	R 31
Roof Assembly Type II	R 36
Roof Assembly Type III (metal roof)	R 30

Integration of Systems

The Burrows Residence employs active and passive strategies in heating and cooling of the building. The design relies on the passive strategy as the primary source for the heating and the cooling load.

The active and passive strategies included in the Earth Residence design can exist independently of each other. However they are all included into the building for the maximum performance. Their operation might seem complex, when contemplating the integration of active and passive strategies. Yet the passive heating and cooling strategies are logical integration of nature on the basic human level of dwelling shown in the primitive architecture. The structural systems here also act as a passive mechanical system since they are design to allow for passive heating and cooling functioning.

The design is a blend of century old techniques and new technology. It would be possible to incorporate future technology but only if it would elevate the implementation of the space. Since the building is functioning in respect of the initial proposal idea, the technology incorporated now could be easily replaced with the future one, without diminishing the Earth Residence's performance.

Costing

No information was available regarding specific budgeting of the building as it related to the final cost of construction.

Leadership in Energy Efficient Design Certification

The LEED rating is based on the current LEED Version 2.1 document. According to the LEED rating system The Burrows Residence receives 53 points, which gives the project rating of Gold certification. That means that the building is working successfully through an environmentally sustainable design perspective. It also implies that the building is working to the full potential the design promised.

The implication of imperfection is not necessarily described to the building performance, since as an estimator I have to admit that building is a success. The building received all the necessary points where the LEED point system related to the design strategy. However there were the points that the structure did not receive such as category of the Brown-filed development or the existing Building Reuse. Since those categories are part of the rating system, a newly build building is therefore punished for the not using the existing structure, which is not always possible.

The rating system seems to work well for the urban redevelopments or where the conditions described before are present. It however fails where circumstances such as the possibilities of a brown-filed redevelopment and a renovation are not there in the first place. The LEED Rating System would benefit from including the categories for the buildings that are not set in urban setting.

Conclusion

The Burrows Residence has been built as a learning environment that would teach people how to leave in an environmentally respectable way. As a building it displays various environmentally sustainable techniques in manipulating the quality and temperature of the space. Since it is a learning space it is designed to operate in a user friendly way. The design relying on the passive heating and cooling with the supporting active mechanical systems demonstrates that environmentally sustainable design can be successful. The success of the building can be attributed to the inclusion of the passive strategies as a primary directive. That way the building is relying on its environment not merely substituting the environmentally active mechanical strategies for the commonly used ones.

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Endnotes

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