Project #1: Sustainable Design Case Study

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Arch 226: Environmental Building Design

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West Vancouver Aquatic Centre *Hughes Condon Marler Architects*

Southeast Façade from Civic Green

The West Vancouver Aquatic building is a part of the Waterfront Recreation Complex. In addition to the renovation of an original 25 year-old community centre, the expansion provided the aquatic facility with a new leisure pool, waterslide, fitness areas, hot tub, steam room, sauna, and family change rooms.[1] The shell of the existing centre was retained, however an $8 million dollar budget from the City of West Vancouver, in which 7.5 million was used, allowed for extensive use of engineered wood in the construction.[2]

Construction Process

The extensive refurbishment of the West Vancouver Aquatic Centre was designed by Darryl Condon, a partner in Hughes Condon Marler Architects (HCMA) of Vancouver. All primary architects as well as all the associates in the firm are LEED Certified. The Leadership in Energy and Environmental Design's Green Building Rating System assists in encouraging the design of sustainable buildings.[3] HCMA have completed three LEED certified buildings. They include the Spring Creek Fire Hall (LEED silver), the Whistler library and Museum (LEED gold) and the HCMA office (LEED gold). Certain assumptions were made during our analysis suggesting that although the building was not designed with LEED certification in mind, the underlying sustainable principles could still be applied, seeing how they have been in the past. Unfortunately some of the requirements for LEED were so specific that it was not possible to award points under certain categories due to unavailable information; an example being the many points awarded for the construction phases of the project.

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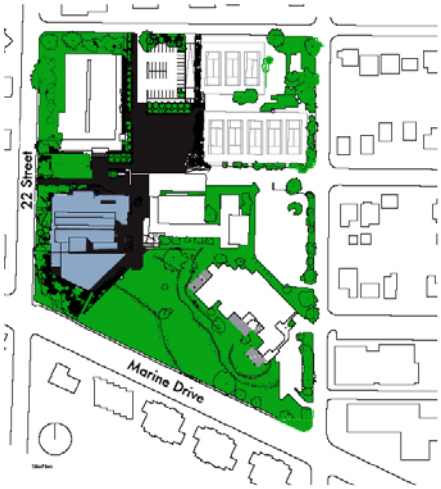
[1] West Vancouver Aquatic Centre: New Life for an Old Building
http://www.cwc.ca/publications/case_studies/Outstanding_Wood_Buildings/west_vancouver.php

[2] West Vancouver Aquatic Centre: A Wood Showcase
http://www.woodchampions.com/woodchampions/default.asp?NewsID=109&NavBarID=22&SideBarID=103&Cat=LR

[3] LEED: A Tool for Analysis and Comparison for Canadian Building Case Studies
http://www.fes.uwaterloo.ca/architecture/faculty_projects/terri/Leed-CA/SESCI_case_BOAKE.pdf

Site Plan



The recycling of the original aquatic center plays a great role in the sustainability of the building. Not only does it extend the lifespan of the original recreation center as a whole, it also re-uses a site that is already situated within a dense urban area with an existing infrastructure. This eliminates any need to further disrupt existing green-fields, habitats, and natural resources. The expansion was also designed in a matter which minimizes the impact on mature existing trees on the north and west sides of the facility.[4]

Although the renovation and expansion required the site to undergo significant reorganization and upgrade, the disturbance of the site was significantly reduced. Key landscape elements have remained and new native and adaptive vegetation were planted in order to restore the natural site.[5] The civic lawn remains as a large open green space adjacent to the aquatic center, which provides for direct circulation in and out of the building. This space allows the center to exploit the potential of the site by creating new sight lines for desirable views and allows access for available sunlight.[6] This is accomplished with floor to ceiling windows that look out onto the existing mature trees and provides for a panoramic view of the North-Shore Mountains.[7]

The heat island effect is minimized through various design elements of the building. Non-roof components that accomplish this include the use of an open-grid pavement, shading devices, and natural vegetation which surround the building. Unfortunately, no attempts were made to reduce the heat island effect on the roof.

Open-grid pavement outside Southeast entrance way

View to existing mature trees

Civic Green Conceptual Sketch

The site provides for good access to public transportation. Bus stops are present within a quarter mile radius of the building and sky trains are also a transportation option. Change rooms with showers along with the use of bicycle storage will promote alternative mode of transportation, since more members will be inclined to ride their bikes to the recreation center.

Vancouver Bus Route Map

Minimal consideration for storm-water management is utilized in the building. The system does not collect and treat storm-water, though it does incorporate unique methods of driving the water away from the building. Rain water leaders are used to carry the water within the wall cavity and deposit it near the foundation wall, thus avoiding the staining of the curtain wall. This system however does not fulfill LEED requirements which could have been accomplished in order to be credited for rainwater management. Other methods that would have increased the sustainability value of the project, but were overlooked, include the use of brown-field redevelopment and light pollution reduction.

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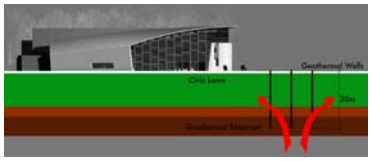
[4] New Life for an Old Building
[5] Hughes Condon Marler Architects. (no date). West Vancouver Aquatic Centre [pdf]. Vancouver, BC.
[6] HCM Architects
[7] Special Edition Tidings: Making Waves in Your New Aquatic Centre
http://www.westvancouver.net/upload/documents/leisure_guide/new-aquatic-centre/special-edition-tidings.pdf

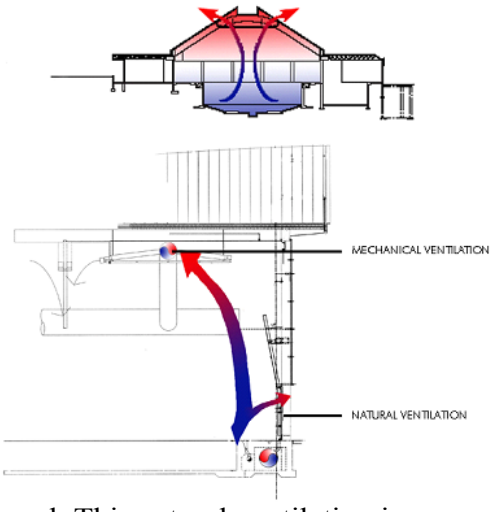
The site selection benefited the natural geothermic activity below ground. The building was able to harness and utilize this potential alternative fuel by assigning all the heating and cooling tasks of the building to a system which uses pipelines driven directly into the ground to divert the heat source.



Geothermal System

The West Vancouver Community Centre utilizes the site, specifically the area underneath the civic lawn, as a key element for its energy conservation strategy. The aquatics facility is situated above a geothermal reservoir which yields power for the recreation facilities without polluting the environment. There are seventy-six vertical geothermal wells drilled 30m deep into the ground to bring the hot water up to the surface.[8] The geothermal power generated from these wells can be used for electricity, heating in the winter and cooling in the summer. The heat pumps and underground piping system provide energy for the entire community centre and helps save energy transfer between each facility. The geothermal system can also aid in the recovery of excess energy being wasted.[9] The recovered heat, heat collected from the dehumidifiers and waste heat from the adjacent ice arena is recycled and used to heat the pool water. The new energy efficient system integrated into the building allows for performance optimization due to the high amount of energy required to pump and heat three pools. The building does not use either wind turbine or photovoltaic energy sources, therefore the geothermal heat can account for only five percent of renewable energy on the LEED's scale. Through both the geothermal system and the ozone water treatment, small amounts of greenhouse gas emissions are reduced but not sufficient enough to earn any LEED points in ozone protection. Aside from the energy conservation goals achieved by the integrated system, day-lighting and natural ventilation strategies help reduce energy consumption.

Ventilation and Thermal Comfort



The passive design components incorporated into the new building not only help with heating and cooling expenses as previously described, but also add to the indoor environmental quality and comfort. Contrary to the original aquatic center, which lacked in passive design as it had very little natural light and no natural ventilation, the new design makes extensive use of natural light and ventilation.[10] The south-east wall is covered with a curtain wall glazing system that accommodates the glazed overhead garage-style doors and a series of electrically operated solar shading devices.[11] These doors in the large open space in conjunction with mechanically operated vents and other operable windows in the smaller spaces allow for plenty of natural air flow throughout the building.[12] Not only does this help to cool the building during warmer months, it also helps to keep the indoor air of chlorine and other chemicals giving it the ambiance of an outdoor pool. This natural ventilation in conjunction with the new ozone system and flush deck[13], reduces the use of chlorine and the amount of stagnant water on the deck combine to create a fresh indoor air quality that should be adequate to meet

[8] A Wood Showcase
[9] Making Waves
[10] A New Life for an Old Building
[11] HCM Architects
[12] A New Life for an Old Building
[13] Making Waves

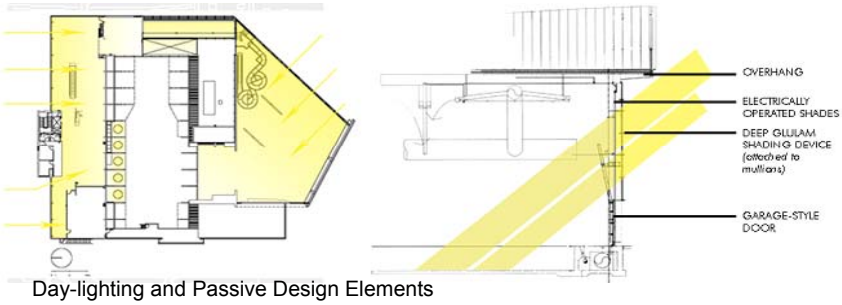
LEED requirements. As it is a municipal building, environmental tobacco smoke is controlled by having it a non-smoking facility with designated areas around exterior entrances, which further ensures the quality of the indoor air.

Shading devices are present throughout the south facades, both for interior and exterior spaces. Along the south-east curtain wall, the deep glulam structure provides an efficient balance between solar control and natural light.[14] The electrically operated shading devices along the same wall not only allow for shading on the entire wall, but make it easy for them to be adjusted by staff according to time of day and quality of light. The large swimming space can thus be flooded with direct or even natural light. These moveable sunshades are vibrantly imprinted with "Aquascapes", the work of local artist Sylvia Tait, which are meant to compliment the bright colours used throughout the facility.[15] The curved roof has a significant overhang which helps to deal with sun angles during the warmest months and takes into account the height.

Southeast and East Shading Devices

Above the east entry is a long wooden grill mounted to the building face providing some shading to the fitness center on the upper level. While this method allows some shading to the space during late morning, it is certainly not the most effective way to treat an east-facing wall. The trellis along the same wall offers a nice light pattern with a balance of sunlight and shade throughout the walkway. In the afternoon, the building itself along with the high roof above the pool will provide shade to that area. The other two sides of the fitness center that face outward are made up of curtain walls providing exterior views of natural vegetation. This means that the space receives a large amount of north light throughout the entire day. The west side also has adequate lighting and the trees help filter the harsh direct light during the evening. The south side of the fitness space opens to a view of the existing lap pool. This use of natural vegetation as shading is a great integration into the overall building design. In the natatorium where the existing lap pool remains, the suspended ceiling obstructs the light distribution from the skylights at its roof peak. However, voids in the ceiling allows for an interesting pattern of circular light projections on the wall and floor of the natatorium. This leaves the room quite dark, which means that lighting the area appropriately will rely heavily on electric lights and ignoring the potential for passive natural lighting.

As a result of all these approaches to lighting and ventilation, operable windows and lighting control are supplied for all regularly occupied areas as required in LEED and at least 90 percent of the spaces in the building as explained receive natural daylight and have plenty of view.

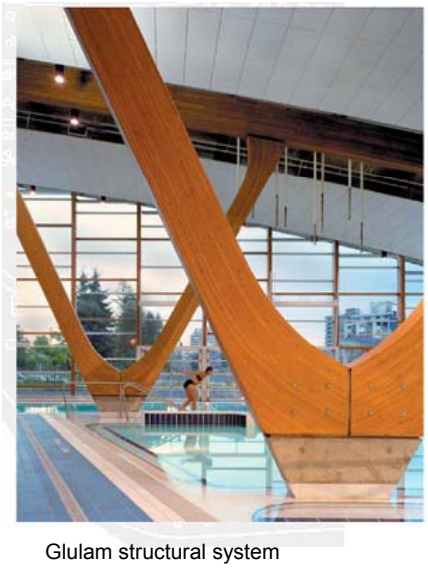


Day-lighting and Passive Design Elements

In an attempt to work in accordance to the indoor environment of the facility, the material selection uses minimal composite material obtained by exposing the structure throughout the design whenever it was

[14] A New Life for an Old Building
[15] Making Waves

possible.[16] The shell of the existing building remains, consisting mainly of reinforced concrete or concrete masonry. Although the original shell is retained the structural grid was used solely as a starting point for the renovation and expansion.



Glulam structural system

Along with these reused materials, the extensive use of wood became a major focus feature in the building. The structural system of the new pool space is composed primarily of glulam beams and purlins. These glulam columns become an innovative part of the exterior curtain wall façade system. The glulam is able to tolerate higher stress levels making it the optimal choice in this project. Most of the wood excavation for Canada takes place in Vancouver; however, the glulam materials for this project had to be shipped to the site because the prefabrication took place in Western Archrib's Edmonton plant.[17]

Although natural, wood is unfortunately not considered rapidly renewable due to the length of time it takes trees to regenerate. However, the wood adds a distinctive atmosphere suitable to the facility creating a visual connection to the surrounding hillside forest landscapes. In addition to these atmospheric qualities, the wood provides benefits towards the humidity and acoustical issues related with pools. The use of wood helps endure high humidity levels created by the pool, unlike steel that would tend to corrode under similar conditions.

The pre-requisite for materials and resources category of LEED entails the collection and storage of recyclables in order to reduce waste that the building or its occupants may produce. Although no specific documentation was found specifying this, the assumption was made that because the project is a municipal building, waste and recyclable management would be required whether or not LEED was involved. With the pre-requisite obtained, all other sub-categories could be considered, which is thirteen points.

LEED Point Chart for West Vancouver Aquatic Centre

LEED

23 Points Achieved — Possible Points: 69

Certified 26 to 32 points Silver 33 to 38 points Gold 39 to 51 points Platinum 52 or more points

7 Sustainable Sites — Possible Points: 14

Y	Prereq 1	Erosion & Sedimentation Control	
1	Credit 1	Site Selection	1
1	Credit 2	Urban Redevelopment	1
	Credit 3	Brownfield Redevelopment	1
1	Credit 4.1	Alternative Transportation, Public Transportation Access	1
1	Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
	Credit 4.3	Alternative Transportation, Alternative Fuel Refueling Stations	1
	Credit 4.4	Alternative Transportation, Parking Capacity	1
1	Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space	1
	Credit 5.2	Reduced Site Disturbance, Development Footprint	1
1	Credit 6.1	Stormwater Management, Rate and Quantity	1
	Credit 6.2	Stormwater Management, Treatment	1
1	Credit 7.1	Landscape & Exterior Design to Reduce Heat Islands, Non-Roof	1
	Credit 7.2	Landscape & Exterior Design to Reduce Heat Islands, Roof	1
	Credit 8	Light Pollution Reduction	1

1 Water Efficiency — Possible Points: 5

	Credit 1.1	Water Efficient Landscaping, Reduce by 50%	1
1	Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation	1
	Credit 2	Innovative Wastewater Technologies	1
	Credit 3.1	Water Use Reduction, 20% Reduction	1
	Credit 3.2	Water Use Reduction, 30% Reduction	1

5 Energy & Atmosphere — Possible Points: 17

Y	Prereq 1	Fundamental Building Systems Commissioning	
Y	Prereq 2	Minimum Energy Performance	
Y	Prereq 3	CFC Reduction in HVAC&R Equipment	
2	Credit 1.1	Optimize Energy Performance, 20% New / 10% Existing	2
2	Credit 1.2	Optimize Energy Performance, 30% New / 20% Existing	2
	Credit 1.3	Optimize Energy Performance, 40% New / 30% Existing	2
	Credit 1.4	Optimize Energy Performance, 50% New / 40% Existing	2
	Credit 1.5	Optimize Energy Performance, 60% New / 50% Existing	2
1	Credit 2.1	Renewable Energy, 5%	1
	Credit 2.2	Renewable Energy, 10%	1
	Credit 2.3	Renewable Energy, 20%	1
	Credit 3	Additional Commissioning	1
	Credit 4	Ozone Depletion	1
	Credit 5	Measurement & Verification	1
	Credit 6	Green Power	1

1 Materials & Resources — Possible Points: 13

Y	Prereq 1	Storage & Collection of Recyclables	
1	Credit 1.1	Building Reuse, Maintain 75% of Existing Shell	1
	Credit 1.2	Building Reuse, Maintain 100% of Existing Shell	1
	Credit 1.3	Building Reuse, Maintain 100% Shell & 50% Non-Shell	1
	Credit 2.1	Construction Waste Management, Divert 50%	1
	Credit 2.2	Construction Waste Management, Divert 75%	1
	Credit 3.1	Resource Reuse, Specify 5%	1
	Credit 3.2	Resource Reuse, Specify 10%	1
	Credit 4.1	Recycled Content	1
	Credit 4.2	Recycled Content	1
	Credit 5.1	Local/Regional Materials, 20% Manufactured Locally	1
	Credit 5.2	Local/Regional Materials, of 20% Above, 50% Harvested Locally	1
	Credit 6	Rapidly Renewable Materials	1
	Credit 7	Certified Wood	1

5 Indoor Environmental Quality — Possible Points: 15

Y	Prereq 1	Minimum IAQ Performance	
Y	Prereq 2	Environmental Tobacco Smoke (ETS) Control	
	Credit 1	Carbon Dioxide (CO_2) Monitoring	1
1	Credit 2	Increase Ventilation Effectiveness	1
	Credit 3.1	Construction IAQ Management Plan, During Construction	1
	Credit 3.2	Construction IAQ Management Plan, Before Occupancy	1
	Credit 4.1	Low-Emitting Materials, Adhesives & Sealants	1
	Credit 4.2	Low-Emitting Materials, Paints	1
	Credit 4.3	Low-Emitting Materials, Carpet	1
	Credit 4.4	Low-Emitting Materials, Composite Wood	1
1	Credit 5	Indoor Chemical & Pollutant Source Control	1
1	Credit 6.1	Controllability of Systems, Perimeter	1
N/A	Credit 6.2	Controllability of Systems, Non-Perimeter	1
	Credit 7.1	Thermal Comfort, Comply with ASHRAE 55-1992	1
1	Credit 7.2	Thermal Comfort, Permanent Monitoring System	1
1	Credit 8.1	Daylight & Views, Daylight 75% of Spaces	1
	Credit 8.2	Daylight & Views, Views for 90% of Spaces	1

4 Innovation & Design Process — Possible Points: 5

1	Credit 1.1	Innovation in Design: Exemplary Performance in 98% CWM	1
	Credit 1.2	Innovation in Design: Exemplary Reduction of Water Use	1
1	Credit 1.3	Innovation in Design:	1
1	Credit 1.4	Innovation in Design:	1
1	Credit 2	LEED™ Accredited Professional	1

The West Vancouver Aquatic Centre, in its architecture, not only deals with many issues of sustainable design, but does so in a manner in which its design is not limited but rather integrated. The efforts in creating plea helped to achieve a pleasant atmosphere and

[16] HCM Architects
[17] A Wood Showcase

number of sustainable design methods were successfully incorporated in the West Vancouver Aquatic Centre even though LEED certification was not a project goal, including but not limited to; sustainable site planning, passive design in heating, cooling and ventilating, innovative façade systems, sustainable planting and landscaping. Through this analysis it was found that this building would have acquired 23 LEED points and would not have been able to be classified as a qualified LEED building. However, perhaps if the proper precautions were made and documented during construction further points could have been accumulated.

Un-Cited Sources:

Hughes Condon Marler Architects: Welcome!
http://www.hcma.ca/web/project.php?pid=1015

Hotson Bakker Boniface Haden Architects Online: West Vancouver Community Centre
http://www.hotsonbakker.com/westvan.html

Geothermal Education Office: Geothermal Energy Facts
http://www.geothermal.marin.org/pwrheat.html

Images Provide By or Taken From:

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Darryl Condon; Principle Architects, HCM Architects

John McFarlane; Student, University of Waterloo

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http://www.westvancouver.net/upload/documents/leisure_guide/new-aquatic-centre/special-edition-tidings.pdf