NICOLA VALLEY INSTITUTE

MERRIT, BRITISH COLUMBIA

BUSBY + ASSOCIATES ARCHITECTS INC.

Ian Peterse
M.Arch Candidate
University of Waterloo

NICOLA VALLEY INSTITUTE

MERRIT, BRITISH COLUMBIA

QUICK FACTS

Building Name	Nicola Valley Institute of Technology
City	Merrit, British Columbia, Canada
Construction	2000 - 2001
Cost	$7.0 Million
Architect team	Busby and Associates (Peter Busby, Susan Gushe, Rod Maas, Alfred Waugh, Brian Wakelin, Nathan Webster, Thomas Winkler)
Consultants[1]	Structural - Equilibrium Consulting Inc; Mechanical - Keen Engineering; Electrical - Earth Tech Canada; Civil - True Engineering; Landscape - True Engineering; Contractor - Swagger Construction Ltd.; Code - Pioneer Consultants; Quantity Surveyor - Helyar and Associates

Program	Post-secondary institution
Gross Area[2]	4,519 m²
Site Area[3]	17.5 Ha
Project Manager/ Client[4]	The University College of the Cariboo
Steering Committee[5]	Nicola Valley Institute of Technology
Climate	Hot dry summer; moderately cold winters
Special Site Conditions	None
Image[6]	'A new and refreshing perspective on our First Nations and the contribution they make to our collective contemporary culture.'
Structural System	Wood columns and concrete slab
Mechanical System[7]	Two-pipe fan coil system with two high-efficiency boilers and an air-cooled chiller
Floor to Floor Height[8]	3.5 meters
Number of Stories[9]	2.5
Special Construction[10]	Douglas Fir Columns designed and cut using Computer Numerical Control (CNC) technology; Eco-Smart Concrete with fly ash SCM
Day lighting	East-west oriented atrium; 90% of all areas receive natural daylight and views
Shading[11]	Movable panels of wood sun shading louvers
Ventilation[12]	Sensor-operated windows in the atrium.

INTRODUCTION

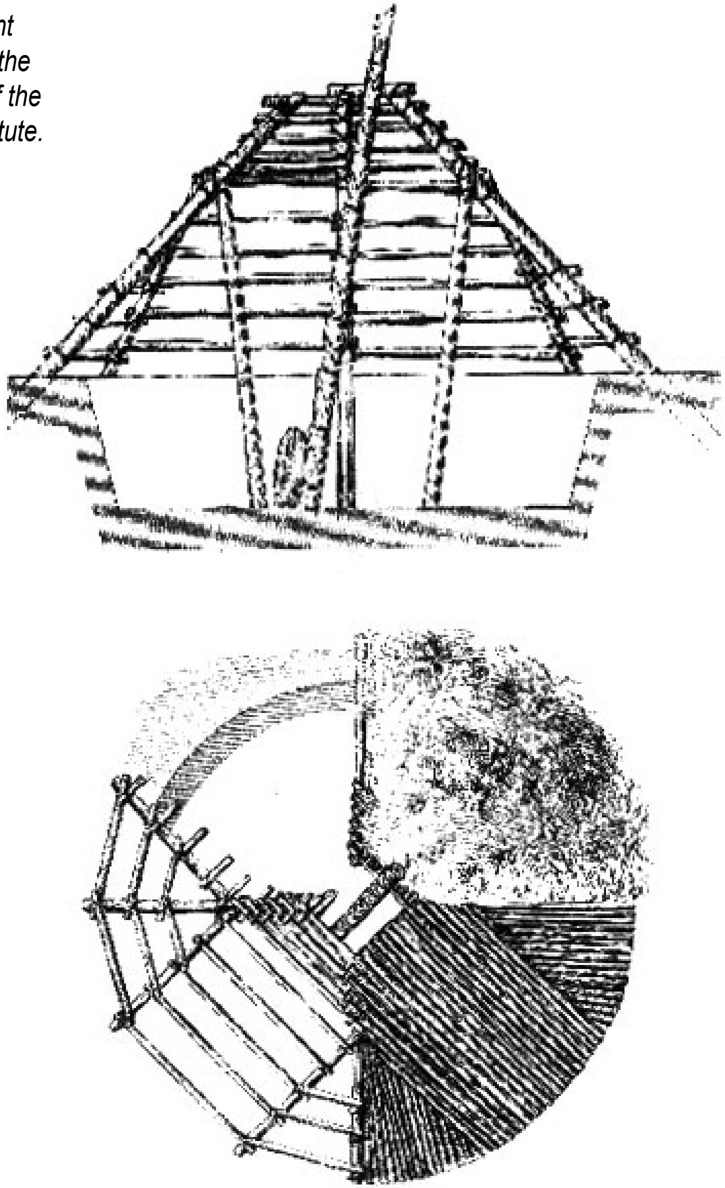
The Nicola Valley Institute of Technology is the first building of the master plan for The University College of the Cariboo in British Columbia. 'On September 01, 1995 the Nicola Valley Institute of Technology was designated a Provincial Institute under the British Columbia College and Institute Act.'[14] Designed by Busby and Associates of Vancouver, NVIT stands as one of Canada's 'premiere First Nations post-secondary facilities to be shared by both native and non-native institutes.'[15] The sensitivity expressed in the design is the result of the architect's close working-relationship with the client, reflecting native cultural imperatives and resulting in state-of-the-art facilities and sustainable building design. The architecture sets a precedent for future campus development from an ecological perspective but, more importantly, as an historical vernacular established by traditional Native Architecture. It bridges the low-tech approach found in historical aboriginal structures with the high-tech sustainable building systems that are only recently employable. In this case energy efficiency is the result of a reverence for nature and the land, which is traditionally an aboriginal precept to building.

'The Nicola Valley was a winter encampment for the Interior Salish First Nations people for centuries before European settlers arrived. Pit house depressions remain'[16] in the area and have provided inspiration for the architecture of NVIT. The architects have been accompanied by local native elders on many site visits in order to determine the building's relationship with the land and resulting microclimate. The resulting configuration is semi-circular with the main entrance facing east. The circle itself is a strong native theme, while the cardinal axis represents a spiritual orientation. NVIT embodies a pragmatic approach to designing around firmly established spiritual and ecological criteria native to its surroundings.

Table 1.0 Nicola Valley Institute Demographics [13]

Number of students	233	21%	Part time
		79%	Full time
Age Ranges		26%	Are 24 and under
		31%	Are 25 to 34
		26%	Are 35 to 44
		17%	Are 45 and over
Gender		64%	Female
		36%	Male
Aboriginal Status		76%	Status
		3%	Non-Status
		0.4%	Inuit
		4%	Metis
		0.4%	International Aboriginal
		15%	Non-Aboriginal
		1%	Unknown
Where Students are From		21.4%	Nicola Valley
		71%	Within Province of BC
		7.4%	Outside of BC

Figure 1: Precedent used for the design of the new institute.



PROGRAMME

While the building is designed to reflect the cultural characteristics of the aboriginal students attending the institute, there are much broader implications to the highly tailored programming of NVIT. The program includes classrooms, faculty offices, social spaces, and labs, as well as a bookstore, cafeteria, and library.[17] Locations of the various areas are determined to establish a non-hierarchical internal environment. The adjacency of faculty to students, young people to elders and relationships between various functions, works to knit together the interior spaces into one. Elders are on campus to guide and support staff and students.[18]

Many of the buildings being developed for First Nations clients in B.C. 'have become important instruments of social and cultural rehabilitation.'[19] Many Native communities are in need of these facilities; a strong sense of sustainable development already a part of Aboriginal culture. Facilities like NVIT are providing state-of-the-art research tools and promoting leadership in this renewed field of interest. 'As ancestral stewards of the land and its resources, they [Canada's First Nations] have positioned themselves at the forefront of the environmental movement.'[20]

'NVIT addresses the need within First Nations communities for individuals who work to preserve traditional culture, and who nurture a connection between these communities and future development and education. Students at NVIT have the opportunity to develop skills to manage the natural environment, deliver effective social services, and maintain a strong influence within the political and socio-economic arenas. The programs are designed as a tool to encourage ongoing education, to pull people forward for future challenges and opportunities both within and beyond our communities.'[21]

The report entitled 'Building the capacity of Aboriginal, rural and northern communities to generate sustainable economic activity based on natural resources,'[22] outlines a list of objectives with probable advancements and future directions. It becomes clear how NVIT's policy regarding the environment is holistic in scope and broadens the topic from green building to sustainable community development. As an example of one of the reports focuses, objective 2.3.6 submits to '[by] 1998, initiate with the Nicola Tribal Association, the Nicola Valley Institute of Technology and [Coldwater, Shackan, Nooaitch, Upper Nicola, and Lower Nicola Bands of the Nicola Valley], the development of computer technologies for the analysis and storage of codes and environmental ethics, traditional Aboriginal information and forest management information.'[23] This target advances sustainable development as it '[improves] social, environmental and economic conditions in First Nation communities by providing training and strengthening independent forestry management.'[24] In terms of future directions the assumption is that '[the] success of the pilot Sustainable Communities Initiative has enabled Aboriginal, rural, northern and coastal communities to improve their ability to plan, make decisions and create partnerships.'[25] Other areas covered deal with infrastructure and industry development that involve intensive studies on the local environment and how sources can be utilized and sustained over time. NVIT is deeply engaged with this agenda, combining 'the timeless lessons of the vernacular tradition with aesthetic refinement and technical virtuosity of modernism.'[26]

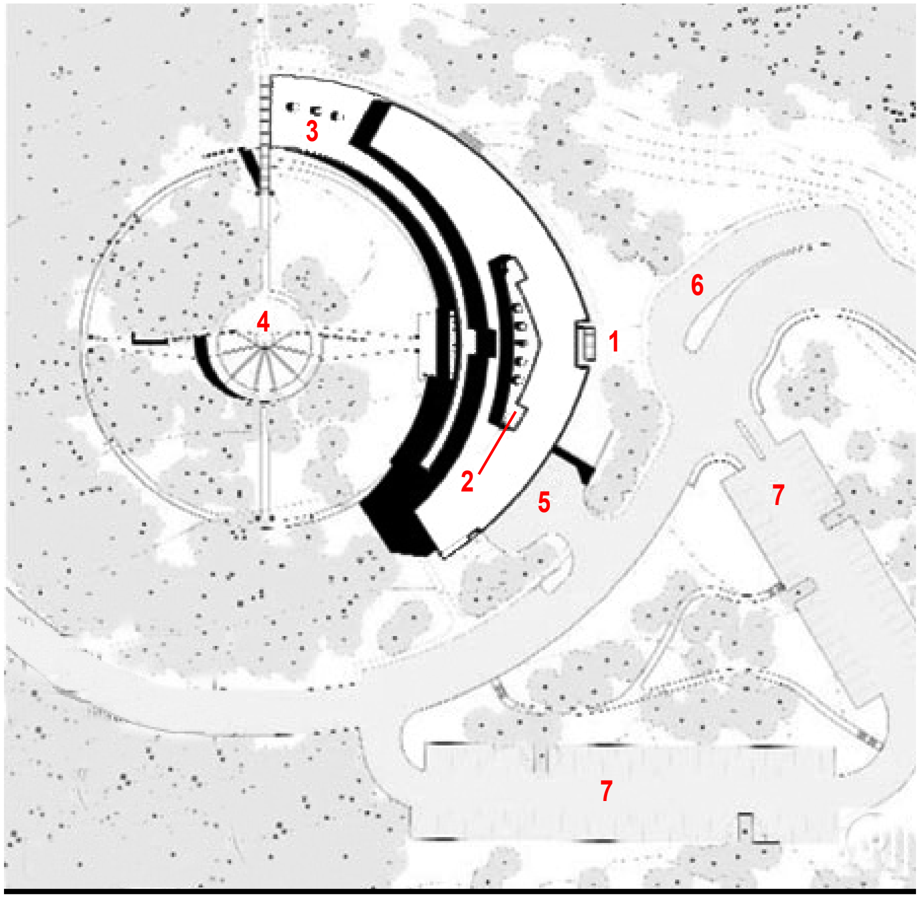


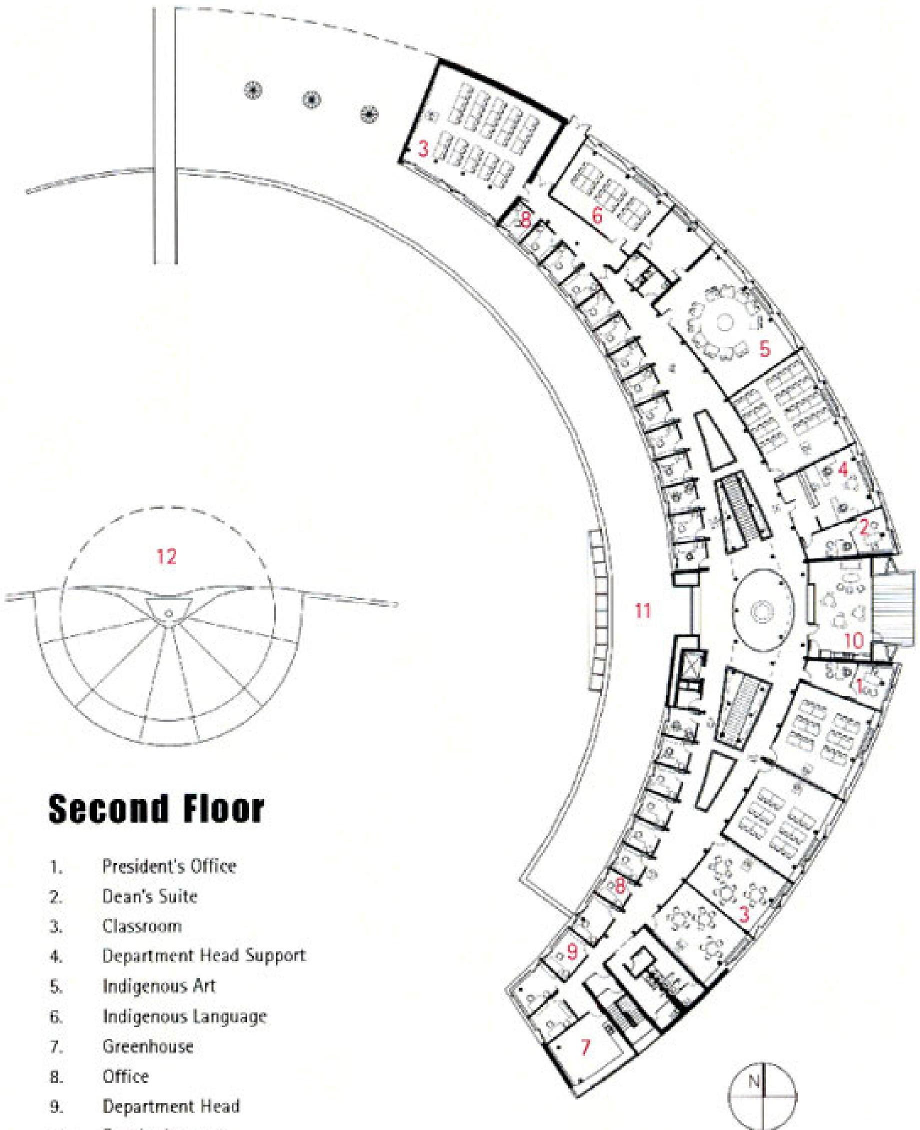
Figure 2: Site Plan

1. Entry Plaza
2. Ventilation Atrium
3. Planted Roof
4. Ceremonial Arbour
5. Loading Dock
6. Drop-off
7. Parking

North

EXTERIOR SITE

Located in Merrit, British Columbia, NVIT is designed to be energy efficient in a cold climate. The building's 400-foot long form defines the eastern edge of a circular communal court, with a ceremonial arbour marking the centre point. This



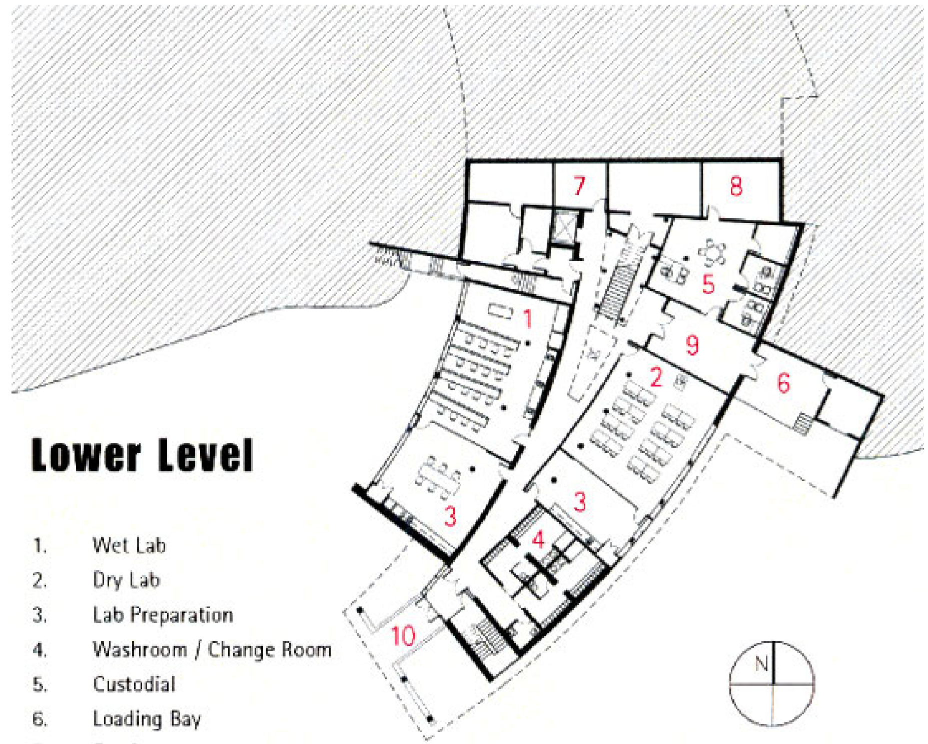


Figure 3 (Left): Second Floor Plan (Entry). Figure 4 (Above Right): Lower Level Plan.

is the first phase of the court's periphery development. The campus is seventeen (17) hectares in total and campus housing will follow NVIT, continuing the outer ring.[27] The northern portion of the building is embedded in the hillside with the intention to integrate building and landscape. Three storeys are exposed as the building curves away and out from the hill. On the lowest level of the roof, an indigenous low-creeping plant called kinnick-kinnick is planted. The area of excavation is a zone that follows criteria concerning management of displaced and disrupted soil and the preservation of existing trees and natural vegetation, especially forest floor growth. In order to preserve the site's natural character and ecology, disrupted areas are reclaimed and replanted with native plants. Trees throughout the construction site have been tagged and preserved where possible.[28] While the intention of NVIT's siting strategy is to employ a didactic through construction, there are also cost-savings through the inherent energy efficient qualities of the construction techniques and materials used.

INTERIOR SITE

The interior configuration structures the program along an interior street. The street brings life to the interior and assists in creating a non-hierarchical social environment, which makes the institute feel less institutional. Aligning the east-west axis and dynamically interwoven with the interior street, above and below, is a student lounge with a centrally located hearth. The interior street widens and opens views between both levels. This layered social environment offers moments of both passive and more intimate social engagements. The architecture reflects this perfectly as both the hearth and passive solar design use light and warmth to recreate this social dynamic through metal, glass, wood and concrete. The student lounge and main entrance are oriented east, which in Aboriginal culture symbolizes the start of a new day. The student lounge traces

Figure 5 (Above): View of the Southern most tip of the facility. Figure 6 (Below): A view of the central atrium space - NVIT's interior site.

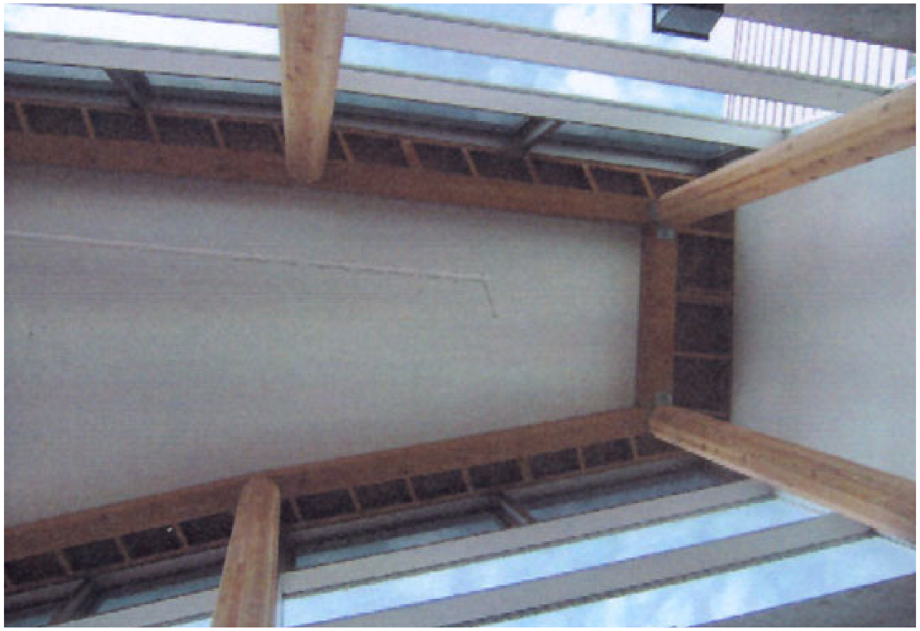


Figure 7 (Above): View of the ceiling of the central atrium space.

light across the floor and pushes air up through its ventilation atrium, subtleties which add to the dynamism of student activity.

SUSTAINABLE DESIGN

The architecture of NVIT reflects traditional forms and building techniques. This is apparent from the planning configuration, but even more so through the sectional and spatial analysis of the central atrium space. The design concept is 'based on traditional native pit houses having in-ground construction, sod roofs to limit solar gain, and vaulted construction open at the top for ventilation.'[29]

The microclimate of the Nicola Valley is hot and dry in the summer and quite cold in the winter. It is from this climatic condition that the Aboriginal people learned to construct two effective building types. 'The tepee was a simple and efficient ventilation structure that promoted cooling by convection in the summer months.'[30] This concept is difficult to utilize in most contemporary building types. It demands close attention be paid to solar orientation, sun-angles and building glazing and thermal materials.

At NVIT natural ventilation through convection is achieved in the atrium space. The teepee is effective in the warmer months, '[the] pit house, on the other hand, was an earth-sheltered structure built with a southern orientation to maximize solar heat gains in winter and which relied on thermal mass to minimize heat losses.'[31] While the building does not attempt to replicate the traditional forms of either structure, it uses the same principles. Building into the existing slope increases shelter and insulation to the north. On the lower level of the roof 150mm of soil is placed and covered with kinnik-kinnick to contribute to the 'reduced heating and cooling loads in the building.'[32] As integrated systems, the earth sheltering helps to insulate the atrium and through passive solar heating, a pressure differential is created to naturally ventilate the building. Further, '[the] site is dry in the summer so the building is located below the elevation of natural water pressure to avoid pumping water uphill.'[33] Since water is a limited resource, '[low] flush fixtures and landscaping measures, including the storm water retention area enclosed by the parking lots, help to conserve water.'[34]

Sustainable design is a broad topic and certainly does not rest with the completion of building construction. It is ongoing and requires planning tactics and strategies early in the design of the building. This is necessary to successfully reduce the embodied energy and waste material over the lifespan of the building's use. In the case of NVIT, the building plays a didactic and academic role, which could potentially influence the direction of future development in the area and abroad. This is mentioned earlier in the program outline. Equally important is the flexibility of the building to respond to seasons, fluctuations of energy and changes in use that have not been pre-determined through the course of its design. Sustainability means a collective effort, and so environmental controls play an important role in the users understanding of energy consumption.

ENVIRONMENTAL CONTROLS

Busby and Associates' work has 'successfully manipulated the modernist palette according to local environmental criteria, hinting at an architecture that is technologically advanced yet regional in character.'[35] At NVIT the influence of both the site conditions and demands of an aboriginal client has thus stimulated an architecture that uses the knowledge and resources acquired through the many urban projects the firm has worked on while applying truly local criteria. NVIT is the firm's first project outside of an urban context. The buildings systems are highly advanced, but do not conform to the aesthetic one would imagine of a building with equally sophisticated controls. Computerized sensory systems are invisible. Mechanical systems are not always exposed. The customized design of the building's visible systems is no less than honest in its traditional aboriginal aesthetic. 'NVIT reveals its cultural context not as an assemblage of symbols and metaphors, but through the embodiment of intrinsic cultural values.'[36] The architect-client decision to exploit its traditional approach rather than the more high-tech systems that monitor and control its use of energy is what makes the building didactic rather than an image of power or technology.

The building is 'a fully integrated environmental system that uses sophisticated energy modelling techniques and state-of-the-art control systems to optimize

Figure 8: Ventilation Schematic

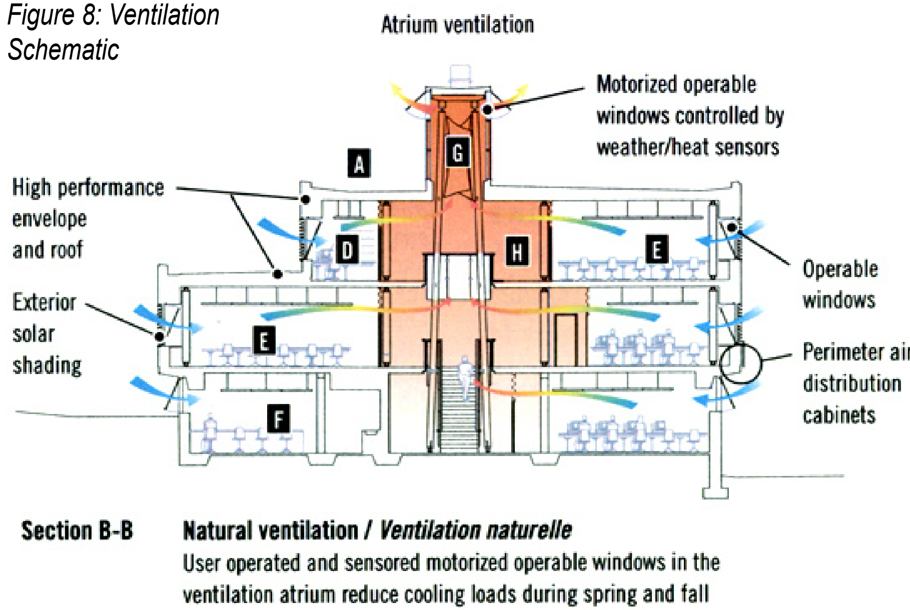


Figure 9 (Below): View of the college's prior to the planting of the green roof. The central atrium space rises from the building in the centre background.

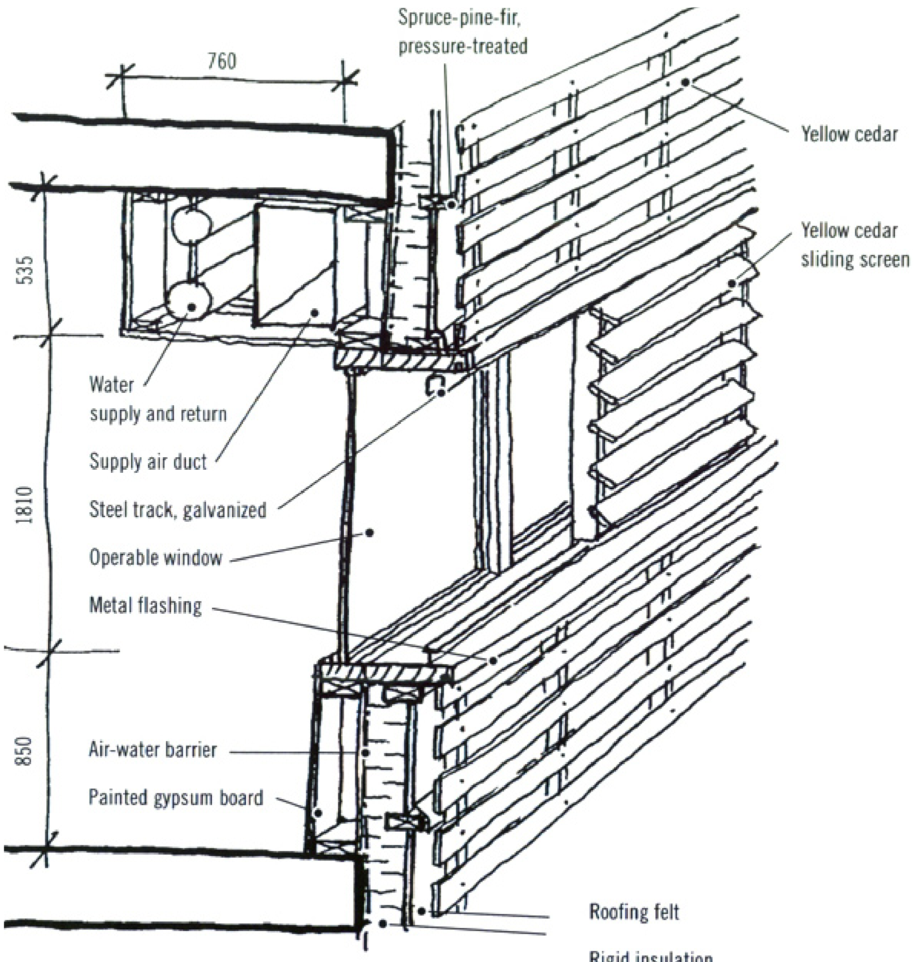


Figure 10: Schematic Wall Section

performance.'[37] The design of environmental control systems usually starts with the envelope, or the mediation between interior and exterior environments. It is important for the building user to have control over his/her environment. In response to this, the envelope incorporates PVC-framed tilt-and-turn windows, shaded by moveable panels of yellow cedar sun-shading louvers.[38] It is important to exercise discipline in opening and closing, turning on and off, systems in order to maintain a comfortable environment in a way that conserves the most energy. Often user-controlled systems, such as lighting and ventilating devices, involve procedures that are highly tailored. Procedures are derived from both the comfort level that is established internally and technology that mediates between interior and exterior environments.

At NVIT, 'grilles between the perimeter rooms and the central ventilation atrium, and sensor-operated windows in the atrium provide natural ventilation.'[39] The thermal chimney 'reduces cooling loads in spring and fall'.[40] Interior systems actual extend out into the surroundings via 'independent weather station monitoring of wind direction speed and precipitation.'[41] This demonstrates how user oriented environmental controls can affect the entire building environment. Again, it is important for users to be aware of their environment. The mechanical system used 'is a two-pipe fan coil system along the building perimeter that uses two high-efficiency boilers and an air-cooled chiller.'[42] Internal Air Quality (IAQ) performance requirements have been met and Thermal Comfort has been maintained as per LEED guidelines.[43]

The building uses relatively little artificial lighting as 90% of all areas receive natural daylight from exterior glazing. 'The sliding yellow cedar sun screens have blades of four different angles determined according to solar orientation that cut off the sun angles to reduce cooling loads.'[44] They are fastened to a track at the top, allowing them to be moved for cleaning and adjustments. When adequate natural lighting is not provided, the building uses a 1.15W/s.f. light power density.[45] 'Daylight sensors and occupancy sensors maximize energy saving potential in concert with natural lighting.'[46] In institutions and offices, natural lighting is in most cases adequate where task lighting is not required.

Through its numerous monitoring systems and controls, NVIT performs 35% below ASHRAE 90.1 standards for energy efficiency.[47]

CONSTRUCTION / MATERIALS

The construction method chosen for NVIT embodies a sense of stewardship, as a result 'more than 50% of the material for the structure and the envelope of the building [were] sourced from the local region.'[48] The essence of the teepee and pit house is captured in the tectonics of the interior. The architects have worked to reconcile traditional Aboriginal construction methods and contemporary systems and building materials. The resulting construction stands as a hybrid between each methodology and practice. The building's structure is primarily glulam columns, which support flat concrete floor slabs. The intention is to use wood sparingly as it is a highly regarded resource in Aboriginal culture and appreciated more for its aesthetic qualities than its structural integrity and workability. In other words, it is exposed as much as possible and used to bring warmth to the interior. The building has 35% glazing with thermally broken seals.[49] Concrete is treated as a thermal mass and intended to be as aesthetically 'invisible' as the glass that feeds its energy.

The dominant material at NVIT is wood. Wood makes a major contribution to improving the overall environmental performance of any building by 'reducing energy use, reducing resource use, and reducing environmental impacts.'[50] It has very good insulating value compared to other building materials. 'Canada is a world leader in the development and implementation of third party forest certification programs.'[51] 'As a result, Canada has 90% of the original forest cover that existed at the time Christopher Columbus landed in America.'[52]

Figures 11 and 12: Detail views of the yellow cedar rain screen on the exterior.

Figures 13 and 14: Detail views of the building's wood column connections.

Douglas Fir is used in the glulam columns that run along the interior street. It is native to the area and chosen for vernacular use in terms of its compressive strength. The strength of the columns is further increased as a glulam fabrication and the faceted extrusion is attributed to Computer Numerical Control (CNC) technology. There are potential environmental benefits of using timber, especially glulam structures, as viable alternatives to steel, concrete and aluminium. Glulam products 'make use of fast growing species to produce high strength products without requiring large dimension timbers [.][53] Throughout the building, wood is cut in 'dimensions and diameters that require the cutting of increasingly scarce first growth timber.' [54] Replanting has ensured that the forest remains intact. The columns used in the interior are intended to reflect the rhythm of the surrounding forest – the trees are used to support the building that has replaced them. 'The density of columns increases around the atrium, where poles up to 12 meters in height rise through the building to support the roof lantern.'[55] At this point, the verticality recalls the poles used to support traditional pit houses. Above all, wood lends warmth to the interior spaces, juxtaposing the materials used in conjunction with it.

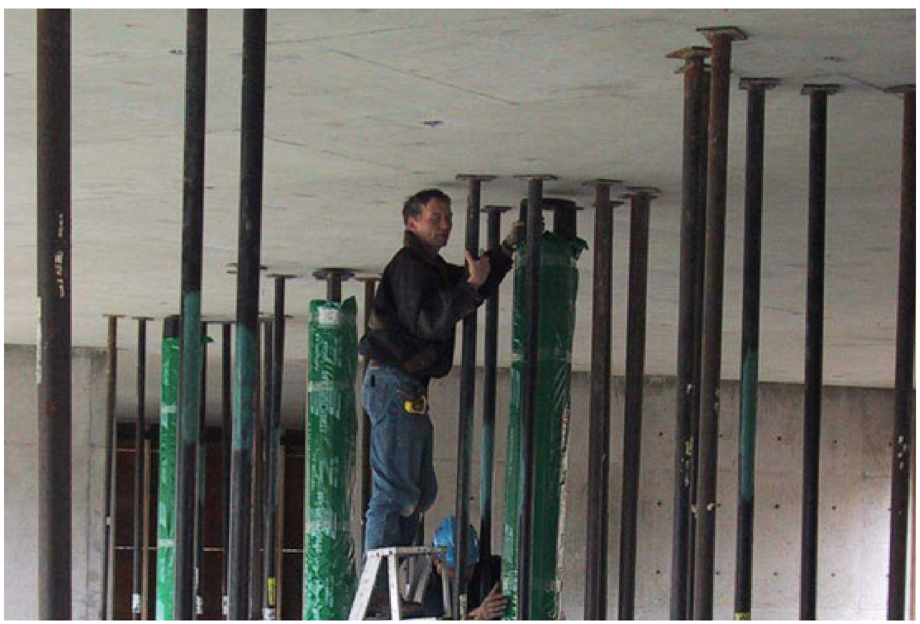
The Yellow Cedar tree contributed perfect materials for early civilizations - tough straight grained wood - easily split, carved and beautiful to behold - it was fashioned into shelters, bows, paddles, containers, masks, and tools. The inner and outer bark provided textiles strong and durable enough to make blankets, baskets, hats and capes that lasted for generations. No wonder the cedar tree is held in the highest respect by Northwest Natives.[56] It also contains natural rot resistant oils, which means it doesn't require treating. Yellow cedar is articulated along the exterior of the building in horizontal bands of sun shading louvers, which 'will age gracefully over time to a silver grey, blending with the landscape and natural vegetation.'[57] While it is aesthetically engaging, it is equally innovative in its integration with the building envelope. The 'faceted modular wood frame rain screen wall', which uses yellow cedar, 'is designed with a single membrane performing the combined functions of traditional water and vapour barriers.'[58] The wood releases a citrus aroma when it is heated by the sun.[59]

Busby's use of EcoSmart™ Concrete, incorporating 100% recycled steel reinforcing bars, has had an overall positive effect on the building environment. The details are outlined in the firm's report entitled 'EcoSmart™ concrete Usage-Nicola Valley Institute of Technology,'[60] dated March 30, 2001. It is apparent that concrete manufacturing embodies high amounts of energy and actually emits CO_2 into the air. The use of EcoSmart ™ concrete at NVIT succeeded in reducing 40% of CO_2 emissions by reducing the same percentage of cement, used in the concrete. Supplementary Cementing Materials (SCMs) are typically natural pozzolans, blast furnace slag and fly ash. Fly ash, a by-product from coal-fired power plants, is the SCM used in the concrete at NVIT. Type F fly ash was obtained from Lafarge in Alberta. Approximately 2300 cubic metres of concrete and 82 cubic metres of fly ash were used in the construction. All of the concrete is left exposed for its aesthetic appeal and thermal mass quality.[61]

The appearance of the concrete, using fly ash, is warmer and lighter in colour with a smoother finished surface. An advantage at NVIT lies in fly ash's sulphate resistance, wherein Thompson Nicola Region, 'sulphate ions are found in the soil and ground water.' 'Equilibrium Engineering recommended fly ash mixes for its higher compressive strength and increased durability of the concrete due to the lower level of mixing water in the wet mix.' (EcoSmart ™ Concrete Usage) The problem at NVIT with the use of fly ash, is in the extended curing time required to achieve high compressive strengths. The foundations and footings were poured in late October due to a delay in the tendering process, which means colder weather and substantially slower set up times since fly ash content lowers the heat of hydration. The roof slabs were completed in mid-March of the following year. Temporary hoarding and heating were required to assist in curing thinner elements. This meant that the overall cost of fuel and labour was increased by 25%, and the added fuel meant more embodied energy. Craig Wittman of Swagger Construction has said of fly ash concrete construction in the winter months: "Knowing what we know now, we would factor in the increased cost associated with the use of fly ash in our next bid for a project, but that would very well mean that we might not get the job." While there are clear disadvantages to the use of fly ash, it is noted: 'EcoSmart™ Concrete use for architectural work is currently in a "ground-breaking" stage.'[62]

Figure 15: Detail view of the yellow cedar grilles moved into the open position.

The report outlines two comparative studies: Eco-Smart concrete usage in the summer months and its use at York University Computer Science Building in Toronto. In the Thompson Nicola region, fly ash content in concrete is typically 20-25%, used to protect the concrete from sulphates. At NVIT, it is demonstrated



that wintertime concrete construction is not cost effective using fly ash. The problem with the region is that summer months are also disadvantageous in terms of curing. In Merritt, the summer brings '30 mile per hour winds and low humidity', which causes crusting on the surface due to rapid dehydration. The only way to prevent this is by using a spray-on membrane, which again increases the cost.[63]

A successful application of EcoSmart™ concrete can be found at York University, again a project by Busby and Associates Architects. Construction took place in minus 10°C weather, but in this case curing time was faster than normal concrete. Also, fly ash content is 50% in most elements. The contractor at York had 15 years of experience with concrete mixes using fly ash, which is essential to fluid and efficient set up times. The type of fly ash used is Type C instead of Type F, which has higher calcium content increasing the speed of early strength development. Finally the 'the high alkaline found in Ontario cement with a PH of 12 to 13.5 also contributes to EcoSmart™ concrete's early strength development.' [64]

COSTING

The budget for the project was $7.6 million and the building was built for $7.0 million. 'Exposed thermal mass to offset peak heating and cooling loads, careful siting of the building within an existing sloped landscape, natural ventilation, and solar control are the primary strategies used to achieve the energy targets without adding cost to the Provincial budget of $1,280 per square metre.'[65]

Figures 16 and 17: Views of the NVIT's concrete work while under construction.

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN

To place the Nicola Valley Institute within the spectrum of other sustainable buildings in Canada, a preliminary LEED assessment was conducted to determine how the building measures up to the industry standard of "green building" evaluation. Overall, the institute scores twenty-eight (28) out of sixty-nine (69) possible points. This earns the building "Certified" status. Although this ranking is not the highest achievable, it must be noted that many of the credits within the LEED rating system are geared towards urban buildings that use more conventional – albeit more energy efficient – structural, mechanical, and electrical systems. Consequently, the rating system can unfairly score buildings with exceptional circumstances, such as the Nicola Valley Institute, which are remotely located. In other words, in small, remote communities such as Merrit, it isn't possible to receive credits for alternative transportation because the only means of transport is the personal vehicle because the town cannot support public transit. This also means that points allotted to locally produced materials can be difficult to attain because many of the building products have to travel long distances from their last place of manufacture and harvest. In the case of the Nicola Valley Institute, however, the architect was careful to choose materials that were locally harvested such as the wood, to account for over 20% of the materials used in the building. This earned the building two points in the "Materials and Resources" category.

In general, the building performed very well in all of the categories, with some minor exceptions. For example, in terms of water efficiency, there is no documentation that low-flow plumbing fixtures were used in order to conserve potable water. Only one point was earned in the "Water Efficiency" category for the use of native planting to reduce the landscaping irrigation requirement by half. The installation of aerator faucets and low-flow toilets are easy to

Table 3.0 LEED GREEN BUILDING RATING SYSTEM 2.1

Project Checklist	
Sustainable Sites	**6**/14 Possible Points
Water Efficiency	**1**/5 Possible Points
Energy & Atmosphere	**7**/17 Possible Points
Materials & Resources	**3**/13 Possible Points
Indoor Environment Quality	**11**/15 Possible Points
Innovation & Design Process	**1**/5 Possible Points
Project Totals	**29**/69 Possible Points
Nicola Valley Institute Result	**Certified Status**

Figure 18: View of the light-filled east-facing main entrance to the NVIT.

accommodate in the design of a building, and are easy points to earn within the system.

The building faired the best in the “Indoor Environment Quality” category, scoring eleven (11) out of fifteen (15) possible points. Points were earned for the building’s permanent monitoring system that includes CO_2 sensors; ventilation effectiveness; low-emitting paints, sealants, adhesives and carpet; indoor pollutant control; controllability of systems; and daylight and views to 90% of regularly occupied building spaces. Through these measures, the architects were able to create an enjoyable and healthy indoor environment for the building’s occupants. Despite its poor performance in other areas of the rating system, the high-quality indoor environment is the most readily appreciated by building occupants. Thus, creating an institute that promotes healthy living and working, as well as saves on energy, is the true mark of a successful, “sustainable” building.

CONCLUSION

The Nicola Valley Institute of Technology is a successful example of Canadian sustainable architecture. Busby’s office has inextricably connected building to site, both physically and culturally. A North American contemporary vernacular is evoked at Nicola Valley – clearly a result of the firm’s conviction. As a fully integrated system, the building achieves its energy goals and is capable of maintaining its goals over time. As a tool for instruction, NVIT will continue to inspire new directions and creativity from its users now and in the future.

Figure 19: View of the central atrium with fireplace penetrating the gathering space.

BIBLIOGRAPHY

Periodical References

1. Canadian Architect. Volume 47, No. 8, August 2002. "Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia." Jim Taggart p. 16-19
2. Wood le Bois. No.41, Spring 2003. "Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space"* Alfred Waugh

Internet References

1. BC Parks - Monck Provincial Park. Source: http://www.britishcolumbia.com/ParksAndTrails/Parks/details/?ID=245
2. Canadian Lumbermen's Association: Sustainable Forest Management. Source: http://www.cla-ca.ca/English/ForestManagement/
3. Canadian Wood Council: Nicola Valley Institute of Technology/ University College of the Cariboo. Source: http://www.cwc.ca/environmental/sustainable_buildings/case_studies/nvit/index.html
4. Cedar: Trees of Life. Source: http://www.woodentubs.com/tubs_cedar.html
5. Green Buildings and Sustainable Communities. Source: http://www.gvrd.bc.ca/sustainability/GreenBuildConf2001/PeterBusby.pdf
6. Natural Resources Canada: Sustainable Development Strategy. Source: http://www.nrcan.gc.ca/sd-dd/pubs/progfinal1997strat/nrcan_en/obj2_3.htm
7. Nicola Valley Institute of Technology – Merrit Campus. Source: http://www.sustainability.ca/Docs/Busby-NicolaValleyInst.pdf?CFID=1535348&CFTOKEN=11799311
8. Nicola Valley Institute of Technology. Source: http://www.nvit.bc.ca
9. Nicola Valley Institute of Technology/ University College of the Cariboo. Source: http://www.busby.ca/9907nvit/index.htm
10. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC. Source: http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf

ENDNOTES

1. Canadian Architect. Volume 47, No. 8, August 2002. "Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia." Jim Taggart p. 16-19
2. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
3. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
4. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
5. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
6. Canadian Architect. Volume 47, No. 8, August 2002. "Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia." Jim Taggart p. 16-19
7. Wood le Bois. No.41, Spring 2003. "Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space"* Alfred Waugh
8. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
9. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
10. Canadian Architect. Volume 47, No. 8, August 2002. "Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia." Jim Taggart p. 16-19
11. Canadian Architect. Volume 47, No. 8, August 2002. "Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia." Jim Taggart p. 16-19
12. Canadian Architect. Volume 47, No. 8, August 2002. "Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia." Jim Taggart p. 16-19
13. Nicola Valley Institute of Technology http://www.nvit.bc.ca
14. Nicola Valley Institute of Technology http://www.nvit.bc.ca
15. Nicola Valley Institute of Technology http://www.sustainability.ca/Docs/Busby-NicolaValleyInst.pdf?CFID=1535348&CFTOKEN=11799311
16. BC Parks - Monck Provincial Park http://www.britishcolumbia.com/ParksAndTrails/Parks/details/?ID=245
17. Nicola Valley Institute of Technology http://www.sustainability.ca/Docs/Busby-NicolaValleyInst.pdf?CFID=1535348&CFTOKEN=11799311
18. Nicola Valley Institute of Technology http://www.nvit.bc.ca

19. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
20. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
21. Nicola Valley Institute of Technology http://www.nvit.bc.ca
22. Natural Resources Canada: Sustainable Development Strategy http://www.nrcan.gc.ca/sd-dd/pubs/progfinal1997strat/nrcan_en/obj2_3.htm
23. Natural Resources Canada: Sustainable Development Strategy http://www.nrcan.gc.ca/sd-dd/pubs/progfinal1997strat/nrcan_en/obj2_3.htm
24. Natural Resources Canada: Sustainable Development Strategy http://www.nrcan.gc.ca/sd-dd/pubs/progfinal1997strat/nrcan_en/obj2_3.htm
25. Natural Resources Canada: Sustainable Development Strategy http://www.nrcan.gc.ca/sd-dd/pubs/progfinal1997strat/nrcan_en/obj2_3.htm
26. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
27. Nicola Valley Institute of Technology http://www.nvit.bc.ca
28. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
29. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
30. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
31. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
32. Nicola Valley Institute of Technology http://www.sustainability.ca/Docs/Busby-NicolaValleyInst.pdf?CFID=1535348&CFTOKEN=11799311
33. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
34. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
35. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
36. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
37. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
38. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
39. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
40. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
41. Nicola Valley Institute of Technology http://www.sustainability.ca/Docs/Busby-NicolaValleyInst.pdf?CFID=1535348&CFTOKEN=11799311
42. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
43. Nicola Valley Institute of Technology http://www.sustainability.ca/Docs/Busby-NicolaValleyInst.pdf?CFID=1535348&CFTOKEN=11799311
44. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
45. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
46. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
47. Nicola Valley Institute of Technology http://www.sustainability.ca/Docs/Busby-NicolaValleyInst.pdf?CFID=1535348&CFTOKEN=11799311
48. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
49. Wood le Bois. No.41, Spring 2003. “Nicola Valley Institute of Technology: *Native forms and new construction ideas deliver modern space”* Alfred Waugh
50. Canadian Wood Council: Nicola Valley Institute of Technology/ University College of the Cariboo http://www.cwc.ca/environmental/sustainable_buildings/case_studies/nvit/index.html
51. Canadian Wood Council: Nicola Valley Institute of Technology/ University College of the Cariboo http://www.cwc.ca/environmental/sustainable_buildings/case_studies/nvit/index.html
52. Canadian Wood Council: Nicola Valley Institute of Technology/ University College of the Cariboo http://www.cwc.ca/environmental/sustainable_buildings/case_studies/nvit/index.html
53. Canadian Wood Council: Nicola Valley Institute of Technology/ University College

of the Cariboo http://www.cwc.ca/environmental/sustainable_buildings/case_studies/nvit/index.html

54. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
55. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
56. Cedar: Trees of Life http://www.woodentubs.com/tubs_cedar.html
57. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
58. Canadian Architect. Volume 47, No. 8, August 2002. “Modern Vernacular: Nicola Valley Institute of Technology, Merrit, British Columbia.” Jim Taggart p. 16-19
59. Cedar: Trees of Life http://www.woodentubs.com/tubs_cedar.html
60. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
61. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
62. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
63. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
64. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf
65. Use of EcoSmart Concrete: In Nicola Valley Institute of Technology Merritt, BC http://www.ecosmart.ca/use/case/other_pdf/NVIT.pdf

IMAGE CREDIT

All images used in this document were borrowed from both Wood/Le Bois Spring 2003 issue, and the Woodmags website.