THE ARCHITECTURE OF LEARNING :

Spaces for architectural learning within
the Mi'kmaq context

by
Brett Ferguson

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for the degree of Master of Architecture

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The undersigned hereby certify that they have read a thesis entitled "The Architecture of Learning: Spaces for architectural learning within the Mi'kmaq context" by Brett Ferguson, and recommend it for acceptance to the Faculty of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Architecture.

Date: _____

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Richard Kroeker, supervisor

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Roland Hudson, advisor

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Peter Lynch, external examiner

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Author:	Brett Ferguson
Title:	The Architecture of Learning: Spaces for architectural learning within the Mi'kmaq context
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ABSTRACT

This thesis explores the use of local materials and vernacular to create a building for a First Nations community in Eskasoni, Nova Scotia, within the context of the design of a school of architecture. At its core is the issue of creating architecture within a regional and cultural context that is reflective of Mi'kmaq philosophy and is relevant to the current global architectural discourse. The design of the school, both in form and location, is in response to current efforts by the Mi'kmaq people, who are working towards an educational system that is more supportive of their culture and philosophies. The community is also working to create a built environment that adequately fulfills its needs and is more reflective of its cultural identity. The design process is a two-pronged approach: one uses recently developed digital tools; the other works with the physical properties of the materials in an effort to find form using materials not often used in current architectural design.

ACKNOWLEDGEMENTS

Many thanks to Richard Kroeker for his knowledge, wisdom and patience as I found my way through this process. His breadth and depth of knowledge were unending throughout my time a Dalhousie. He is truly one of the best educators I have encountered.

To Roland Hudson, for his insight into the dovetailing of digital and physical worlds. His door was always open when I came looking for advice.

To Albert Marshall, from whom I have learned so much, through his generosity of time and knowledge. I have benefitted greatly from our ongoing discussions, both for this thesis and personally. Both Albert and Murdina Marshall opened their home and their lives to me and my colleagues on many occasions in our travels to Eskasoni, for which I am grateful.

To Mike Cook and Jordan Molnar for the nimble fingers and graphic know-how. To Neda Pavela for the many design discussions at all times of the day. To Jessica Linzey and my parents for providing love, support and understanding during this long process.

Jessica and Neda, thank you for picking me up and carrying me to the end when time was running out.

Introduction

After generations of systematic suppression of their language and culture, the Mi'kmaq people are at an exciting point in their history. Efforts are being made to gather, document and pass cultural knowledge and understanding on to their youth. As a result, larger and larger numbers of Mi'kmaq people are regaining pride in their cultural background and recognizing the enormous value and wisdom in their long history and guiding beliefs.

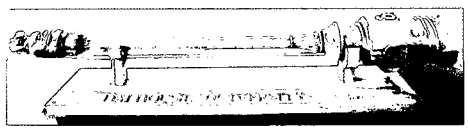
Scenes of Mi'kmaq celebrating their cultural identity in Sydney, NS. The celebration was part of a nation-wide protest to raise awareness of systemic poverty on First Nation reserves.
top: Mi'kmaq Nation Flag.
middle: Young women dancers.
bottom: Men from several generations singing and drumming together.

Within this resurgence, there are two areas of focus important to Mi'kmaq Elders that are also relevant to architectural pursuit: working towards an educational system that is more supportive of Mi'kmaq culture and philosophies than what is currently offered in the Western system, and working to create a built environment that is more reflective of their cultural identity.

With 80 per cent of the population under the age of 25, the matter of educating Mi'kmaq youth has become a primary concern. Strategies for finding ways of educating youth so that their efforts and skills can be put to use within the community are being sought out. Currently, the best and brightest have to leave the community to go to school, and have few opportunities to return to, forcing them to seek employment elsewhere, much to the detriment of the Mi'kmaq community.

These above-mentioned initiatives are currently being undertaken by Mi'kmaq Elders Albert and Murdina Marshall, both of whom have recently received

Honorary Doctorates for their work in bridging First Nation and Western ways of thought in the educational system. It is not hard to understand why this might be necessary if one looks at the description of the Dalhousie University Mace, the symbol of the University's power, from page 48 of the May 2010 convocation booklet:



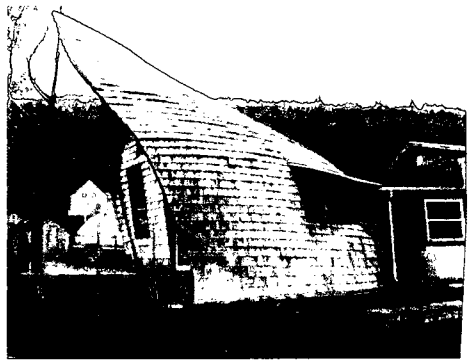
The Dalhousie University Mace. A symbol of traditions and people from another land. Source: Dalhousie University, 2010.

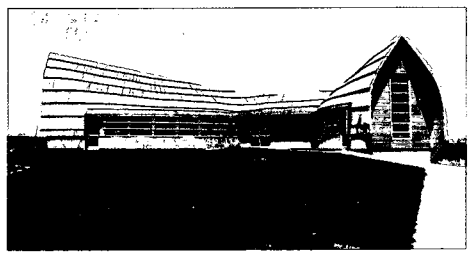
> [It] is a circular scene of sea nymph calling across the waves towards the setting sun in representation of the impulse that led navigators to our shores. The roots put down by early settlers and the tall trees that met their gaze are reflected in a pattern extending the entire length of the shaft ... Set above the leaf is a carved circle of mayflowers, which symbolizes both the province and the flowering of a new civilization in the province which led to the establishment of the University.

Note that there is no mention of First Nation people, leaving the reader with the impression that either they did not exist, or were of no consequence to the "new civilization" being established in the middle of First Nation territory. Although the above statement is a ceremonial one, it highlights a lack of recognition and understanding of Canada's aboriginal populations – without which the country's institutions seem ill-equipped to provide appropriate service to First Nation people.

This issue is neither new nor unique to the Mi'kmaq. However, through the efforts of people like Albert and Murdina Marshall, ground is finally being gained in the struggle for cultural recognition.

Elders within the community believe that the architectural expression of their culture is an important part of this cultural resurgence. For this





Two of Richard Kroeker's projects.
top: The West Wing, an addition to Albert and Murdina Marshall's existing home.
bottom: The Pictou Landing Health Centre.

community's built environment to be truly reflective of their culture, the Mi'kmaq people must play a larger role in conceiving, designing, and building it.

To this end, Albert and Murdina Marshall have been working with architect Richard Kroeker to build architecture they feel is more in line with Mi'kmaq tradition than the architecture currently being built in their communities by government.

It is my belief that the next logical stage is a marriage of the above-mentioned areas of focus to provide a place for Mi'kmaq people to study architecture in a form that is more relevant to them than the Euro-centric systems currently available. It is worth noting that "as outsiders, Euro-centric scholars may be useful in helping indigenous people to articulate their concerns, but to speak for them is to deny them the self-determination that is so essential to human progress." (Mi'kmaq Resource Centre 2010) By providing a place within which the Mi'kmaq can define what is built in their communities, rather than being subject to outside governmental will, perhaps we will witness the real architecture Mockbee describes:

> The best way to make real architecture is by letting a building evolve out of the culture and place. (Dean 2005, 2)

Thesis Statement

This thesis explores the design process, through both digital and physical means, to create a culturally and regionally relevant architectural school, using locally available materials and fundamental values of the Mi'kmaq people.

Context

Mi'kmaq Culture, Ethics and Principles

Firstly, it is important to recognize that there are major differences in the way individual cultures view the world. It is a false assumption to assume that everyone thinks and therefore learns the same way. The following section considers some of those differences in an attempt to understand how a place of learning might differ from western tradition, when framed within a Mi'kmaq world view.

It is also important to note that I by no means consider myself to be expert, or even deeply knowledgeable, in the issues presented here. My experience is limited to a small number of visits to Eskasoni, and the reading of a dozen or so books, essays and speeches – considered to be relatively accurate by trusted resources – on the subject. However, as uncomfortable as I am to make statements that could read as sweeping generalizations, and though my understanding may be limited or flawed, I believe it is necessary to try to convey the rationale for some of the decisions made as part of this design. The concepts that follow are those that I believe would play an important role in the shaping of such an institution, and therefore the form of the building that houses it.

Language

Language is more than simply a means by which to communicate ideas between two people. Language structure and vocabulary are shaped by the fundamental beliefs, values and thought patterns of

the society that created it. The existence or absence of a concept or words within a language are both influenced by as well as shape the people that use it.

In contrast with English or French, which are object-based, the Mi'kmaq language is verb-based, "emphasiz[ing] relationships and states of being, rather than things" (Johnson 1992). It is interesting to think about how the use of Mi'kmaq might influence the pursuit and evolution of architecture. Would the focus become more about the activity within the space than about the formal or object-based architecture of today? How would a different understanding of the power of forms and spirit of objects define the architecture coming from that perspective?

Connection to Nature

Mi'kmaq culture is deeply rooted in a nature-centric worldview. The Mi'kmaq considered themselves the custodians of Earth, not the owners, and understood that maintaining a balance with the environment around them was key to both their own well-being, and the health of the natural environment. This understanding has been maintained to present day.

Non-Interference

The concept of non-interference in Mi'kmaq culture is the idea that everyone has both the privilege and responsibility to make their own decisions. It is considered rude and disrespectful to impose one's ideas or beliefs on another by telling him or her what to do or how to think (Ross 2006, 12-28). It is each person's individual pursuit to form his or her

own ideas. This also applies to the teaching/learning relationship, in that the teacher (schoolteacher, parent, elder, friend, child) does not tell the learner (schoolteacher, parent, elder, friend, child) what to think or how to act. It is up to the learner to ask questions, and discover for him/herself through observation and personal pursuit the solution to a problem or question. Until one is ready to ask the question, one is not ready to receive the answer.

Everything is Shared

Traditionally within Mi'kmaq culture, all assets and resources of a family or extended family were shared. These assets and resources were not just monetary or physical, but also skills, abilities and knowledge. Within this philosophy, it was immoral to take more than you needed or to let anything go to waste. This was developed as a means of survival in times in which doing otherwise could endanger the welfare of the group. Although this tradition is not fully employed in present day, it can certainly be seen in some form within the community. In contrast with much of today's western values, the Mi'kmaq traditionally value the collective survival and amelioration over individual recognition and prosperity (Mi'kmaq Resource Centre 2010).

The Time Must be Right

This is the idea that activities should happen at the appropriate time, not before and not after. It is believed that the origin of this comes from a strong dependence and connectedness with nature. The

Typical housing found in Eskasoni. Vinyl-clad two-storey houses have very little to do with any Mi'kmaq tradition or culture. These structures are often of very low quality, with myriad design and construction flaws resulting in serious health issues such as black mould.

Many commercial buildings in Eskasoni are either larger or slightly modified versions of the residential buildings.

Housing is scarce in Eskasoni. Extended family often live in trailers, shacks, and multiple houses in varying state of repair on a single lot.

seasons, migratory paths and harvesting times dictated when activities occurred.

To move camp too early or harvest berries too late could have dire consequences. The indicators for when the time is right both traditionally and present day are diverse and perplexing to many. But there is a certain logic and efficiency in this that could be beneficial to all.

Current Built Form in Eskasoni

Current architectural form found in Eskasoni, as well as on many other First Nation reserves, rarely has any link to its local, regional or cultural context. The archetypical vinyl-clad suburban house is often transplanted to reserves in an attempt by the Canadian government to provide basic housing needs for First Nation communities. Public buildings are often larger versions of the same structure. They are also often of very poor quality and built without regard to the people inhabiting them, and therefore fall short both structurally and functionally. The result is buildings with serious design and construction flaws which can result in major health hazards, such as black mould.

Mi'kmaq – a Tradition of Building

Unsurprisingly, the Mi'kmaq have a long tradition of building with materials readily available in this part of the world, and in ways that respond effectively to the local climate and environment.

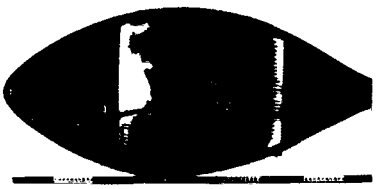
Interestingly, we Westerners are increasingly adopting the practices that indigenous peoples have been

right: Mi'kmaq hockey stick crafted from a single piece of yellow birch. Source: Bobby Rouillard's "World's Oldest Hockey Stick".

far right: birch bark container. Source: Adam Read, 2008.

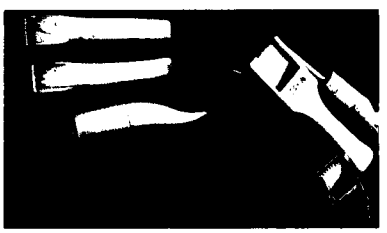
right: Birch bark canoe. Source: Gardner, 2010.

far right: Traditional Mi'kmaq snowshoe. Source: Mamie Griffith, 2008.



right: Crooked knives were used to shape wood, split ash roots and peel birch bark from the tree. Source: Building a Birchbark Canoe: Tools.

far right: Mi'kmaq basket-making tools. Source: Melanie Abbott, 2008.

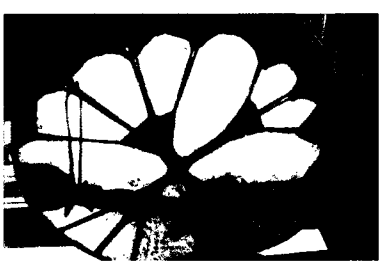


right: Quill basket. Source: Work Through Time | Mi'kmaq Work Poetry, 2009.

far right: Pile of completed baskets by Rose Anne Bernard, an Eskasoni basket maker. Source: Melanie Abbott, 2008.

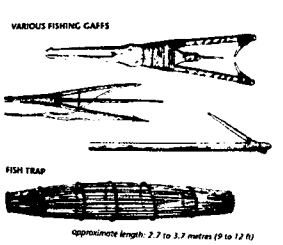
right: Hand drum weaving detail used to pull the hide over the frame and keep it tight.

far right: Moose skin hand drum made by Robert and Joywind Todd.



right: Traditional Mi'kmaq fishing tools. Source: Mi'kmaq Traditional Fishing Camp.

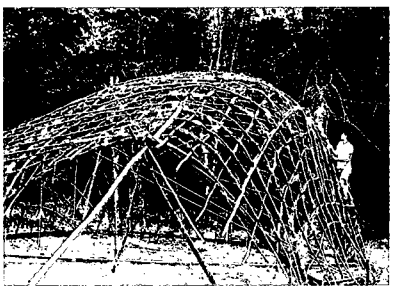
far right: Mi'kmaq summer eel fishing spear.

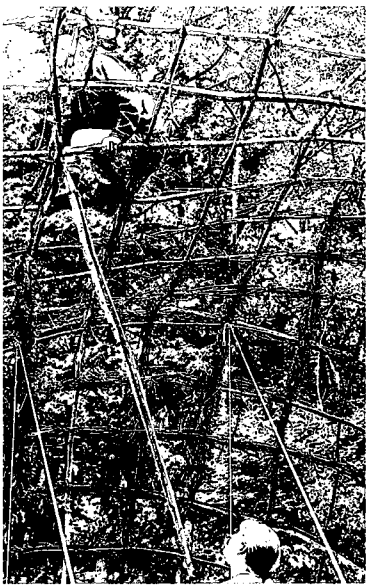


right: Moose calling horn, made of bark.
Source: Work Through Time | Mi'kmaq Work Poetry, 2009.

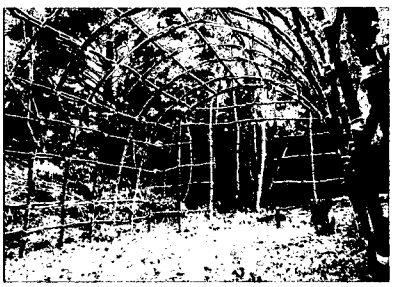
right: Gridshell being raised. Source: Richard Kroeker.

far right: Roundwood gridshell being constructed during a Dalhousie FreeLab.



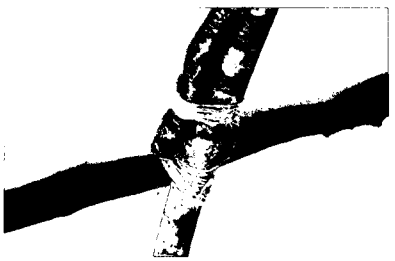


right: Longhouse roundwood structure. Source: Richard Kroeker.



right: Close-up of lashing detail.

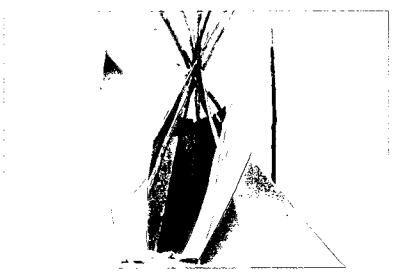
far right: Roundwood wigwam structure.



right: Rear detail of tipi ventilation flap.

far right: Tipi at 2010 powwow in the Halifax Common.

right: Front detail of tipi ventilation flap.

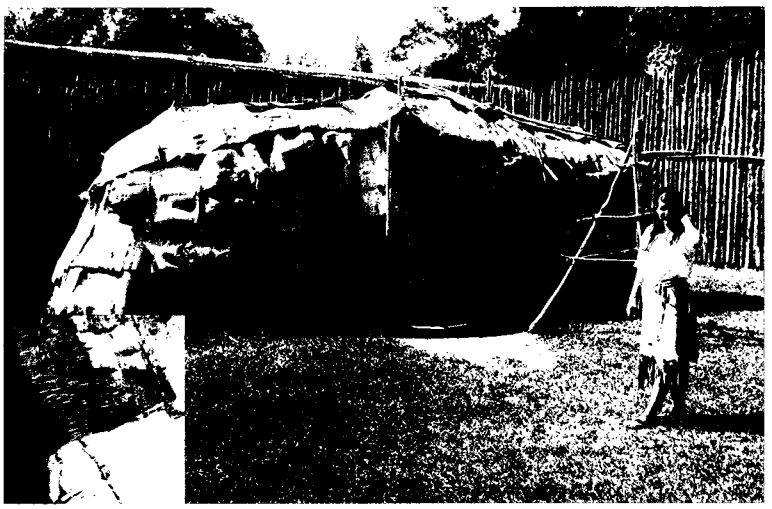


Reconstruction of a traditional Mi'kmaq wigwam. Spruce poles were lashed at the top to create a conical structure, braced with smaller horizontal poles. The structure was then clad with birch bark, and lashed down with spruce root and additional spruce poles. Source: Mi'kmaw Daily Life - Shelter and Implements, 2010.

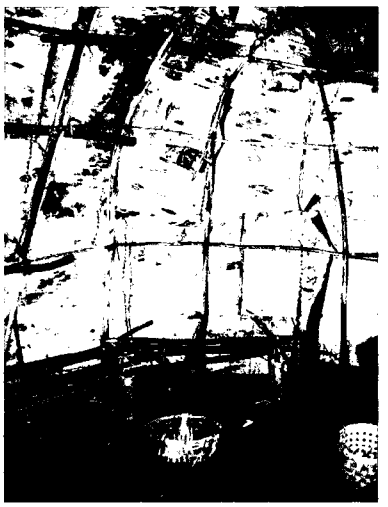
employing for thousands of years. It is becoming less and less acceptable – or even feasible – to build with complete disregard for local conditions or the source of building materials. Using local materials and knowledge of environment to influence our design is becoming more and more important as resources become increasingly depleted.

As such, it is important to look at what traditional techniques of building were used, what materials were incorporated, and what forms grew out of that as a starting point.

Two of the many precedents that were considered during this thesis come from techniques used in the wigwam: the use of wood as an intact bundle of fibres rather than a milled slab, and the use of lashing in roundwood construction. These ideas are expanded on in the Material Investigations portion of this paper.



Birch bark wigwam with inset stitched bark cladding detail
Source: Shannon Kyles, 2010.



Wigwam interior.
Source: Shannon Kyles, 2010.

Design

Approach / Philosophy

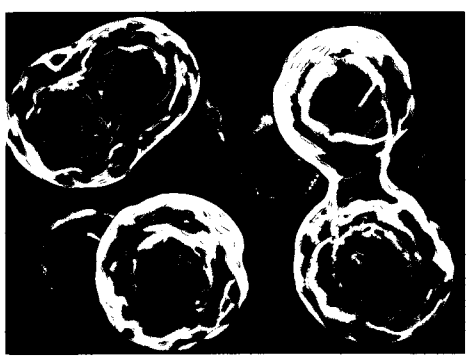
The design proposed as part of this thesis is meant to explore how local materials can be used to create architecture within a regionally specific indigenous context. My intent is to propose an architectural form, from an external context, which is hopefully both culturally and regionally relevant. The hope is to create a design using a "Two-Eyed Seeing" approach, as Albert Marshall describes it for the Integrated Science program at Cape Breton University:

> "Two-Eyed Seeing" is more than a label...it is a powerful reminder of the Integrative Science program's visionary goal of learning to see from our one eye with the strengths of Indigenous knowledges and from our other eye with the strengths of mainstream scientific knowledges... and to use these together for the benefit of all. The Integrative Science program works to achieve such "Living Knowledge for the 21st Century" through learning opportunities in classrooms, laboratories, outdoors, community workshops, and work placements. (Mi'kmaq Studies Program at CBU, 2010)

Guiding Principles

The following are some of the guiding principles I employed when considering the design of the building. These principles influence much of the project – from site selection, to material selection and use, to program definition and formal layout.

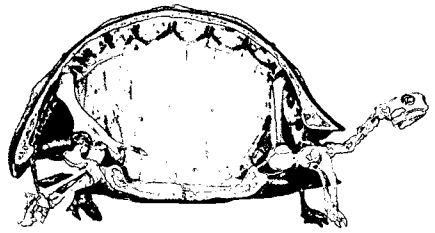
- Non-interference and self-esteem building resulted in non-hierarchical spaces
- Preservation of nature – efficient use of materials
- Connection with nature – selection and visibility of materials and views to centre oneself in the world
- Collaboration



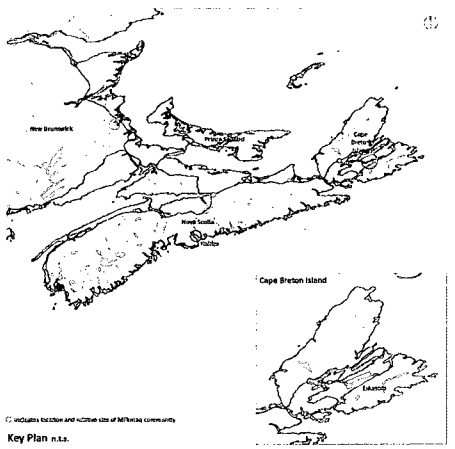
Different stages of cells splitting. Source: Lyon's Den: Introduction to Chapter 12, 2010.

- Pattern-reasoning – intuitive, non-linear reasoning (unconscious, or unreasoned decisions) obtained from observing patterns over long periods of time. This resulted in spaces for building, hands-on design and material investigation.

The structure of a clam shell becomes undulated as the main shell curvature becomes flat. Source: Henry, 2007.



The shape of a turtle's shell, its primary source of defense. Source: Reptilis 2009.



Location of site on Cape Breton Island, Nova Scotia.

Nature as Precedent

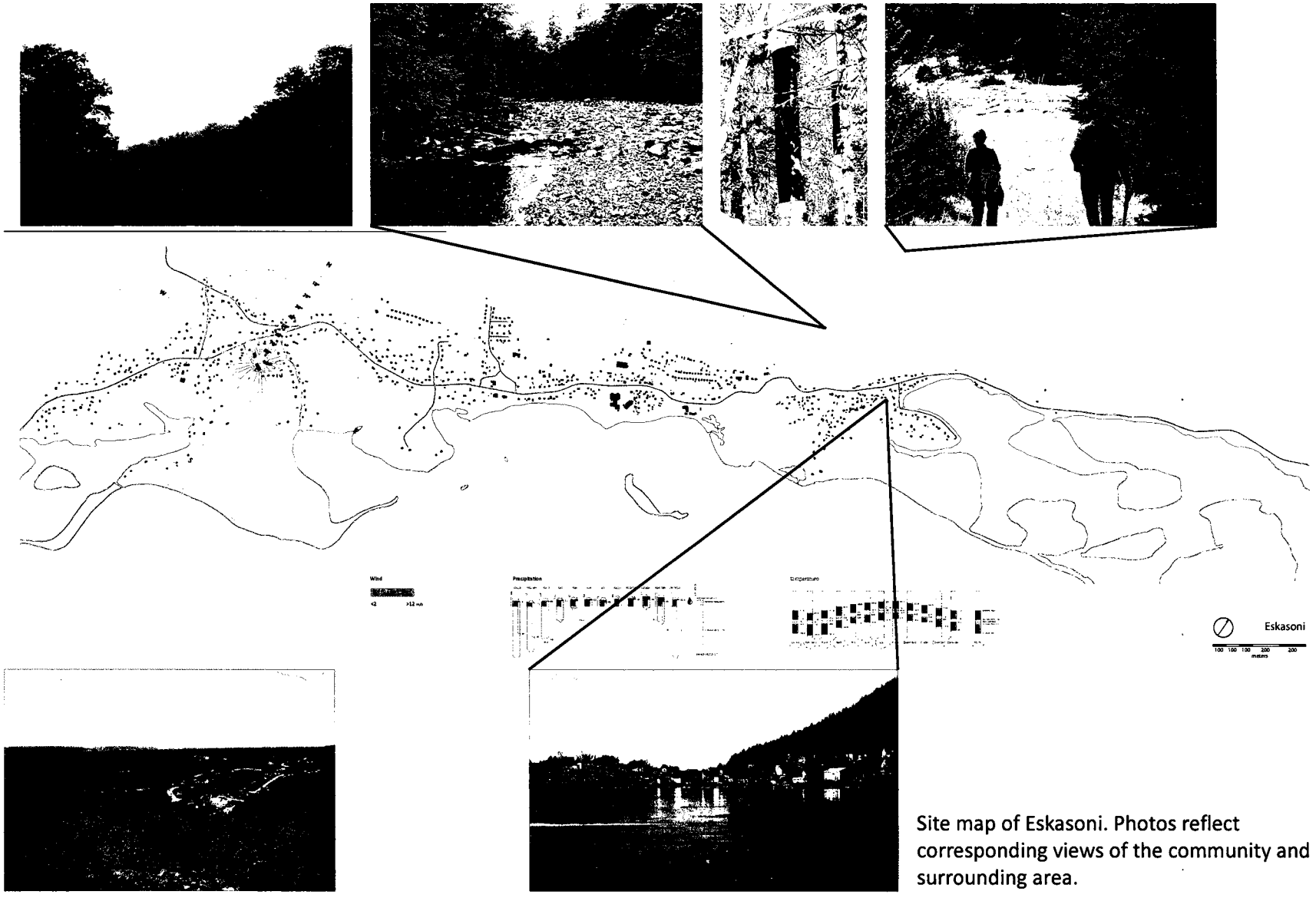
One of the underlying philosophies of this design is looking to nature as a way of learning and as a primary reference point. This is consistent with both the traditional cultural connection with nature and the use of first-hand information and knowledge.

The clam shell provided inspiration for the building's undulating roof. In particular, I was interested in how the shell's waves become tighter for strength as the shell thins out towards its edges. When thinking about how curvilinear rammed earth walls could fit within an enclosed space, I looked to the shape and form of a kidney. The turtle shell provided an example of strength of form for the roof, and microscopic cells illustrated the shape and relationship of various rooms.

Site

Geographic Location

The site is situated in Eskasoni, the largest of the Mi'kmaq communities with a population of approximately 3,000 people. The town is located on the edge of the Bras d'Or lakes in central Cape Breton, Nova Scotia, and surrounded by forested hills on the other sides. The town is fairly linear in nature, with pockets of public buildings distributed along the transportation spine.



Site map of Eskasoni. Photos reflect corresponding views of the community and surrounding area.

Vegetation & Local Resources

Eskasoni literally translates to "where the fir trees are plentiful" (Mi'kmaq Resource Centre 2010). The forested reserve is home to a variety of low-lying bush (including wild blueberry), deciduous hardwood (such as alder, elm, birch, and oak), as well as the evergreen spruce and fir, among others.

The nearby Pictou Landing First Nation Reserve became both the first woodlot in Nova Scotia and the first First Nations-owned lot in all of Canada to earn Forest Stewardship Council certification. Between this and the Mi'kmaq-run Unama'ki Institute of Natural Resources, there is a wealth of First Nations expertise in harvesting local wood in a sustainable fashion.

The soil in the area is clay-rich, and there are large gypsum deposits. The Bras d'Or Lakes waters are a mixture of Atlantic seawater, freshwater run-off, and a small amount of fresh groundwater. Eel, mackerel, and rainbow trout contribute to a rich fishery.

Comparison between summer and winter colours

Climatic Conditions

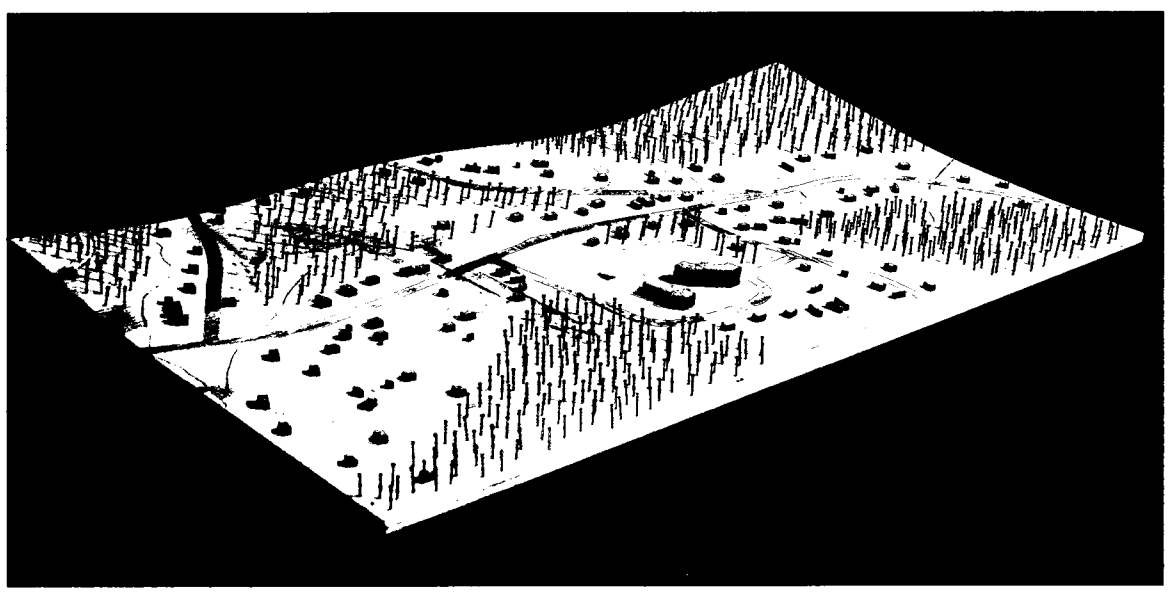
Eskasoni receives an annual average of 1,200mm of rainfall, distributed relatively evenly over the year, and 300cm of snow, mostly between December and March, but some years extending into November and April.

The temperature is fairly moderate, averaging -5 in the winter to +18 degrees Celsius in the summer; however, extreme temperatures range from -32 in the winter to +37 in the summer.

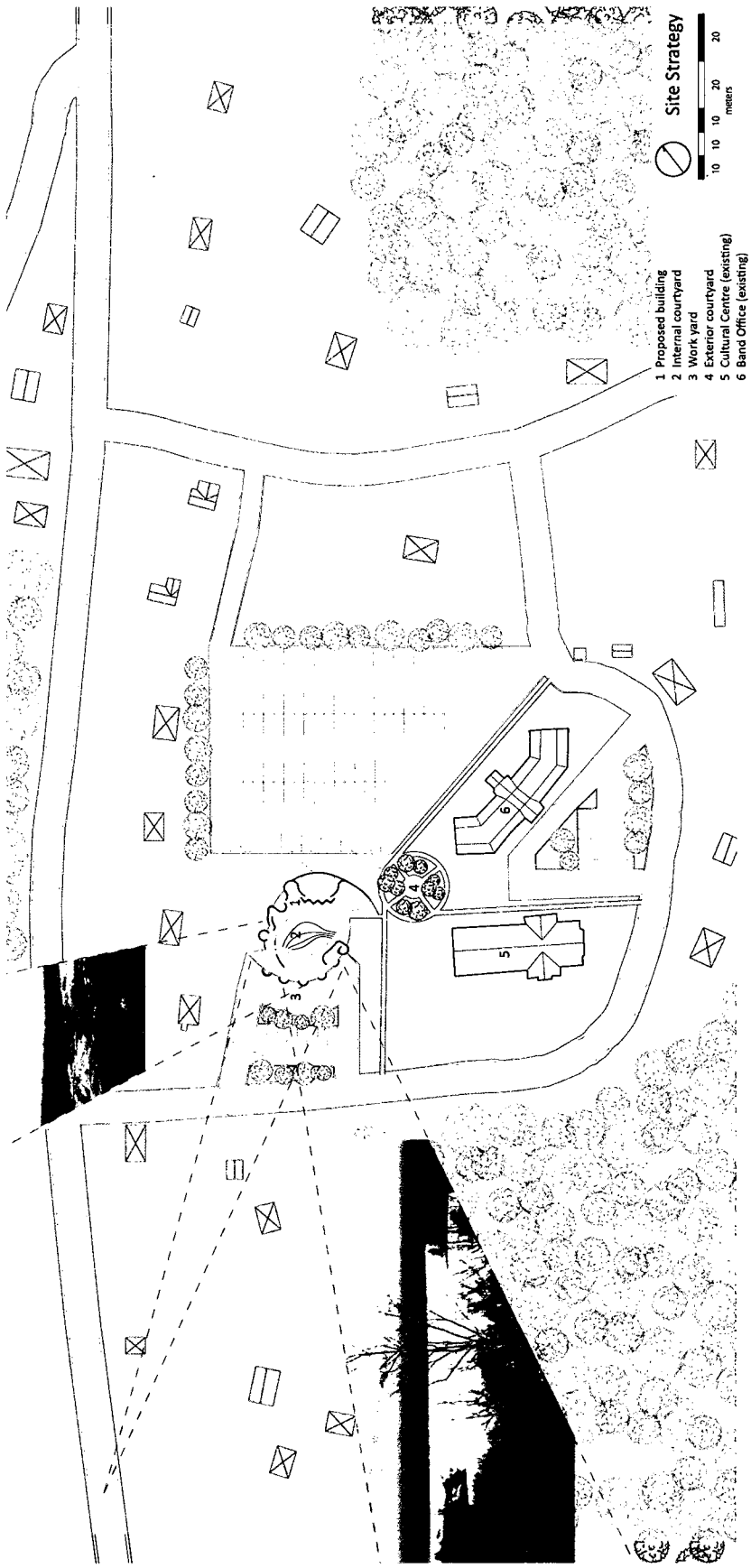
Site Strategy

The chosen site would form part of the existing cluster of public service buildings near the south end of Eskasoni. Nearby are buildings of import to the community, such as the band office and the Sarah Denny Cultural Centre.

The site was also chosen for its connection to nature – from here one can see both the water and the mountains.



Site model viewed from the south. Red area indicates proposed site.


Site Strategy
10 10 10 20 20
meters
1 Proposed building
2 Internal courtyard
3 Work yard
4 Exterior courtyard
5 Cultural Centre (existing)
6 Band Office (existing)

The site, a south-facing slope, is visible from the road when entering Eskasoni. Building into the slope allows the building to take advantage of the more moderate temperature of the ground while also being able to take advantage of solar gain. In addition, it means the building can be part of the landscape, rather than stand in contrast to it.

The predominant winds come from the south off the lake in the summer and from the northwest in the winter, but the nearby hills can make winds somewhat unpredictable.

Jersey Devils
- Design/build integration

Rural Studio
- Collaboration-focused
- Community-based projects

Barefoot College
- Financial stimulus within community
- Development of the business sector
- Social- and community-based issues
- Engaging/educating within the community

Dalhousie Gambia Project
- Resource-sharing
- Community-focused design

Architectural Association
- Performance-based accreditation
- School as a "place to be" – student-driven education, casual, social environment

Other academic/practice models considered when looking at academic precedents.

Academic Program

What is proposed here is an idealistic system. Issues of actual accreditation processes, local regulations and limitations are beyond the scope of this discussion. The academic program is only relevant here insofar as it informs the types and size of spaces necessary for the building.

There are two parts of this exploration that, although tangential to this architectural thesis, I feel are important to note.

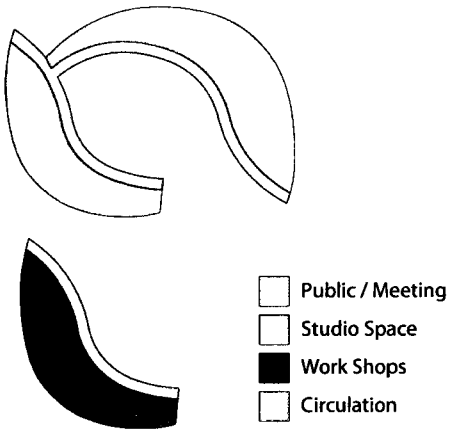
First, it is vital that the educational system proposed be part of the mainstream accredited system. This is important as it provides a means by which Mi'kmaq knowledge and history can be recognized as valid within the mainstream culture. Without this recognition, the Mi'kmaq people and other indigenous peoples with worldviews different from our own will likely continue to be marginalized.

Secondly, it is important to create additional industry sectors within Mi'kmaq communities. Systemic unemployment is an issue on Mi'kmaq reserves, as it is on most reserves across the country. Today, the vast majority of Mi'kmaq income is spent off the reserve. By keeping the design and construction of reserve buildings within the community, perhaps less money would be spent elsewhere. Another advantage is that it would foster a set of skills that could be employed beyond the reserve, bringing net new monies into the community.

Building Program & Interior Strategy

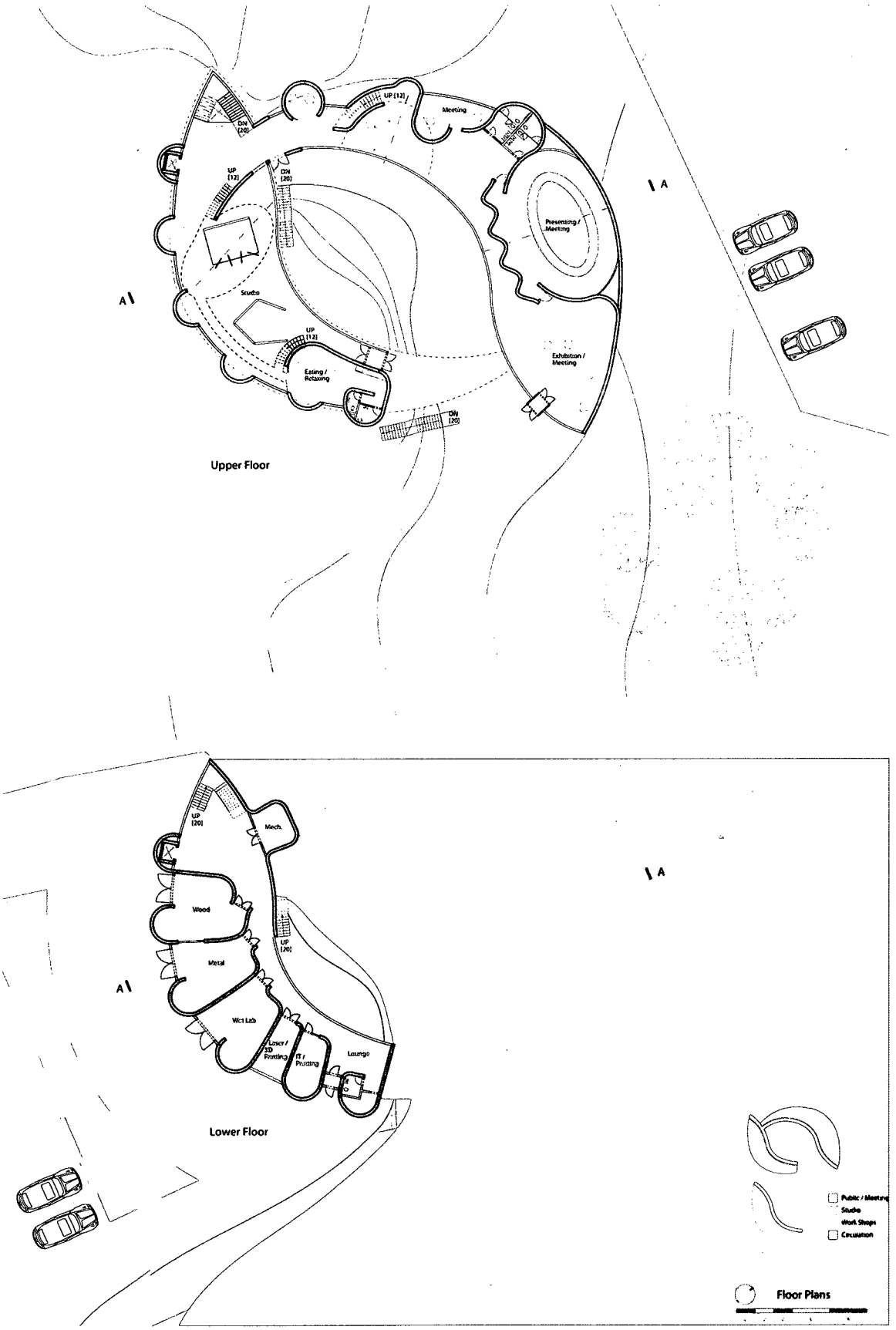
Capacity

The initial size of the building is intended to accommodate between 80 and 100 students at a time. The intent is to draw students from local Mi'kmaq communities as well as indigenous populations with similar worldviews, from around the world. This could provide a platform for discussion and sharing of architectural ideas in a context outside of current Western institutions.



Space Types

The types of spaces proposed are, for the most part, less formal than those in typical Canadian institutions, with the emphasis on informal gathering areas to promote discussion among peers and instructors as a learning mechanism. This follows the "modeling" way of teaching rather than the "shaping" model, and supports more traditional forms of learning within Mi'kmaq society, where knowledge was passed on


UP [12]
Meeting
DN [20]
UP [12]
DN [20]
Presenting / Meeting
Studio
UP [12]
Exhibition / Meeting
Eating / Relaxing
DN [20]
A
A
Upper Floor
UP [20]
Mech.
Wood
Metal
Wet Lab
Laser / 3D Printing
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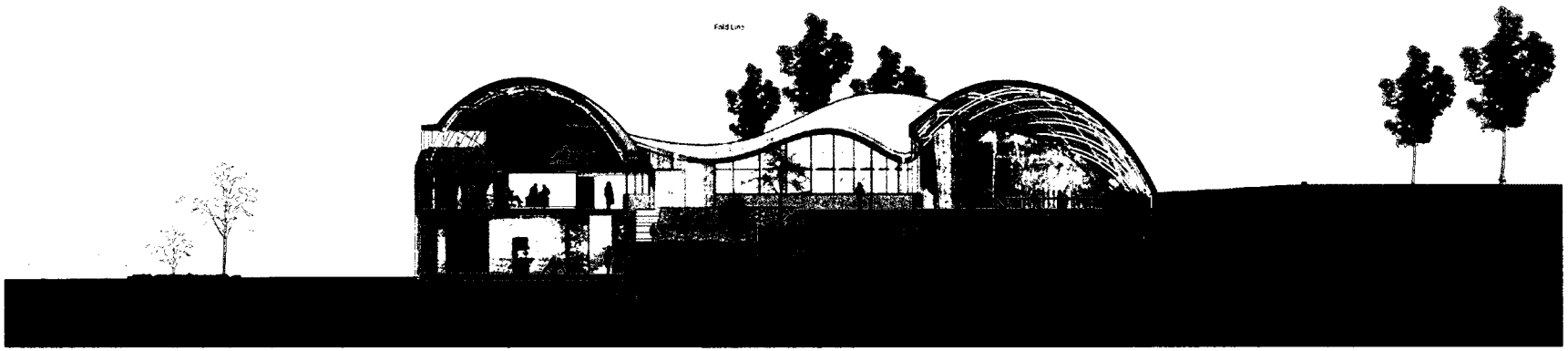
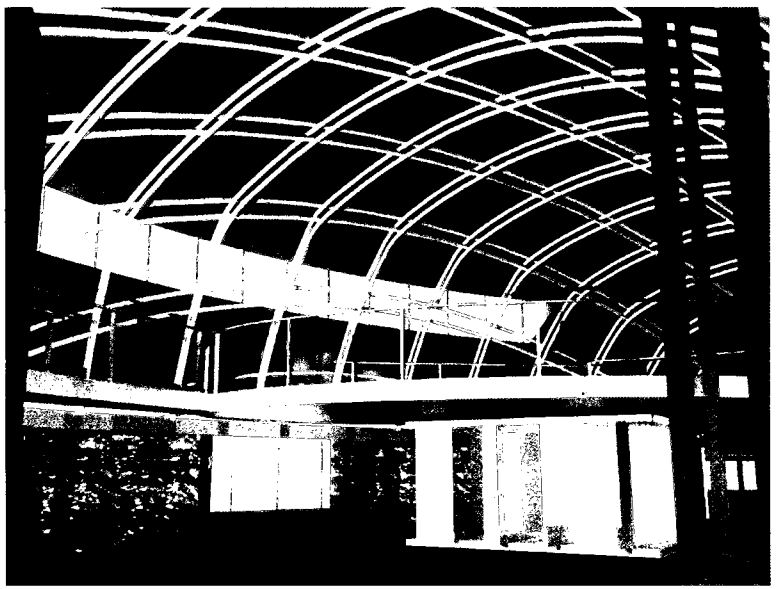
Lower Floor
Public / Meeting
Studio
Work Shops
Circulation
Floor Plans



Section AA

Main Entrance



Studio

either verbally or by example (Mi'kmaq Resource Centre).

The other emphasis of the school is in doing rather than observing as a form of learning.

> Intuition ... provides them with an understanding of a continuous, mobile, fluid and interconnected world. (Hipwell 2001, 46)

Rupert Ross describes this sort of intuition in *Dancing with a Ghost* as "pattern reasoning", a complex path of reasoning that can't be logically followed because it is made up of hundreds or thousands of small indicators that one becomes sensitive to or aware of through repetition of experience. This experience cannot be taught or explained in a book, but must be gained through experience and careful observation. Ross describes this within the context of his experience as a fishing guide, knowing where the fish will bite over the years, or when the weather will change, but not being able to explain *why*. Thought path is not necessarily a linear one, making it difficult to explain logically, but has been experienced by most at some point in time. This type of understanding is used to solve highly complex problems that intellect-based approaches would struggle to solve.

These same principles exist not just in the natural world, but in many other circumstances of complex reasoning as well: a carpenter who knows how far a piece of wood will bend before it will break; an engineer who feels that a support is too big or too small before running the calculations; a mathematician who knows how many hours a mathematical proof will take to solve before solving it; an architect who senses the

quality of a space before it is built. I would argue that the intuition applied in all of these examples is gained through experience – through repetitive perception resulting in an increased awareness or understanding.

For architects, the sooner they can start to develop this intuition, the better off they are. This can be achieved through experiencing the objects they design and the spaces they create, by building the objects that are so easily laid down on paper. The sooner one can see, feel, smell, build the spaces designed, the sooner one can relate the intention of a space to the realities of the space itself and the process of building.

This process of learning by doing and learning by observing is also the way knowledge is gained in Mi'kmaq culture (Mi'kmaq Resource Centre).

Although it is relatively uncommon, there are examples of architectural institutions that provide opportunities for students to learn by experiencing the physical manifestation of their designs. The Dalhousie FreeLab, Auburn University's Rural Studio, and University of Virginia's Studio 804 all provide various degrees of hands-on experience, where architectural students can build their design.

The intention with this school is to apply these ideas and theories to the curriculum as a whole. The vision is that students would design and build real projects throughout the course of their education, providing them with a real feedback loop, from their designs to the types of spaces and building processes necessary to achieve them. I am not suggesting that everything

that is designed at the school is built, as that would be both unrealistic and would limit the types of projects possible. There would, however, be a more continuous integration of building and physical exploration in the curriculum, rather than a one-off studio or two-week window in which to cram the physical side of architecture.

Doing this not only aligns with the traditional way of learning in Mi'kmaq culture, it has several other advantages as well. Beyond students having the chance to actually experience the spaces they design, which allows them to refine their designs through experiential feedback, these projects could also help provide for the needs of the community. Housing shortages, buildings in disrepair, and a general lack of well-designed architecture within Eskasoni and other Mi'kmaq communities could be addressed as part of the program. Less waste could be produced by applying knowledge and efforts to real world projects that have a lifespan beyond the end of a semester.

The development of intuition or reason-patterning is supported by providing interior and exterior spaces to allow for building, investigating, and experimenting at various scales. There is an ample series of workshop spaces, and the studio area is left as an open space so to allow its occupants to design and shape their own learning spaces.

The focus on collaborative working spaces meant that fewer typical classroom teaching spaces were necessary. This also made it important for "places to be", unprogrammed spaces that would be comfortable

to promote the sharing of ideas. These types of spaces could be used for meeting, eating or simply relaxing.

Local materials/colours/textures

Many indigenous peoples are currently working towards an increased awareness of traditional knowledge – knowledge that can be shared through artifact exhibition and discussion. This process of learning can be supported by providing spaces to exhibit such objects. The entrance space was designed to allow for a rotating collection of projects and artifacts from indigenous populations around the world.

Building Form

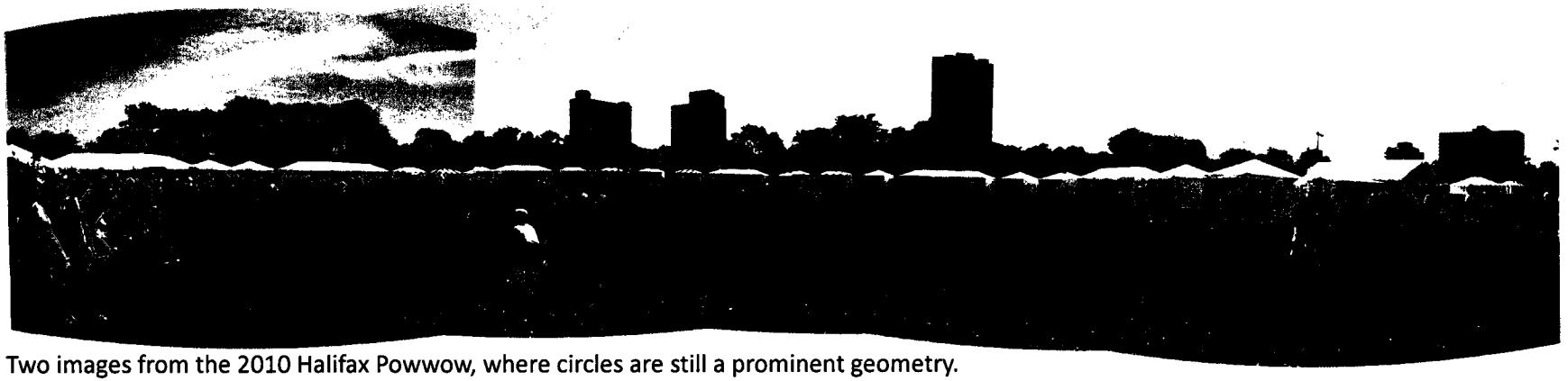
The overall building form was mainly influenced by a combination of using local, low-impact materials, forms in nature, and shapes that are culturally significant and powerful within the Mi'kmaq culture.

Forms and Spaces Found in Mi'kmaq Culture

Within Mi'kmaq culture, there is always a central space of import. This speaks back to the community's tradition of applying non-hierarchical learning methods, and is seen in the form of the arbor or the circular powwow ground. The building's central courtyard and the rounded walls that delineate the learning spaces are intended to reflect the importance of the circle in Mi'kmaq culture.

Materials

The goal with the material selection was to use locally available materials. Based on this criteria, the main two materials chosen were wood and rammed earth.



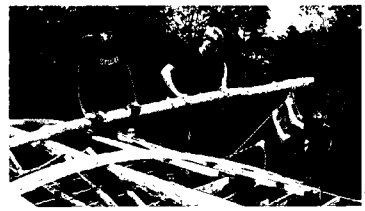
Two images from the 2010 Halifax Powwow, where circles are still a prominent geometry.
above: Vendor's tents arranged in a circle.
right: Dancing circle where dancing and drumming competitions where held.

left: View of cabins on Chapel Island. Source: Kimberly Fuller.

right: Two dance competitors.

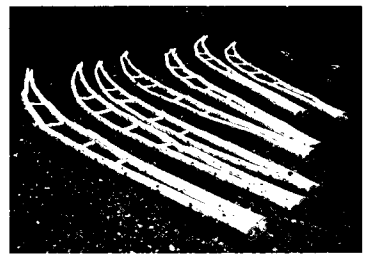
left: Cabins are densely packed, leaving open gathering spaces. Source: Kimberly Fuller.

Building skeleton of 2008 Guest House FreeLab, led by Richard Kroeker.



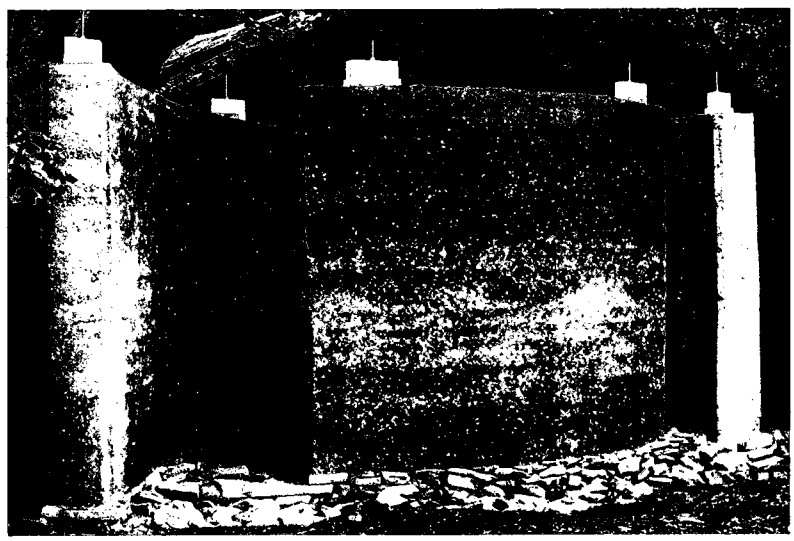
Bending inside chord of roundwood truss.

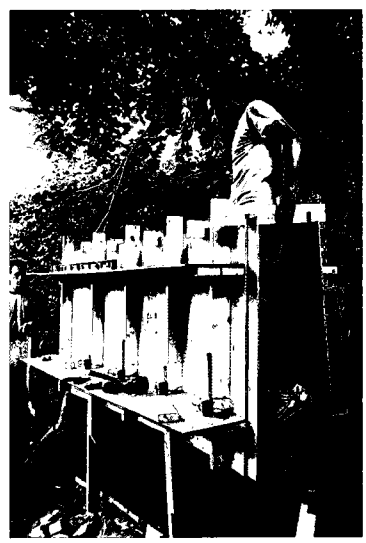
Roundwood trusses on the vertical bending jig.

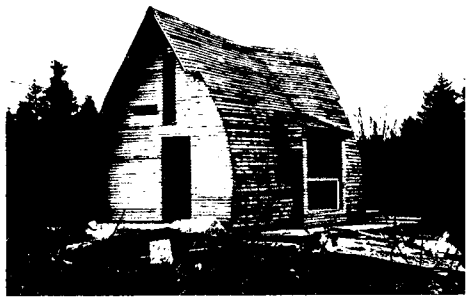


Formed trusses ready to be paired

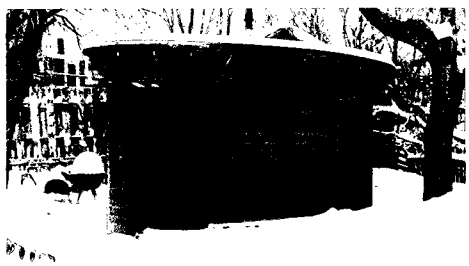
below and right: Construction of the 2006 Rammed Earth Bicycle Pavilion FreeLab in Halifax, led by Peter Sassenroth.







Completed Guest House FreeLab.



Completed Rammed Earth Bicycle Pavilion.

Eskasoni is surrounded by forest on one side, making wood a logical choice. When discussing the use of wood with Albert Marshall, he stressed that ideally the use of larger trees should be minimized. Local knowledge indicates that larger trees make stronger seeds, which are important to maintain a strong, healthy forest.

The size of trees in the area tend to be smaller and grow more slowly than one would find in other parts of Canada. This makes much of the forest unsuitable for milling into dimensional lumber. Another advantage to using smaller, younger trees is that the stock taken can be replenished much faster than their larger counterparts.

The other main material selected is rammed earth. Clay is readily available in many parts of Nova Scotia, making it a viable building material. It is also has much lower embodied energy than concrete or brick, making it a better alternative for construction.

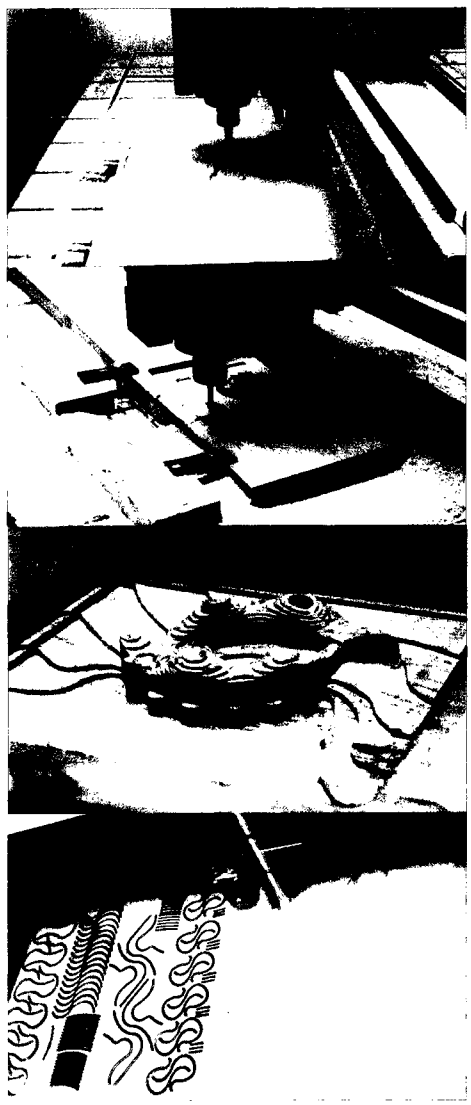
Form-Finding Process

Initially looking to nature for precedent and shape, my approach to finding form was multi-pronged, and is described in detail below.

As with many other gridshell structures, the process of determining the structure's form involved both physical and digital modeling. I was interested in how the digital world could inform the physical world, and vice versa. In this particular case, the starting point for the process was based on a series of paper sketch models.

Process used to design gridshell from paper sketch model

Wood-bending test with Rhino digital model overlay created from it.



Digital models were used to help fabricate physical models.
top to bottom: CNC router cutting formwork for 1:100 scale model, CNC router cutting 1:500 scale site model plug, finished plug in wood, laser cutter cutting out layers for rammed earth walls

Digital Modeling & Analysis

Digital and parametric modeling were used for three main purposes.

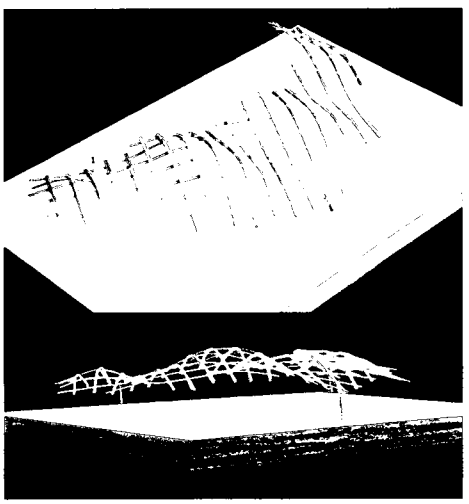
1) To help find the form of the building by applying parametric rules to generate it.

After determining a general form and plan shape from the paper models, it was traced into Rhino so that Grasshopper could be used to create a set of variables for a parametric investigation of the shape. The intention was to iterate through a series of forms digitally to produce a physical model from each form, and then to do an analysis of those forms for the next digital iteration.

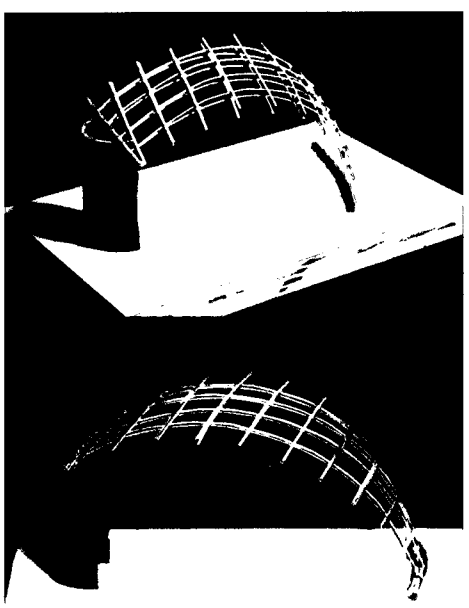
2) To help determine the gridshell configuration for the shapes found through digital and physical models. This provided the ability to determine the length of lath members, and the number and location of nodal connections along each member. The physical characteristics of the material can also be incorporated in the digital and parametric form-finding to ensure the materials being used were capable of following the form being generated.

3) To facilitate building physical models by generating formwork and detailed information of the forms generated. This was done as an exercise to see how this process could be used to inform the construction of such a building at full scale. This information could be used to determine the amount of wood required, and the number and location of the nodal connections.

Paper model of initial concept



1:200 scale study model of roof structure



1:100 scale models used to examine the structural effects of increasing the space between gridshell layers.

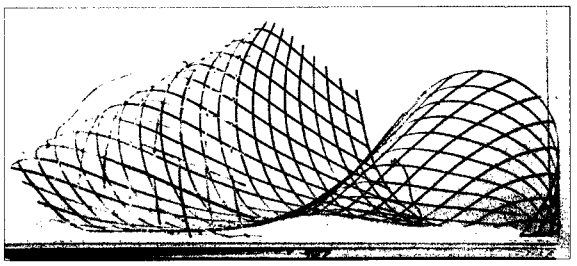
Physical Modeling

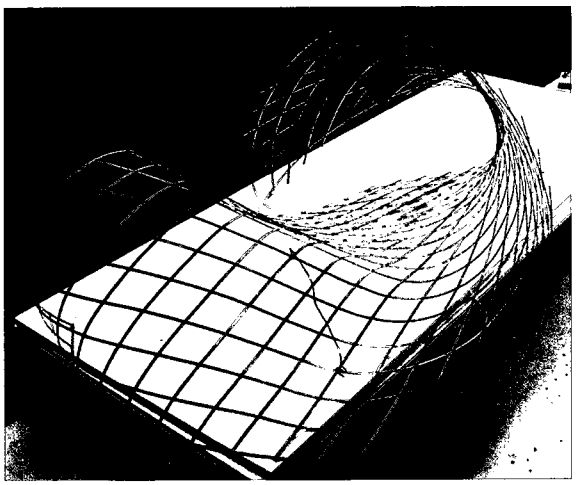
Scale and full-size physical models were generated from both the digital models as well as on their own. This helped to understand how the materials and structure behaved physically. The scale models also provided a means to understand the quality of the spaces that were often difficult to understand in a digital form.

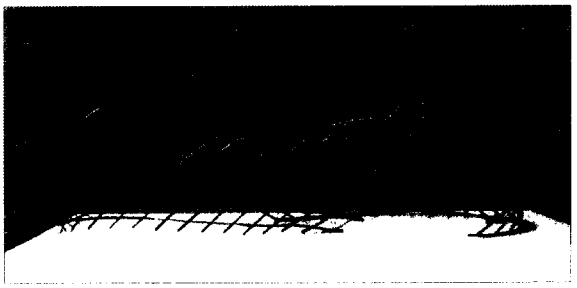
Material Investigations

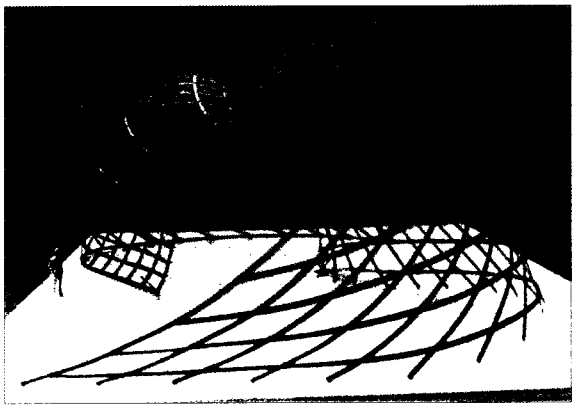
As with any building material, an understanding of the material's properties is critical to its use within a project. There is a significant difference between how the Mi'kmaq and Westerners understand wood in the context of building. The Western way is to cut down large trees and then mill them into smaller dimensional lumber, treating the lumber as slabs of material. In Mi'kmaq culture, trees are considered to be bundles of fibres, which are left intact as much as possible. This makes the wood stronger per square inch than when it is milled.

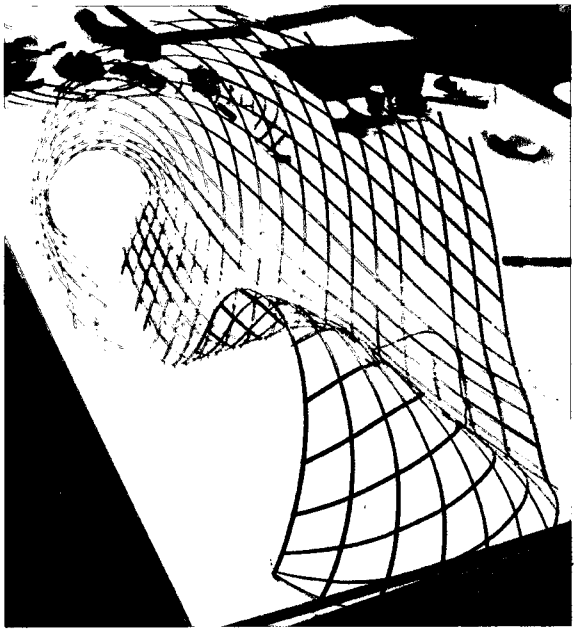
My understanding of roundwood has benefited greatly as a result of prior research done by Richard Kroeker in his development of roundwood trusses, as well as a FreeLab that I was part of in the summer of 2008. This experience gave me insight into how far the trees could be bent before cracking, their profiles when they are bent, and knowledge of details and processes that have been proven to work in previous projects.

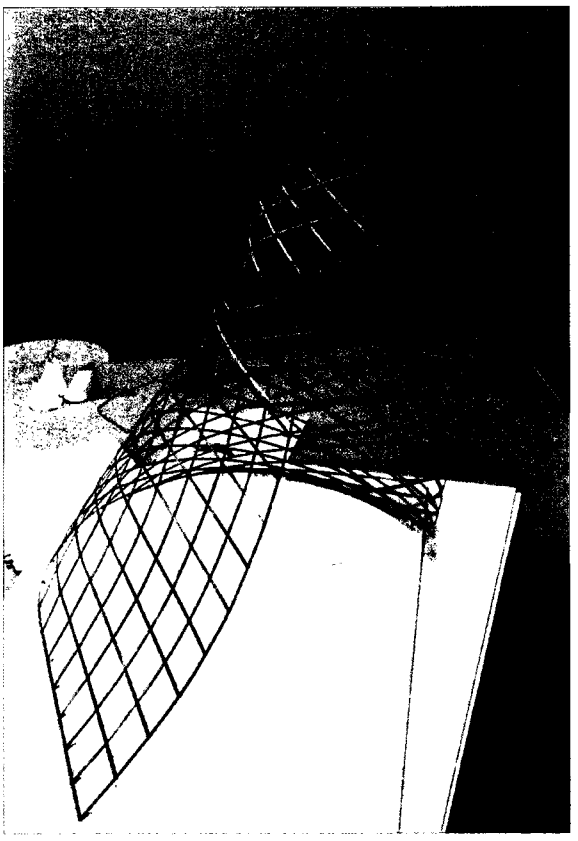




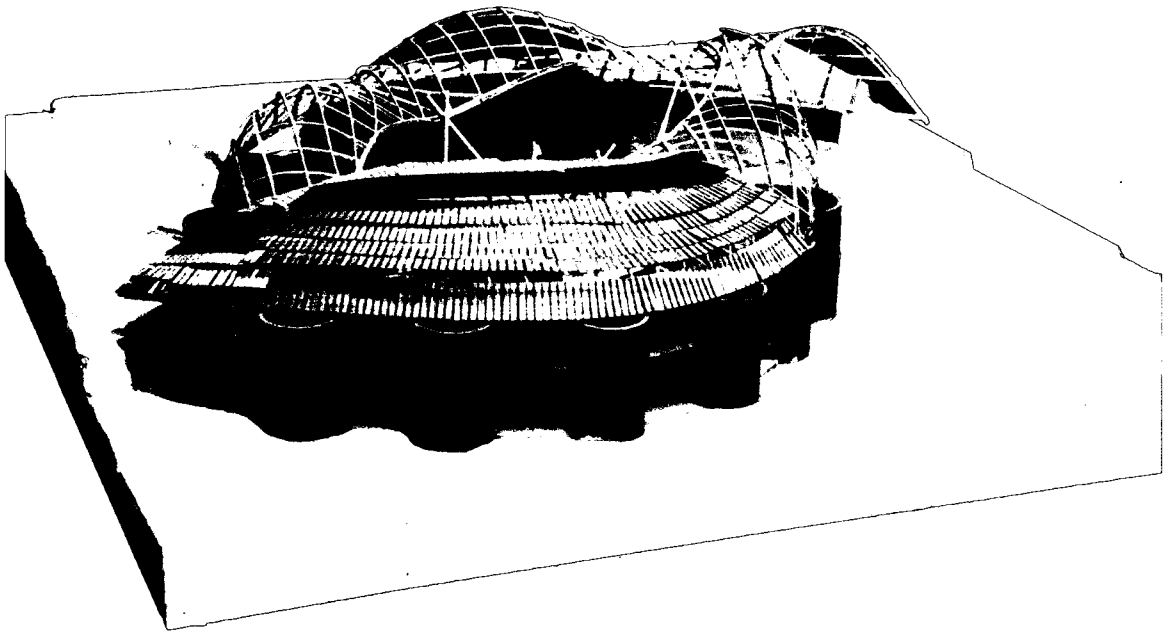


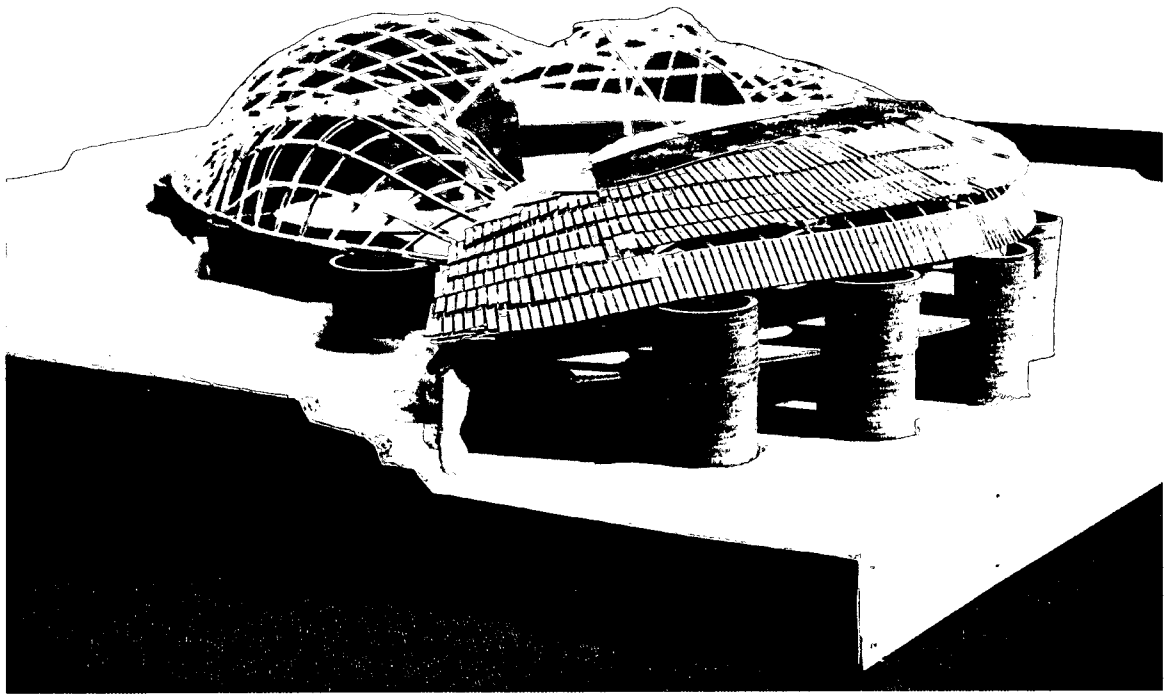


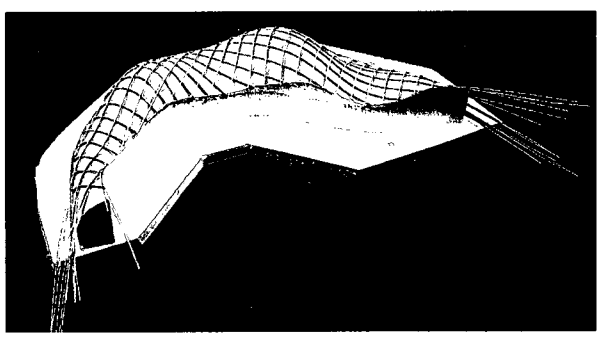




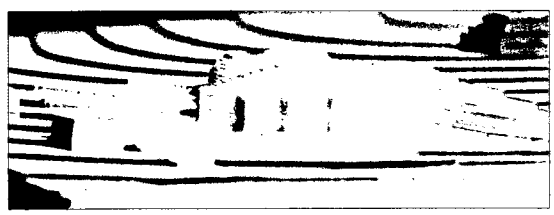
Series of studies done with a 1:50 scale gridmat







above: Views of 1:100 scale model
left: Gridshell roof structure on CNC milled form.
below: Milled building form in site model.



Wood fibres are continuous around knots. The process of milling severs the fibres at these points making it relatively weak.

Advantages of Roundwood

Aside from the local availability of green roundwood as a building material, there are several reasons for exploring it as a building material.

Roundwood is stronger than an equivalent cross-section of milled wood (Murphy, 2005). This is because the fibres are left intact for the entire length of the member. Milled wood severs any fibres that are not directly in line with the milling direction, causing fibre discontinuities along the length of the member. This is particularly true in areas around knots, where the wood grain curves, causing the fibres to flare out.

Roundwood also allows an extra degree of freedom over rectangular dimensional lumber, as it bends in any direction. The circular cross section also removes the need for the members to twist when following a doubly curved surface. Finally, because there is no milling of the material, there is less loss of wood in the processing of it.

Freshly cut saplings with ends soaking in dye. This method can be used on a larger scale to both introduce preservatives in the wood or to slow down the drying process between tree harvesting and use.

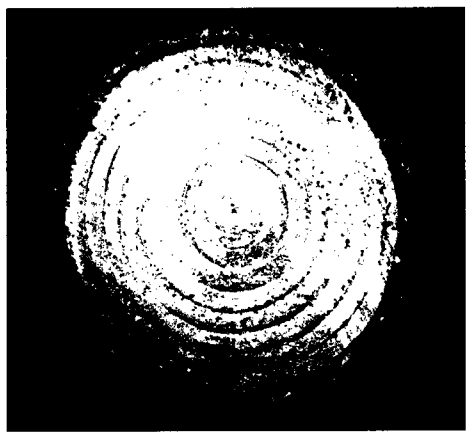
Challenges of Green Roundwood

The challenges of employing green roundwood include how to keep it flexible when storing; how to apply adhesives when wet; how to best resolve round section connections; and how to handle shrinkage during the drying process.

Harvesting / Storing

The types of trees that this method of construction calls for are thin (end diameters between two and four inches), straight, and as tall as possible with the

End of tree dipped in dye. Only the cut end soaked up the dye.



Cross cut of tree. Note darker areas where dye was pulled up through the tree. This shows where preservatives would permeate the wood.

Green roundwood can be bent into a very tight radius.

least amount of change in diameter as possible. These trees are quite young, the ones we tested being only seven years old, and can be found in densely forested areas, where the tree is shooting up to find light. Spruce trees were traditionally used by the Mi'kmaq for wigwam construction, as saplings could be found that were tall, straight, with few large knots. The oils in the tree were also known to repel insects, which was definitely an advantage in keeping mosquitoes and flies out of the building.

As previously noted, one of the challenges is storing the trees after harvesting. If the trees dry out before they are used, they become more brittle, making them prone to breaking when bent. To slow the drying process the harvested trees should be stored with the bark on. If the trees need to be stored for more than a few days before they are used, they can also be stored with their cut ends in water to maintain the greatest amount of flexibility.

Bending Roundwood

Although many tests were done to determine the bending radius for the trusses developed by Mr. Kroeker, the size of tree proposed here is much smaller, and therefore other tests were necessary to determine the bending radius of the smaller material. The types of trees being investigated are approximately 20 feet long with a diameter of between 1.5 and 4 inches.

Two Band-It® connections used in the Guest House FreeLab.
top: Connection at peak of trusses.
above: Example of chord/web connection detail.

Proposed grid nodal connection using Band-It®.

Preserving Roundwood

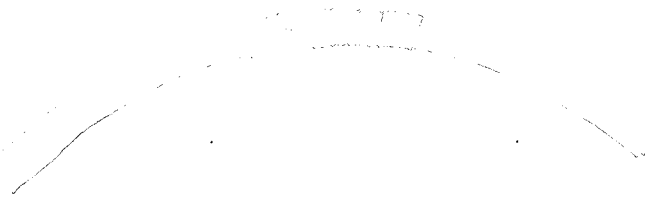
Studies showed that live trees, if cut under water, or immersed immediately after cutting, will continue to absorb liquid. In this way, liquid with boron salts can be fed through the tree to preserve them where exposed to the elements. The studies were conducted with dyed water to determine the extent and layers of absorption, and were a continuation of a series of similar studies.

Connections

When examining end-to-end connections, I conducted a number of studies using typical dimensional lumber details such as scarf and finger joints. I then looked at several lashing connections from traditional bentwood construction in conjunction with wood joinery connections, before arriving at a connection made using a combination of the scarf joint and drilling into the core of the members to insert a steel rod, which was then glued in place (see p36). The advantage of this type of connection is that the fibres on the outside of tree are left intact where continuity for strength is most needed. The pin allows the connection to be flexible in all directions – much like the roundwood itself – as opposed to a steel plate, which only bends along one axis.

In looking at nodal connections, I began with the plate connections found in the Downland Gridshell. This type of connection proved unsuccessful, as the plates are designed to work with dimensional lumber not roundwood, over which they simply rolled. I also avoided the use of drilled pin connections, such as

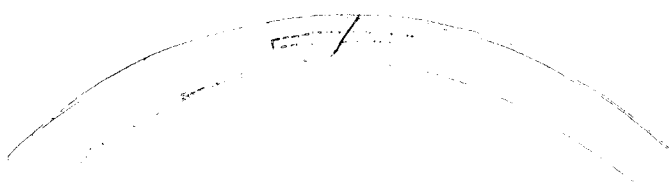
Lashed scarf joint.



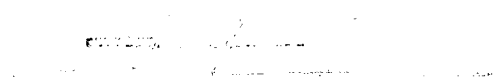
Bolted scarf joint.

Bolted scarf joint with steel backing plate.

Scarf joint with metal rod drilled into core and glued in place.

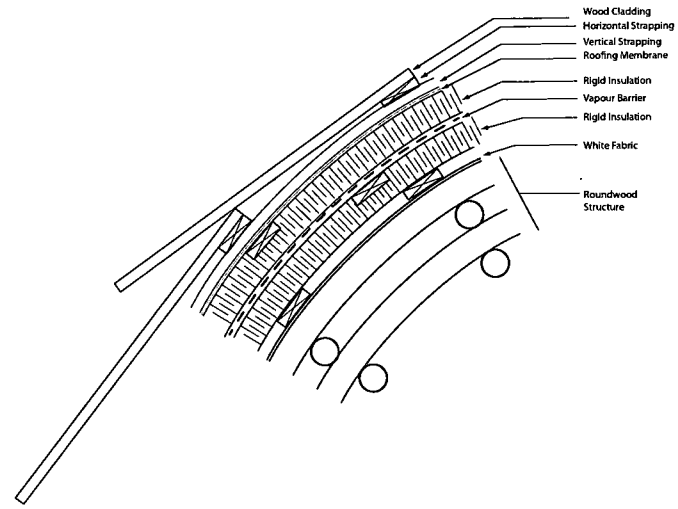


Above connection being set in place.

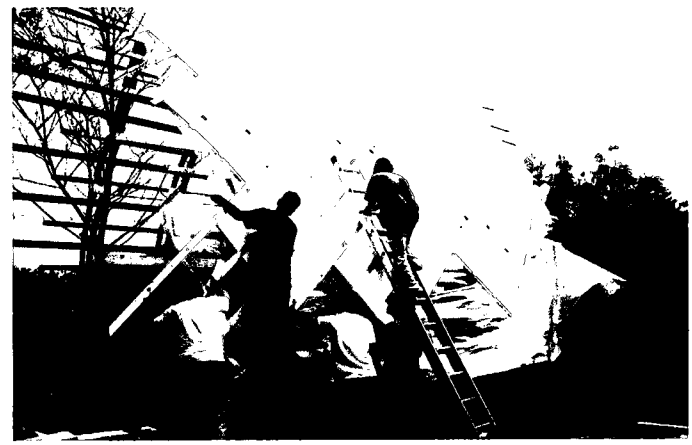


Study drawings of end-to-end connections to create continuous gridshell members.

Section demonstrating concept for proposed roof assembly.



Installing rigid insulation using 1x3 strapping. The strapping provides cross bracing to the main structure while holding the insulation in place.



Close-up of insulation/strapping system.

those used in the Mannheim Multihalle project, because it would weaken the members at the nodes. Tests using Band-It proved most successful. Taking a cue from the lashing technique of the Mi'kmaq wigwam, trials showed a flexible band works best because it adheres to shape of wood. This type of connection also tightens under load – if one member tries to pull or move across the other, the band will dig into the wood, preventing either from moving.

Dealing with Shrinkage

The reason for using green roundwood when building is that it is much more flexible than when it dries. However, as it dries in place, it shrinks. With the end-to-end rod connection, we found that as the greenwood dried, it contracted around the pin, making the connection even stronger.

For the nodal connections, although shrinkage is minimal, any slack in the connections could be dealt with during construction by setting the members in place with minimal nodal connections, and then waiting for the wood to dry before installing the final connections in its shrunken state.

Reflections and Extensions

The investigation in this thesis was necessarily short, and as a result only scratched the surface of the topics explored. Nevertheless, some things became evident during my studies.

The availability of more intuitive and easier-to-use digital tools make the integration of digital and physical modeling more readily accessible than in the past. This means that individuals and small organizations now have access to new design processes that would only have been available to larger firms with specialized tools and resources.

With regard to physical construction, we have much to learn from the knowledge and traditions of other cultures. When thinking about design, we need to look beyond the norm for construction materials and processes, and find news ways and approaches to building with non-typical materials. As such, the materials proposed in this thesis would need further testing and thought as to how they could be best employed from the very beginning of the process.

It would also be critical to determine how the structure could be built employing local labour and resources, and in such a way as to have a long-lasting impact on the community. Doing so would lead to both short-term and long-term economic benefits, and could result in new knowledge and skills to be leveraged by the community.

Finally, the success of this project would depend on finding skilled educators capable of working within

different educational systems, and willing to bridge the learning traditions of various communities. Further discussions with prospective educators and the community would be necessary to ensure both the curriculum and the spaces were truly appropriate.

In the end, it is my hope and belief that the ideas put forward by Albert and Murdina Marshall will appeal not just to First Nations people, but to people from communities all over the world – indigenous and otherwise, whether of similar worldviews or not – who would see the wisdom in learning in such a setting.

Bibliography

"Building a Birchbark Canoe: Tools." 23 July 2010 [cited 2010]. Available from http://www.jumaka.com/birchbarkcanoe/toolspage/tools.htm.

Canada. Indian Claims Commission, Renée Dupuis, and Metepenagiag Mi'kmaq Nation. *Report on the Mediation of the Metepenagiag Mi'Kmaq Nation Hosford Lot and Red Bank Indian Reserve 7 Negotiations*. Ottawa: Indian Claims Commission, 2008.

CAP Society of Cape Breton County. "Work through Time | Mi'kmaq Work Poetry." 30 June 2009 [cited 2010]. Available from http://www.workthroughtime.ca/Rural/Work_Poetry.php.

Cities & Environment Unit. *Pictou Landing First Nation Community Plan 2002*. Halifax, N.S.: Cities & Environment Unit, School of Planning, Faculty of Architecture and Planning, Dalhousie University, 2002.

Dalhousie University. *Convocation Program May 26, 2010*. 2010.

Dean, Andrea Oppenheimer. *Rural Studio : Samuel Mockbee and an Architecture of Decency*. 1st ed. New York: Princeton Architectural Press, 2002.

Dean, Andrea Oppenheimer, and Timothy Hursley. *Proceed and be Bold : Rural Studio After Samuel Mockbee*. New York: Princeton Architectural Press, 2005.

Gardner, Don. "Paddle Making (and Other Canoe Stuff): OldWays by Don Gardner." 23 July 2010 [cited 2010]. Available from http://paddlemaking.blogspot.com/2009/06/oldways-by-don-gardner.html.

Hockey Stick Expert. "Bobby Rouillard's "World's Oldest Hockey Stick"." in Hockey Stick Expert [database online]. 23 July 2010 [cited 2010]. Available from http://hockeystickexpert.com/bobby-rouillards-worlds-oldest-hockey-stick/.

Johnson, Eleanor V. "Mi'kmaq." Ph.D. diss., Saint Mary's University, 1992. Available from: http://mikmawey.uccb.ns.ca/eleanor.html

Krinsky, Carol Herselle. *Contemporary Native American Architecture: Cultural Regeneration and Creativity*. Oxford, NY: Oxford University Press, 1996.

"Lyon's Den: Introduction to Chapter 12." 20 July 2010 [cited 2010]. Available from http://smabiology.blogspot.com/2008/11/inroduction-to-chapter-12.html.

MacDonald, George F. *Chiefs of the Sea and Sky Haida Heritage Sites of the Queen Charlotte Islands*. Vancouver, BC: University of British Columbia Press, 1989.

"Mi'kmaw Daily Life - Shelter and Implements." July 11, 2007 7:59:51 PM [cited 2010]. Available from http://www.muiniskw.org/pgCulture1d.htm.

Mi'kmaq Resource Centre. "Enabling the Autumn Seed: Toward a Decolonized Approach to Aboriginal Knowledge, Language, and Education." January 7, 2010 [cited 2010]. Available from http://mikmawey.uccb.ns.ca/battiste.html.

Mi'kmaq Resource Centre. "Mi'kmaq Ethics & Principles." January 7, 2010 [cited 2010]. Available from http://mikmawey.uccb.ns.ca/brant.html.

"Mi'kmaq Studies Program at CBU: Bachelor of Science Community Studies (BScCS) Integrative Science." in Cape Breton University [database online]. June 27, 2010 [cited 2010]. Available from http://www.cbu.ca/academics/mikmaq-studies/mikmaq-studies-degrees.asp.

"Mi'kmaq Traditional Fishing Camp." 07 April 2009 [cited 2010]. Available from http://micmacfishingvillage.com/.

Murphy, Joe. "Strength of Small-Diameter Round and Tapered Bending Members." in Forest Products Society [database online]. Madison, Wis. 01 March 2005 [cited 2010]. Available from http://www.allbusiness.com/management/benchmarking-quality-improvement/375031-1.html.

Nabokov, Peter. *Native American Architecture*. New York: Oxford University Press, 1989.

O'Brien, Catherine, and Unesco. *The Barefoot College -- Or Knowledge Demystified*. Paris: Unesco, 1996.

Palermo, Frank, Beth Jo-Ann Lewis, Louise Van Wart, Dalhousie University. Cities & Environment Unit, and Metepenagiag Mi'kmaq Nation. *Metepenagiag Mi'kmaq Nation Community Plan 2002*. Halifax, N.S.: Cities & Environment Unit, School of Planning, Faculty of Architecture and Planning, Dalhousie University, 2002.

Parke, G. A. R., and P. Disney. *Space Structures 5*. London: T. Telford, 2002.

Piedmont-Palladino, Susan, and Mark Alden Branch. *Devil's Workshop : 25 Years of Jersey Devil Architecture*. 1st ed. New York: Princeton Architectural Press, 1997.

Ross, Rupert. *Dancing with a Ghost : Exploring Indian Reality*. Markham, Ontario: Reed, 1992.

Sanoff, Henry. *Community Participation Methods in Design and Planning*. New York: Wiley, 2000.

Sanoff, Henry. *School Design*. New York: Van Nostrand Reinhold, 1994.

"The Reptipage: A Site Devoted to Reptiles." 23 January 2010 [cited 2010]. Available from http://reptilis.net/2009/01/.

"Tribal Housing and Travel." in Teya Peya Productions [database online]. June 3, 2010 3:41:15 PM [cited 2010]. Available from http://www.shannonthunderbird.com/tribal_housing_and_travel.htm.

University of Alberta. Intercultural Education Program. "Canadian Journal of Native Education." 8, no. 1 (1980): 16.

Unknown. *An Alternative Approach to Affordable and Appropriate Housing on the Indian Brook Reserve*. Nova Scotia : S.n., 199:1990.