a montessori school

DESIGN by NATURE 2010

mathias fitzer

DESIGN BY NATURE

A Design Thesis submitted to the Department of Architecture and Landscape Architecture of North Dakota State University

By

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In Partial Fulfillment of the Requirements for the Degree of Master of Architecture

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9/8/2010

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May 2010

Fargo, North Dakota

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1 thesis abstract

This thesis examines the ability of designers to use nature as an inspiration in their design process, often referred to as biomimicry. The final design for this Montessori school of 180 students in Winnipeg, Manitoba will encompass natural systems interpreted through architecture for heating, cooling, and ventilating the building. It will explore materials and patterns inspired by those found in nature; specifically, the school will colonize a vacant grocery store.

Biophilic design is the term used for the design of the built environment to foster a connection between people and nature. Biophilic design is the opposite of biophobic design, which is the design of a built environment that isolates people from nature.

The design solution will serve as a vehicle for investigating the connection between humans and the natural environment.

Nature, design process, biomimicry, Montessori school, Winnipeg, Manitoba, natural systems, heating, cooling, ventilation, materials, patterns, colonization, biophilic design, biophobic design, environment.

problem statement

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How can a designer learn to embrace the systems and patterns found in nature?

statement of intent

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statement of intent

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Project Typology:

A Montessori school.

Theoretical Premise/Unifying Idea:

Designers cultivate a process in order to explore a design problem. This exploration is intended to result in a design solution. It is in this process that a designer can identify the relationship between natural systems and the building systems in their design solution.

It is up to the designer to perceive nature as a designer in order to understand the parallels between a natural process and a man-made process.

Conclusion

A designer may find that a natural system can provide design guidance.

Project Justification:

Man-made processes consume resources and generate waste, whereas natural processes will result in neutral resource usage; nature has no waste. It is imperative for all kinds of designers to learn how to find design solutions that minimize or eliminate waste in order to sustain a comfortable standard of living in human society for future generations.

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the proposal

As we enter the twenty-first century, we are facing a new challenge in sustaining human society. The industrial revolution has brought about for humans an ever-increasing level of mechanical control over their environment. Slowly, realizations about the increasing difficulty in obtaining the resources needed to continue this "progress" has called our motives into question.

It is perhaps born out of our desire to conquer nature that we have spent the last few centuries designing environments that strive to isolate us from nature. I began to question this conquest of nature when sitting for eighty minutes at a time in one of the dozen or so classrooms in my high school that provided absolutely no hint that we are part of an outside world. The environment the designers created manages to provide a mind-numbing white noise to all the senses: the extraterrestrial glow of the fluorescent lights, the hushed roar of the ventilation system, the smell of the volatile compounds used in the paint and carpet, the feel of the completely texture-less surfaces of the desks.

What has driven me to examine this particular topic is finding the reasons why an environment like this even exists. One must wonder why the basic support elements of life on this planet, light and atmosphere, are denied to students. Was there a lack of money? Was this intentional, based on the notion that students are not to be "distracted" by the "outside world"?

Vast efforts are being made in researching technologies needed to sustain the present standard of life, and control of the environment, afforded to Western society. One could argue that society is ad-

dressing problems related to sustainability by throwing technology at it, when it should be instead assessing whether the current standard of life can even be maintained at all.

I have chosen to address this topic by designing a Montessori school. What has led me to this decision was my own experiences as well as the Montessori School's teachings and their emphasis on a hands-on approach to gaining an understanding of the world. In many Montessori schools the students keep a garden in order to help them understand how us humans have domesticated nature to bring about a higher quality of life.

I see the school as an education center not just for the students attending but the surrounding community. Direct community involvement will be only a small part of the program, but I feel the project will have an impact in showcasing the natural world in an urban environment.

One component I can bring to this particular project is that in the spring of my second year I designed a Montessori school project. I see this as only a positive factor in that I had barely a basic understanding of how the Montessori Method works and how its teachings can be manifested into a building project. Being able to investigate this project at a graduate level will bring an entirely different level of understanding.

I believe that this project will foster an understanding of the relationship between man and nature, which is important as our society begins to experience the effects of our striving to dominate the natural world.

user/client description

User

The primary users of this building will be the students, teachers, and supporting staff of the Montessori school. The residents of the surrounding neighborhood will have a small level of involvement with the project as well. Below is a list of estimated building population:

Students - 120 in Kindergarten through 8th grade.
Students - 60 in pre-school
Faculty - 8 teachers for Kindergarten through 8th grade.
Faculty - 4 teachers for pre-school.
Staff - 2 administrative staff
Staff - 1 support staff
Maintenance - 2 custodial and maintenance employees

Client

Winnipeg Montessori School - "Winnipeg Montessori School is a licensed non-profit organization managed by a volunteer parent Board of Directors. The Board is responsible for the hiring of staff and for the establishment of School Policies." (WMS 2009).

This school currently operates a small facility in Southeastern Winnipeg and has been around for more than forty years. Their long-standing presence is desirable and the urban agriculture portion of the project is an opportunity for expansion into an area of Winnipeg that current has no Montessori School nearby.

major project elements

A Montessori school is intended to promote education in a hands-on environment. The spaces required are different than those for a typical public educational program, particularly because the students generally manage their own time throughout the day and the "teacher" rarely has to communicate with the entire class at once.

Major Spaces

Classrooms - the "prepared environment" of the Montessori Method. Very close attention must be paid to the details in this space. Spatial variety within is ideal.

Common Areas - space for students of different ages to meet.

Wet Lab - for completing prepared lessons that are too messy for the classroom.

Media/Knowledge Center - a centralized library space, mainly for older students.

Indoor garden - to carry out nature-based prepared lessons in winter months.

Administration - space for staff to carry out job duties.

Outdoor Spaces

Garden - space for carrying out nature-based prepared lessons.

Outdoor classrooms - for when weather permits.

Support Spaces

Mechanical - systems to supplement passive heating, cooling, ventilation, and humidity control

Restrooms

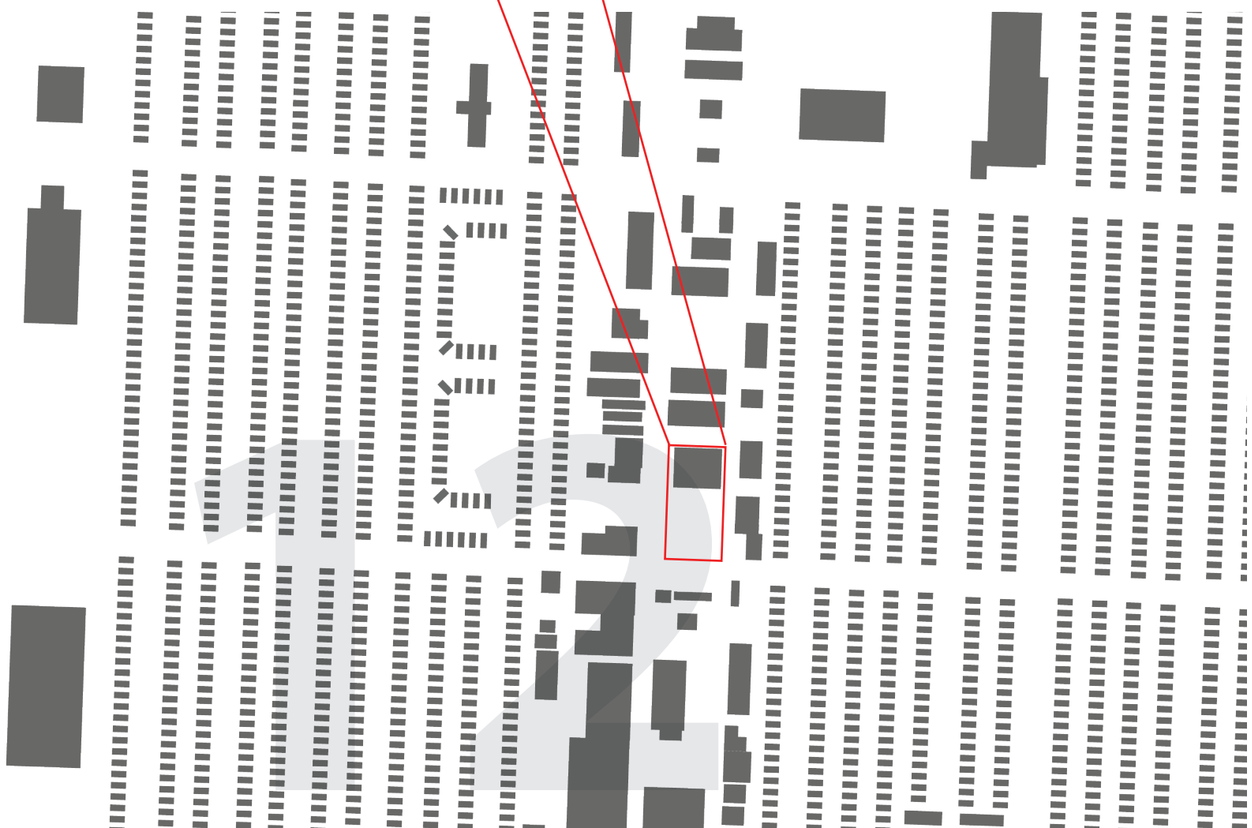
Vestibule

Winnipeg is the capitol and largest city in the Canadian province of Manitoba. It has a population of 633,451 as of 2006, more than half the population of Manitoba (2006 CP). The city lies at the confluence of the Red River and the Assiniboine River in the dry lake bed of the glacial Lake Agassiz. The geography is known to be flat and the winters are long, cold, and windy.

Winnipeg is known for its vibrant cultural diversity, with nationalities of people from all over the world.

The project site is located in the West End neighborhood, which lies between the airport and downtown. This area of town is near the downtown area and easily accessible by car and bus.

From Google Maps



The site chosen for this project is a vacant Safeway grocery store in the West End of Winnipeg, at the corner of Ellice Ave. and Wall St. It is located in a small strip of commercial and industrial properties within a close-quartered residential neighborhood. The neighborhood lies near an industrial area.

The high density of the area leads to a lack of open space. The only nearby open spaces are public recreation facilities, such as baseball and soccer fields. The only distribution of large trees is in allées along the residential streets.

The Safeway grocery store that used to operate on the site was the only business selling groceries in the area until it closed in December of 2008 (CTV Winnipeg,2008). What this has left is referred to as a "food desert", where the route from a source of food to a residential area is so long it must be completed by car or public transport.

project emphasis

This thesis project will examine the relationship between humankind and nature, mainly in the ways in which humans build their own environment. A designer makes choices about how to maintain a level of comfort for people in the built environment. The processes of nature can inform these choices if the designer of the environment has the ability to perceive the natural processes as design solutions.

The research will also examine the connection between humans and nature in their everyday life. In essence, the present-day built environment is capable of dissociating people from nature. This dissociation can be referred to as as a biophobia, where designers of the environment intentionally, though not necessarily consciously, create an environment devoid of any connection to nature. The design philosophy intended on re-establishing the connection to nature is biophilic design.

What will be most emphasized with the research is understanding the social and cultural factors that have created a biophobic ethic in the design of the built environment. This ethic is being examined in an educational environment as well as in an urban setting. Additionally, a discussion of the domination of nature versus the domestication of nature will be a part of the research.

plan for proceeding

Research Direction

The research for this thesis project will be of the mixed-method approach, synthesizing qualitative and quantitative methods to paint a broader picture of the research topic. Research on the premise and its history will consist of secondary quantitative data and qualitative analysis of writings related to the subject.

Research on the project typology and its spatial programming will be conducted with the same mixed-method approach but with personal observations of the site and existing library. Case studies of similar educational projects will be assessed for additional insight into the research topic as well as typology assessment.

Design Methodology

How the research will relate to the final design is an important subject for a designer to understand. Design education equips designers with the tools they need to assess and situation and start to develop a design solution. An initial process of physical models and drawings lays the framework for a further investigation with digital design tools.

The data collected with the mixed-method approach will be analyzed with the Concurrent Transformative Strategy. This strategy is chosen as it allows designers of the environment to use any data they need to explore a topic, whereas other strategies are more specific to a single idea.

The facts and numbers of quantitative data are paramount for a designer to justify certain aspects of their design solution. Analysis of quantitative data is important in relating it to the concepts of qualitative data.

Qualitative research is the result of human perception and can be conducted with a variety of methods. Participatory observation of people and their interaction with the built environment is crucial for a designer's understanding the social aspects of design.

Documentation of the Design Process

It is important to document any work on the design of the thesis project. Digital files will be duplicated when making any major changes in order to preserve a history of the design development and will be named according to the date of their creation. Small process sketches and drawings will be kept in a folder and large drawings will be kept on a large art clipboard for easy access and organization. Process models will be kept near the work area in a manner that ensures their safety, such as upon a shelf. Process sketches, drawings, and photographs of models deemed to be the most important in the design development will be scanned and included with digital design files on a CD to be placed in the library copy of the thesis book.

Second Year

Fall 2006 - ARCH 271 - Darryl Booker

A Tea House - Fargo, North Dakota
Mississippi River Rowing Club - Minneapolis, Minnesota
Mountain Dwelling - Colorado

Spring 2007 - ARCH 272 - Bakr Aly Ahmed

Montessori of Moorhead - Moorhead, Minnesota
Prairie Dance Academy - Fargo, North Dakota

Third Year

Fall 2007 - ARCH 371 - Cindy Urness

UND Center of Excellence - Grand Forks, North Dakota
Cranbrook Academy Library and Museum - Bloomfield Hills, Michigan

Spring 2008 - ARCH 372 - Steve Martens

Fargo Children's Museum - Fargo, North Dakota
Hell Creek Fossil Conservation Laboratory - Marmarth, North Dakota

Fourth Year

Fall 2008 - ARCH 471 - Don Faulkner

Zeno Place - Mixed-Use High Rise - San Francisco, California
My Life in a Cigar Box - Artifact Design Competition

Spring 2009 - ARCH 474 - Stephen Wischer

AVE Train Station and Hotel - Barcelona, Catalonia, Spain

Fifth Year

Fall 2009 - ARCH 771 - Regin Schwaen

Fargo Air Hotel - Fargo, North Dakota

As our modern civilization continues to develop new ways of improving the quality of our lives, we must take a step back and ponder whether these improvements actually improve. Humankind has long battled with the elements of nature, from building a simple shelter to keep dry in the rain to growing plants for food rather than waiting for them to grow themselves. We found ways of improving our shelter and our ability to manipulate nature to provide more food, and we slowly developed an increasing level of comfort with our lives. In the past century, we have become obsessed with improving this sense of comfort. We may have taken this obsession too far; we may have lost the ability to understand how we live.

Introduction

Sitting on a polyester chair under fluorescent lighting with the whirr of a ventilation system keeping the room at a perfect 72°, one has to feel that humans have succeeded in conquering nature. Our modern technology has afforded us the choice of lifestyle where the natural elements are no longer part of the equation.

In choosing this lifestyle, however, one could argue that we are dooming our modern way of life to an early demise. We hear that our oil is being depleted at an alarming rate, yet there is still gas available at the pump for a price that won't break the bank. We are blind to these problems in the world. It is so damn easy and convenient to live, so why should we have to make any changes?

What this thesis research will examine is how designers of the built environment can use their abilities to help remedy this situation. Designers have the ability to design environments that remind us that we are part of the natural world, so why do we keep constructing buildings that shun this idea?

Biophilia

Biophilia is defined as "the affinity for life and lifelike processes" (Kellert 2008). It is, in essence, a love of nature, and a desire to include elements of nature in our daily lives. This concept is fairly broad in scope, and can be connected to any aspect of the way we live. The buildings we build, the way we choose to spend our time, the way we eat, and the way we relax all have the potential to enhance the connection between us and the natural world.

Biophilia is the opposite of biophobia, which is essentially the desire to dissociate from nature. In Kellert's book, Orr and Pyle refer to the effects of biophobia as "the extinction of experience" (2008). What they are referring to is that people have intentionally, and possibly consciously, distanced themselves from the natural world. They have described the act as a "precipitous decline", implying that it is slowly working its way into more elements of our society and that it is not doing anything to help in the long run.

Biophilia is a term starting to become used more often in the environmental design field. This perhaps due to our society beginning to realize that we truly are dependent upon nature, and that we must find a way to deal with this and still sustain a reasonable quality of life. Designers of the built environment have the ability to effect change in the spaces in which we live, work, and play, and thus the power to make major social changes in the fabric of society.

Biophilic Design

A thorough examination of biophilic design philosophies will be conducted to help understand the concept of biophilia. These design philosophies are really no different than those taught in any reputable design education program, except they have a strong base in the patterns, systems, and experiences of nature. Stephen Kellert's book *Biophilic Design* outlines his six principles of biophilic design: environmental features, natural shapes and forms, natural patterns and processes, light and space, place-based relationships, and evolved human-nature relationships (2008). Only the lattermost concept is not directly based upon a basic design principle that any environmental designer would understand.

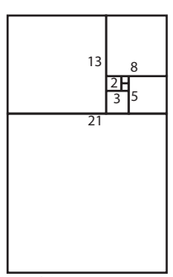
What is most important in biophilic design is that the designer must have the ability to make the connection between the nature and the built environment. In essence, the designer must be able to *perceive* nature as a designer itself. It requires a high level of understanding in how natural processes and patterns work in order to manifest them in a design project.

A designer must look to many different disciplines of thought in order to be successful in biophilic design. A classic example is discovering the structure of a nautilus shell. It would be easy for someone to simply copy a shape into a floor plan and claim to have designed using biophilic principles, but they would fail to understand what is at work.

Section of Nautilus Shell. From maths.surrey.ac.uk

Patterns in Nature

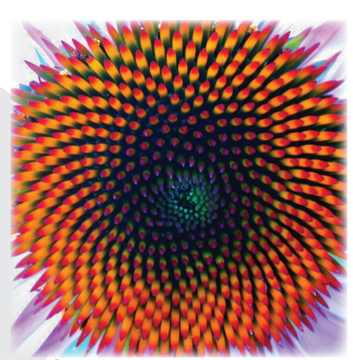
What is at work is a mathematical pattern called the Fibonacci sequence. The pattern is a simple series of numbers, starting 1, 1, 2, 3, 5, 8, 13, 21, 34, and so on. The relationship between the numbers is that two conescutive numbers added together become the next number in the sequence., for example 3+5=8, 5+8=13, 8+13=21. This pattern, shown graphically, is present in the way a nautilus shell is constructed.



Graphic representation of Fibonacci Sequence. From maths.surrey.ac.uk

The nautilus shell is not an entirely mathematically-accurate representation of the Fibonacci sequence, but the underlying geometrical relationship is there (Knott 2008). The pattern can be explored further and expanded upon with other forms of patterning through other examples found in nature.

An example of the pattern expanded upon is in the way many plants organize their leaves, petals, or similar structures. The cone flower provides a very clear picture of this sequence in a more two-dimensional fashion, providing the flower with an ordering system that allows it to best catch sun and water in order to live. The size and formation of the seed pods of the cone flower is a perceptible example of this type of structure.



Cone flower. From maths.surrey.ac.uk

The sequence serves as a basis for the organization of how plants are structured in three dimensions as well. This is where it is appropriate to describe the hierarchy and balance found in nature as well. An example can be found in the sunflower plant, which shows a clear relationship between the sizes of the leaves vertically, along the stalk. This is so that each leaf can gain a maximum solar access without restricting too much solar access from other leaves (Knott 2008).

Sunflower plant.. From maths.surrey.ac.uk

What is most important about using patterns found in nature is that although nature is not a designer, we must perceive it as one in order to understand how these processes work. The processes that led to these patterns and relationships are the result of an endless evolutionary progress. We may find beauty in the Fibonacci spiral of the cone flower, but for nature it is purely the result of a function developed through countless cycles of "trial" and error.

It is possible for designers to focus on natural systems purely from a systemic approach as well. Studying patterns in a broad sense and finding appropriate uses for these patterns and relationships can help to create a very beautiful and efficient design, but focusing on a single instance of a natural structure can help a designer find effective solutions as well.

Burr from a burdock plant, the inspiration for Velcro. From maths.surrey.ac.uk

Biomimicry

The term biomimicry is defined as "the act of learning from nature, borrowing designs and strategies that have worked in place for billions of years." (Kellert 2008). Biomimicry can be described a subset of biophilia, the specific design process that is used to derive design solutions from nature.

Bimimicry is a term that has been finding use outside of the environmental design field, particularly in material sciences. A classic example of biomimicry in scientific development is the invention of *Velcro*. A Swiss electrical engineer named George de Mestral noticed how strongly burdock burrs stuck to his hunting dog's fur. He studied the burr closely and realized he could use this natural

system, used to carry seeds long distances for plant reproduction, to design a temporary way to hold things together (Stier 2009). He was able to develop a way to manufacture the array of tiny hook structures from the burr.

A simple example of biomimicry in architecture is that of early Hispanic settlers in Colorado. They built dwellings of adobe, simply the material the ground was made of, but had no way of knowing how thick to make the walls in order to find a balance between winter and summer climate conditions. They discovered that the Columbian ground squirrel somehow had this figured out in digging its ground burrow to a certain depth. All the settlers had to do was measure how deep the burrows in the area were and build their adobe walls exactly that thick (Kellert 2008).

Eastgate Center in Zimbabwe. From biomimicryinstitute.org

A more complex and famous case of biomimicry in architecture is the Eastgate Center in Zimbabwe, an office building that uses no air conditioning despite the hot climate. The designers studied the air ducting systems in termite mounds to develop a cooling system for the building. The termite mounds are able to keep the termite nest within one degree celsius of a stable temperature year-round. The finished building uses fans and its system of air routes. This consumes one tenth the energy to cool the building compared to a similar air-conditioned building.

Termite Mound. From biomimicryinstitute.org

This is something that humankind has been doing since its inception, and Benyus believes that it is what enabled us to "ratchet ourselves to a higher evolutionary plane." (Kellert 2008). If this is really what started the rapid creation and revolution of a society, then why is this society on the verge of tumbling into extinction? Why do we need to define a term to describe what seems so straightforward a concept?

Nature Deficit Disorder

In his book *The Last Child in the Woods*, Richard Louv has coined the term "nature deficit disorder" as a way of describing the disconnect between people and nature in our society (2005). This book compares Louv's own experiences as a child to his observations of how children play today. His positions are aligned with the principles of biophilia, actively seeking to undermine the societal shifts that have led to biophobia.

Calvin and Hobbes, a cartoon strip by Bill Waterson about a creative, adventerous six-year-old. From www.garydubose.com

Louv postulates that one of the most contributing factors to the widespread ethic of biophobia in our society is that parents convey nature as a "boogeyman" to their children. What he means is that children are taught to fear the world around them from an early age. He questions the notion that the outdoors is more dangerous than indoors, and why children are discouraged from something as harmless as sitting in the backyard and playing with dirt. He cites that the distance from home that children were allowed to wander was nine times further in 1970 than in 1990 (2005).

Louv best summarizes his feelings with the very quote that opens his book, "I like to play indoors because that's where all the electrical outlets are." This quote is from a fourth grade student living in San Diego. Louv is disappointed that children prefer playing indoors to outdoors for fear that they lose their creative abilities. Nature provides children with "primary experience" (Louv, 2005) offering them the ability to learn though their own perceptions.

Perhaps the role model in a more modern child-rearing example is the cartoon strip *Calvin and Hobbes*. Calvin, a six year old boy with a stuffed tiger for a best friend, is always in flux about whether he should be playing outdoors or indoors. On Saturday mornings, Calvin could be found in front of the television watching cartoons, with his tiger asking him why he is not playing outside. Most other times, Calvin can be found embarking on journeys in the woods behind his house. These journeys may be considered dangerous, but his world view is expanded because of it.

Reenchantment

Peggy Bartlett takes an anthropologist's perspective on the issue in a journal article about teaching sustainability principles in schools. She uses the term "reenchantment" to describe the process whereby people can re-connect themselves to the natural world in order to foster a higher level of creativity (2008).

Bartlett sees a problem in that people seem to value rational thought over a "spiritual connectedness" to nature. She believes that more emphasis is being placed placed on studying nature as an object and not as a realm of wonder, and that this quantification leads to a disenchantment from nature (2008).

This discussion of quantification brings about parallels to other large societal issues beyond the simple reality that our current way of life cannot be sustained given our planet's resources. Has the environmental design field, and our society as a whole, lost itself in trying to quantify everything in the world?

McDonaldization

Sociologist George Ritzer coined the term "McDonaldization" to describe rampant quantification of everything in modern society. He outlines four concepts: efficiency, calculability, predictability, and control (1993). What these concepts are meant to explain is how our society tries to engineer concepts and things in an objective manner, in parallel to how McDonald's was able to rapidly expand itself.

The concept of efficiency is very much a driving force in the environmental design field. Of course clients would like their building to be more affordable, but in the boiling down of how efficient a building can be to an equation level a lot of design possiblities are lost. This is similar to how McDonald's engineered its hamburgers to be made at the lowest possible price.

Calculability is increasingly becoming a part of environmental design. It is simply the act of putting quantity over quality as a form of measurement, and the idea that only rational, objective thought can be correct. McDonald's knows that their hamburgers are successful because of strong sales, and not from anyone telling them they taste good.

Predictability is the antithesis of uniqueness. McDonald's wants to ensure that their burger tastes the same in Fargo as it does in San Diego or Barcelona. Taking a drive through any American suburb, one will find the same chain restaurants in strip malls that just might hint at local culture in the way the building is decorated. Any time an environmental designer actively chooses not to explore a new idea, they are being predictable.

Control is perhaps the most damming force against biophilic design. McDonald's sets a high standard of control to make sure all procedures are followed exactly. Too much control will dictate something just for the purpose of dictating it, even when it is not the best solution. Control in environmental design means that nature, which is anything but predictable, is essentially out of the equation.

The desire to have control is why so many new buildings, especially educational buildings, do not have operable windows. If a window were to open, the indoor environment would no longer be the "perfect" temperature and humidity level and the ventilation system could no longer achieve a high level of efficiency. It is the will of the school administrators, perhaps with the idea that children need an optimized environment for proper learning? It is the designers, concerned with keeping the budget in check so as to avoid losing a client? Whoever it may be, it certainly isn't the children.

Conclusion

Ever since humankind began to domesticate nature, the quality of life has improved. People were able to ensure that they had food and shelter by growing their own food and building their own shelter. Over time, people became obsessed with keeping nature out of their "shelter", leading to a biophobic ethic.

Designers of the build environment have the ability to re-introduce the natural world into the built environment, if they are able to perceive nature as a designer and understand how to bring about effective biophilic design. It is perhaps the greatest challenge of designers to try and foster a love of nature into society, with an open and creative exploration into how we are connected to the natural world.

Introduction

The most important idea to be drawn from this research is *why* it is important for environmental designers to challenge the biophobic ethic in society. Of course an explanation of what biophilic design is would be important to the process as well, as would an outline of how all types of designers can find inspiration in a natural system or pattern.

Priority

This entire research document was structured around exploring the relevance of designers practicing biophilic design philosophy in the built environment. What was important in drawing a conclusion was to first prove whether or not a biophobic ethic is prevalent in modern society, then to start to figure out how this ethic came into play.

The approach taken in setting this priority was to work backwards. This was mainly so that the theoretical premise research could conclude with the tying together of this idea to other ideas related to the premise. Also, it helped to gather relevant research from other fields with ties to biomimicry.

Findings

This research study was able to conclude that there is a strong biophobic ethic, both in the realm of society and in the field of environmental design. A thorough explanation of what comprises biophilic design shows that there is relevance to the ideas for connecting people to nature.

Biomimicry is a very important skill set for any designer to possess. Gaining the ability to perceive nature as a deisgner allows one to understand how natural processes have been successful in sustaining life on this planet for millenia. From the smallest piece of Velcro holding a television remote control to the side of the couch, to an entire office building in a hot climate, designers have found ways of finding design solutions in the natural world.

Relevance

As a basis for all subsequent research findings, it was important to understand the impact of the biophobic ethic present in society. This was outlined early in the research findings, using quotes containing strong words from researchers who specialize in studying the connection between humankind and nature. The term "extinction of experience" implies that all connections between people and the natural world have the ability to disappear entirely. Another author made clear their feelings about the biophobic ethic present in society, using the term "precipitous decline" to describe a rapidly-spreading disease of thought.

The basic design principles outlined in the research can be worked in to the process in any design. The design process cultivated by all designers can easily incorporate an emphasis on natural systems and patterns, particularly in the spatial organization and hierarchy of a building.

The concept of the Fibonacci sequence in environmental design is a basic way of understanding how nature has patterned itself in order to optimize its resources. This allows the designer to find parallels in other fields of study. In all examples illustrated in the research, graphic examples were provided in hopes of fostering a more thorough understanding of the approach.

Conclusion

The intention of this research was to identify several concepts related to the design of the built environment with a tangible connection to the natural world. It was important to sort out concepts related to society and how it is perhaps heading down the wrong path, in order to understand the relevance of environmental designers learning how to design with the help of nature.

Case Study - Montessori Childrens' Center - San Francisco, California

View of building from street.

Designed by Mark Horton Architecture

Introduction

Sited in a residential neighborhood in western San Francisco, this 4,000 square foot private pre-school is built specifically to accomodate the Montessori teaching methods. It is comprised of two classrooms and a few small support spaces for up to 60 pre-school students. The small size of the building is desired by some Montessori educators, as is its humble presence in the neighborhood. The owners of this building do not want it to showboat itself, and believe that the architecture should impact the users of the building instead.

Cubby room, showing light conditions.

Findings

Like other Montessori school projects, the Montessori Childrens' Center is designed to reflect the hands-on approach that is essential to the Montessori Method of education. It affords a strong connection between the indoors and the outdoors, with details such as a door scaled for small children that leads to the outdoor learning area.

This project is solely a pre-school intended for children under the age of six. This is not uncommon in Montessori schools, as the method's hand-on teachings are very beneficial to younger children. The spaces in the building do not offer the level of flexibility that is typical in Montessori schools, likely due to concerns over the young age of the children.

Site

The site of this project was originally a small number of residential lots. The lots were never intended to house a school, but this helped the school adiministrators accomplish their goal of building a school that does not create a strong impact on the surrounding neighborhood. The project seems successful in its ability to blend in the the two-story 1950's-era houses of the neighborhood but not to hide the fact that it is an educational building.

The building responds to several environmental factors, chiefly the shade from the roof overhang and the collection of water for watering the landscaping at the lower end of the long-sloping roof.

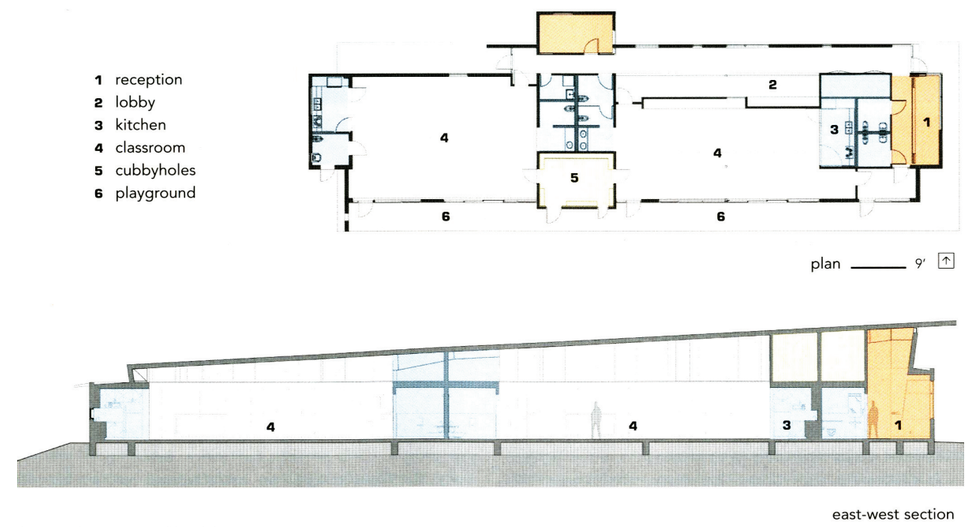
Analysis

The building is built with off-the-shelf components from commercial construction, which are well-suited to the design intentions of the building and also allow for a swift construction process. The play of light in the

building is accomplished with the use of storefront-style extruded aluminum window frames, which were cut and fitted on-site. The overall shape of the building, which is a single mass with several additive and subtractive elements, is composed of corrugated steel decking as a roof structure. All interior walls are non-bearing.

The building is almost entirely rectillinear, save for the slope of the roof and windows and the slight outward canting of the front wall. The roof plane is given a thick profile, creating a position of a "lid" on top of the building.

The composition of spaces in the building is very simple. A single hallway serves as both the entrance and as the main circulation path. The reception desk is located inside the main entry, at the upper-right corner of the plan drawings. The two classrooms, main restrooms, and



Plan and section of building.

administration office are accessed directly by the hallway.

Each classroom has within it a small kitchen area and direct access to the main restrooms. A "cubby" space is shared between the two classrooms, which is used as the main route between indoors and out.

The building's functions are kept to a single flat plane, but the designers took an opportunity to provide a hierarchy to spaces in the

building section. All support spaces are capped at a typical ceiling height, with space above them left open to the cathedral ceilings of the classrooms and main circulation space.

Conclusion

The way in which this particular Montessori school enhances the connection between humans and nature is only manifested in the presence of light in the interior spaces. The outdoor play area is comprised entirely of man-made materials, as are nearly all surfaces in the interior of the building.

The main value in this case study is the way it addresses its site, particularly the design decisions regarding its low-key presence in its quiet suburban setting. It is also the only case study explored that is solely for pre-school age kids, and it addresses the concerns for this type of building user.

From:

Woodbridge, S. B. (2005, April). Kids on the Block. *Architecture*, 68-71.

Case Study - Montessori Island School - Tavernier, Florida

Front of building, showing metal roof and concrete walls

Designed by Jersey Devil

Introduction

The Montessori Island School is a pre-school and elementary school located in the small town of Tavernier in the Florida Keys. The 8,500 square foot school has room for 120 students and two teachers in each of its four classrooms. What is most distinctive about the project is its use of passive cooling strategies, an anomaly for a school building in South Florida.

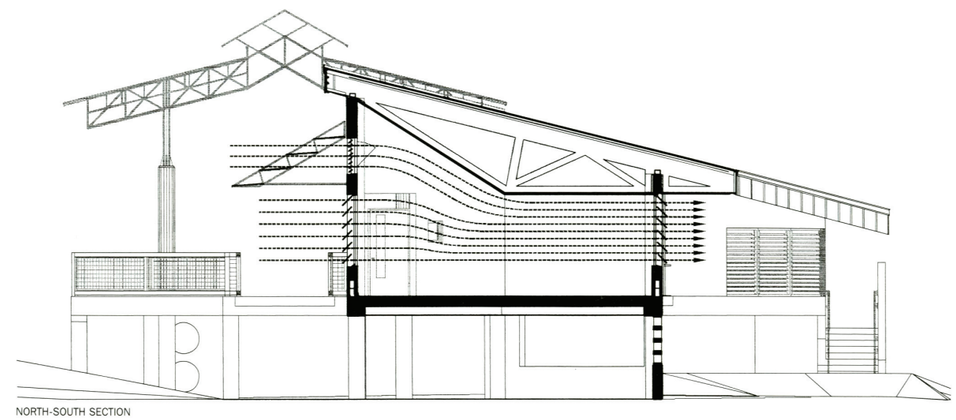
Findings

The large open interior spaces are present in any well-designed Montessori school, as is a connection between the indoor spaces and outdoor spaces. The tactility of the materials is found everywhere in the design of this building, from the texture of the exterior walls to the integrity of material in the flooring and ground cover.

Rear of building showing outdoor circulation and play area.

What sets this case study apart is its thorough use of outdoor space in its architecture. The indoor spaces are located on a single floor

that is elevated above the ground, with a covered outdoor classroom and playground beneath the building. The comprehensive response to the environment for this case study is above and beyond the others and is exemplary for any building.

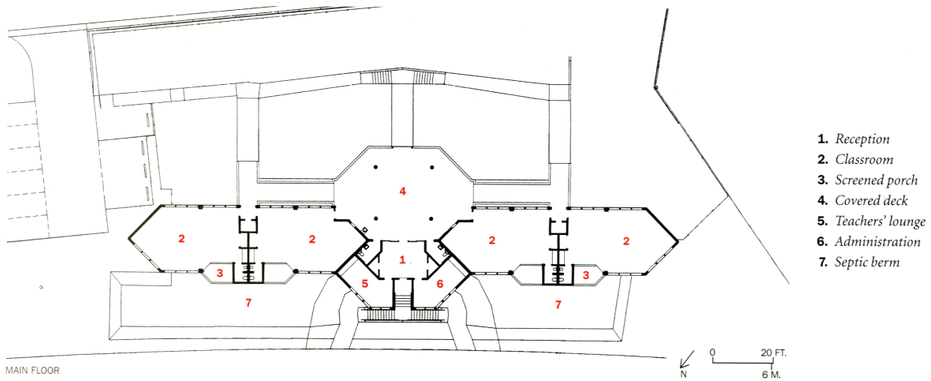


Transverse section, showing natural ventilation

Site

The way the building acknowledges the climate of South Florida is prevalent in the entire building design. The spaces are lit and ventilated naturally, with only a few ceiling fans helping to cool the structure. The roof and non-shaded walls are clad in sheet steel, which reflects a great deal of heat from the sun. The windows are shaded by simple canvas shades, and the sectional design of the building cools the spaces almost entirely with passive systems.

The passive cooling design principles in this building are already highly successful, with energy costs just over $100 per month on average. Where it goes far beyond the other case studies is that the building is designed to be added on to. When it is, its energy use per student will drop even further. The planned addition is simply the reverse of the current structure, with an atrium in between that creates a heat chimney to reduce or eliminate the use of ceiling fans. The future atrium is currently a covered, screened-in outdoor gathering area.

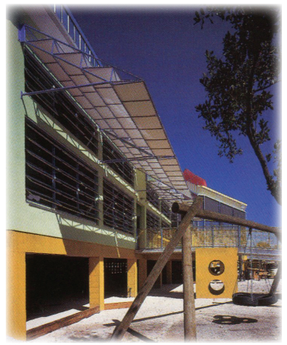


Main floor plan of building.

Analysis

The building is built primarily of concrete, mainly in the walls and floor. The concrete textures are left exposed, and the flooring in the interior spaces are simply a sealant applied over the slab structure. The roof trusses are enclosed within a ceiling vault, with the angle on the underside intended to diffuse light. This also allows for varied ceiling conditions in different areas of the classrooms.

The circulation in the building is comprised entirely of outdoor spaces. Two of the classrooms and main restrooms are accessed directly from the covered atrium but the outlying two classrooms are accessed by partially-sheltered walkways. The staff areas are accessed through the reception area.



Close-up of sunshades.

The walls in the building are aligned at either a 90° or a 45° grid, but are composed in such a way that they do not create any acute-angle corners in the main spaces. Only the storage closets have acute angles. This orientation of walls helps to create a variety of nooks and corners, but avoids any closed-in feeling.

The plan of the building is laid out with a clear and simple sense of hierarchy. Each classroom has its own servant support spaces, including a screened porch, restroom, and storage area. Every space in the building is servant to the outdoor environment, with an emphasis on the covered atrium space. The building is perfectly symmetrical

longitudinally and will be transversely when the addition is completed. Each classroom wing of the building has its own longitudinal symmetry, with a circulation node in the area between the two classrooms. This node can be seen as branched off from the main circulation node: the atrium.

Conclusion

A comprehensive response to nature is most valuable in this theoretical premise research. It is manifested in the material choices, lighting and cooling design, and tree-like hierarchy and symmetry in the spatial layout. The strong tactile qualities and pattern of hierarchy is the premise of biophilic design, and the nature-driven systems to light and cool the building are the emobdiment of biomimicry in architecture.

Outdoor classroom beneath the building.

From:

Dunlop, B. (1997, October). Montessori Island School. *Architectural Record*, 118-121.

Case Study - Milwaukee Montessori School - Milwaukee, Wisconsin

Designed by Studio Works

Main entrance, showing the only exterior additions to the existing building.

Introduction

The task set out to the architects for the Milwaukee Montessori School was to rennovate an office building that was originally built as a Catholic school into a Montessori school on a budget of $15 per square foot. The project is larger than the other case studies, at over 50,000 square feet, and is located in a cold climate.

Findings

This Montessori school project encompasses the same tactile quality of materials as the other case studies, and there is a level of flexibility in the spaces. The light and general environmental qualities are a major driving force in the design.

The most distincitve characteristics of this particular case is that it must address constraints that the other cases did not have. The school's placement in an existing structure limited what the designers could do with passive ventilation and lighting, as the majority of the building skin had to be maintained. The ability to connect the indoors to the outdoors was limited by the climate, so the designers had to focus almost entirely on the interior of the building.

Relationship of new spaces and materials to existing space.

Site

A major challenge for the designers of this building was to keep the integrity of the Montessori Method in a building designed for maximum efficiency. The circulation paths between spaces are mostly retained, but they are expanded at various points into informal gathering spaces to encourage interaction between students of different age groups.

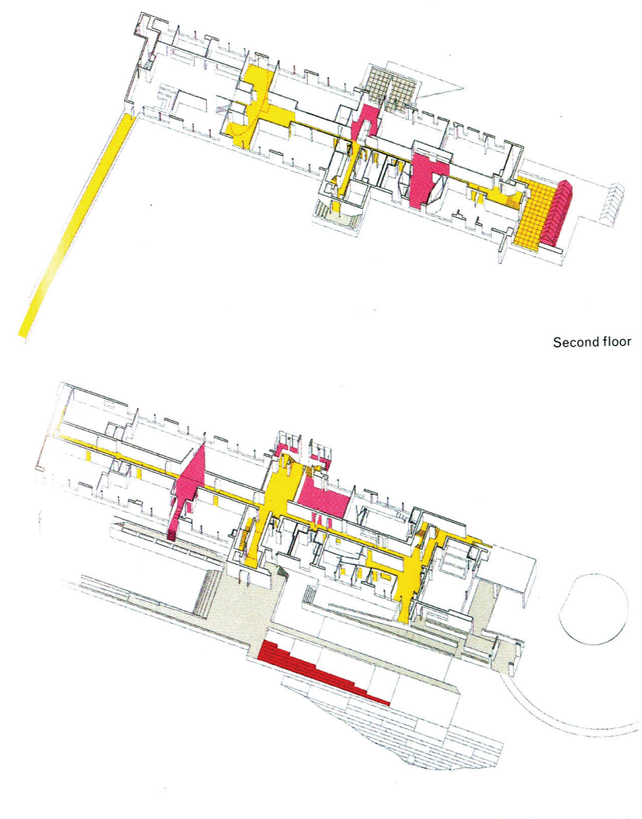
Analysis

The structure is typical of a 1960s era institutional building, with concrete bearing walls and concrete slab floors. No changes were made to the structure or openings. Many of the existing windows are placed up against the ceiling plane, providing ample natural light.

The exterior of the building is nearly unchanged from its original 1960s design, so the form is very clean and rectillinear. The masses of the single-story and two-story sections of the building are cautiously integrated in each other, and the canopy structure added during the remodel does very little to cause any stir in the overall composition of the building.

The interior spaces of the building have seen a great deal of change, particularly in the floor and wall surfaces. The designers set out to keep existing walls and surfaces intact wherever they could, and made drastic alterations otherwise. The circulation spaces were kept mostly intact, but with new gathering spaces scattered along their length to try to erase the repetitive nature of the original circulation and spatial layout. These gathering spaces act as nodes, as they are placed at the meeting point of circulation and classrooms spaces, which helps to bring hierarchy of movement into a formerly monotonous layout.

The most bold change is in the addition of a multi-functional gathering space on the main floor, which is set up as a small theater. The space wedges itself between two classrooms and has a sloping floor within the wedge, a way of changing spatial characteristics in both plan and section. The powerful gesture of the



Isometric plans of the building.

Multi-functional gathering space, with its plywood surfaces and ramped floor.

space is made more powerful by its material, which is sealed plywood for the walls, floor, and ceiling.

Various sheet wood materials are used as flooring throughout the building, including OSB, fiberboard, wheatboard, and MDF. The designers used these to create play in the space, giving unique conditions for people to interact within the space.

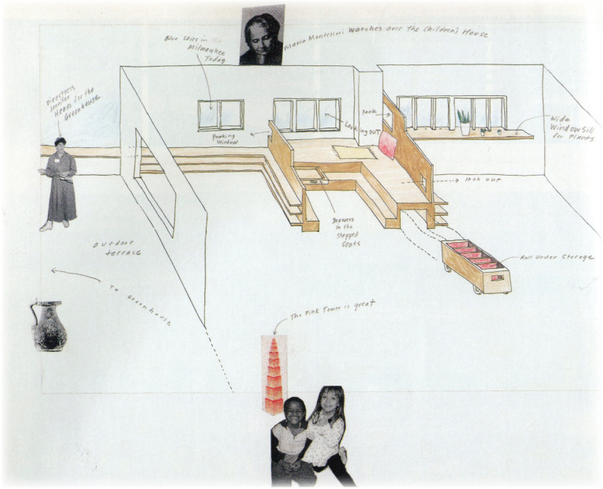
Varied natural floor materials and movable walls.

Conclusion

Elements of biophilic design are prevalent chiefly in the material surfaces of the building and also in the spatial organization. Particularly, the textures of the different floor materials showcase ways in which humankind has domesticated trees and other plants to build dwellings.

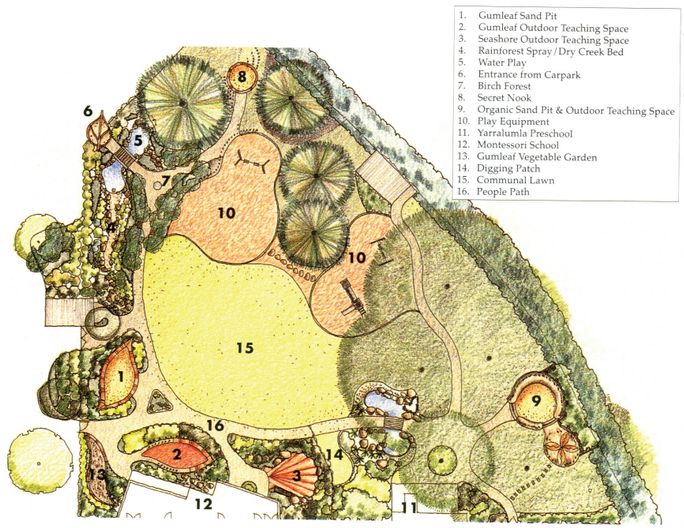
From:

Giovannini, J. (2000, June). The Montessori Method. *Architecture*, 117-121.



Conceptual drawing of interior space details

Case Study - Montessori School and Yarralumla Pre-school - Canberra, Australia



Plan of landscape.

Designed by Kiah Environmental Designers

Introduction

This landscape design project was completed on the sunny north-facing side of a small school building in a suburban area of Canberra, the capital city of Australia. The triangular-shaped site was developed with Montessori teaching principles and heavy involvement from the local community.

Findings

The tangible material qualities and involvement of all five senses are major elements to this project, moreso than in the previous architectural case studies. There is a strong connection between the indoor and outdoor spaces, much like the other warm-climate cases.

This project being of the landscape design discipline affords opportunities that would not necessarily exist in an architecture project. The designers were able to play with materials on the site and incorporate interactive water elements.

Site

The project site is very ideal for an outdoor play and learning area, mainly in its direct exposure to northern sunlight. Large trees provide shade and a diversity of micro-climate conditions. Landscape surfaces are varied throughout the project, with hard surfaces, such as concrete and loose rock, and soft surfaces, such as mulch and lawn.

Leaf-shaped play area.

These varied environments effectively create different social spaces, with different activities able to be carried out throughout the project. The large open lawn and the pond are perhaps the most social spaces, with the rock gardens and shaded areas being more intimate and personal.

The personality of the project is very strong in how the designers involved the community with its design and construction. Elements of the projects are incorporated, both abstractly and literally, based on the location of the project near the ocean. One hard-paved area is shaped like a seashell, others like leaves. A small pond area with a mist-spraying machine allows children to interact with the water in ways they never could have indoors.

Social space with varied textures

People are able to interact directly with the domestication of nature in the gardens kept on the site. There are both flower and vegetable gardens, and the vegetable gardens provide the ability to experience the site in a way that architectural and landscape design projects typically can not: through taste.

Analysis

The composition of spaces across the landscape project embodies a large variety of conditions. The open and flat nature of the lawn is contrasted with the jagged-feeling nature of the rock gardens. The areas of shade and the areas of shadow are well-balanced, essential for varied weather patterns both seasonally and throughout the day.

Interactive water element.

The circulation paths are laid out in varied surfaces and compositions and lead people near and through the various landscape features of the site. Even in the circulation path to the parking lot there is a variance in sensory inputs: the noises made and textures felt by walking on different materials, the feel of the sun versus the shade, and the smells of the flower gardens.

Conclusion

This project is essential to understanding the theoretical premise from more than just the perspective of an architect. The involvement of natural materials and patterns in this project gives a very strong biophilic connection. People are very much a part of this design, both in how the project is put together and how people interact within the spaces.

The flower and vegetable gardens are not out of the ordinary for a suburban area, but finding them in a childrens' playground shows that the designers understood the concepts of biophilia in the design of a Montessori school.

From:

Van Gelderen, J. (1998, March). An Imaginative Response to a Functional Brief. Landscape Australia, 210-211.

Water-spraying element.

Introduction

These four case studies were chosen mainly for their varied size and scope, and the strong design characteristics that each of them convey. The small, quaint pre-school in a quiet suburb of San Francisco is important in understanding how an architectural project can blend in to its community. The sunny South Florida school building demonstrates a level of response to the environment far beyond what most designers can fathom. The re-development of an office building into a Montessori school shows how a designer can make simple, bold gestures in the right places to completely transform an existing series of spaces. The Autralian landscape design project shows how designers other than architects can incorporate a strong connection between people and the natural world. All of these projects only helped to strengthen the theoretical premise research.

Analysis

What was found an all case studies was the embodiment of some principle of the Montessori Method for education. Also found in all cases was at least some investigation of design with biophilic elements, some obviously stronger than others. The presence of biophilic design in the projects was very helpful in understanding the different ways that those principles can work their way into the building design. The Montessori Island School school showed the use of a natural ordering system for creating spatial hierarchy and variation in the spaces with simple, straight lines. The Milwaukee Montessori School showcased the patterns found in the structure of trees in its composition of wood panels.

The project that is most different from the others is the Montessori Childrens' Center in San Francisco, mainly in that it did not make any bold gestures toward biophilic design or any sort of biomimicry in the way the building is lit and ventilated. The client stressed that it blending in the nighborhood more than it showed itself off as a Montessori child care center, and as a reult design opportunities are lost.

The one non-architectural case, the playground in Canberra, Australia, perhaps presents the most lessons to be learned about biophilic design. This is not only in its strong, successful use of the principles but in the opportunities it presents that an architect may not necessarily take. It took a very holistic approach to biophilic design, and is able to convey lessons from nature to the students through all five senses. The tactile quality to the entire design, highlighting the difference between light and dark, soft and hard, open and intimate, presents the natural environment at a level that the architectgural case studies were unable to achieve.

Only the Montessori Island School came close to the level of the Autralian playground. The Island School went beyond the others in terms of biomimicry, relying almost entirely on natural systems for lighting and cooling the space.

The two new-construction architectural cases took very different approaches to responding to their site. Whereas the Montessori Childrens' Center took a soft-footed approach as a way of respecting the neighborhood, the Montessori Island School took full advantage of its site conditions in an

almost celebratory manner. The Milwaukee Montessori School did not have the budget or the scope to deal with the site beyond the existing building and took very bold and calculated gestures to completely transform the building.

The social context of the site was strongly prevalent in the Montessori Childrens' Center and the Austrlian playgound. Whereas the Childrens' Center sets out to operate as a separate entity from the community, in keeping with the separation of a subdivision, the Autralian playground embraces the social and cultural makeup of the surrounding community. These two approaches are valuable to study side-by-side, as the results of their different ethics are clearly apparent.

The Montessori Island School and Australian playground both show a great emhpasis on the function of the outside environment in their circulation paths and comfort systems. The Island school forces students to travel outdoors between spaces. The Milwaukee Montessori School shows a great variety of function to the spaces within the building.

The spatial relationships of all four projects have a clear sense of the natural concept of hierarchy. The strongest showing of this was in the Montessori Island School, with the way it sets out a pattern in its floor plan that brings about the kinds of spaces and spatial relationships desirable for a Montessori school.

The project that most addresses the pragmatic issues is the Milwaukee Montessori School, mainly in how it occupies a building that did not previously embody and biophilic design characteristics. The challenge of changing the function and spatial organization without making any drastic physical changes to the building appears to have been resolved successfully. The challenge the architects put upon themselves for the Montessori Island School in building a school in South Florida with no air conditioning was a great one, and their understanding of how the systems of the building would need to function like natural ones led to a successful design.

Conclusion

This typological analysis is successful in analyzing projects that embody both the principles of the Montessori Method of education and in biophilic design and to show the strong connections between the two. It may not be that the Montessori Method of education is the key to addressing the prevalence of the biophobic ethic in society as outlined in the theoretical premise, but the analysis of these case studies has shown where the concepts of biophilia work in favor of a nature-based educational system.

Dr. Maria Montessori became interested in the educational development of children while she was a medical intern at a phychiatric hospital in Rome. She began developing her methods while working with mentally challenged children. As she began to develop her approach to helping the children learn, she began to see a great deal of progress in the childrens' abilities. She eventually coined the term Casa dei Bambini, or "children's house", to describe her teaching method. Her work became famous very rapidly in the United States by 1913, likely due to her ideas tying in to the progressive politics of Theodore Roosevelt (Montessori 1964). The popularity died off but began to re-surface in the 1960's and is beginning to re-emerge again today.

Introduction

The Montessori Method of education developed by Dr. Maria Montessori in the early twentieth century is perhaps the strongest example of biophilic principles in education. Though the education system is not intended exclusively to connect children with nature, it uses elements from the natural world to help students learn how to learn.

The Method itself is composed of several concepts that serve as the underlying ideas for the way the children are set out to learn. This investigation into the history and workings of the Montessori Method of education will provide an understanding into the typology and theoretical premise for this thesis project.

Liberty

The most basic concept for the Montessori Method is the idea that the children are completely in charge of their learning. The children are given the choice of when, where, and how they complete their lessons. The students may even complete the same lesson as many times as they want. The intent behind this is that the child will become relaxed and familiar with a concept before beginning to learn another (Standing 1962). In effect, the child will feel like they have become a master at a concept and work with other students to develop it further.

The concept of liberty serves as the basis for the function of the other concepts. Though it is not to be thought of as a limitation, the child really only has liberty within their "house" and the prepared lessons they can take on.

Prepared Lessons

The essence of the Montessori Method is the idea that children learn best through various sensori stimuli, particularly touch. Children are given "prepared lessons" that teach concepts through hands-on investigation. These lessons deal with concepts such as counting numbers and learning the alphabet, and are carried out with physical objects to represent the ideas themselves. For instance, children may learn spelling by physically spelling out words with wooden letters.

The children are free to complete the lessons on their own time. This is only possible within the environment of the Montessori school, which must be designed and implemented carefully in order for the free nature of the program to produce results. The term "prepared environment" is used to describe the level of detail that must go into how children will interact with it.

Prepared Environment

"It would take a book -- several books, in fact -- to describe all the teaching materials to be found in a Montessori classroom, materials which vary according to the age of children." (Standing 1962). Standing is outlining the immense amount of thoughtful investigation that must go into designing the environment for the Montessori Method.

The prepared environment refers to both the space used and the objects within the space. This is where the principles of biophilic design can help to enhance the learning environment. The environment must serve the education system entirely, making it one of the most difficult aspects in a successful Montessori school. Nothing can be in the environment that does not contribute to the process.

What Standing touched on as well was the difference between age groups in the way the Montessori Method is carried out. Dr. Montessori started to develop her method by working with children of elementary school age and younger, and the method has to adapt the way it teaches specifically to different age groups. It is not generally broken down to kids of an exact age, as in traditional school. A span of three years for age groups within a class is typical for a Montessori school (Mathews 2007).

Montessori Pre-school

The teaching principles of the Montessori Method tie in well with children younger than elementary school as well. At this age, children are still most interested in only the sensory qualities of an object (Standing 1962). What this means is that the children may not be able to learn concepts beyond the simplest ones by playing with the objects in the prepared environment. The prepared lessons for pre-school age children are not as intensive as those for elementary school are children, but the concept of the prepared environment is still present.

The development of concepts from objects begins around the age between pre-school and kindergarten (Standing 1962). It is perhaps that at this age the Montessori Method would have the greatest impact on a child's education, which may help to explain the existence of pre-school-only Montessori schools like the Montessori Childrens' Center case study in San Francisco.

Though, it is likely that the Montessori method is often used in pre-schools because more parents are willing to put their children in private pre-school than private grade school. A vast majority -- more than 97% -- of Montessori elementary schools are privately-funded (Mathews 2007), though the number of publicly-funded Montessori programs is increasing.

Public Schools

Dr. Montessori was a harsh critic of the typical public education system. She uses the example of school desk design to explain what she sees as wrong with the traditional approach to education,

> *"The schools were at first furnished with the long, narrow benches upon which the children were crowded together. Then came science and perfected the bench. In this work much attention was paid to the recent contributions of anthropology. The age of the child and the length of his limbs were considered in placing the seat and the desk was calculated with infinite care, in order that the child's back should not become deformed, and finally, the seats were separated and the width so closely calculated that the child could barely seat himself upon it, while to stretch himself by making any lateral movements was impossible. These desks are constructed in such a way as to render the child visible in all his mobility. One of the ends sought through this separation is the prevention of immoral acts in the schoolroom." (1964).*

Dr. Montessori has, in a book originally written in 1912, effectively outlined the four principles of George Ritzer's *McDonaldization of Society*. The control principle is very prevalent, in that children are not allowed to do anything besides sit straight up and look straight forward, and they cannot reach each other. The efficiency and calculability principles are apparent in the approach to the design of the desks related to body size, and predictability dictates that children will sit the same way at every public school to ensure an "equal" education.

The underlying concept in Dr. Montessori's writings is that traditional schools have an unnecessary level of control over the students. This control is in how the buildings are designed, how the furniture is designed, and how the teacher is expected to dominate the learning process by lecturing.

Keith and Willaims refer to this as an "anti-democratic process" (2000) in their article titled *Democrary and Montessori Education*. They

go on to describe how the Montessori Method teaches children to think democratically at an early age by "filtering all learning through the lens of peacemaking." They go on to argue that since peacemaking is expected to be used by both children and adults, it includes everyone (2000). This ethic is the basis for the teacher-to-student relationship in the Montessori Method.

Directors and Directresses

The best way to describe the student-to-teacher relationship in the Montessori Method is that there isn't one. The adults that are present to guide the students through their exploration, "teachers" if you will, are referred to as directors.

The role of the directors is exactly that: to provide direction. The directors are never to punish nor reward the children, or to try to instill a sense of right and wrong. The director is to relate any question a child has about their prepared lesson directly to the objects of the prepared lesson themselves, in such a way that the child has to learn how to complete the lesson.

Effectively, it is the role of the director to guide the children to learn how to solve their problems exactly as they are, without any external factors. This democratic approach is used in the process of completing the planned lessons as well as in conflict resolution between students, if necessary. To resolve a conflict, the children involved are asked to look each other in the eye, use each other's names, tell each other why they feel the way they do about the situation, then say what it is they want the other to do (Keith and Williams 2000). In essence, the children are asked to do the same between themselves and their prepared lesson.

Biophilia

Though the term *biophilia* did not exist during the development of the Montessori Method, it is very much a part of the educational philosophy. The children will in their prepared lessons care for plants, which leads them to approach the tending to the plants in the same democratic manner they would approach a conflict or planned lesson involving numbers.

The foremost concept underlying the tending of plants is patience. The patience manifests itself not just in waiting for the plants to grow, but in carrying out the labor necessary to get them growing in the first place. Children begin to find a connection between the tasks they undertake and the results of the effort - the fruits of their labor, if you will. This helps them to develop a "virtue of patience", as well as a love of the natural world that they will carry with them their entire life (Montessori 1964).

An example of a person with a strong *virtue of patience* in a related manner is a Oakland woman named Novella Carpenter. Novella decided that her urban life was not going to let her get in the way of her rural upbringing and decided she would like to grow her own food. To accomplish this, she simply turned to a vacant lot near her apartment and cleared it herself to initiate a garden. She grows countless fruits and vegetables and even raises egg hens, rabbits, and goats on the 4,500 square foot lot (Vlahos 2009). The owner of the lot has warned Novella that he may develop the lot some day, but he does not care that she is cultivating a "squat garden" on his land.

The driving force behind Novella's growing of these food items is just that she enjoys the virtue of knowing that she can sustain her own life. While Novella may not have been educated in a Montessori school, she has certainly learned one of the most important life lessons in the Montessori Method.

Conclusion

This explanation and discussion of the Montessori Method of education developed by Dr. Maria Montessori is intended to show the parallels between the ethics of education and the view of the natural world. It is not difficult to equate the Montessori Method to biophilia when looking at the relationship between biophilia and biophobia as a way of explaining negative aspects of traditional educational methods.

It is possible that the founder of McDonald's looked to the Western education system when developing a business model that allows for a rapid expansion of profits with tangible improvements in virtually nothing else.

Academic Goals

The main goal of this thesis project in the academic realm is to conduct a thorough research investigation of the connection between humankind and the natural world, and to carry out the findings of this research through an architectural exploration. The result of this goal will be a book of the research and architecture bound and placed in the Klai/Juba Architecture Library at NDSU.

The final book will serve as an addition to the body of knowledge found in the thesis books of all students that have graduated from the program before. It is my hope that this book will provide insight into the development of the thesis projects of students in the future.

In the academic environment, it is important to foster a discussion of ideas and concepts amongst the faculty and peers. Throughout this project, it is my goal to foster constant discussion of my project and my peers' projects, whether they are discussed verbally, in writing, graphically, or with models. I feel the process of discussion is the most important aspect of a graduate program.

Professional

This project will demonstrate my ability to explain concepts and ideas, conduct research, and carry out my best design abilities. It is the final project in the Master's Degree program and must reflect that my education hs provided me with the insight and skills needed to succeed in the professional environment.

What is very important in showcasing the results of my work on this project is an attention to detail, in both the writing, design, and presentation. I will approach this project with the level of exploration of ideas befitting a graduate student but with an investigation of how the building would go together.

I am confident that this project will be my best work, and will make an addition to the portfolio of work done throughout my five years at North Dakota State University.

Personal

The single most important thing I can accomplish with this project is to prove my abilities to myself. I have always thought of architecture school, especially at the gratuate level, to be a personal investigation as much as it is a research or design investigation.

Since the beginning of this thesis project, I have chosen to investigate concepts related to design that are of great interest to me. I feel one of the greatest abilities of an architect is to design a response to the site, whether they be social site conditions, climatic considerations, or political issues. I am also very interested in how architects can bring elements of nature into the built environment.

I have wanted to explore the design of an educational environment since I first learned about the thesis project in my first year. I was excited to design a Montessori school as a second-year project, and am looking forward to further exploration into the philosophy of the educational system in an architectural manner.

Introduction

The site for this thesis investigation was chosen initially on the basis of its urban context, located in an area with a level of density where the manmade environment plunders the natural. Also important to the ideas discussed in the thesis research is that the site portray some aspect of Ritzer's *McDonaldization of Society* in a way that can be addressed through the ethics of biophilic design.

The site that was chosen is a small Safeway grocery store that was closed down in December of 2008. The store served the people in the surrounding neighborhood, providing a source of food within walking distance even in the cold Manitoba winters. The owners of the grocery store decided to close this location to focus on developing their larger, more profitable stores (Olafson 2008). In the process, they have created a "food desert" in the West End neighborhood, as the next nearest grocery stoe lies roughly a mile from the site in a large area of suburban sprawl.

A large vacant commercial site, referred to as a "grayfield" site, is desired for this thesis examination because it represents the folly of the sort of overly-objective decision making that is prevalent in modern society. A grayfield site can come about due to various reasons, but the empty stores and vacant, overgrown parking lots serve as a reminder to the problems we are facing related to the environment.

Photograph of site, looking Northeast across Ellice Ave. Photo by Mathias Fitzer.

Views

As this site is located in a region with virtually no slope to the land, the views do not extend far past the surrounding structures. To the south of the site is a large gas station, and to the west is the loading docks of industrial building across the railroad tracks. To the north of the site lies a small transmission shop in a CMU block structure. The view providing the most pedestrian activity is to the east, with several buildings containing small businesses and the ensuing foot traffic. As a whole, views from the site do not extend far from the local area, and only a few trees peek out above surrounding structures. There is no view of the skyscrapers of Downtown Winnipeg from anywhere on the site.

View of small businesses to the east, with residential area and trees behind. Photo by Mathias Fitzer.

Structures

Buildings and other man-made constructs dominate the views of and from the site. The surfaces are best described as industrial, or durable. CMU blocks comprise the facades of entire buildings, and ribbed steel sheet panels stand out above the concrete one the larger building to the east. Some small houses are visible between the commercial buildings to the east. Overall there is a dense "wall" of buildings surrounding the site on all four sides. Several large signs dominate the airspace of the site, as do the lights for the parking lot of the site itself. The structure for the sign for the grocery store is visible from at least three blocks in every direction.

Nearly the entire surrounding area is taken up by buildings or pavement. The only relief from this is the overgrown open ground along the railroad tracks.

The existing structure takes up nearly the entire northern third of the site. All wall surfaces of the structure are masonry, with painted CMU walls on the west, north, and east sides and a fieldstone facade on the south side. The south face of the building is dominated by glazing.

View of gas station and other low-lying structures to the south. Photo by Mathias Fitzer.

The roof of the building is its most striking feature, with a gentle wave form. The roof structure is left exposed inside, with large laminated beams supported by slim steel pipes at each third of the beams' length. Remnants of the fixtures and furniture from the building's use as a grocery store are clearly visible on the floor surface.

View into interior of existing structure through front windows. Photo by Mathias Fitzer.

Light

There is very little to block or reflect light in the area of the site. As most surfaces are either paved or masonry, most light is absorbed. The lack of any structures over one story in height south of the site gives full sun exposure throughout the day, which can become bright if no clouds are present.

One of the only reflective surfaces found near the site is the large expanse of glazing on the south face of the existing building on the site. Indirect sun angles can create a strong reflection of light.

Late afternoon light reflecting off glazing. Photo by Mathias Fitzer.

Vegetation

The site itself contains no vegetation, and only small hints of nature are present around the site. There is a view of trees one block away to the east and to the west, and a large expanse of brush along the railroad tracks. A small strip of grass separates the parking lot surface from the sidewalk.

It is inherently a goal of this thesis project to re-introduce native species of grass and other plants to this site. Though, consideration will be given to species that were not necessarily native to this specific site, such as large trees for shade and wind-blocking.

Wildlife

The only sign of animals near the site is what appears to be the tracks of an un-leashed dog through the snow in the parking lot. No area around the site in its present state would be a suitable habitat for more than just a trace of wildlife.

View of overgrown along east edge of site. The only hint this land used to be open prairie. Photo by Mathias Fitzer.

This can be seen as an opportunity to restore native wildlife to this urban environment.

Wind

Standing in the open paved area of the site, there is very little to block the wind. The strength and direction of wind on the site is slightly erratic even in a light breeze, though it does not stray heavily from the prevailing direction. This is likely due to the scattering of low-rise buildings around the site and the lack of any trees in close proximity to the open area.

South face of existing structure, showing its curved roof structure and lack of recent maintenance. Photo by Mathias Fitzer.

People

People have a reasonably strong presence in an area that is so dominated by concrete and asphault. People walking on the sidewalk to and from shops are farily frequent and people standing next to their cars at the gas station provide signs of social life.

Nearly everything within the environment of the site is man-made. It is more appropriate to ask how nature has intervened on the manmade site than to ask how humans have intervened in the site.

As for the site itself, a completely vacant building will not have any visitors. A few people had parked their cars in the corner of the parking lot to visit the shops next door. The dusting of snow provided clues that a lot of people have driven diagonally across the site to avoid driving through the intersection of Wall St. and Ellice Ave., but no visible foot traffic had crossed the site.

Distress

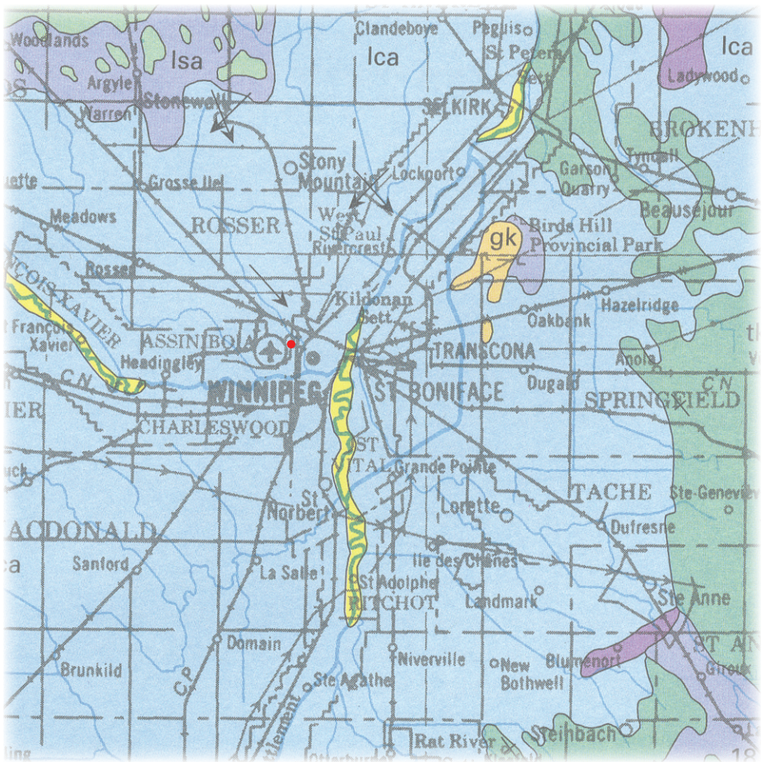
The entire site is in a slight state of distress, and clearly no maintenance has been performed on the building or the land since the business was shut down one year prior. Most notable is peeling paint and a few loose fieldstones on the building. The paved surface did not show any excessive cracking. The connections on the building where the signs had been attached are beginning to rust.

A second area of distress is along the eastern edge of the property. The brush along the railroad tracks are beginning to take over the concrete dividing wall at the edge of the paved area.

Conclusion

Overall, this site presents many challenges and opportunities in regard to the theoretical premise and the typology. The manmade nature of everything about the site provides opportunities to explore biophilic design in an area sorely lacking in natural context.

Photograph of grocery store in operation in 2008. From Panoramio.



Map of surface soil in Southern Manitoba. From the USGS.

•Project Site

The soil for the project site is classified by the USGS as "lake clay and silt", a soil type that is described as "soft to very firm; cohesive and compact. Very plastic and sticky where damp, hard where dry." The engineering classification of this soil is "plastic silt".

The site is bordered by power lines partially to the west and fully to the east. Large power lines run along the opposite side of Ellice Avenue. A large electrical box lies at the southeast corner of the site, and another near the southwest corner on the other side of the dividing wall. Electrical utilities are shown in yellow.

A single storm drain lies near the middle of the parking lot, shown in blue.

Utilities at site. From Google Maps.

vehicle traffic

Vehicle traffic counts in cars per day. Image from Google Maps.

The traffic noise from Ellice Avenue to the south dominates the site. Noise from Wall St. to the east is intermittent and bounces off the buildings across the street. A bus stop lies at the south end of the site. Buses are frequent on Ellice Avenue, which is a major bus route between Downtown Winnipeg and the airport.

Above is daily vehicle traffic count numbers for the major roads near the site (2008 TFM). The direction of traffic flow is indicated as well.

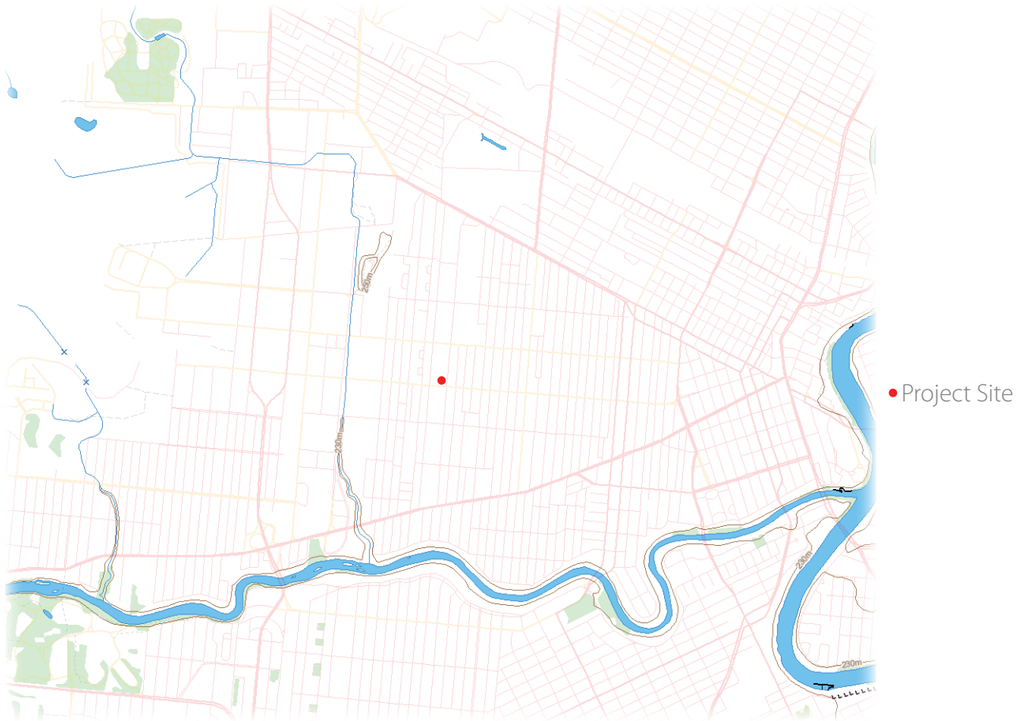
pedestrian traffic

Pedestrian traffic around the site is mostly from the shops along Wall Street and on Ellice Avenue, east of Wall Street. The surrounding neighborhood is very easy to walk to from the site, since most of the vehicle traffic is contained on Ellice Avenue.

Below is a graphic representation of observed pedestrian traffic. The light lines show sparse traffic and the thicker lines show more heavy traffic. A bus stop at the south end of the site is a source of pedestrian traffic.

Map of pedestrian density. Image from Google Maps.

topography



Contour map of Winnipeg, with 10 meter intervals. From atlas.nrcan.gc.ca

The topography of the site is virtually flat with an average slope of less than 1°. The only areas of the site with a noticable slope are the south parking lot entrance to Ellice Avenue, with a vertical change of roughly one foot, and the dipped area near the loading dock at the north end of the existing building.

Above is a contour map of Winnipeg with 10 meter contours. The only major elevation change in the entire city is a drop along the banks of the rivers and a small hill northwest of the site.

The nearest body of water to the site is a small creek a few blocks to the west. The Assiniboine River lies roughly one mile to the south, and the Red River three miles to the east.

site character

The most prominent sign of change to the site over time is the site itself. In December 2008 the grocery store that occupied the building on the site closed down. This has likely resulted in major changes to pedestrian and vehicular traffic, as residents that were able to walk to this site for groceries must now travel one mile to the west. A small gas

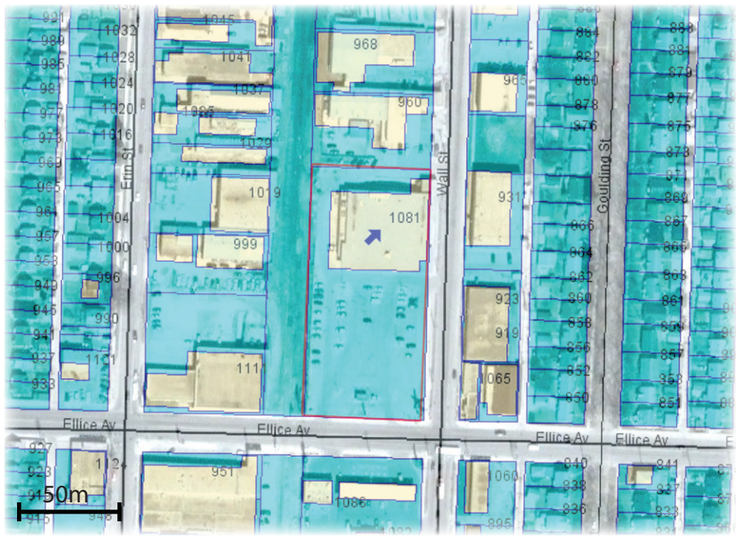
Photo of small gas station no longer on the site. From Google Street-

station used to operate at the south end of the parking lot, even after the grocery store closed down. There is no trace left on the site of this gas station.

The railroad tracks to the west of the site show signs of dwindling use. It must have been prudent at one point in time to cut a right-of-way for the railroad through this area, but there were no hints upon the site visit that a train had passed through recently. At the grade crossing on Ellice Avenue, the small space between the slats and the crossing surface were packed with snow and road grime from a snowfall two days prior and there was no sign that a train had pushed the snow aside.

Railroad grade crossing on Ellice Avenue. Photo by Mathias Fitzer.

boundaries



Legal boundary map (from www.winnipeg.ca) overlaid upon satellite photo (from Google Maps).

The legal boundaries of the site are a perfect rectangle, 62 meters (203 feet) wide east-west and 128 meters (420 feet) north-south. The gridlines that depict the site boundaries and the urban context of the surrounding area is 3° from true north.

vegetation

There is no vegetation on the site itself, as any surface not covered by the existing structure is paved. There is a small strip of grass on the east edge of the site and the railroad right-of-way to the west is mostly vegetated. Large trees that are visible from the site are highlighted, as well as two open expanses of land, one to the east and one to the west.

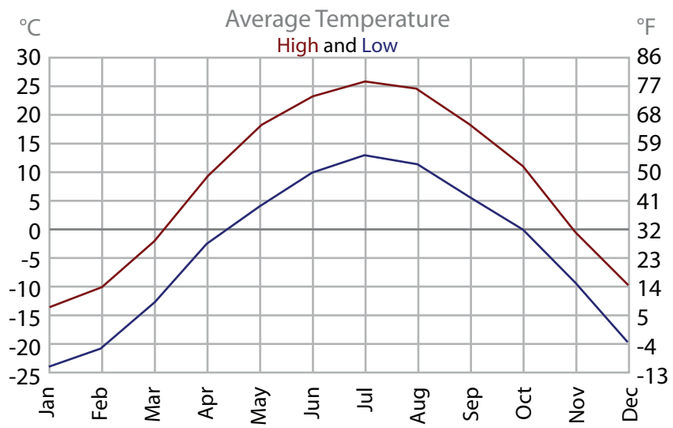
Satellite map of the site highlighting areas of noticable vegetation near the site. From Google Maps.


Bill Knight


STAR BOOKS

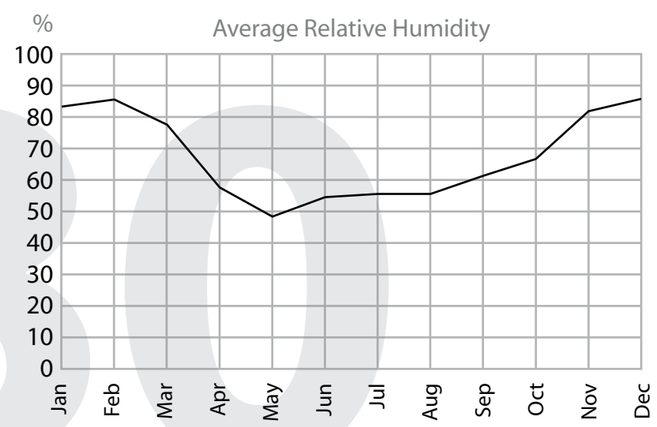

STAR BOOKS

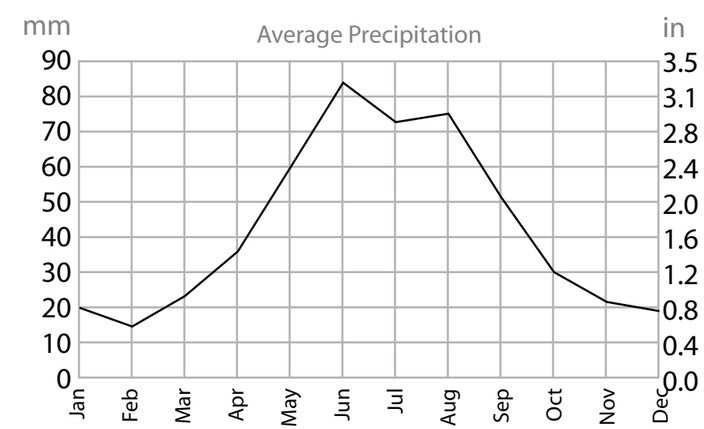

Millennium Gospel Ministries



Winnipeg is located near the geographic center of the North American continent, and is known for its extreme annual temperature range. The summers are warm, but not hot, and the winters are bitterly cold (WMCYCA 2009).

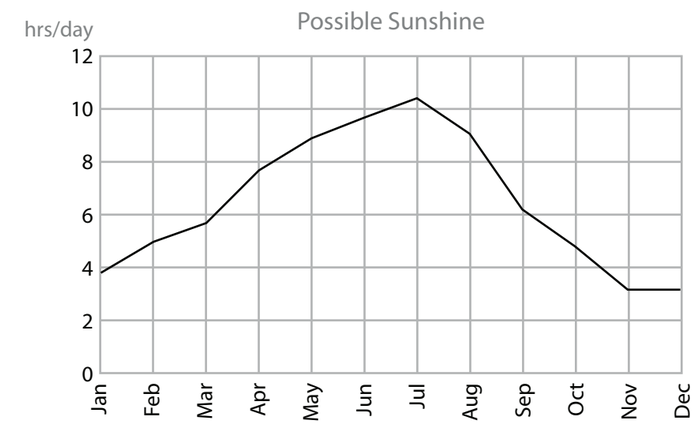
The relative humidity ranges from roughly 50% in the summer to over 80% in the winter. The high percentage of relative humidity in the winter is mainly due to the low temperatures, as the winters are generally thought of as dry (WMCYCA 2009).

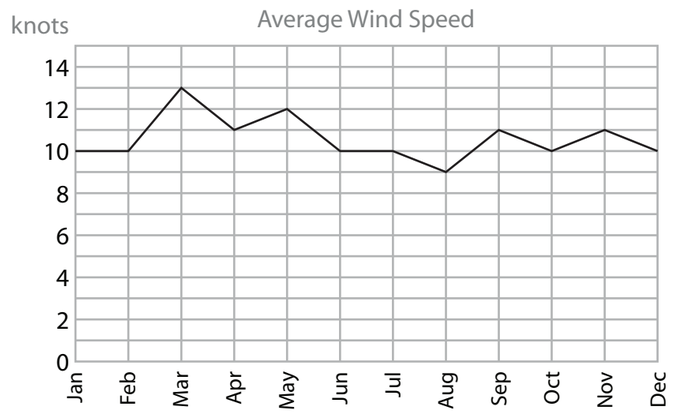




A majority of the precipitation in Winnipeg falls in the summer months. The annual average precipitation is 522mm, or 20.6 in (WMC 2009).

Winnipeg lies at roughly 50°N latitude, giving very short days in winter and long days in summer. The graph of possible sunshine below illustrates a combination of the absence of cloud cover and the length of the day throughout the year, giving a more useful measure of sunshine than percentage alone (WMCYCA 2009).

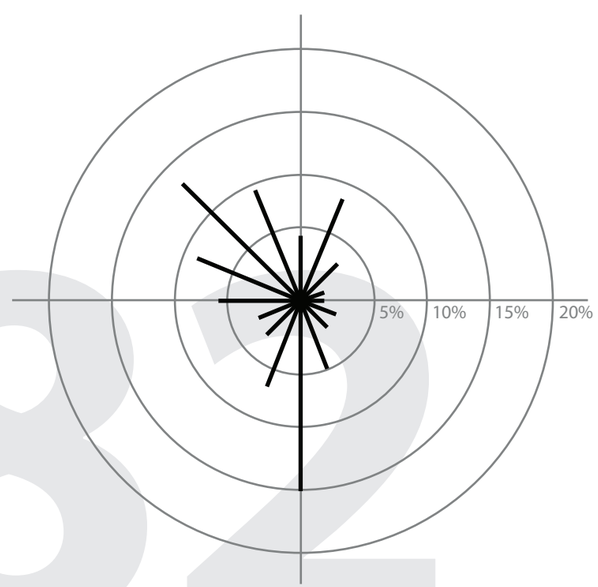




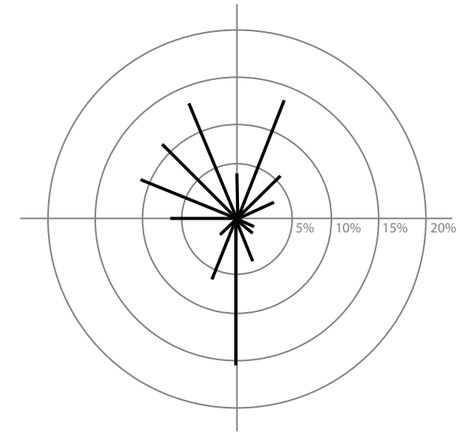
The flat topography leads to a relatively high average wind speed. The wind speed is highest in late winter and early spring, and lowest during the summer (Windfinder 2009).

The predominant direction of the wind is from the northwest and the south. The wind from the northwest comes from the large landmass of Northern Canada, and the wind from the south comes up the extremely flat Red River Valley (Windfinder 2009).

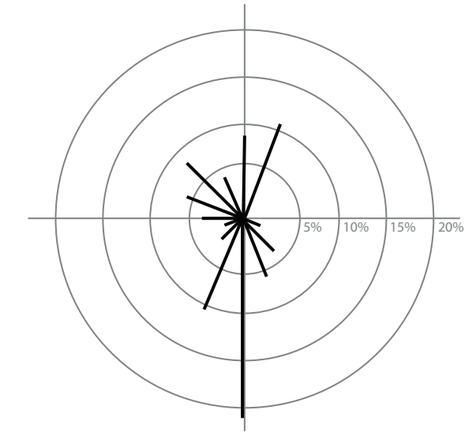
Annual Wind Direction Probability



December Wind Direction Probability

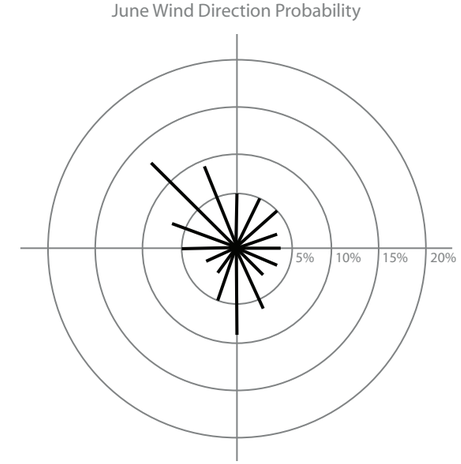


March Wind Direction Probability

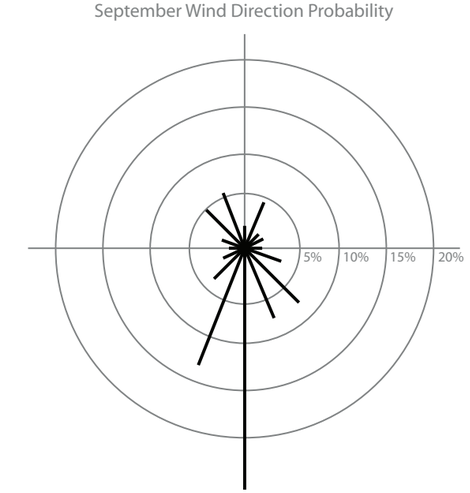


The seasonal variation in wind direction has a strong correlation to temperature. At the spring and summer equinoxes, the wind is predominantly from the south. In both the summer and winter solstices, when temperatures are more extreme, there is a strong chance of the wind coming from the northwest (Windfinder 2009). This analysis is valuable when designing a building with natural ventilation.

June Wind Direction Probability



September Wind Direction Probability

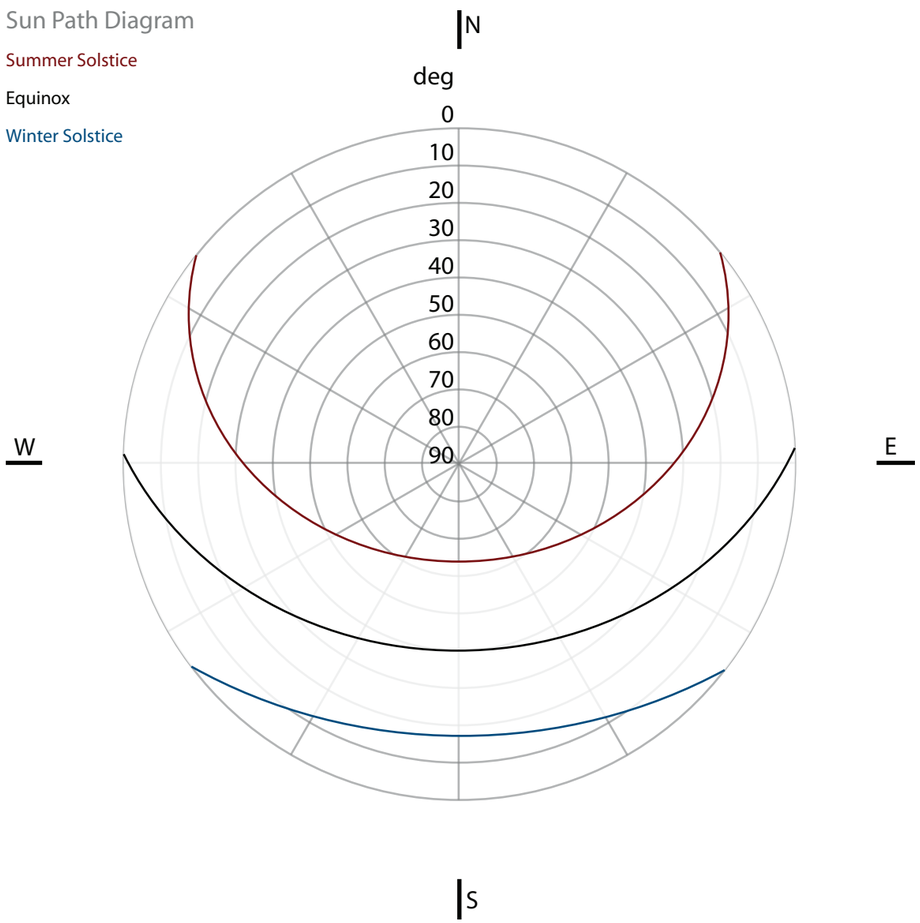


Sun Path Diagram

Summer Solstice

Equinox

Winter Solstice



Winnipeg is located at 49°54′ North, giving a wide variation in the sun angle and hours of daylight seasonally. This sun path diagram shows how at the summer solstice the sun rises from the northeast and sets to the northwest, making shading difficult (Gaisma 2009).

Noise

The auditory characteristics of the site are completely dominated by man-made objects. Traffic noise is the single largest source of noise pollution, and the close proximity of hard-surfaced buildings only enhance the noise.

The site is located three miles from the Winnipeg International Airport. Aircraft are visible from the site, but not audible.

Climate Summary

The extreme seasonal temperatures, sun angles, and daylight hours, combined with the flat terrain, makes for a challenging environment to design a building that responds to its site. Careful attention must be paid to where the sun hits the building at certain times of day throughout the year, to either maximize or minimize solar gain depending on the season. The scattering of low-rise buildings around the site for this project do not pose a major issue to designing for sun angles.

Major Spaces

Classrooms - 800-900 square feet each. 30 students and 2 teachers per classroom. Include sink, large counter area, hard seating, soft seating, varying work surface heights, single bathroom, storage cabinets. Moveable dividers are desired within space and between spaces. Locate pre-school classrooms near administration and main entrance.

Common Areas - allocate space where applicable. Locate between classrooms and criculation paths. Include hard and soft seating. Vary spatial and sensory characteristics of the common areas. At least one should be set up for performing skits or similar exercises.

Wet Lab - 400 square feet. Locate near classrooms for older students and near entrance to outdoor learning areas.

Media/Knowledge Center - 600-700 square feet. Locate near classrooms for older students. Isolation from noise preferred.

Indoor garden - 3,000+ square feet. Include several large sinks, work surfaces of varying height, planting beds. Space should receive maximum possible sunlight throughout the year. Circulation paths should interact with this space. Direct connection to exterior gardens desired.

Administration - 300 square feet. Open office space for about three employees. Include desks, hard seating, some soft seating, storage cabinets. Locate at main entrance to school, near main restrooms.

Outdoor Spaces

Garden - space allocation will take up a large amount of the site. Include sinks, tables of varing height, and lockable cabinets for tool storage. Informal gathering spaces with seating surfaces should be placed throughout. Strong variation in textures, materials, light quality, sound quality, and scale is paramount.

Outdoor classrooms - include hard and soft seating, tables of varying height, lockable storage cabinets. Should be at least partially sheltered from wind, precipitation, and light, with the shelter elements at least partially movable.

Support Spaces

Mechanical - smaller mechanical spaces throughout building as opposed to a single, central location. Integrate natural and mechanical systems.

Restrooms - 300 square feet. Located near main entrance and administration.

Vestibule - located at main entrance, near administration. Maintain a level of security but keep an open flow.

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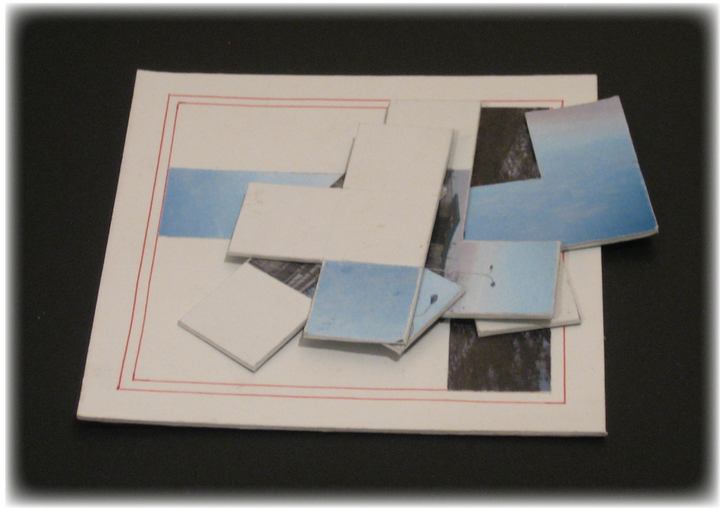
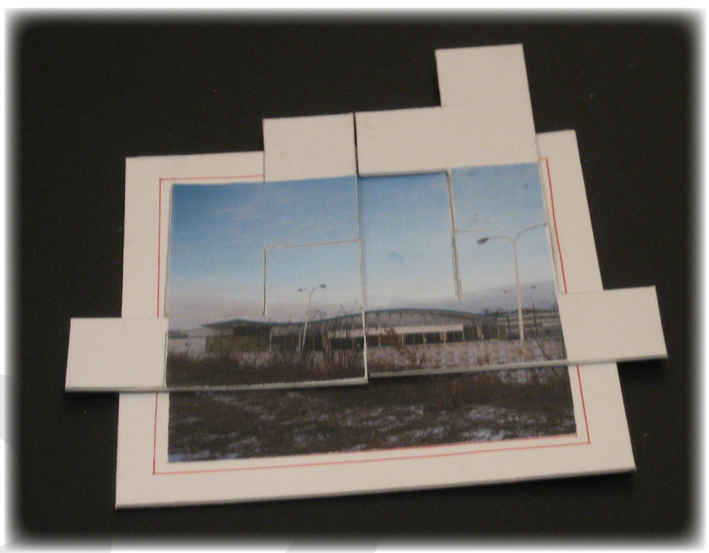
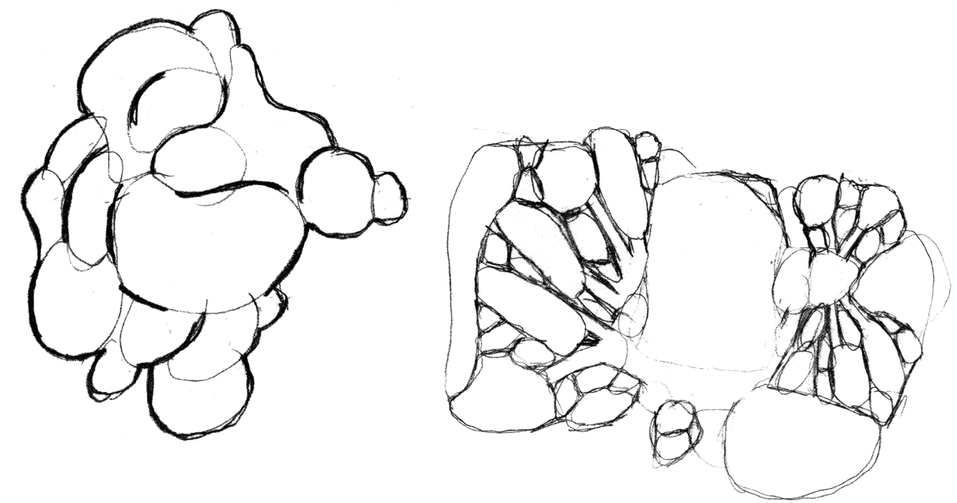
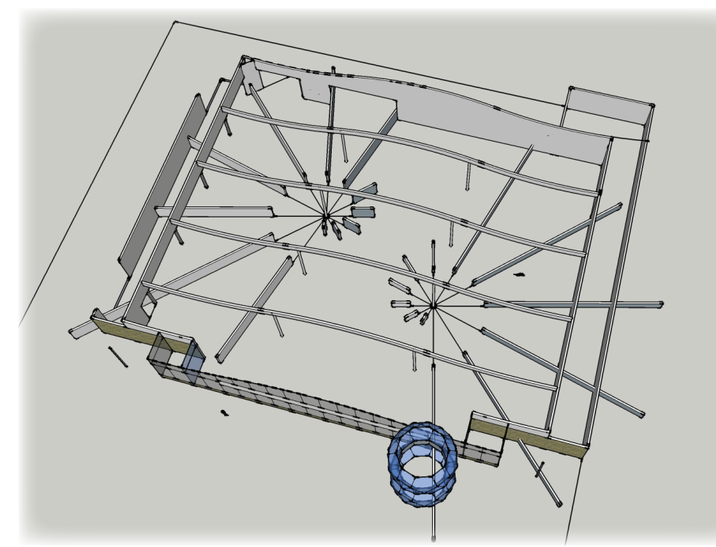
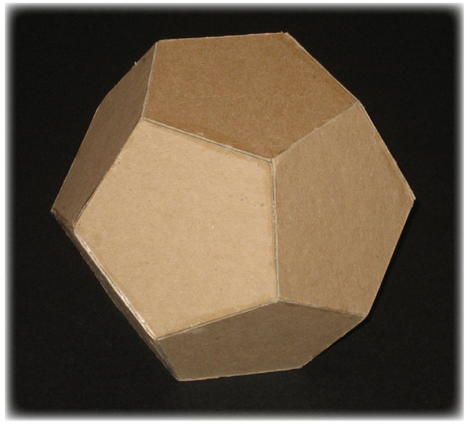
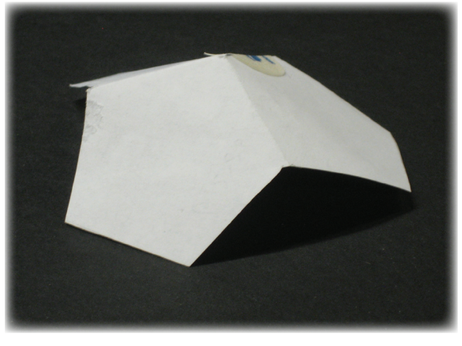


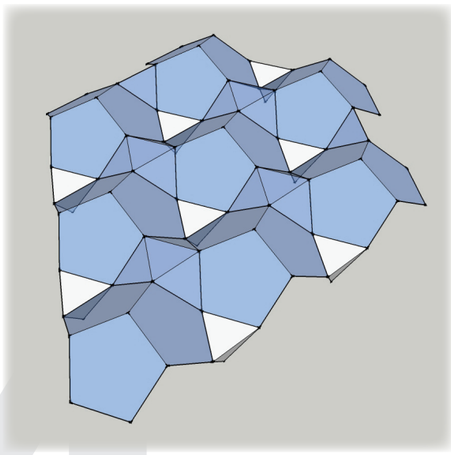


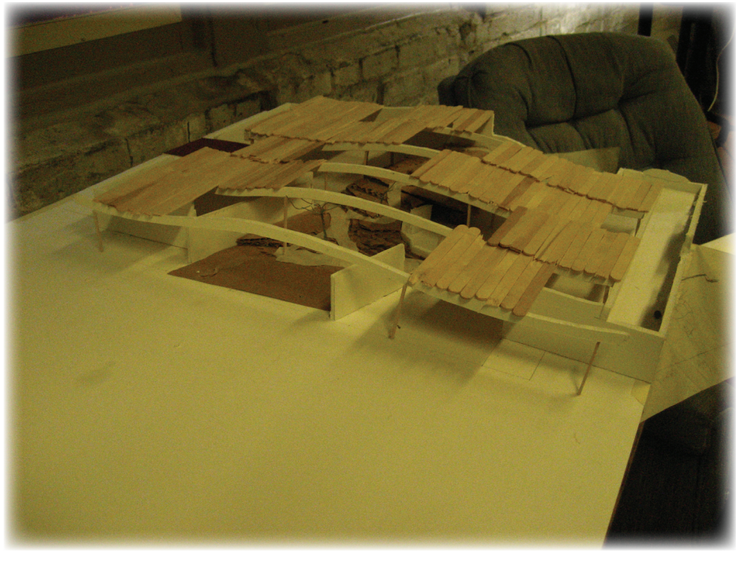


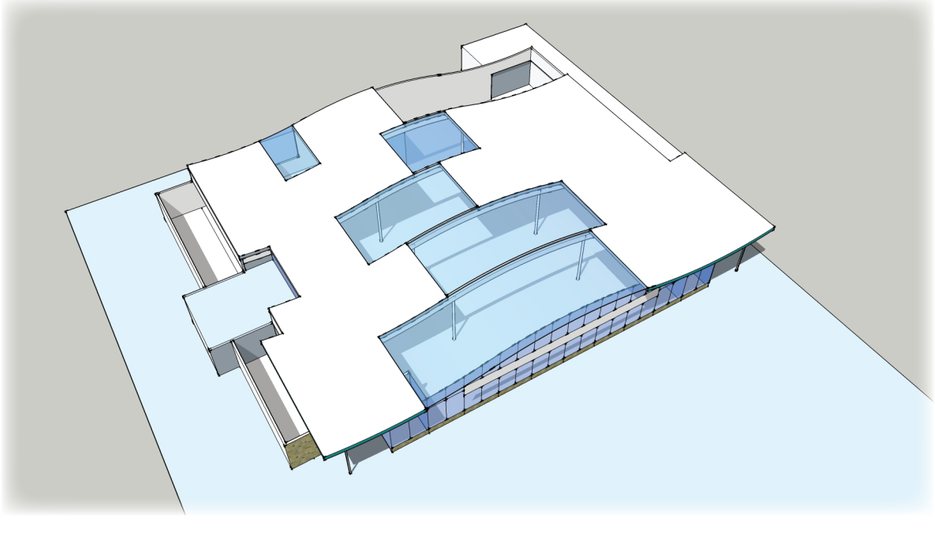




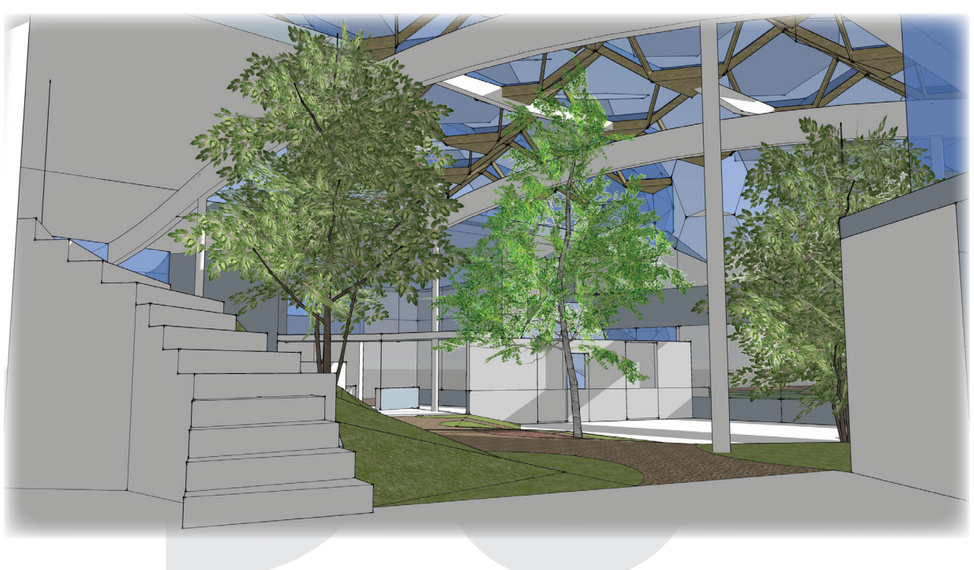




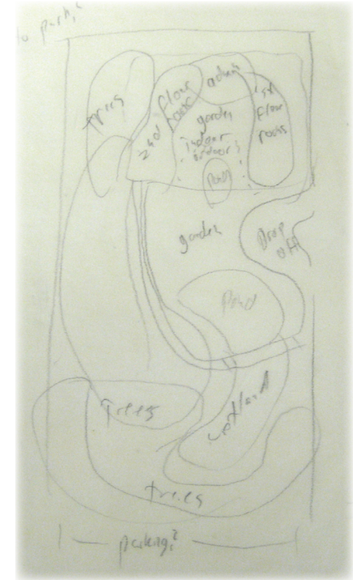


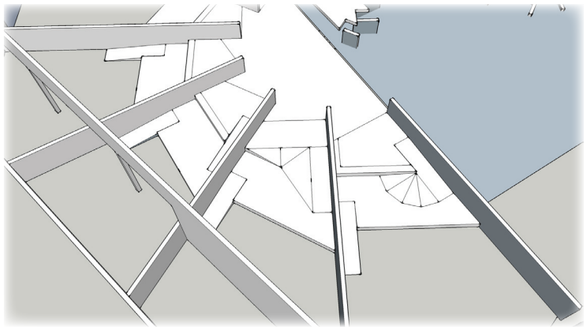


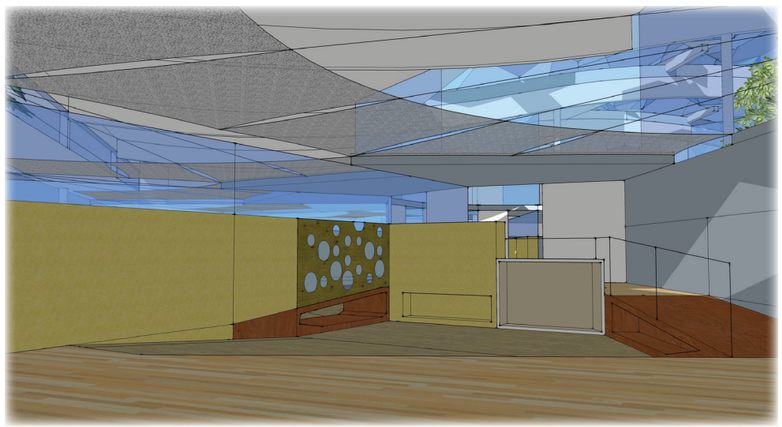
indoor environment

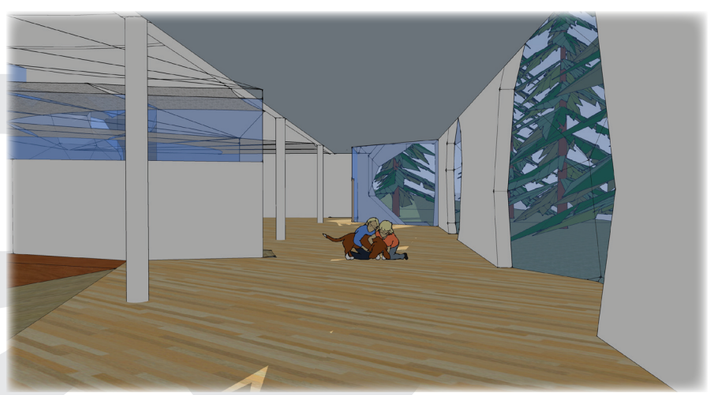


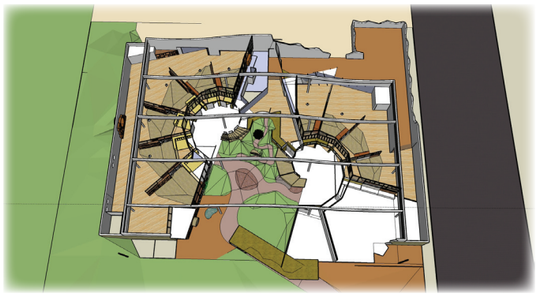
outdoor environment

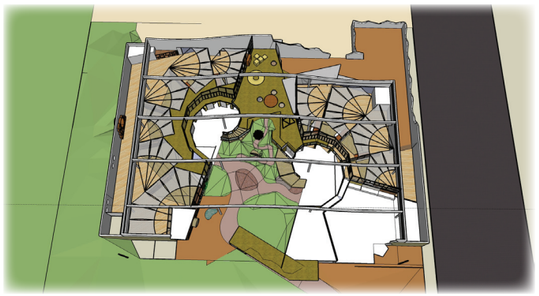


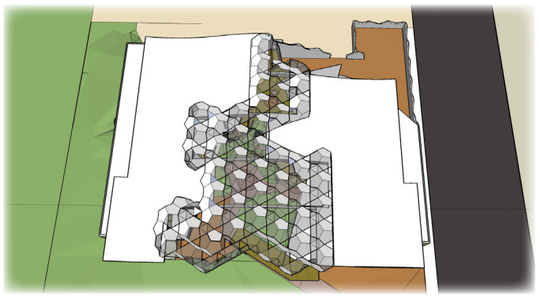


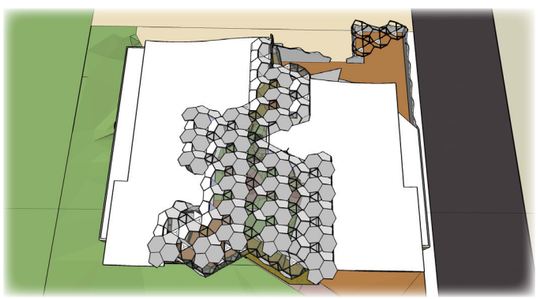






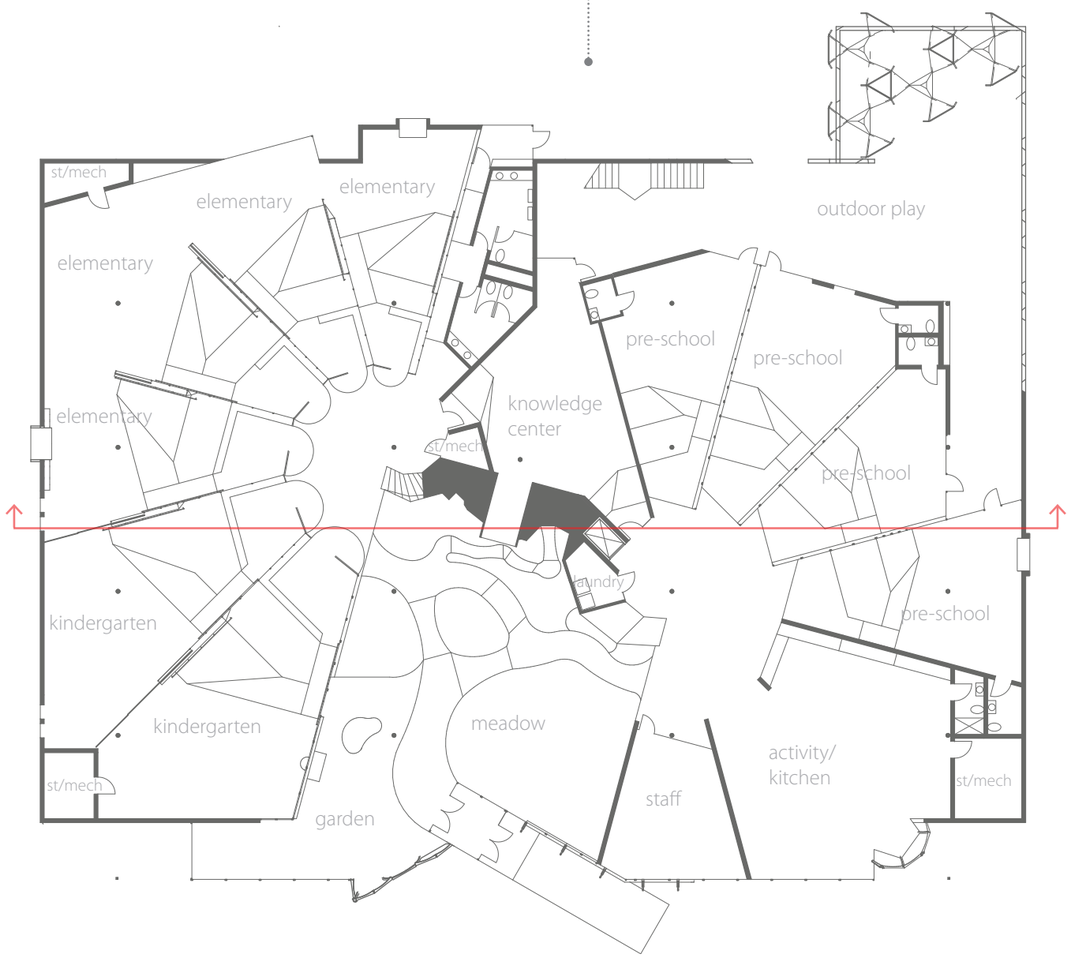




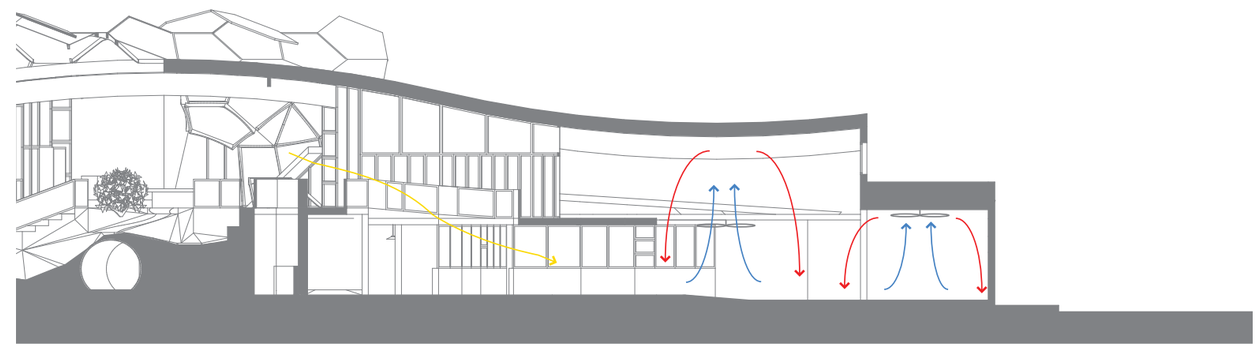


final design

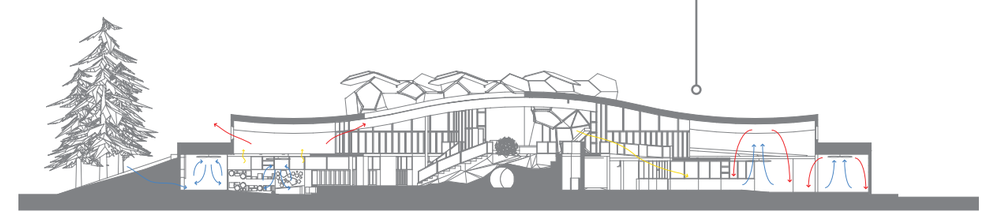
floor plan and wall section



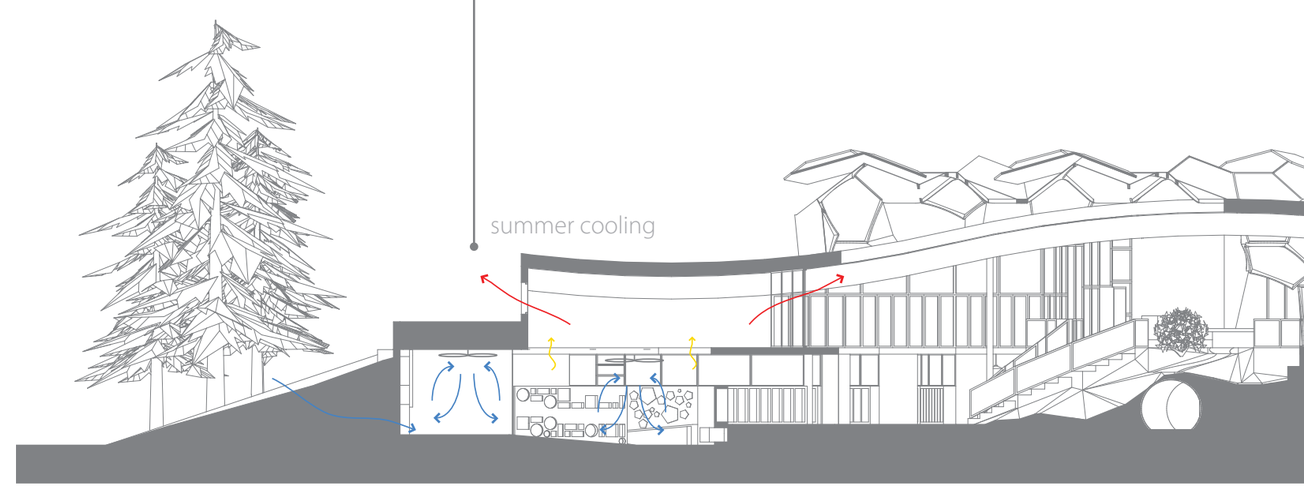
building section

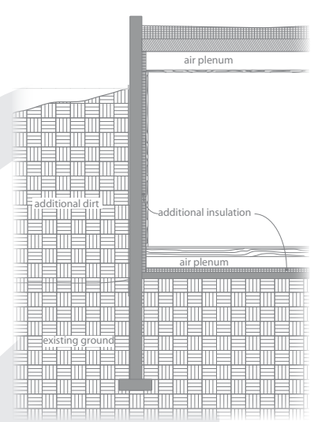


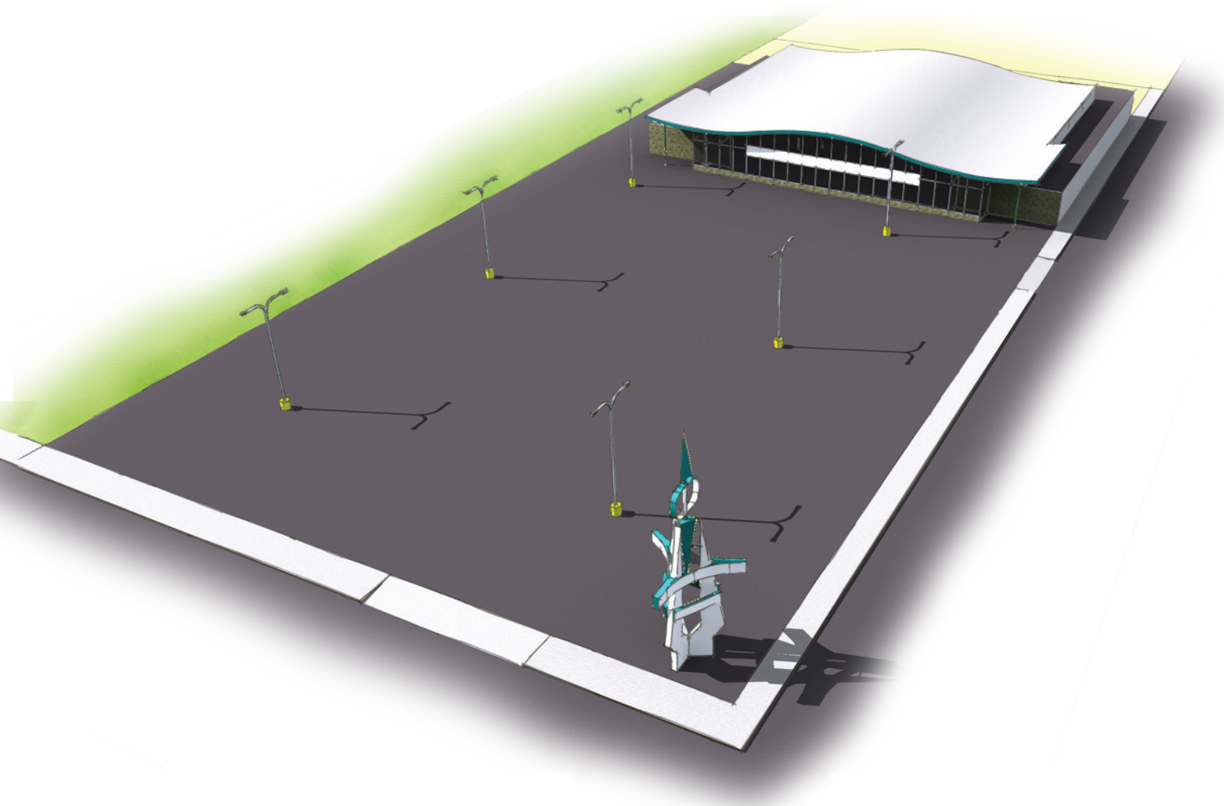
winter warming

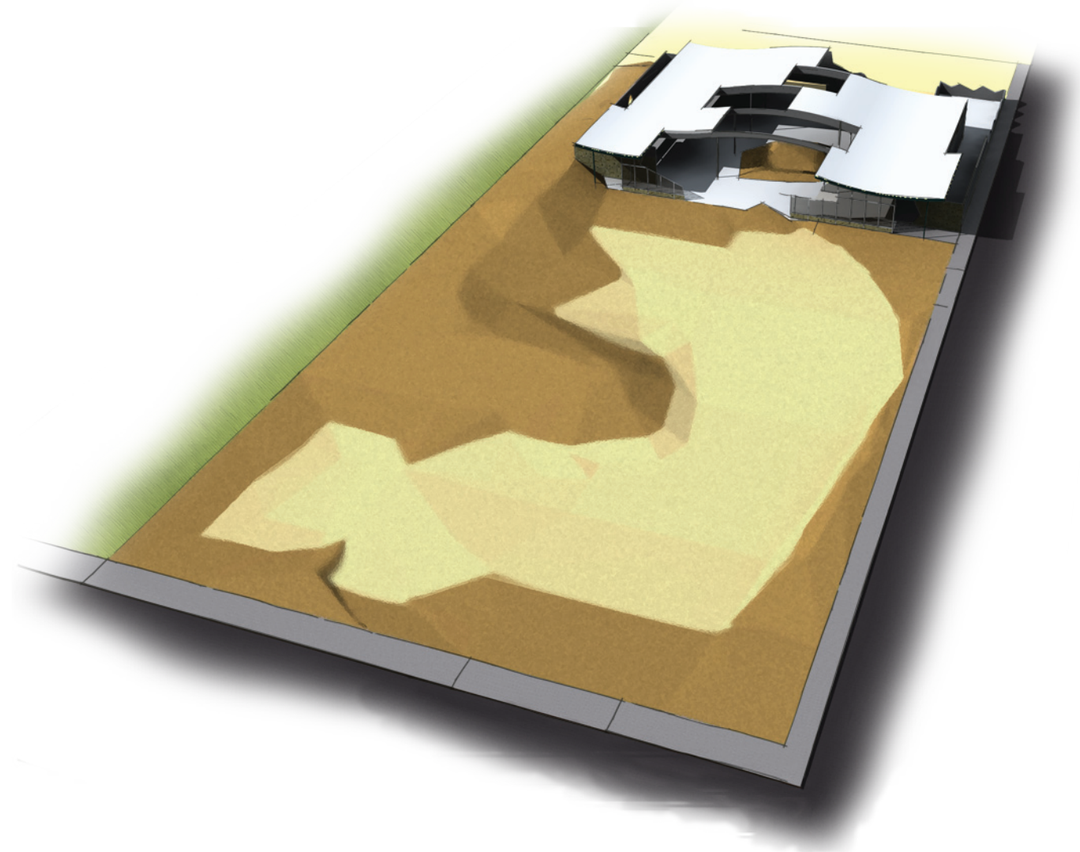


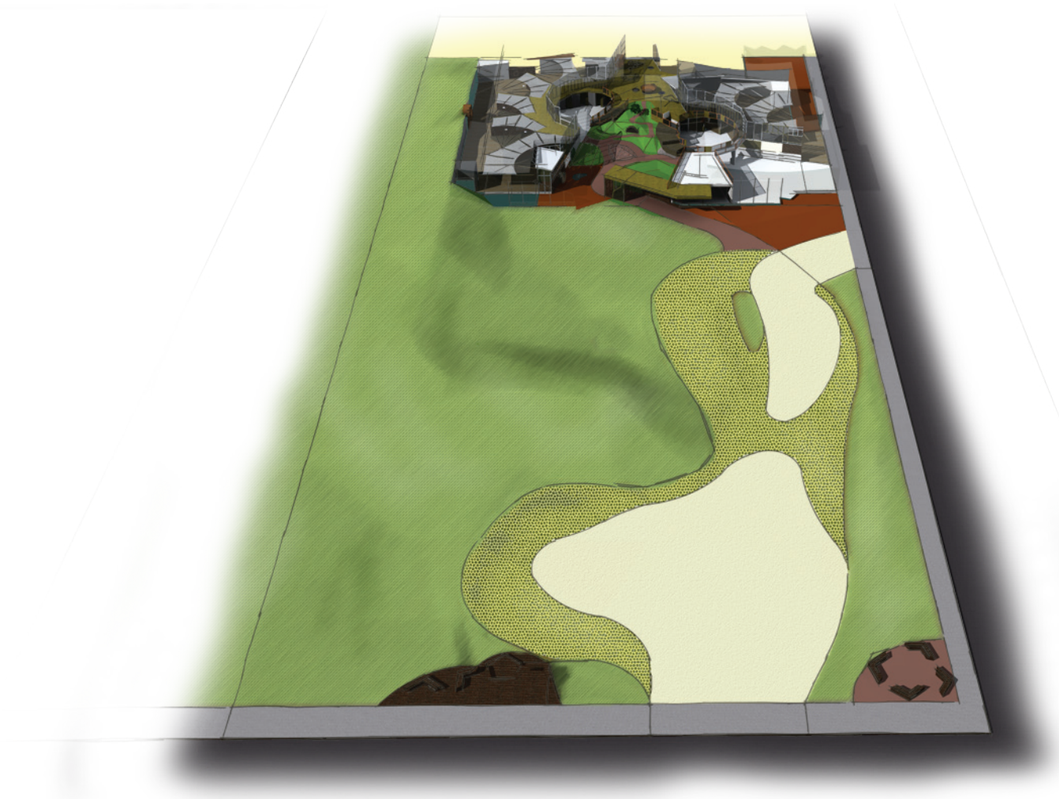
summer cooling

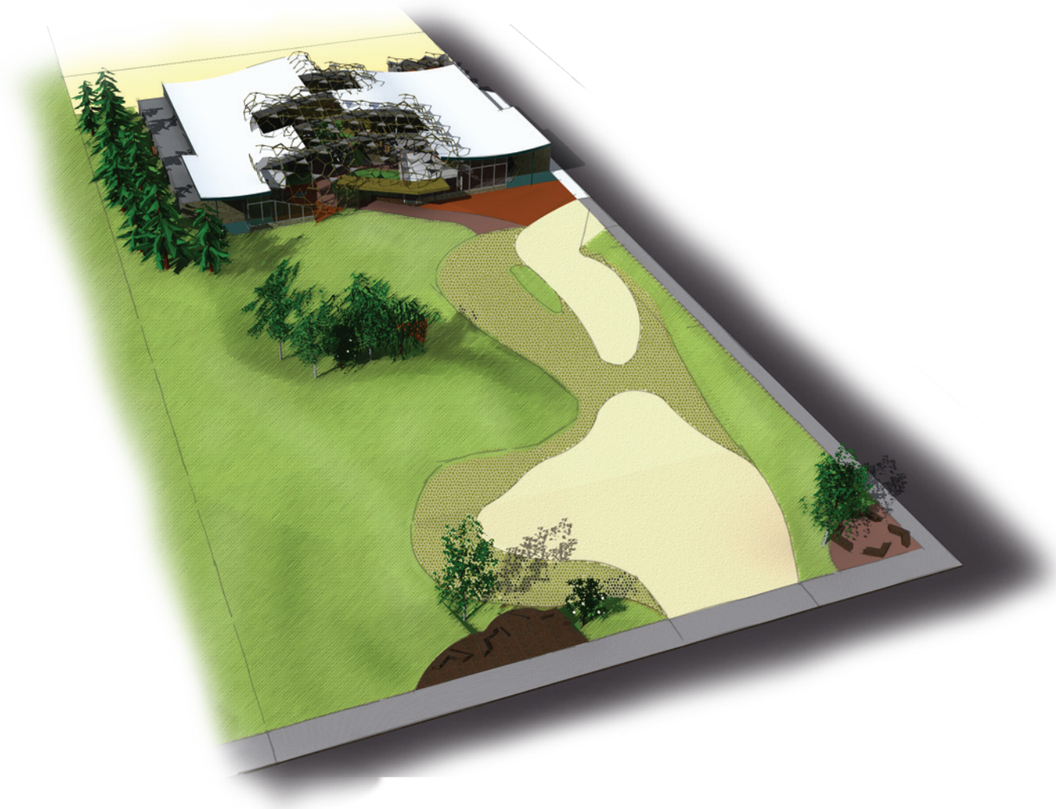


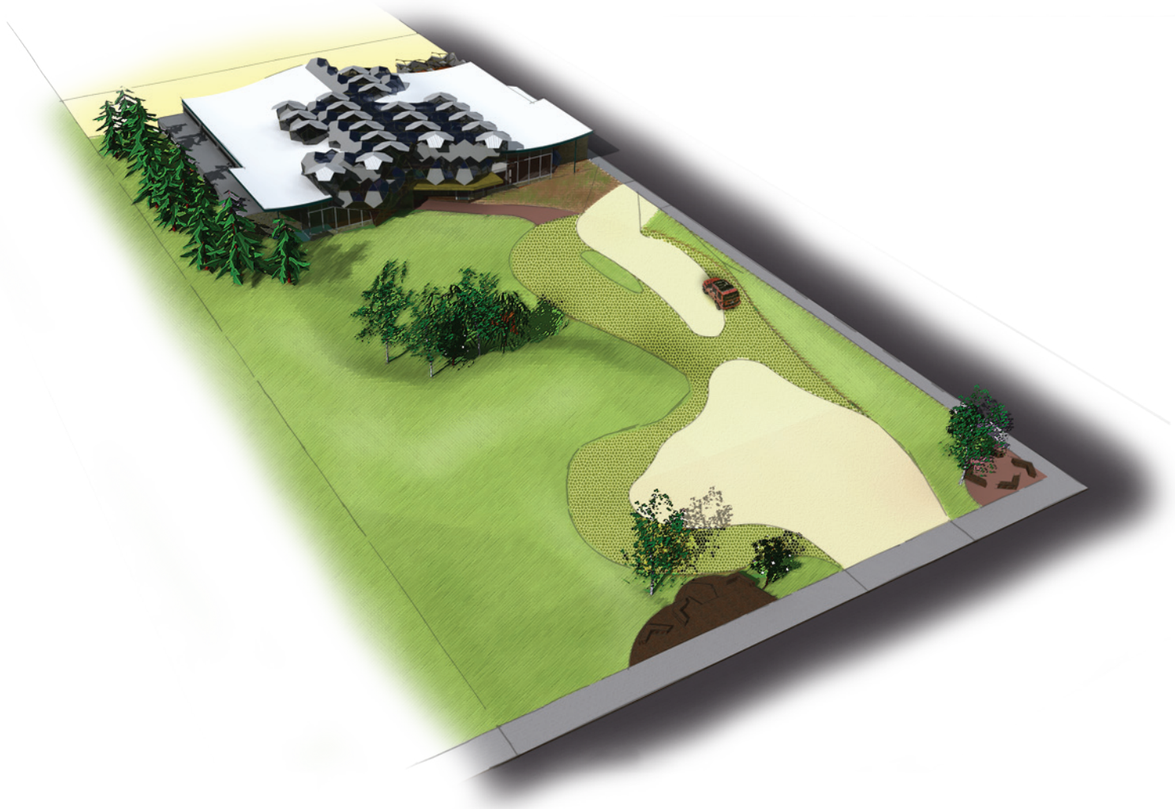


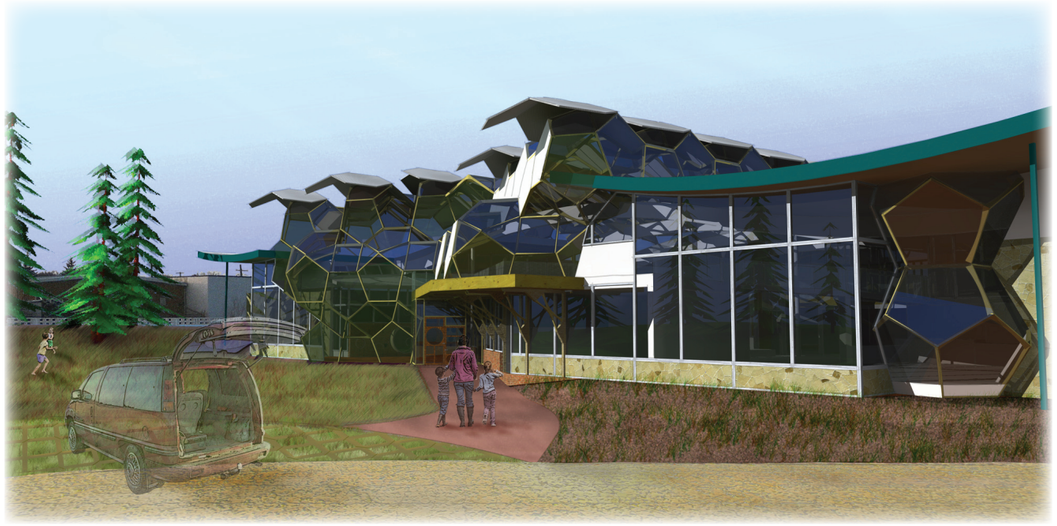


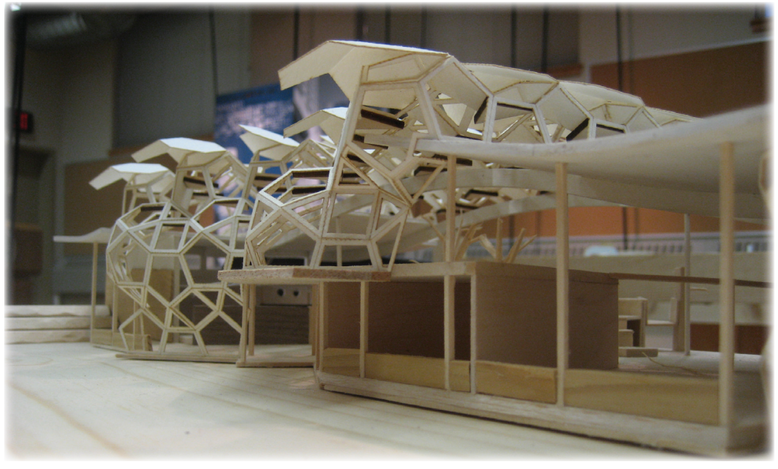




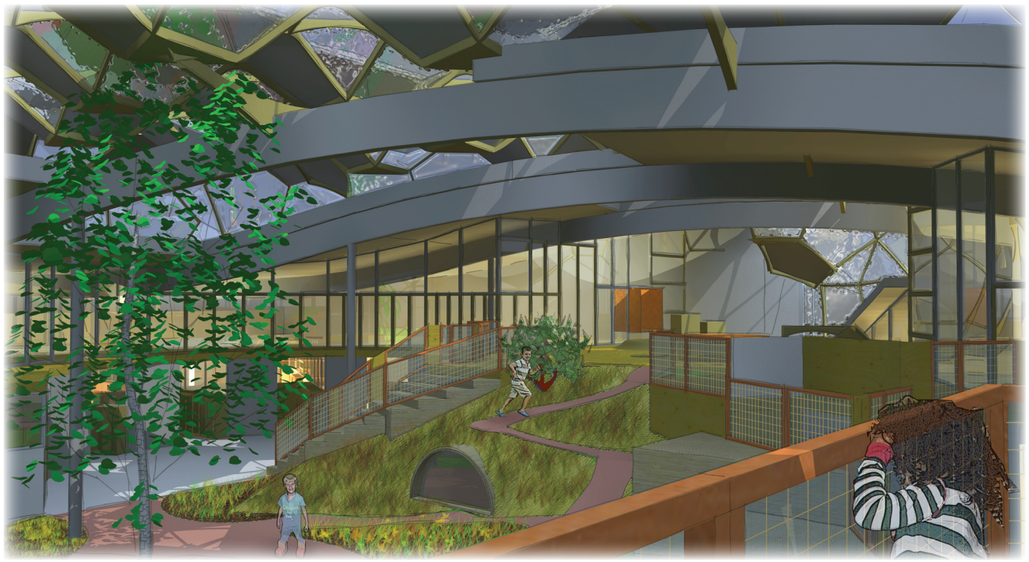




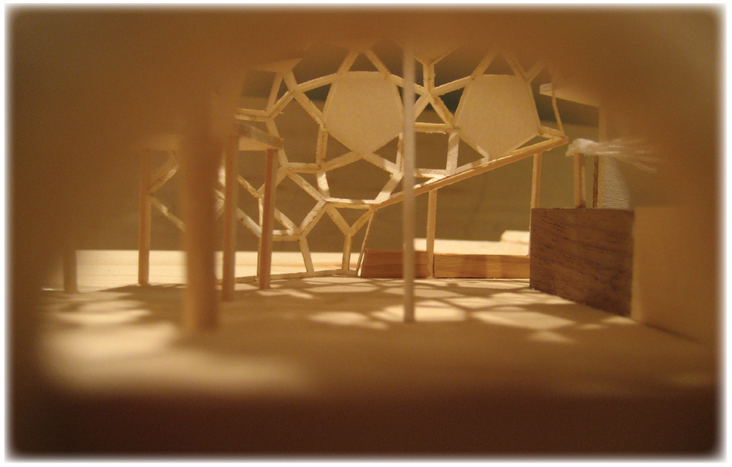




interior atrium

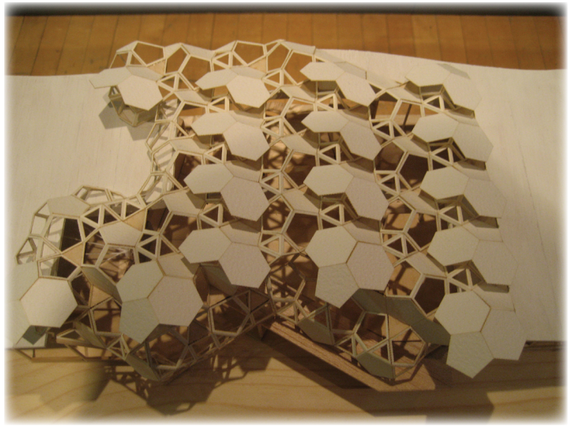


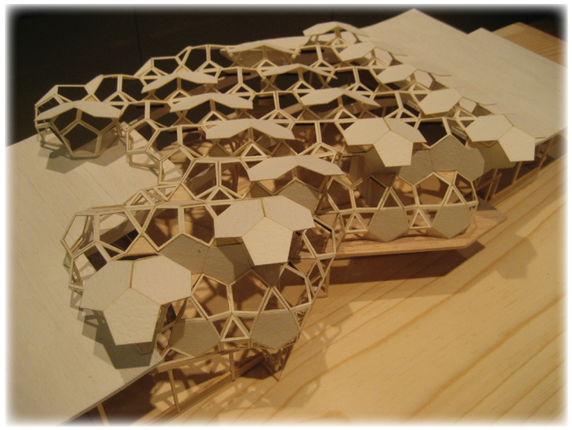
interior atrium, from library

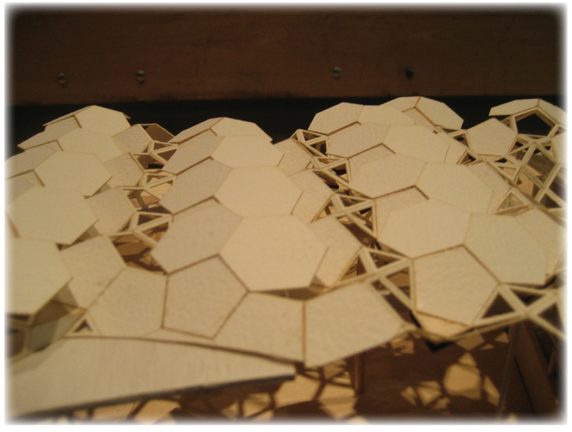


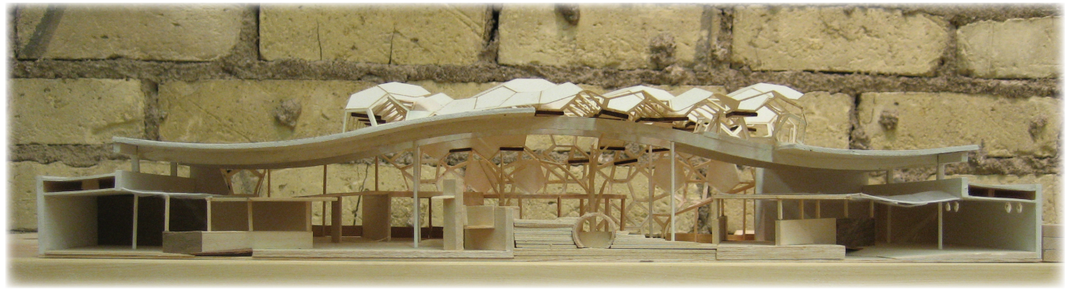
kindergarten classroom

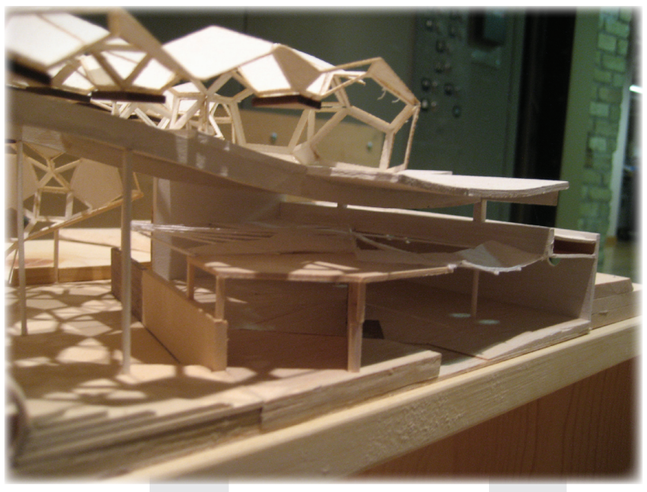
final model

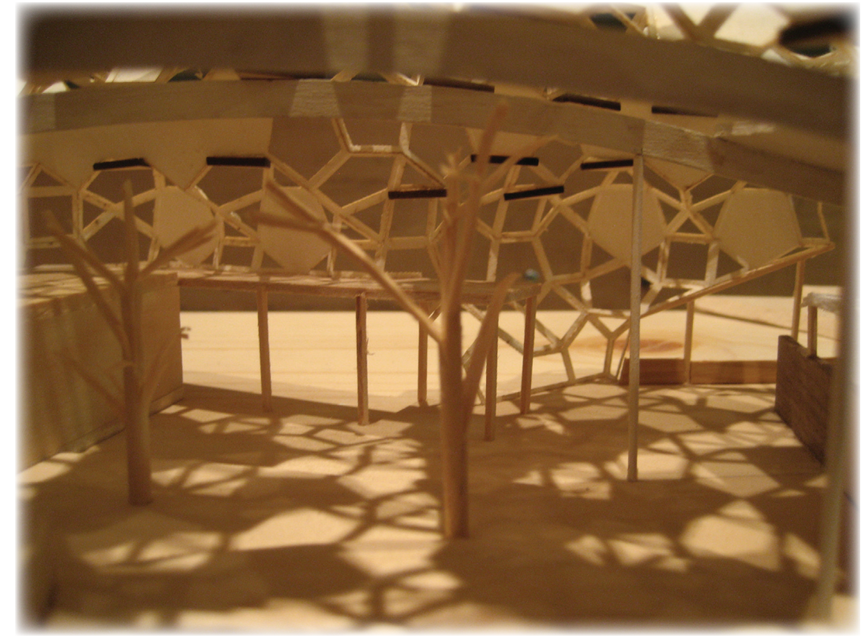










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inhabit
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winnipeg, manitoba
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personal identification

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I have enjoyed my education and experience at North Dakota State University and look forward to where this education and experience will take me.