

FIFTH YEAR ARCHITECTURE THESIS



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Absorbent Minds, Absorbent Learning.



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Absorbent Minds, Absorbent Learning

A design thesis submitted to the department architecture and
landscape architecture of North Dakota State University

By

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In partial fulfillment of the requirements for the degree of
Bachelor of Architecture



Primary Thesis Critic



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Abstract

Absorbent Minds, Absorbant Learning

This thesis is a Montessori school, K-12 300 students, for Shakopee Minnesota. It will examine Montessori educational processes to find correspondence with design processes. The thesis will ask the question, can architecture be erected in the same way that a mind is educated. How can the Architecture teach.

Statement of Intent

Project typology:

A new Montessori school for Shakopee, Minnesota

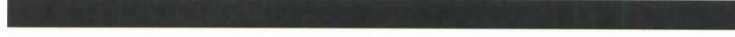
Theoretical Premise:

The thesis will examine Montessori educational processes to find correspondence with design processes. The thesis will ask the question, can architecture be erected in the same way that a mind is educated. Can architecture be a shelter and also teach. Design metaphors, analogies, and or tectonics will be developed from the examination.

Project Justification:

The Montessori educational practice has proved popular with parents and this project will join the dialogue the community is having concerning alternative methods for elementary and secondary education.

Proposal



Narrative

“Whoever touches the life of the child touches the most sensitive point of a whole, which has roots in the most distant past and climbs toward the infinite future.”

-Maria Montessori

The fundamental balance between living and learning can find stability early in our children’s lives. Harnessing the full potential of our children through the educational process is our goal in schools. Developing a system for or a philosophy of education is very important because the desired outcomes, and the processes that develop these outcomes, are engrained in that system. They are balanced, and as a result the objectives are clear and attainable by the installation of that philosophy.

The ‘Montessori Method’ developed by Dr. Maria Montessori in 1907 is one such philosophy of education. It has a certain set objectives and a detailed system to achieve these objectives. The Montessori Method is different than traditional education in that the child learns independently from the teacher. The children work on projects prepared by the teacher at their own pace. The teachers only guide, and observe. They ensure that the learning process of discovery is developed independently by the student. The child becomes self-motivated and begins to love the learning process.

The classes are broken into three-year age groups, allowing children to work with other students of different ages. They develop social skills and the ability to work with other people. Courses focus on the education of the whole personality rather than the teaching of a specific body of knowledge. They are taught to respect individual differences, thus making them better prepared for life after school.

The environment is what teaches the children. The three points of the Montessori Method are the child, the teacher and the environment. “When physical, mental, spiritual, and emotional needs are met children glow with excitement and a drive to play and work with enthusiasm, to learn, and to create. They exhibit a desire to teach, help, and care for others and for their environment.” Montessori: The International Montessori Index www.montessori.edu

I am interested in the Montessori Method for three reasons, one personal, one philosophical and one architectural. First, I feel that education is the most important aspect of a developed society. Its obvious aim is to ensure that the students become an integral part of society. Children hold so much potential, and I feel that some of that potential is lost

through our educational system. I am a strong believer of alternate ways of teaching, and feel that there needs to be a more philosophical and scientific approach to teaching.

This brings me to my second reason. Developing a philosophy of education is a way to ensure the objectives will be reached. A philosophy of anything portrays out a method where all its components are focused on these objectives. The objectives themselves are the most fundamental aspects of society and of human nature. The Montessori objectives that I am attracted to are the importance of individuality, the ability to learn from experience and the environment, the capacity to be social and creative problem solving.

Finally, I have an interest in applying a philosophy to the design process. In this project, I must understand the Montessori philosophy, which is a philosophy of education and produce a physical object where that philosophy will strive and never be compromised. I must approach concepts and solutions in the design process with the attention that they will illustrate the Montessori Method perfectly. To put it simply, my design must be a physical model of the Montessori Method.

When approaching the design I must ask myself certain questions that will intern lead me to the best design decisions:

How does the privacy/isolation of the student, used to ensure the students full concentration, effect the site location and position of the structure on the site?

What kind of site design will help make a rich environment to help foster the educational process?

How will space planning help divide private classroom activities from common/group areas?

What details, such as color, structure, material etc, will create the kind of environment needed to bring the educational process to its full potential?

How will the design focus on the education of all subjects, instead of one subject per classroom/area?

What can be done to embrace the creative aspects of the children?

How will the design accommodate for mixed ages?

What relationships can be perceived from the triangle of the student, teacher and the envi-

What details, such as color, structure, material etc, will create the kind of environment needed to bring the educational process to its full potential?

How will the design focus on the education of all subjects, instead of one subject per classroom/area?

What can be done to embrace the creative aspects of the children?

How will the design accommodate for mixed ages?

What relationships can be perceived from the triangle of the student, teacher and the environment?

How will the independence and individuality of the student be preserved?

Can the design encourage the children to discover?

Can all of the senses be enticed, and encourage discovery?

What relationships can be drawn between the architecture and the idea of spreading and sharing of knowledge between all ages?

“We must help the child to act for himself, will for himself, think for himself; this is the art of those who aspire to serve the spirit.”

-Maria Montessori

Revision and Addition to Narrative

In the Montessori Method, the child learns from his or her own surroundings, their environment. The teacher is merely a guide for this interaction; therefore the students have the freedom to express themselves independently with the environment, and in doing so gains further knowledge, and a joy for learning. The built environment that houses this interaction must promote the learning from and respect of the environment. It must encourage independent actions and interactions of the users. Through the philosophy of the Montessori Method, the students are further encouraged to interact and learn independently from their surroundings. Therefore, the project must enclose these activities and also be a source of information itself.

User/client description

The project is designed for the city of Shakopee, Minnesota, its citizens and its children. It will enhance Shakopee's school systems by offering alternatives in education. It will also help the Montessori Method reach new people and illustrate to other communities the importance of education and more specifically, show that there are alternatives available. Being a school of a special stature, Montessori schools typically are private and are used by children from as early as birth to twelfth grade. However most, Montessori schools range from kindergarten to sixth grade.

The design, to be successful, will need to appropriately accommodate all the activities needed to follow the teaching philosophies of Dr. Montessori. The users will consist of the staff and the students. Any needs such as parking, outdoor facilities, and square foot-ages will be dependent on the age bracket of the attending children.

Major Project Elements

The physicality of a Montessori school compared to a public is slightly different in a few interesting ways. Classrooms need to be sized for many activities and must also be self-reliant. The design demands many meeting spaces large and small, an outdoor space and of course parking and staff needs. What sets Montessori schools apart from other schools are its specific uses. The details and careful design of these schools are going to be a major project element. The questions stated in the Narrative will help develop these elements.

Site Information

For site selection I will look at three main things. One, I want the site to be organic. Having as organic site will allow me to create a campus whose focus is on these organic qualities. Second I wanted something that has little influence from man. I wanted something near a city but slightly outside to achieve this. And third, I want something that is aesthetically pleasing and tranquil. I want the focus to be on the environment and education, nothing else and I think a relaxing atmosphere will achieve this best.

Project Emphasis

My emphasis is on the student. I want the children to be successful, and the success will come from my understanding and my achievement in developing the Montessori philosophy into a built structure. The success of this project and other projects alike, depend on bringing out the teaching philosophy down to the smallest detail.

A second emphasis must be placed on the individuality of the students and also the social environment of the school. They must both be balanced and emphasized throughout the design. I consider this to be important because a poor design may cause a failure in this balance.

A third emphasis, and one that should be a concern for all architects, is the quality of space. For a school, the quality of the space needs to be one that will encourage exploration and a desire to learn. Any space which fails to encourage learning, will not work in this project.

The Fourth emphasis will be on the environment, what can be learned and taught through it. The goal for this project is to combine all four of these into a working unit.

Plan for Proceeding

To begin the project I must dive into the philosophy of Dr. Montessori. I will extract her premises, and understand her rationality. The design must have complete understanding of what she had intended. Following this, I will understand even further the vocabulary used, to create the appropriate metaphors needed for an excellent design. This step will be followed by a large set of case studies which will allow me to see how other designers have dealt with the problem.

The theoretical premise will guide all research. I will, with that in mind, find all qualitative and quantitative facts that are prudent to the project, using certain methods such as finding statistical data, surveys, and interviews and from direct observation.

There will be certain strategies used during the design process too. For organizational purposes, I will use an interaction matrix and/or a Venn diagram, and strategies of the like. All information and steps taken during the design process will be graphically represented through photography, concept and finished models, digital drawings and a sketchbook which will show my work process in a very chronological order.

The design and research schedule outlines like this:

Preliminary research	10/17 – 11/20
Writing the program	10/27 – 11/20
Site Analysis	10/20 – 11/10
Case studies	11/20 – 12/15
Quantitative and Qualitative data collection	11/20 – 1/10
Early concepts	12/20 – 1/20
Development of design	1/20 – 2/20
Venn diagrams and space planning	2/10 – 2/20
Schematic drawings	2/20 – 3/6

Schematic drawings 2/20 – 3/6

Model 3/6 – 4/15

Presentation drawings 3/15 – 4/20

Final presentation 4/15 – 4/21

I will dive into the Montessori philosophy, and relate what I learn from my research into my design. I will look at previous work and learn from them, from their mistakes and successes to achieve a building fully capable of enhancing the Montessori philosophy

Previous Studio Experience

My experience consists of a five year education at NDSU. Throughout this time my design capabilities have matured. I have had a variety of projects from large to small, and from conceptual to client-based. During second year, I was introduced to many issues such as structure, sustainable design, materials, conceptual designs and large, multi-purpose structures. During my third year, these became extremely developed. One such project was a building for the aerospace program at UND. The project was an intense competition between five different groups with a strong focus on sustainable design, and in which my group won. Also in third year, I designed a school, and I discovered a passion for it. I loved to think that my design could help create an atmosphere perfect for learning and also nurturing to the students. Montessori schools were introduced to me at this time, and I was very intrigued. During fourth year, I had a semester of urban design and a semester where we focused on a multi-use high-rise for San Francisco. Now in fifth year I feel that I am prepared for this project, ready to take on its required work load and confident in my abilities as an architect.

Program



Montessori Method

Maria Montessori's work was on developing a Scientific Pedagogy, or in other words, using science and its findings to develop a new strategy in education. She lived a 'new world of scientific process.' In Italy, a School of Scientific Pedagogy was developed to find new ways of education. What developed, perhaps through confusion of the studies, and through the over all aim of the studies, was a scientific approach to understand man, and therefore, we could teach man. "The chief trouble lay in confusing the experimental study of the pupil, with his education" (Montessori Method). For Montessori, that approach seemed more like scientific anthropology, because it was a study of the pupil, but was not a study on how to teach or learn.

She starts developing her method by looking at the teacher. She considers the teacher a scientist who is performing experiments. And as a true scientist, they must become observers of their subject, in this case the student.

"We shall have instructed them (teachers) in anthropometry and psychometry in the most minute manner possible, we shall have only created machines, whose usefulness will be most doubtful."

The teachers must come to respect nature and in turn develop into a true scientist:

"We give the name scientist to the type of man who has felt experiment to be a means guiding him to search out the deep truth of life, to lift a veil from its fascinating secrets, and who has felt arising within him a love for the mysteries of nature, so passionate as to annihilate the thought of himself."

And it is this love for nature that the teacher must pass on the same passion to her students. However, this passion was uprooted by experiment, not by mechanism. Therefore, if we are to teach our children to discover and learn, we cannot teach the mechanisms of experiments, but allow them to experiment for themselves. "This is the spirit of the men of science, to whom nature freely reveal her secrets, crowning their labors with the glory of discovery."

What Montessori saw in public schools was just the opposite. She saw that we teach our children how to do the experiments rather than discover. An example was a study of butterflies. In the public schools, the children see and examine butterflies under glass held in positions with pins. The true scientist will search the forest and stay quiet and still, losing the entire day just for a glimpse of the insect or butterfly of interest. The universal love of man and the self-sacrifice of the scientist is what the teachers should possess.

As a scientist would observe the butterflies, he too must observe the children. So instead of anchoring the children down into locations like the butterflies with the pins, the children are allowed to 'express their personality spontaneously.' "The school must permit the free, natural manifestations of the child if in the school scientific pedagogy is to be born." Montessori saw that the universal idea of liberty was not in the public schools. What she saw, rather, was a form of slavery. An example she gives is on the desks. At first they were a bench, and the students sat together. To ensure proper growth of the bones, science was used to size the chairs and desks. Desks were created to stop any distractions or interactions of the students. The desks and chairs were small, and secured into the floor to allow for little movement, and a straight-forward focus on the front of the room. With these conditions, Montessori asks, what happens to the spirit of the child who is condemned to grow in artificial conditions?

Montessori saw the children as slaves. They were fed dry facts with no real implications; they were forced to focus with prizes and punishments, which she considered 'instruments of slavery for the spirit'. If the student aims for prizes and acts to avoid punishments, the student loses sight of what is most important, learning. Prizes and punishments are misleading to children and could possibly send them to a vocation which they have no interest. A poet or artist expresses his or her inner voice, not for awards, but for personal achievement. "All human victories, all human progress, stand upon the inner voice." There is only one award or joy for Montessori and it happens when we touch and conquer souls.

To counter slavery, we must introduce liberty. "The fundamental principle of scientific pedagogy must be, indeed, liberty of the pupil; such liberty as such, shall permit a development of the individual, spontaneous manifestations of the child's nature." Therefore the child can explore and learn from their creative problem solving skills. Montessori developed her method with the independence of the student in mind, and from this way of thinking she developed everything including the environment of the classroom, the furniture, discipline and so on. The class needs to be open, in other words, no permanent fixtures, and the furniture must be movable. The classroom needs a direct access to outside with a garden and playground to allow free movement inside and out. Each room needs a washstand with each student having a cupboard with soap and brushes, and also ample wall/blackboard space. The children should also be able to sit where and how they want. If a student knocks over a chair in a public school the child may find a punishment or help from the teacher. In a Montessori school, this child will simply correct their balance and pick up the chair, thus learning control. With this freedom, the child learns command of his movements.

Liberty is activity, discipline comes through liberty. Being forced to be quiet or to sit still is not discipline, but rather the individual being "annihilated". A disciplined person is when that person is in control of himself.

“Since the child now learns to move rather than to sit still, he prepares himself not for the school, but for life; for he becomes able, through habit and through practice, to perform easily and correctly the simple acts of social or community life.”

The teacher needs to have the capacity and passion to observe the natural phenomena occurring in the classroom. She therefore becomes passive from having respect of the phenomena. To suffocate the freedom of the child would be to suffocate their life. The hand of the teacher must be held back for the child to learn his own power and abilities. “The expression of joy, anxiety, and hope...faded from his face and left on it the stupid expression of the child who knows that others will act for him.” Discipline is showing the difference of good and evil. The child should not learn that good equals immobility and evil, activity. As a result individual differences show themselves and the child will reveal his true self.

The age span from three to seven is considered to most important time in development. This is when the students learn and develop their senses. The aim in education is two fold, biological, the natural development of the individual and social, or the preparation of the individual with the environment. The children are naturally attracted to the environment with passive curiosity. The stimuli are the base of this attraction. Therefore the education of the sense is important. A problem with schools according to Montessori is the teaching of ideas and facts with no real world experience of these things. The students need to be in a direct communication with their surroundings. The line of teaching goes in this order; the education and development of the senses, general notions, abstract ideas, and finally morality. In other words, from concrete to abstract. In practice, the teacher simply isolates the sense she wishes the child to exercise. The teacher names the sense such as smoothness, she lets the child feel and learn on his own. Then she works on pronunciation of the term. Each child is allowed as much time needed to master these steps before moving on.

Montessori Method in Practice

The teacher's job is to protect the student's concentration from interruption. The student can then begin to have a love for learning. There needs to be a balance of the teacher or parent, with the student and the environment. The preparation of the learning environment is the responsibility of the teacher. This preparation is done by linking the child to a well thought out introduction of books, materials, projects and lessons which nurture the child's willingness for exploration. All subjects will be studied at anytime during the day.

The classes are divided up into periods of development. The children are divided into age groups with three year or six year spans and have the same teacher for the period. Everyday must have a three hour work period where the children will have time for independent or group activities uninterrupted by the teacher. There are three stages of learning; an introduction to a concept by means of lectures or lessons, which is followed by processing the information through experimentation and creation, and the last step is finished by showing an understanding of the concepts learned. This is done by presenting the ability to teach each other the concepts learned.

There are no text books, and children very rarely work on the same thing at the same time. The children develop the environment for each other and they learn directly from each other and from the environment. Large groups are used in the beginning of each class or school year and are slowly phased out.

The class size of the ages 3 to 6 and 6 to 12 are about 30 to 35 students with one teacher and one non-teaching assistant. This provides a variety of personalities and ages in one classroom. The children learn how to respect each other and learn how to work with people of different ages, just like they will have to in society. All subjects are interwoven. Subjects like history, art, music, astronomy, biology, physics and chemistry are not isolated, and the child is free to move from on topic to another. There are no grades. The teacher observes the progress of each child and will work with the child if they are not grasping a concept.

There are no requirements for children in the 3 to 6 age group. However, the children are exposed to amazing amounts of knowledge and learn how to read, write and do calculations that are often unusual for a child this age. The requirements are set by the state or college entrance requirements. These children of K-12 age group, create a schedule with their teacher on what they expect to work on which helps the child learn time management skills. The child learns how to take care of himself, one another and the environment.

Knowledge

Maria Montessori developed her method through the observation of children in the environment. Her Method has strong ties to phenomenology which will be explained later in pages to come. What may be interesting to look at are other philosophies that are in support of her approach in developing her method. First I will look at Plato who came well before Montessori. At the time of Plato, in Ancient Greece, man was forced to look to nature to learn and understand life, and Montessori's Method is a continuation of this practice. The other philosopher that I will look at is G. W. F. Hegel, and his notion of the master and the slave.

Plato believed that knowledge comes from absolute changeless 'things' called forms. The forms are in the invisible world, they exist in the visible world by transcending themselves on to objects. The idea of a triangle is in the invisible world, when we see a triangle, it is merely that idea being applied to a physical object whether it be a three dimensional object or three lines on a paper. We never really see the 'idea' of the triangle, we only see how it is applied to objects in our reality. He believed that before birth we were in contact with these forms and we understood them completely. At birth however, we lost contact with these forms and their properties. We use our senses to recollect information to redevelop these general truths.

"If learning is a process of recollection, the proper form of education is not teaching, but questioning, to bring out knowledge the student already possesses" (The Penguin Dictionary of Philosophy). One of the invisible forms is man, so through our senses, we can relearn what it is to be man.

I mention Hegel because of what Montessori said in her text *The Montessori Method*. She had mentioned that when the scientist goes out to the woods to study insects, he will have to make sacrifices to learn as much as he can. Man cannot love the insect he is studying without making self-sacrifices. The scientist/teacher also already has a love for man, this love will make the teacher's job to observe the child at work a form of self-sacrifice. This is the spirit of the teacher according to Montessori.

This self-sacrifice seems to make the teacher a slave to nature and to the practice of observation. This is not slavery in a negative sense so to speak. Hegel, in his *Phenomenology of Spirit*, mentions a concept called the master, slave relationship. In this concept, two individuals meet and battle for recognition. The loser will be forced to recognize the other's conciseness, and therefore making the winner a stronger consciousness. The loser therefore becomes a slave to his new master. The slave must perform all the tasks the

master demands. As a result, the master does nothing for himself and the slave, although the loser, is able to use and develop his skills in nature, thus having a much richer life. If we relate this to what Montessori was talking about in the development to the teacher/observer, we see that nature and the 'proper' development of man, is the master to the teacher. Therefore the teacher is the slave who is able to use their skills, which are things like their senses, to serve nature and the environment. What develops is a better understanding of man, because as Montessori would, man learns what it is to be man from nature.

Sustainable Design and the Montessori Method

Sustainable design is a true understanding of the environment and its importance. It employs certain strategies that help the building deal with the areas of firmness, commodity, and delight. These areas as far as sustainability is concerned, cover a building's existence into the future, its healthiness and its beauty. These strategies focus on building materials, energy saving strategies and an overall healthy appearance. The goal is to design that which will have little to no impact on the earth and its resources. A secondary goal, but still very important, is the education of these strategies to the general public as to make certain that our future on earth will be the product of a collective effort.

The strategies are discovered through science and from the examination of earth's own sustainable techniques. Phenomenology and the Montessori Method are together interested in what we can learn from the environment. By applying sustainable strategies into a Montessori school, we can do three things: teach our young about sustainable design, show how the things they learn from the environment produce sustainable ideas and finally to show that there is and must be a beautiful balance of man and nature.

The Tahoe Center for a Sustainable Future is an organization developed in 1992 to save Lake Tahoe. In their research they created a guide so to speak on the importance and approach of teaching sustainable designs to schools. The major components of sustainability education include a focus on the environment and its relation to the community. They see a need to introduce sustainable design as a subject in the classroom. However, most teachers cannot find a relation of sustainability to other subjects. A Montessori school however, can teach sustainable ideas through the strong connection of the students to the environment.

One of the programs introduced by the TCSF is project-based work and field study methods. A sample of these field study topics are a basic observation of natural resources like water, vegetation, wild life and human impact on such. What the TCSF discovered is that students learn from the teachers actions. The researchers suggested that a better way is with a problem solving approach. They encourage that students do these lessons as to contribute to their own understanding, rather than merely completing assignments.

With this approach in mind, in a project of this type, a site that can meet the demands of the Montessori Method and also meet the demands of sustainable education is greatly desired. The site should allow the students to move freely in and out of the classroom. It should also have adequate space for gardens and for a playground as required from Dr.

Montessori. The site and the school design should also be developed for the education of these sustainable ideas. With a careful interweaving of these approaches, the final product should be one that is sustainable, focusing on the impact on our planet, sustainable for the purpose of teaching its concepts and one that allows free operation of the Montessori Method.

Fat “L” Shaped Classrooms

“The environmental qualities of classrooms-high/low, open/closed, big/little, vertical/horizontal – do indeed affect the learning process in young children.”

James Dyck, an architect at The Architectural Partnership, tried to see if the shape of the classroom affected the quality of education. He saw learning as an activity which involves people with the environment. According to James, the classroom has to accommodate for small learning groups, and provide separation from other groups to ensure fewer distractions. He also found that the classrooms need to be open from permanent fixtures and need to allow for an easy reorganization. The teacher also needs to be able to manage the entire space. These criteria are helpful in the Montessori Method and have been used in successful designs of Montessori Schools like the one in Delft by Herman Hertzberger.

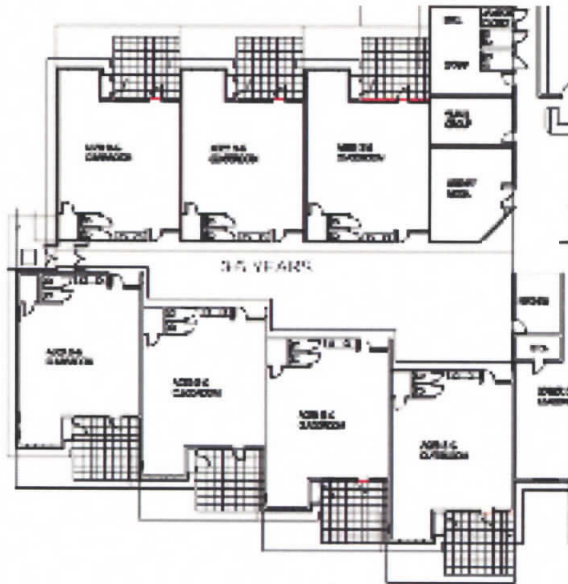
Dyck states that traditional classroom designs vertically and horizontally organized are like an assembly line in a factory. The L-shape is designed for multiple activities. The classroom can accommodate large group gatherings and also provides five corners which can allow for smaller group activities. The corners give the students a prospect and a place for refuge. Crowding is also an important issue. Crowding is a psychological condition that is measured in terms of stress and is a result of the awareness of others in the same room. The L-shape may limit crowding and interruptions of others due to the fact that activities are pushed to the perimeters instead of in the middle.

In Delft, the classroom was “conceived as a learning environment where all the places in the school afford learning.” The rooms, instead of being organized along a hallway, were placed around a “central avenue.” The shape of the classroom was developed from Hertzberger and the teachers of the school. It houses three separate activities, intellectual, practical and creative. These activities can be seen as math/science, social interactions/group projects, and painting/drawing respectively. Each activity was placed in the three legs of the L-shape to ensure privacy and also a connection to each other. Because



of the shape and its organization throughout the school, the spaces outside of the classroom afford another place for students to gather.

The L-shape becomes an interesting way of approaching the Montessori Method. The activities that a student performs in a Montessori School are meant to be either private or in small groups. The goal is to ensure complete concentration, free of distractions from others. The plan should be rather open with little to no permanent fixtures so as to allow the student his or her own creative way of furniture organization. And the space outside of the classroom, interior and exterior, can also be used by the student at any time.



Sustainable Strategies: Healthy Learning Environment

The whole building should focus on:

- Site Design
- Energy Efficiency
- Water Conservation
- Material and Resources
- Indoor air Quality
- Waste Management

What follows are some considerations in these topics:

Site:

The structure should be built into the site with little grading and land disturbance. Drainage and open green spaces should be persevered to the best ability.

Lighting:

Day lighting is a major factor in sustainable designs. The school design should allow for natural light to reach 90 percent of the occupied spaces and when possible, place windows on the north and south elevations the use of light shelves and higher ceilings will allow more light to penetrate deep into the room. Light from two sides provides even more light and views for the students.

Indoor air quality:

Indoor air is very important when designing a 'healthy environment'. From technology, we have developed a world where climate doesn't affect us through the creation of artificial climates. Indoor air quality usual is dependent on the outdoor quality. The further someone moves away from the city and becomes surrounded by vegetation, the healthier the air becomes. The National Ambient Air Quality Standards find that the indoor air quality is very important to children and the elderly. Children breathe in a larger volume of air in relation to their body weight than do adults.

Typical pollutants found in schools include; tobacco smoke, formaldehyde, volatile organic compounds, nitrogen oxides, carbon monoxide, carbon dioxide, allergens, pathogens, radon, pesticides, lead and dust. Inadequate ventilation, inefficient filtration and poor hygiene of air handling units are also to blame for poor indoor air quality.

Built Environment and its Effect on Learning

In a Montessori school, the learning environment is defined by the prepared environment. “The Environment is perceived as the medium through which the teacher helps the child to engage attention and concentration.” The teachers are trying to preserve the essence of the child and also trying to ensure a motivation for spontaneous activity. Through his research Dyck sees six physical attributes that will help support the learning environment; aesthetics, spatial, light, noise, color and thermal.

What is the environment? If we are talking about nature, Buckminster Fuller states that “environment to each must be everything that is not me.” The educational environment defined by Daniel Duke, the Director of the Thomas Jefferson Center for Educational Design, suggests “A learning environment represents the physical, social and cultural context in which learning occurs.” In a Montessori school, nature and the learning process cannot be separate. To house this interaction we develop the learning environment.

Aesthetics:

A study on the learning environment in schools by Maureen Edwards at Georgetown University found that students in poor conditions were expected to fall 10.9 percentage points below students in a school of an excellent condition. In a Montessori school, the visual appeal of the learning materials is very important. The environment must be respectable to in turn cause the children to respect it.

Spatial:

A child’s interest in space can be seen early in his life. A young child seems to be able to find big or little, cozy and or hidden spaces to occupy. These spaces, sometimes called wasted, like a closet or under stairs, can become a space of educational value for a child. When looking at a classroom, Dyck developed an L-shaped classroom. This class room had the longest diagonal distance, the most pronounced inside corners and is asymmetrical. This shape gave students a separation from each other, corners for groups and the asymmetrical shape created a space similar to natural wondering. This shape brings the focus to the walls and corners instead of the center.

Lighting:

Lighting affects children’s feelings, concentration and as a result their learning. A uniformly lit spaces result in greater eye comfort and less eyestrain. Daylighting has also been accredited for raising a child’s concentration. Poor light has been found to disrupt growth, cause an increase in absenteeism and even tooth decay.

Color:

Color can influence blood pressure and behavior. Warm colors raise blood pressure and muscular activity. Cool colors are calming and decreases both blood pressure and muscular activity. The use of natural colors such as blues, greens and browns create a relaxed environment. The colors in a classroom should be natural and light. Bright reds, yellows and oranges should be limited.

Thermal:

Research shows that temperatures above room temperature decrease the reading speed of an individual. Math skills may also be hindered by this higher temperature. The ability to retain information is also affected by an increase.

Acoustical:

Noisy environments result in an increase of frustration by children and an augmented teaching time.

In the book *In My World Designing Living and Learning Environments for the Young*, the author Ro Logrippo gives a list of other issues one must focus on when designing a healthy and functional learning environment for children. "Designing for children means accommodation for big imaginations and small bodies."

In the school, and more specifically in the classroom, single-theme design should be avoided. Decorating in an overall theme places the room in a time frame. The classroom must be able to develop with the times.

Photographs help a child see themselves in a context. Logrippo suggests that a child should have two pictures, (by his bed) one of him and his family, and one by himself in a happy mood and involved in an activity.

The floor treatments should mix vinyl and fiber. This was also mentioned by Montessori. Different materials can break up spaces which can also break up activities that are going on simultaneously in the classroom.

Montessori Architecture

(Taken directly from The Architectural Partnership http://www.taparch.com/montessori_design.php?numa=2)

Physical Elements of Spaces

All of the following elements should be carefully considered:

1. floors - the most important surface because they are experienced multi-sensorial (visual, tactile, and kinesthetic)
2. walls - give horizontal definition and a strongest visual definer of space
3. ceilings - varying height and slopes add visual richness and interest
4. windows and doors - consider child height, views, daylight and window coverings
5. fixtures and hardware's - consider child height and abilities
6. furnishings - child scaled
7. learning materials - special features in the space
8. other structure (posts, beams) - let the structure be a learning tool
9. people and other animals - people are the most influential element
10. vegetation - provides beauty and care of environment
11. water - activity and care of environment
12. air - quality and comfort
13. dirt - basic element

Physical Qualities of Spaces

Environmental qualities which effect learning.

1. space, shape and form
2. scale
3. color
4. texture
5. light (natural)
6. dirty or clean
7. layout - order
8. heat & humidity
9. smell
10. noise
11. composition - foreground, background
12. natural (verses synthetic) surfaces
13. aesthetics - combinations of other qualities

Programmatic Requirements

Each prepared environment incorporates the following areas:

Practical Life

Sensorial

Math

Language

Geography

Science

Art

Music

Line

Support areas outside of the prepared environment vary depending on program and budget but contribute to successful operation.

Entrance Foyer

Library

Gross Motor Areas

Observation Area

Staff Area

-Office

-Work

-Storage

Site requirements which effect function and safety

Drop Off & Pick Up

Entrance

Parking

Outside Environment (s)

-Extension of Classroom Activities

-Active Area

-Quiet Area

-Nature Area

-Animal Care

-Garden

-Storage

Montessori Children's House Design Criteria

A. Entrance - should invite child to enter, provide visual link to drop off/pick up area

- consider scale, materials, and shelter
- what is the first thing you see when you enter? Sets the mood
- separate area; latecomers won't disturb
- tables for coats, chairs for boot removal
- separate cubbies desirable place for coat, bag, hat, mittens, boots and allow bench for sitting
- hangers better than hooks: good practical life activity and more orderly
- container of clothespins: clip boots together, place on mat
- full length mirror and clothes brush

B. Floor - provide multi-sensory feedback visual, tactile, kinesthetic

- maximum 1/3 carpeted; indoor/outdoor type (or commercial) - tight, short, looped pile, not too dark
- hard floor - hardwood, V.A.T., rubber or linoleum. Should be very light in color to maximize light, looks clean, sets things off (a dark floor gives a drab feeling regardless of surroundings)
- patterned tile can be used in special areas (if used extensively, it should be subtle)
- textured sheet vinyl is hard to keep clean

C. Walls- define space and provide a backdrop for materials, furniture and people

- wood, white, or other neutral - generally should not compete with or distract from material and furnishings
- child will tend not to notice things above 4 ft. high on walls
- painting or fabric wall hangings good for color, patterns, texture, and acoustical softening if dense or has backing
- small walls can be strong color (be careful!)

D. Doors - provide separation even implied separation when open

- vision panel at child's level
- low hardware - lever handles are easier for a small child to operate
- separate small door at entrance can set a mood that is respectful to the child

E. Furnishings

Shelves:

- Shelves to store and display materials - Should be clean, light(color), simple
- 2 ft. to 4 ft. long (2 ft. to 3 ft. best), 24 to 30 inches high (if 30", top shelf generally not for material)
- recommend construction of solid pine or 3/4" hardwood plywood (birch or oak) finished with gloss urethane varnish with last coat satin. Painted shelves wear poorly and can leave color on displayed materials.
- generally should have a back, top shelf should have a lip at the back, finished with urethane base paint white, last coat satin, 1/4" masonite. White shelf back maximizes light reflection to materials and shows off materials best from child's level.
- shelves can be placed projecting from wall; can serve to separate workspace; adjustable shelves must be tight fitting. Better to have the shelf slide into grooves so they can't trip when child takes or replaces materials. Some can have doors to simplify the look of the environment, to make advanced materials less apparent to younger children, and to add mystery to environment.

Tables:

- Should be light, natural and appropriately sized. Dark wood surfaces create distracting contrast and increases eye strain.
- 18" x 22" is minimum size
- height - 18" for chair ht. 10"
- height - 19" for chair ht. 11"
- height - 20" for chair ht. 12"
- should be neutral, light hue at working surface - wood, white, putty
- 8" legs for kneeling tables, standing tables 18" to 20"
- rounded corners desirable
- avoid painting table legs as the paint may chip and come off on chairs

Chairs:

- Should fit the child and the table
- knee should rest comfortably on the front of the chair for proper fit
- child's back should fit into back of chair
- start with smallest chair for fitting
- seat should be sculpted (not flat) for comfort and support
- wood chairs are nice but some are too heavy; molded plastic chairs add color where it is not distracting but most are not very attractive

Rugs or Mats:

- Define floor work area and set off materials
- woven are best - roll tighter, lay flat, materials stay in place
- yellow or warm neutral is best. Avoid pronounced patterns that can be distracting from materials
- rug rack should be divided - one slot for each rug to support order

Table Mats:

- Define table work area and set off materials
- felt or rubber depending on function
- store rolled with exercise or all together
- yellow is a good color (other colors and naturals look good on it) or color code to rest of parts of exercise

Trays:

- To carry materials to work place
- plastic, wood, woven, ceramic, generally neutrals but can be a color if coded to materials
- high sides are helpful in practical life

Chalkboard:

- For large perceptual motor development, art and other activities
- 3 ft. high x 4 ft. long (sloped back towards the top 8-10")
- bottom at child's knee height
- can be refinished with special spray paint
- doesn't have to be black

Easel:

- Should be in a protected area if the child is standing
- at least 2 ft. long and 2 ft. high
- should be cleanable, stable, and neutral (white or wood)

Line:

- for group presentation and activity
- 2 ft. per child
- should be on hard floor
- should be wide as a child's foot
- should have curved and straight parts
- plastic tape (color is good here); stretch around corners; first mark out in pencil; use string or wire with loop for arches

Cases Studies. Introduction

The purpose of these case studies is to see how past architects and landscape architects have dealt with the Montessori Method, sustainable design and a combination of the two. A main focus in this combination is to see how the education of sustainable design can become part of the Montessori curriculum and can be taught accordingly. I will examine each case study in this approach and critique them with these guidelines:

Montessori Method

Classroom size and shape

Attributes inside the classroom and in the school

Site and relation of site to building

The over all environment

Color

Materials

Sustainable

Site issues

Daylighting

Strategies used

Education of sustainable design

Ursuline Montessori School

School Information:

Architects:

Architectural Partnership

Square Footage:

13,000 sq feet

Site Area:

-- --

Number of Students:

-- --

Grades:

2-12 years old

Construction Cost:

\$1,565,1500

Date Completed:

2002

Location:

Louisville, Kentucky



Ursuline Montessori School is part of the Sacred Heart Academy which is a Catholic academy. Along with following the Montessori Method, they also offer Spanish, religion, creative dance, music and physical education. Faithful to the mission of the Ursuline Sister, Ursuline Montessori School educates the whole person reverencing life and respecting, inspiring and nurturing the potential of each individual child as a creation of God. Parent involvement is highly encouraged, from the Parent Association to reading stories during visits.

Case Study examination:

Montessori Method

Pros-

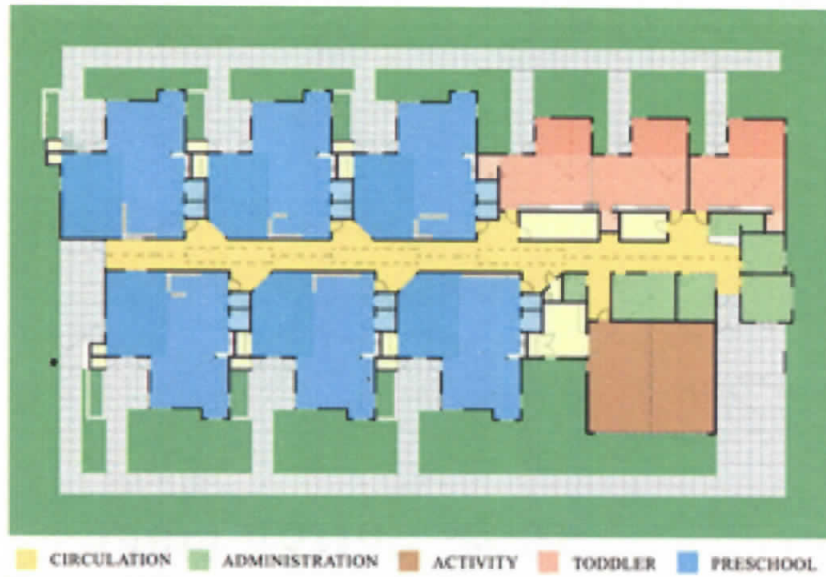
-Class shape and design

-individual gardens

-Campus has strong sense of community

-each classroom is an independent entity





- Cons-
- No interior break-out spaces
 - not a strong relationship of the students to the environment

Sustainable

- Pros-
- Daylighting

- Cons-
- no education of sustainable design

Hilltop Montessori School

First private LEED certified school in Alabama

School Information:

Architects:

HKW

Square Footage:

Site Area:

5 acres

Number of Students:

200

Grades:

Toddler to 8th grade

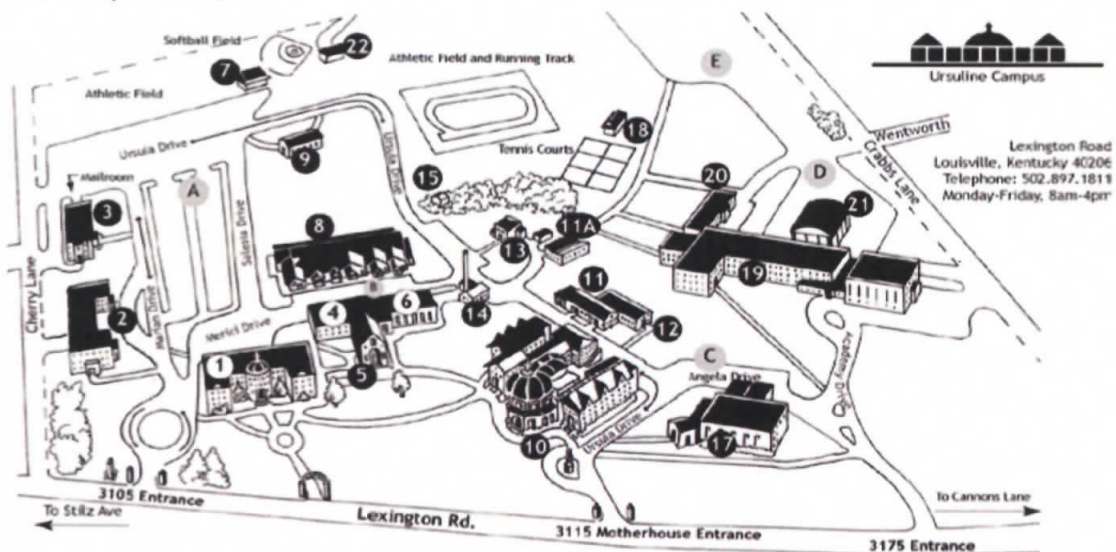
Construction Cost:

Date Completed:

Fall 2006

Location

Mt Laurel, Alabama



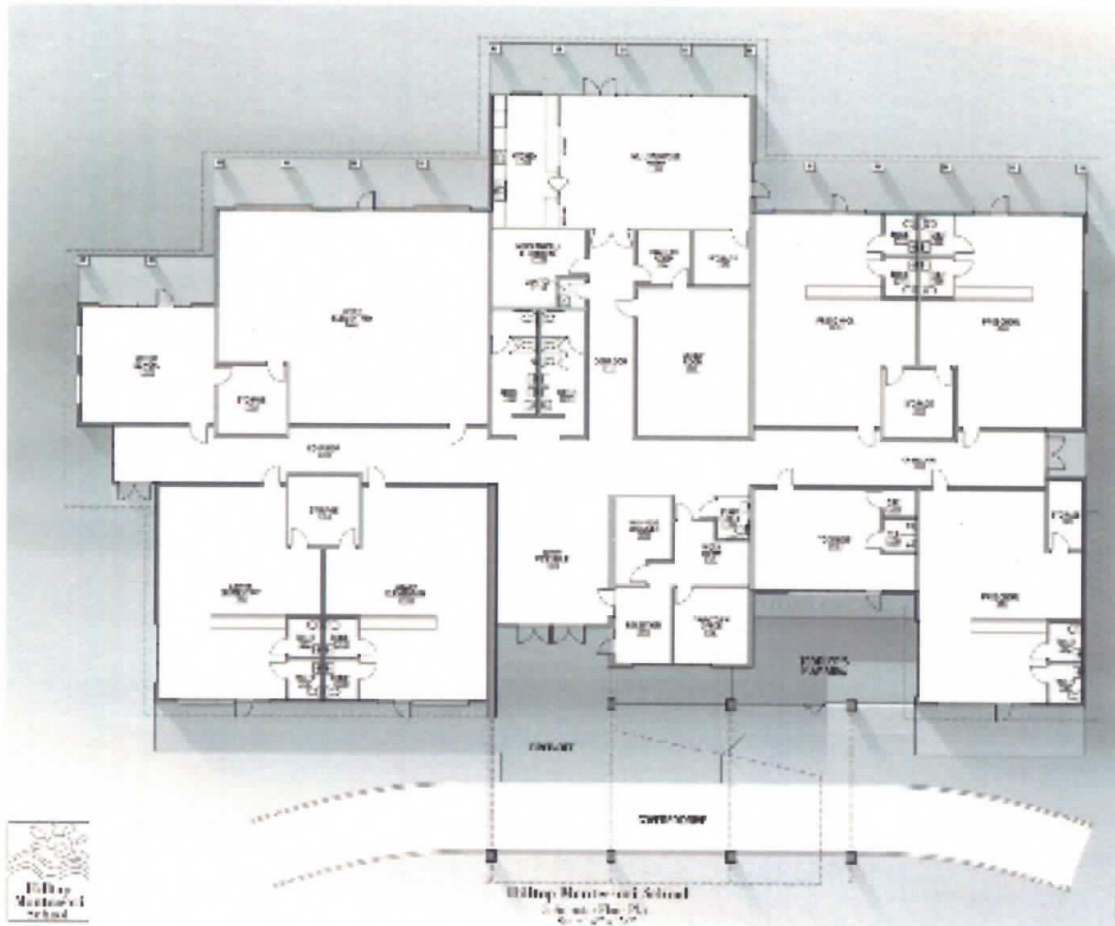
1. Sacred Heart Model School - co-ed, K-8
2. Marian Home - long-term licensed nursing facility
3. Brescia Hall - Ursuline Sisters administrative offices, mailroom and conference rooms
4. Ursula Hall - Ursuline School for the Performing Arts, co-ed, all ages
5. Ursula Auditorium
6. Ursula Gym
7. West Fieldhouse
8. Ursuline Montessori School - pre-school program, ages 2-6

9. Ursuline Child Development Center - co-ed pre-school, 2-5
10. Ursuline Motherhouse - Chapel of the Immaculate Conception and convent
11. Storage
- 11A. St. Jude Hall - storage
12. Craft Shop - 9-4 weekdays, 9-3:30 Thursdays, closed 12-12:30 for lunch
13. St. Ursula Convent - private
14. Maintenance Shop
15. Storage Building

17. Angela Hall - Future home of Ursuline Montessori elementary program and Ursuline School for the Performing Arts (Aug. 2004)
18. East Fieldhouse
19. Sacred Heart Academy - girls, grades 9-12
20. Future home of UCS Office of Administrative Services (Aug. 2004)
21. Sacred Heart Academy Gym
22. "PALS" Garden House - Louisville Diversified Services

P = Parking, listed alphabetically

Revised 3/04



The members of the hilltop school board are proud to create a school that will embrace the Montessori Method. They are also happy to embark on the plan to build their school with sustainability in mind. It will become a lab for living, a place where the community can come and learn about green architecture and concerns. The school will hold seminars for teachers and the community on the benefits of sustainability in the new Eco-Education Center. Students from other schools will come to learn about environmental issues from the teachers and the students of Hilltop. Their will also be hands-on seminars.

The Hilltop Montessori School will offer a full Montessori curriculum. Extracurricular activities such as Spanish, music, art, computer teaching, chess club and PE are offered to the students. There will also be a summer program where students will be introduced to the Montessori Method in a fun and relaxed environment.

Daylighting, healthy building material and indoor air quality was a focus to create a *healthy learning environment*. Native trees, undisturbed during the construction process will provide shade and a natural environment. An Amphitheatre carved into the natural slope will be a place for children's activities. The students can go to gardens which are irrigated with rainwater collected in cisterns. They will also learn about recycling, composting and energy conservation in hands-on activities that will naturally become part of their day. In the Eco-Education Center, children will see models that show how the systems of the school operate.

Case Study examination:

Montessori Method

Pros-

- classroom size and shape
- access to the outside from each classroom
- site (woodland)
- strong education of environmental issues
- bathrooms in the younger student rooms
- extracurricular activities
- site location

Cons-

- no space outside of the classroom inside the school for interaction

Sustainable

Pros-

- teaching program for students and community
- site use i.e. water recycling, composition areas
- LEED certified

Cons-

Compass Montessori Secondary School

The Compass Montessori School is campus of two schools, the Erdkinder School and the High School.

School Information:

Architects:

Ewers Architecture

Square Footage:

Erdkinder 17,135 Sq ft

High School 13, 625 Sq ft

Site Area:

8 acres

Number of Students:

Erdkinder 180

High School 150

Grades:

Erdkinder 7-9

High School 10-12

Construction Cost:

\$2.85 Million

\$91.5/sf

Date Completed:

Erdkinder August 2002

High School October 2002

Location:

Golden, Colorado



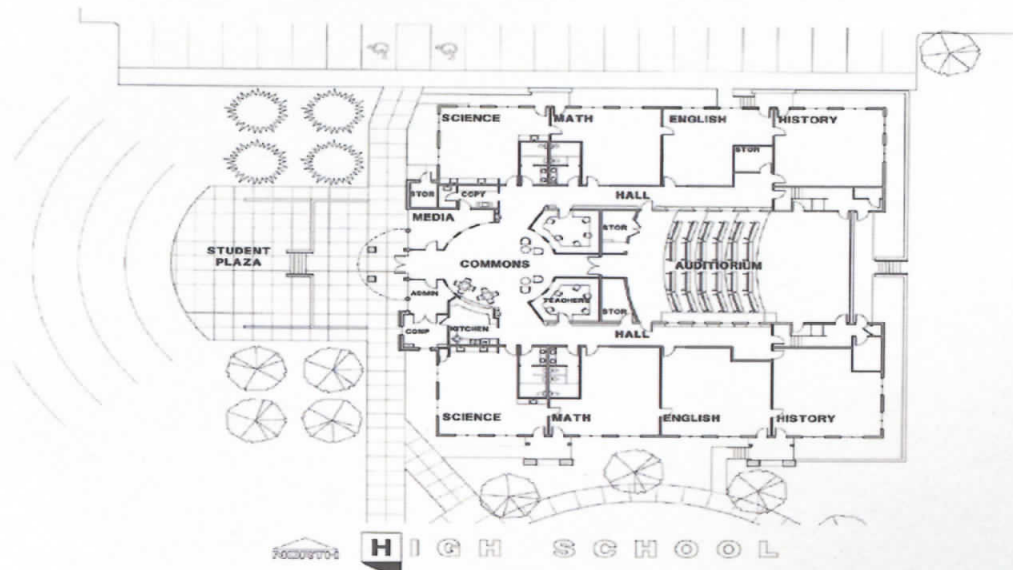
Erdkinder means “children of the earth”. The children learn the basic along with raising livestock and crops. The high school is more focused on the mature self-leaning student.

The campus is set at the base of a mountain formation. The idea is for the students to leave the pressures of society to discover their true nature and talent. The middle school is divided into three villages of 60 students with four teachers to each village. The school was designed to enhance the farm feeling. Each village occupy a corner in the building with their own breakout areas tin the commons and their own exterior learning environments. The three villages interact with each other and eat meals in the commons area. The students also use the kitchen to prepare their own meals.

The high school is more independent. The students leave the farm and enter back into society. There is an open student plaza, central commons, large auditorium and a coffee shop ran by students. These areas encourage the independence of each student.

The schools were completed in a short amount of time, and are about \$18 per square foot less than other schools in that county. Daylighting techniques, environmental sensitive material and systems, high levels of insulation were used to make the school comfortable and efficient.

The users enjoy the design. Its finishes are appreciated and every space is usable. Every village has its own family style bathroom, storage, a sink area, and two rounded spaces for quiet concentration. Each village has an access to outside. In the high school the performance area is the heart. Each classroom are connected to invite interact among all students. The only problem, the user see, is the swamp coolers. They are good for the environment but are too loud for a Montessori setting.



Case Study examination:

Montessori Method

Pros-

- farm theme is done very well
- task of livestock and crop care
- site is a nice setting for a Montessori school
- idea of leaving society to learn then eventually returning back
- natural colors and materials
- unique spaces for activities
- both schools have a nice community feel
- access to outside from each classroom

Cons-

- The classes have a rather large number of students
- Loud HVAC

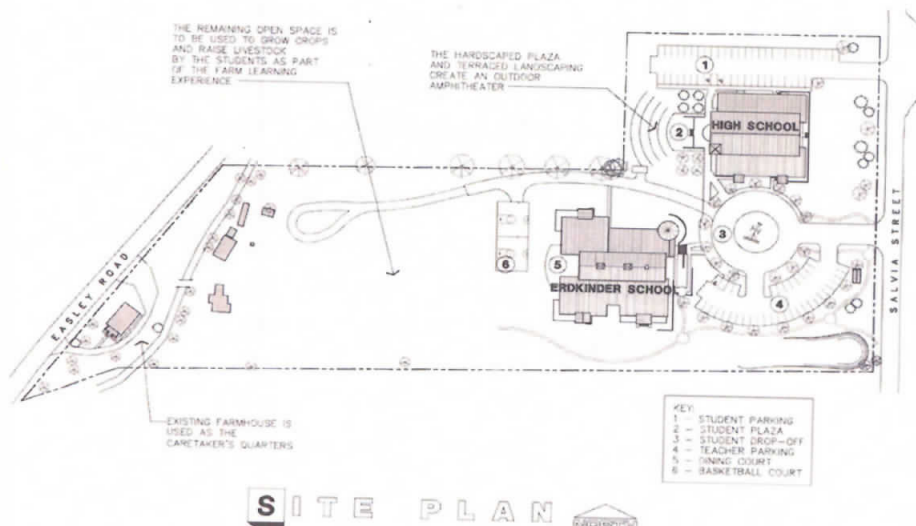
Sustainable

Pros-

- daylighting
- crops and livestock
- natural building materials
- built into, and blend nicely with environment

Cons-

- Sustainable design was not taught through the design



Warren Skaaren Environmental Learning Center

School Information:

Architects:

Jackson and McElhaney Architects

Square Footage:

5000 sq ft

Site Area:

30 acres

Number of Students:

175

Grades:

-- --

Construction Cost:

\$1,167,850

\$201/sq foot

Date Completed:

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Location:

Dripping Springs, Texas (Near a Canyon)

The goal in this project is to create an awareness of basic environmental systems. The approach is to simplify the complexities of the natural sciences and introduce the environmental components; air quality, water quality, protection of the soil and the conservation of energy.

The indoor and outdoor classrooms are considered one continuous space. Along the building, outdoor centers house the environmental issues being explored. These spaces are designed for small focus groups. Other areas focus on the earth and its relationship with the sun.

Many sustainable ideas are employed (to many too name here)

Some examples:

- water recycling
- solar power
- shading
- daylighting
- safe materials

Case Study examination:

Montessori Method (non Montessori)

Pros-

- strong similarities of a Montessori school
- Independent activities performed by students
- The building is an educator
- strong connection the environment and site
- Natural colors and daylighting for a quality learning space

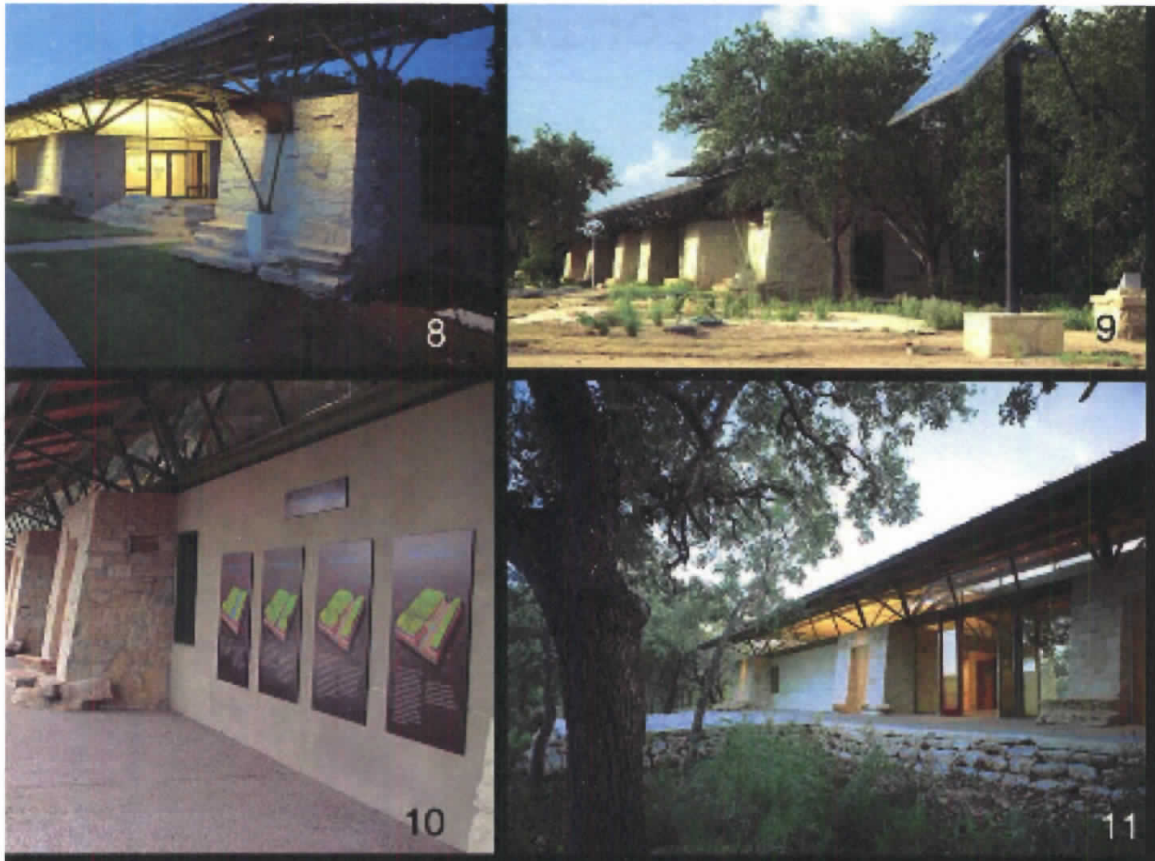
Sustainable

Pros-

- All areas of a sustainable design are taught
- hands-on learning
- Natural building materials

Cons-

- Expensive, the education was approached in a smorgasbord style when in fact a simple introduction of these systems can be performed as in the Hilltop and Prairie Hill



Delft Montessori School

School Information:

Architects:

Herman Hertzberger

Square Footage:

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Site Area:

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Number of Students:

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Grades:

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Construction Cost:

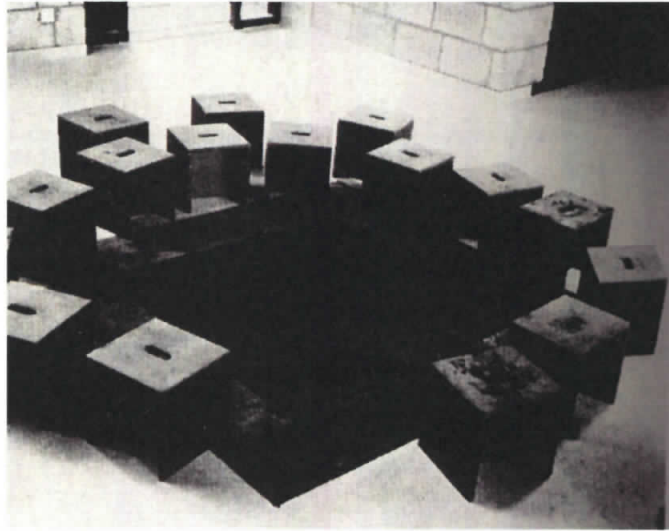
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Date Completed:

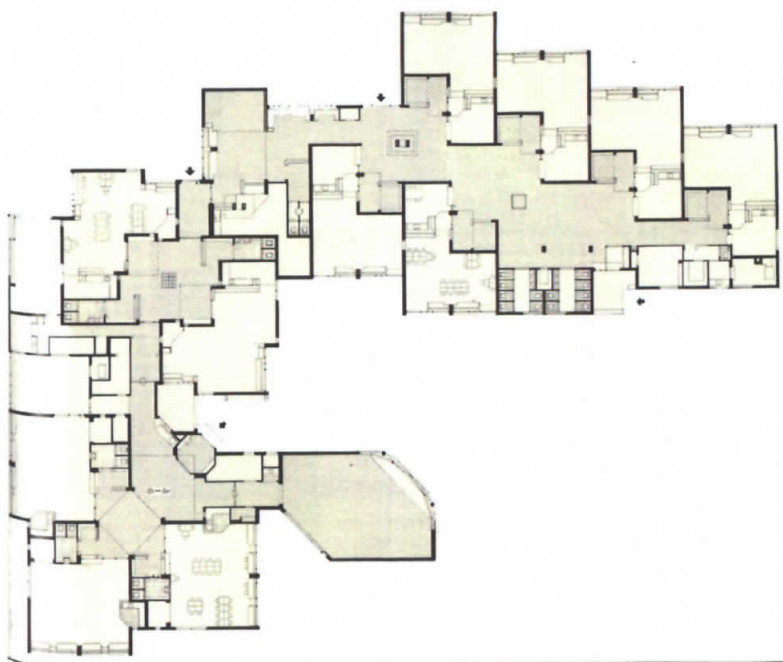
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Location:

Delft, Amsterdam



This is a very interesting example of a Montessori school. Herman Hertzberger, the architect, designed a very elegant example of the Montessori Method in Architecture. This project makes for a good case study because of its focus on details and creativeness of spaces.

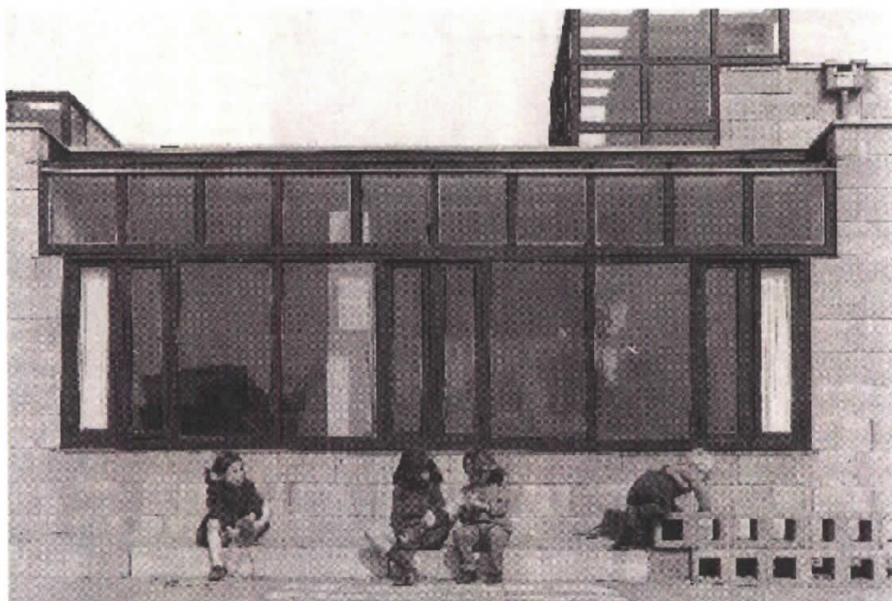


In the hallways, between classrooms and above the door are extra wide planes. These act as open cabinets which can be used for any activity. The main corridor acts as a place for activity. It is wider than normal hallways and it acts as the heart of the school. This 'Main Street' has some items placed into the floor. The children can leave the classroom, and go to these places and organize their own spontaneous meeting.

In the center is a raised platform that is the center of the school. The raised platform breaks up the space and makes itself a focal point. The raised platform "becomes a 'touchstone' and contributes to the articulation of the space in such a way that the range of possibilities of usage increases". The children use this entity as a place to sit, or work on materials. The platform can be extended into a stage with wooden pieces. These wooden pieces can be handled by the students without help from a teacher. It is used for play time after lunch and for performances.

In the Kindergarten section, instead of a raised platform, there is a depression in the floor filled with blocks. These blocks can be removed by the students, and used as seat. The recession gives the students a sense of seclusion and act as a place for spontaneous meetings like the stage in the other wing.

Behind the school, the space is divided into a number of separate oblong spaces with low walls. These spaces act as a garden, sandpit and playground for the students.



Case Study examination:

Montessori Method

Pros-

- Class size and shape
- Strong sense of community, from the 'Main Street'
- Interior breakout spaces with unique entities that promote interaction
- Playground
- each class is identifiable from inside and out
- details

Cons-

Sustainable

Pros-

- Daylighting

Cons-

- not a focus



Berkeley Montessori Elementary/Middle School

School Information:

Architects:

Pfau Architecture Ltd.

Square Footage:

15,000 sq ft of classroom and administrative

Site Area:

45,450 sq ft

On same site of the Berkeley Santa Fe Railway Passenger Depot

Number of Students:

270+

Grades:

Preschool to middle school

Construction Cost:

\$3,200,000

Date Completed:

Fall 2003

Location:

San Francisco, California



The site of the new Montessori school is on the same site of the historic Berkeley Santa Fe Railway Passenger Depot. Preservation of this structure was one of the requirements of the competition. Entireties we asked to incorporate sustainable design features. They are also asked to look at the building as a teacher.



The winning design used simple rectilinear box volumes that brought daylight, and also served to ventilate the spaces, to create a healthy learning environment. Each classroom is provided with views and access to adjacent exterior spaces. Radiant flooring was used for “on-the-floor” learning.

The center play space was developed by Blasen Landscape Architecture, included many sustainable and environmental items such as the a model universe, sun dial, hot-water storage tank, a bio-swale, windmill and native species garden (used by school). The structure itself used a wood frame, and stucco cladding.

Other sustainable features:

- Photovoltaic solar panels connected to a computer link where students can monitor the panels and track energy savings
- Automatic dimming systems
- sunshades
- Plyboo flooring in classrooms

Case Study examination:

Montessori Method

Pros-

- Great landscape design
- central playground promotes interaction and sense of community

Cons-

- 50 students in elementary class, rather large
- Buildings seem a little uncomfortable, not so much a focus on the child but on a winning design
- sustainability was focused on more
- no natural elements, all built or focusing on the technology aspect of sustainable design

Sustainable

Pros-

- natural materials
- systems listed above
- student interaction with these systems (use of technology)

Cons-

- interaction is not part of the activities such as in the Hilltop or Prairie Hill

Prairie Hill Learning Center

School Information:

Architects:

The Architectural Partnership

Square Footage:

3,700 sq ft

Site Area:

12 acre farm campus

Number of Students:

200 students

Grades:

Ages of 1 to 12

Construction Cost:

\$325,000

Date Completed:

Summer 2005

Location:

Roca, Nebraska



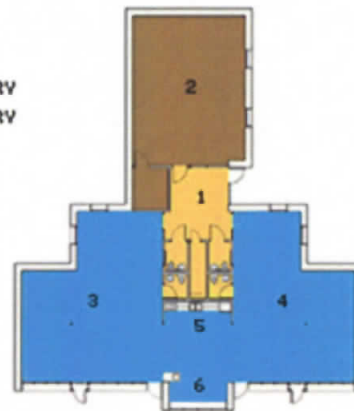
The Prairie Hill Learning Center consists of two inter connected elementary environments and a community room. The focus of the school was to have a historic indoor and a country outdoor environment. This outdoor environment is achieved by the farm environment. The farm environment is a unique way for children to learn about and respect nature. Activities performed in the farm environment are; caring for animals, watching life cycles, observing nature, experiencing the changing seasons, planting, nurturing and harvesting.



The school is full of sustainable entities for children to learn from. The school provides a hands-on model of energy education. On the campus, children will see how wind and solar energy can be used. On the campus, an oversized garage captures the power of the sun, the school uses daylighting techniques, there are rainwater collectors and grey water recycling, roof garden, and straw bale construction (in the school). The campus also offers summer camps and special events where student and parents can learn and cooperate with sustainable tasks.

The school “integrates the classrooms and the design reflects an understanding that learning is not defined to an area, but rather occurs between settings. In addition, the structural column located approximately in the center of each classroom assists in defining areas in which different activity settings may be organized. Yet, they don’t disrupt the flow of activity within the classroom. The Prairie Hill Learning Center within its simplicity is a rather complex design. Not only do the physical elements afford flexibility and variability in the creation of the activity settings, they also afford an integrated learning environment within the classroom as well as between the classrooms where students may always be engaged in the activities of others as they work on their tasks-at-hand.” (Peter C. Lippman, the Fat L-shape Classroom)

1. ENTRY
2. COMMUNITY
3. LOWER ELEMENTARY
4. UPPER ELEMENTARY
5. KITCHEN
6. SOLARIUM



Case Study examination:

Montessori Method

Pros-

- classrooms are open to each other and to the breakout space, with its size, this large open space works well
- Classroom shape
- Strong sense of community, for the design of school, to the task at hand on the farm
- Very strong to connection to environment
- independence with the tasks at hand on the farm

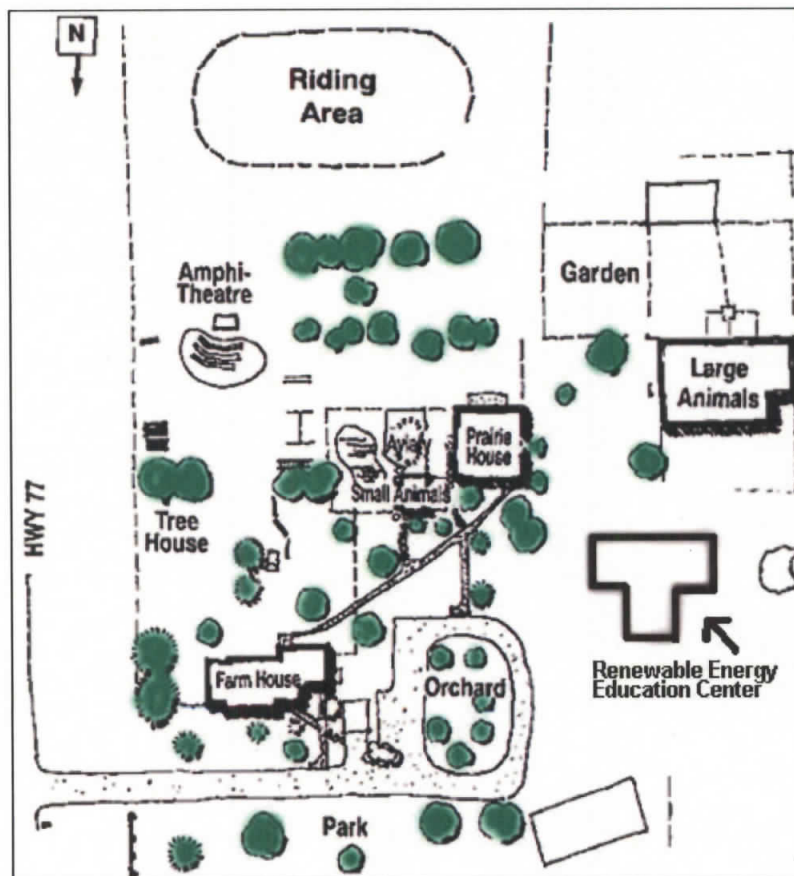
Cons-

Sustainable

Pros-

- Daylighting is used very well in the classrooms
- straw bale construction
- environmental activities all over campus
- All areas of a sustainable design are touched, wind and sun energy, lighting, water recycling, natural building material, animal and crop care, and site issues
- an awesome sustainable site

Cons-



Case Study Overview

A focus on sustainability and Montessori Schools

Sustainable issues can be approached in three ways. First, sustainability can be used to make the building a comfortable space to be in. Second, it can be used to help preserve our planet, its resources and its living inhabitants. And third, it can be done in such a way that it educates the users on our impact on the environment and how we can contribute in the preservation of it.

The first approach is the most important, and is the goal of any architect to create comfortable spaces. Using daylighting, adding plants, and lowering the amount of toxins in the air are examples of how to do this.

The second is equally important, especially in the last 150 years. The industrial revolution has developed us into a society of comfort, and from this comfort, we have used many resources and polluted our planet. We are now trying to fix the effects of these actions. We try to recycle, use less energy, conserve the loss of energy, and impact the world less. We employ strategies in architecture that try to do so, such as, solar power, natural building materials, daylighting, water recycling, wind power, and site design.

The third approach is the education of these ideas and strategies. Most architecture that tries to deal with this approach use sustainable practices as an 'example' to learn from. In my case studies I found four schools that not only teach by example, but also have created things that directly teach the users. It is an obvious solution to the third approach mentioned, place items that will teach sustainable ideas in a learning environment. Teaching children the importance of these issues is an excellent way to ensure a long healthy life of our planet. The four schools I saw that did this well are the Hilltop, Compass, Warren Skaaren Environmental Learning Center and Prairie Hill School.

When examining the case studies in their effectiveness of capturing the Montessori philosophy I see many occurring characteristics. First, the shape of the class is important. A square classroom is too inwardly focused for a Montessori school. No entity in the classroom is suppose to be a focus, such as the teacher or physically the center of the classroom. The children need to be able to have full concentration on their tasks, by bringing their activities to the perimeter of the room; they will be able to focus on their tasks instead of something else like the teacher, or each other.

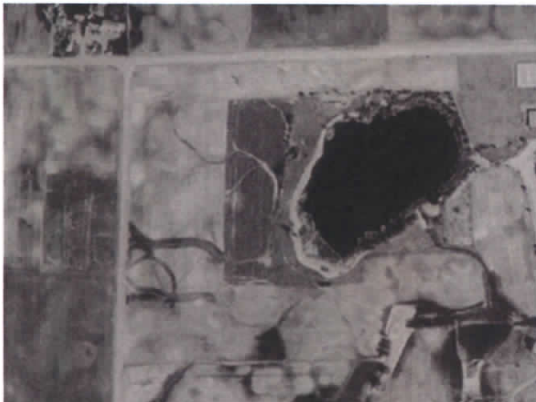
Second, the sense of community is important, because with it brings out the ability to learn from each other in the children. The Prairie Hill did this very well, and in two ways. One, the class rooms themselves were turned towards each other but still had a

sense of separation. The whole school itself, being small, but still having private areas was able to preserve the concentration of the child and still encourage interaction. The second way Prairie Hill is successful is in the farm area. In the farm 'environment', the children are carrying out tasks with each other. Thus creating a community and teaching the children to master control of their movements and senses.

Thirdly, the creation of indoor and outdoor spaces for spontaneous activities I found to be important. This coincides with the first two characteristics mentioned. Each school gave the child the ability to leave the classroom to an outdoor space. The Delft Montessori School also gave the children a place to go inside the school. These spaces were unusual in their design but very practical in their use. Not only can the children use them for meetings and group work, they also helped in the development of their problem solving skills by having the freedom of constructing their own space. These areas enhanced the sense of community and the child's concentration.

Site Analysis

The location of the site, Shakopee Minnesota, is a southern suburb of the Twin Cities. Shakopee is located just south of the Minnesota River Valley in Scott County, the 12th fastest growing county in the nation. The site is slightly south of Shakopee. Its location is secluded, but at the same time, it is also easy for travel. It is in between Chaska, Shakopee, and Prior Lake who's population amount to 53,934. It is also a few miles from highway 169, a major highway running north and south. A small to moderate amount of traffic runs by the site, making it secluded but reachable. There is no pedestrian traffic or paths.



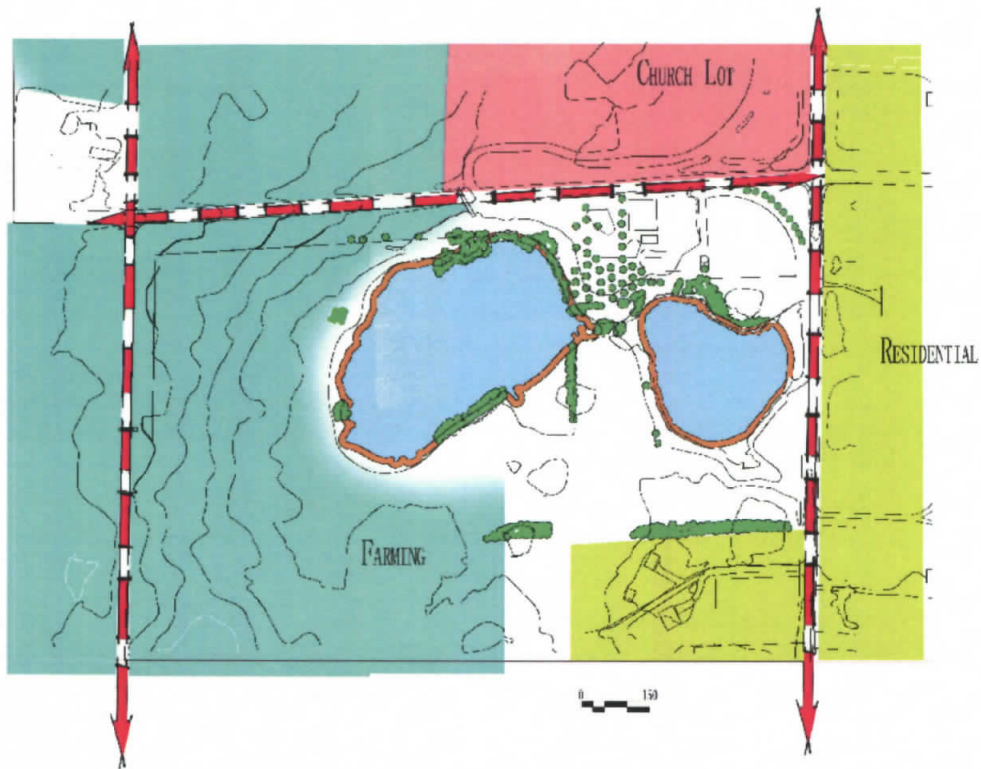
The site itself is located next to Jackson Park, a very frequently unused park with two baseball fields, two tennis courts, a VFW, also frequently unused, and a very calm tranquil open space. As for the context, the area is surrounded by farmland to the south, and a small amount of construction to the north. This construction includes a new and rather large church and a small amount of housing. At eye level, one can look north to see down into Shakopee which actually adds to the seclusion feeling, because the busyness of the city is focused away from the viewer. East and west views do not reveal any man made interference. To the south, there are gently rolling hills used for farming with an occasional farm house.

The site has a gentle slope, gradually moving south towards two small permanent, clean, lakes/ponds, inaccessible and unused for recreation. South of these bodies of water, the land gradually slopes back up. The vegetation is mainly grasses and a few medium sized trees. On the west side of Jackson Park, trees were planted in a slight controlled fashion and create a very calming space.

There are no obstructions of light to the site, and wind is free to move, with some force through the site. The wind in this area mainly comes from the northwest (see wind roses). Precipitation averages to about 2.2 inches a month. There is little to no erosion visible, and the site drains very well into the two bodies of water.



The site has been used as farm land since early 20th century. It has been sculpted by the many generations that have passed. The site was mostly grassland vegetation with few trees. The site still stands as a farm land surrounded by homesteads and farmland. The city is slowly moving towards this site, bringing with it a new large church and some residential. The growth in this direction is slow, and the residential lots are rather big, which still preserves the farmland and not city feel.



The site was chosen for three reasons:

First, this Montessori school, wanting to hold true to the environment and student connection, places itself in an organic site. This organic site is the same place a scientist (as described from Maria Montessori) would go to observe the natural happenings of his or her world. This is where knowledge of the world forms.

Second, these world forms, the particulars, are our only way to know anything under Plato's epistemology. The 'forms', for Plato, are intangible things that are outside of our world. We recognize these forms when we see their particulars on earth. The closest we can get to the forms are from these particulars, and anything that is a copy of these particulars is bad. Therefore, the best site is one that is free of artificial copies of the particulars, a site that is organic.

Finally, the site helps to promote a healthy learning environment. The site was chosen for its tranquil atmosphere. It has very little examples of human influences with respect to anything built, (It has been however sculpted by man for many years). This site is set outside of a large city, which offers less distraction than a school inside the city. It also has a complete access to the sun, access to wind for ventilation and very importantly, attractive views.



Program

Classrooms: 10 classrooms, total -----	11,000 sq ft
Ages 3-6	
Ages 6-9	
Ages 1-12	
Ages 12-14	
Ages 14-18	
Two classrooms per age each with	
-30 students	
-1100 sq ft	
Commons area/Lunchroom -----	6000 sq ft
Gym -----	7000 sq ft
(Used for more than basketball	
i.e. Rock climbing wall)	
Kitchen -----	2500 sq ft
Faculty Offices -----	2100 sq ft
Library -----	3200 sq ft
Music Room -----	2800 sq ft
Science Room -----	1200 sq ft
Mechanical Room -----	4000 sq ft
Total Square Footage plus circulation-----	approximately-----61,000 sq ft

Site entities:

(Points of interest/structures on site promoting education, discovery and play)

Themes such as---

- Astronomy
- Farming
- Sustainable design
- Alternative building materials
- water/water recycling
- energy alternatives

Requirements for Design:

- Limited Site disturbance
- Preservation of farmland
- Protection of pesticides
- Classroom shape
- Classroom relationship

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Final Product

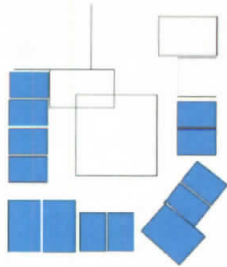


Development

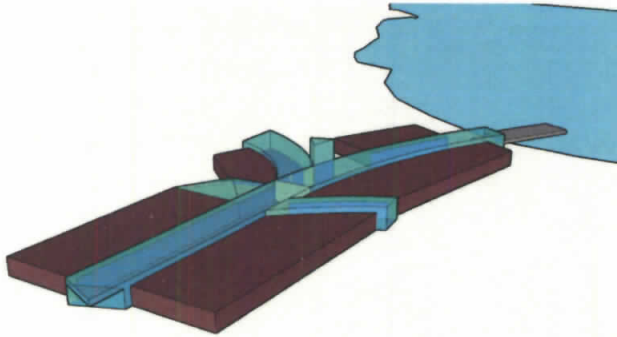
Addition to Narrative (developed during early steps in design process)

In the Montessori Method, the child learns from his or her own surroundings, their environment. The teacher is merely a guide for this interaction; therefore the students have the freedom to express themselves independently with the environment, and in doing so gains further knowledge, and a joy for learning. The built environment that houses this interaction must promote the learning from and respect of the environment. It must encourage independent actions and interactions of the users. Through the philosophy of the Montessori Method, the students are further encouraged to interact and learn independently from their surroundings. Therefore, the project must enclose these activities and also be a source of information itself.

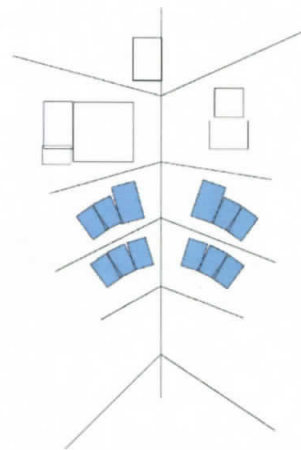
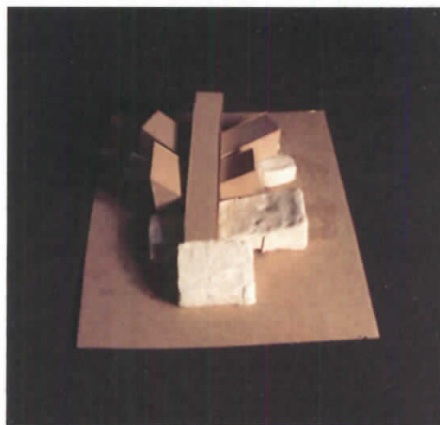
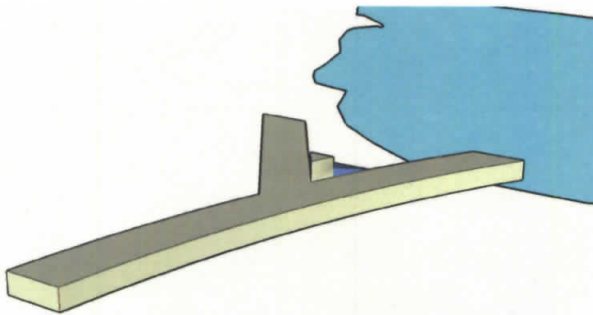
If the focus is on the environment, the building cannot prevail over it. Since man needs shelter to live, the building must be just that, a shelter. Hence the building must be less present in a way that the organic environment will be able to shine its full potential onto the students.



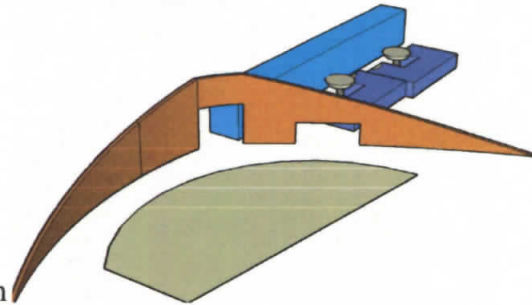
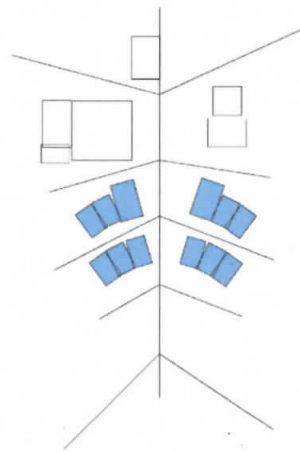
First the design focused on the arrangement of classrooms. (Shown in blue on the diagrams) A radial arrangement created a focal point which would have been good for large group activities. However the design was focus inward and not out to the site.



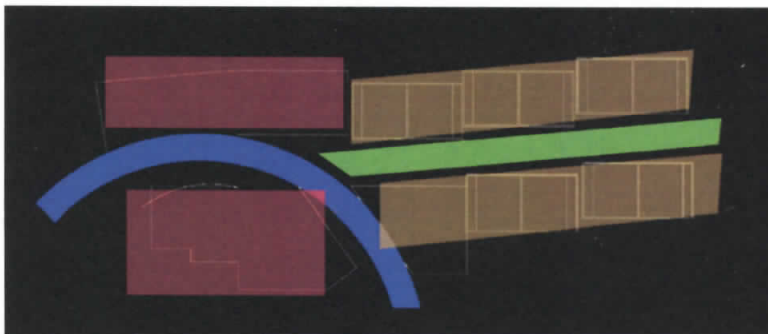
Creating a sense of discovery was more important in this design problem. By creating large axis, and putting the classrooms along these axis, I caused the building to stretch out into the site. And the sense of discovery in heightened with a corridor to explore.

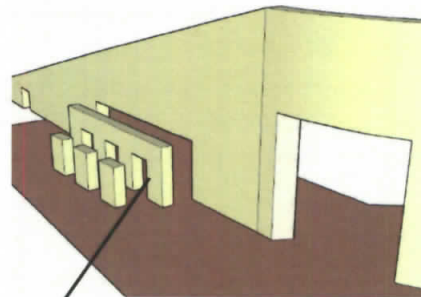
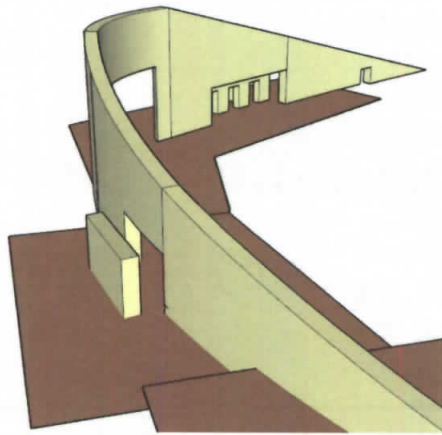
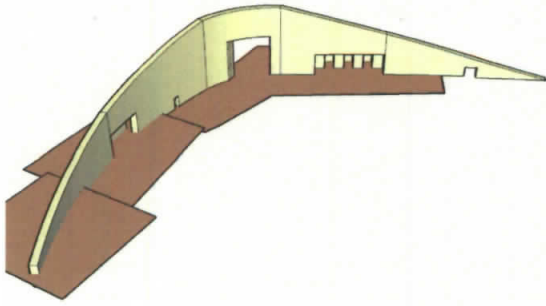


The idea that leads this project was the metaphor for absorbent learning. The term “Absorbent Learning” refers to the dual interaction of man (in this case the students) with his environment, and all the knowledge gained from this. It is being engulfed in the activity of learning and intermingling built environment with the natural. Therefore the design absorbs itself into the site. It pulls itself out of the ground bringing with it the organic, the earth wall, plants and water. The users are also engulfed in to the design by it respecting their independence, their thrust for discovery, thrust for knowledge and ability to interact. Respecting the natural environment for what it has to offer causes us to respond back in a healthy and sustainable way. This source of knowledge, the environment, must be preserved, but we as humans have been abusing it. This building is not only sustainable, it teaches sustainability. Teaching this is the same as learning about the natural environment because knowing all that we can about our surroundings cause us to interact with it in a healthy way. The design therefore allows the students to interact with its sustainable strategies, and it also stands as a symbol for what and how things can be done. Showing an example of what can be done allows people to find new ways of how to do it.

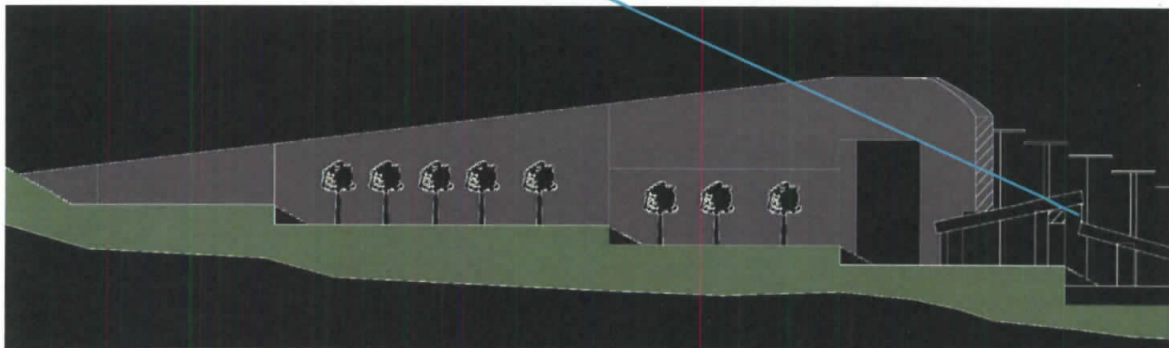


To create an axis, a large earth wall is drawn out of the site. It frames the view to the next axis which runs to the classrooms and ending to the lake as a pier.

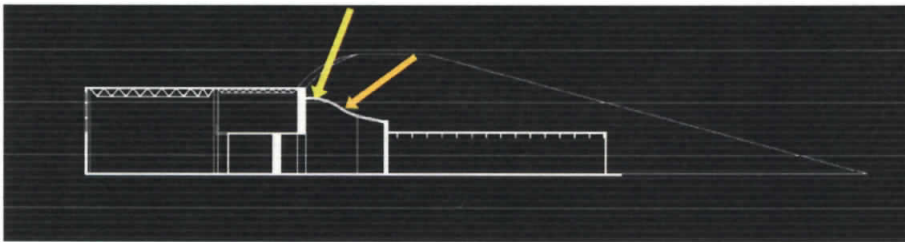
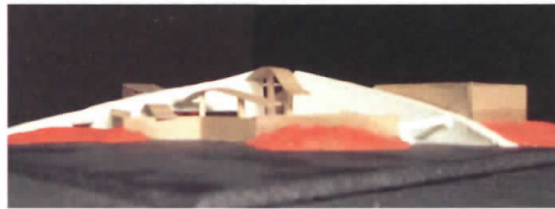




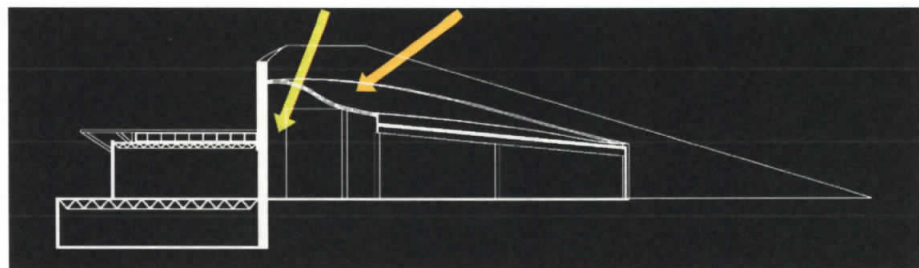
Parts of the earth wall are pushed away to create the entrance to the gym (Above) and the library (Right). The main structure of the library is rested on these pieces of the earth wall.

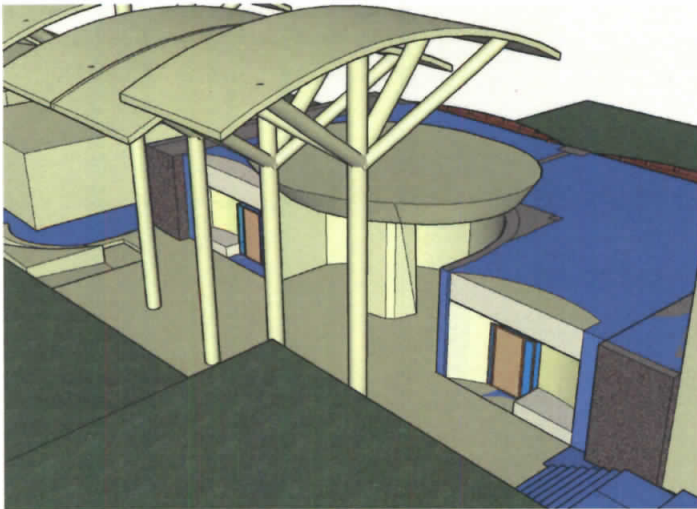


Final Product

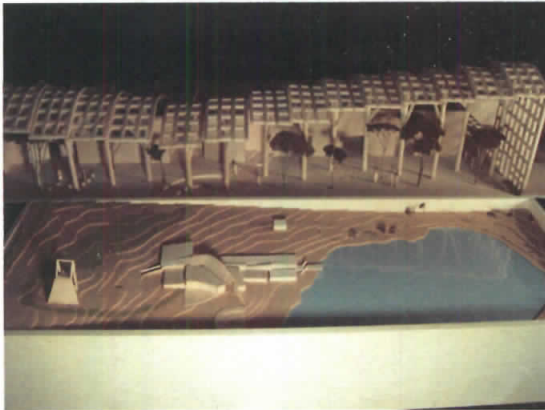


Earth wall acts as a thermal storage wall

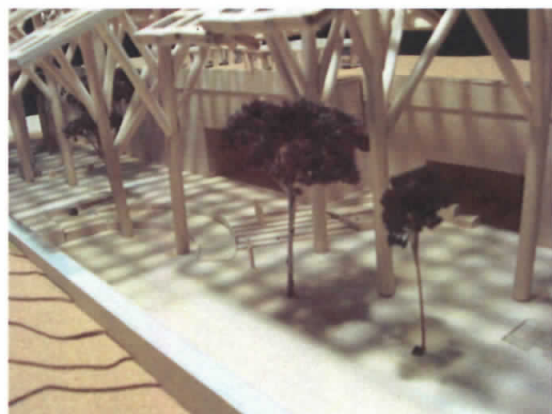
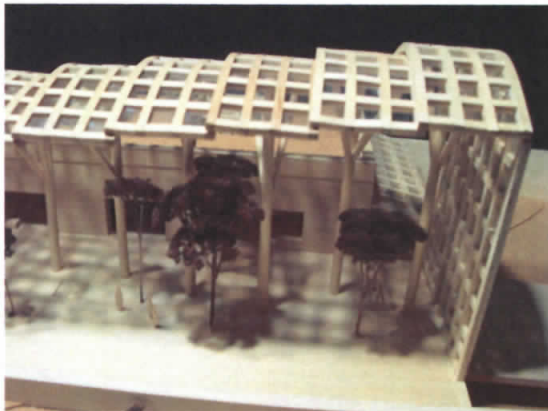
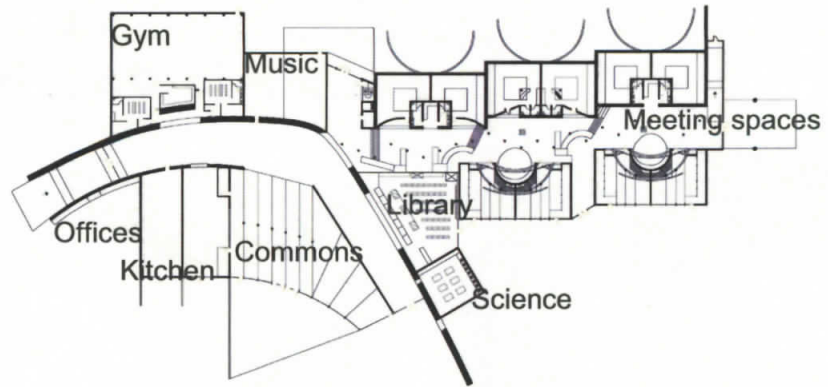




The Tree and the Mushroom-- parts of the design literally using nature as a usable source of knowledge. They act as playful parts of the design take break up the main corridor.



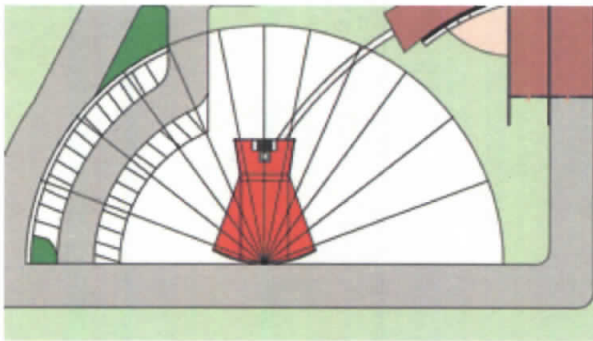
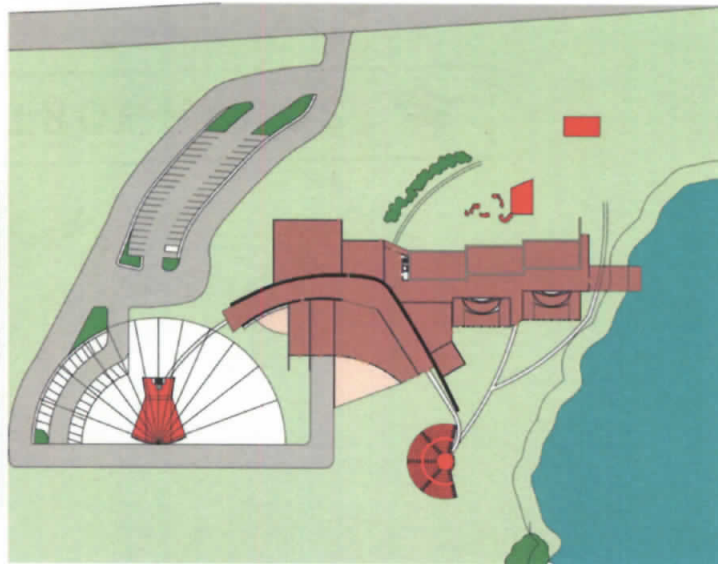
The rooms are called meeting spaces as to not get trapped into the preconception of the term 'classroom'. By calling the rooms meeting spaces, the time spent inside seems to be more temporary, meaning equally important time is spent elsewhere. These 'elsewhere' spaces are the spaces that the students can go to independently (as encouraged through the Montessori Method) and create their own temporary meeting space. This is shown



through the unique corridor space, places for discovery; as in the over all layout of the design, places for observation; the level changes and pier, and to the immediate access to the exterior. The corridors are full of different shaped ramps, corners, fountains, plants, the depressed blocks all with the intention of allowing the children to discover and create their new meeting space.

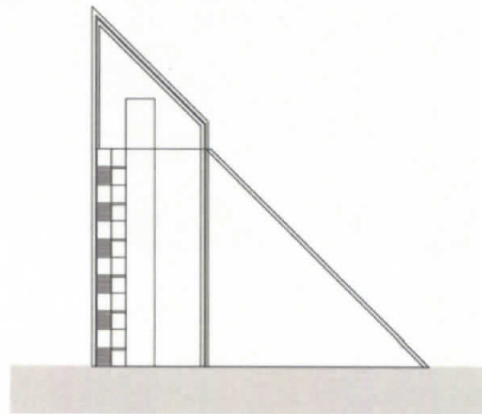
Site Design

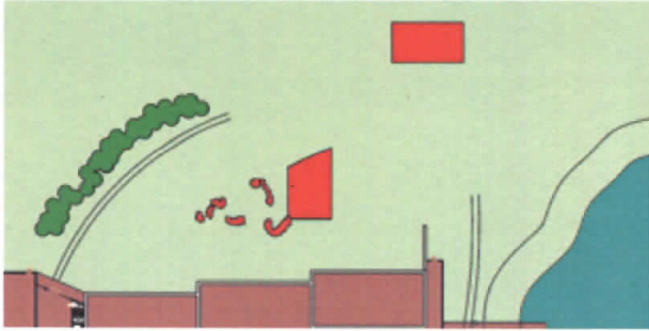
Broken into three parts



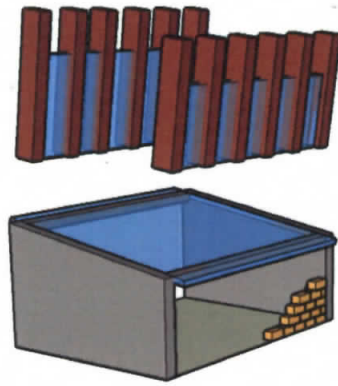
The Tower

- 95' high observation tower
- Elevator, heat and lights are powered by PVC Panels
- Tower acts as gnomon in sundial
- Observation deck is heated by sun, the rest of the body is slender with less volume

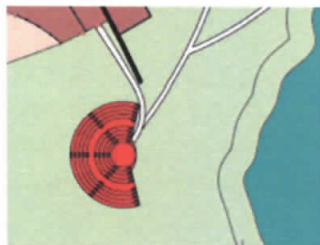
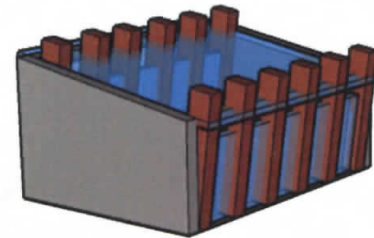




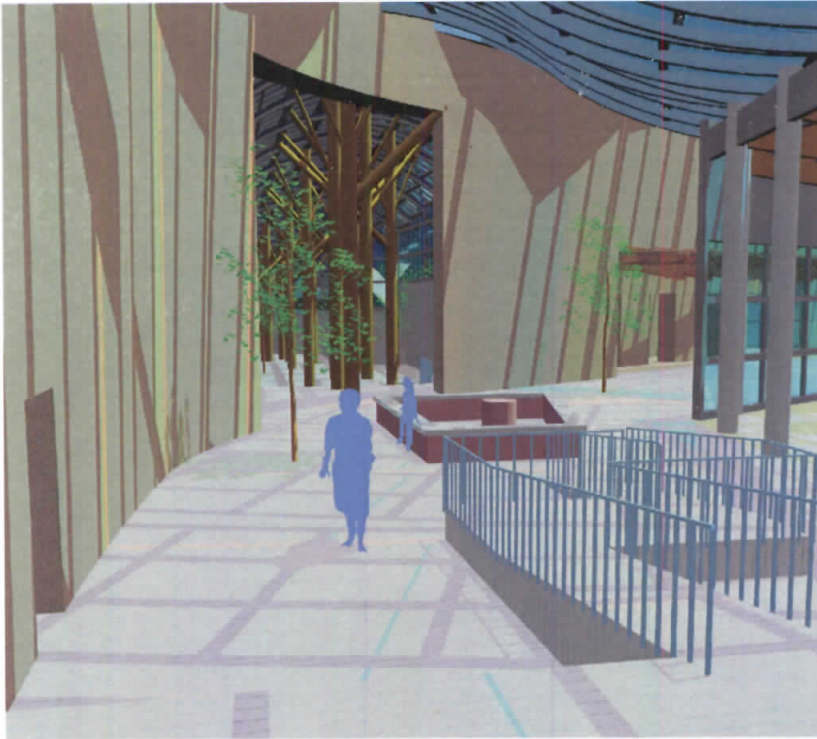
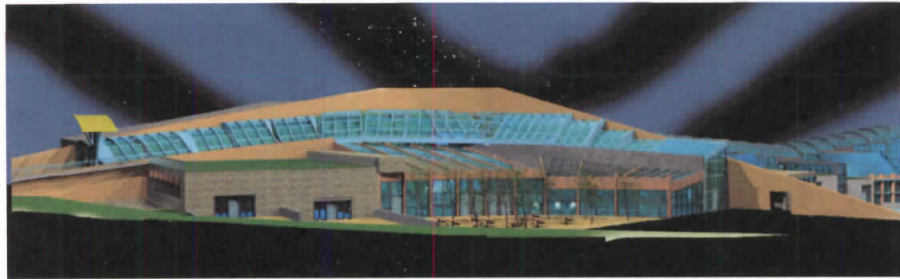
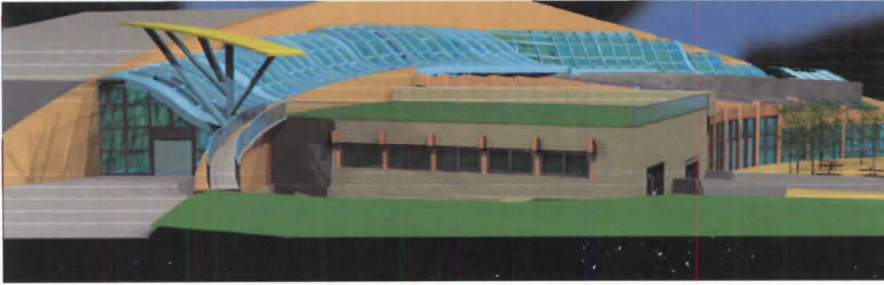
The playground and sand box will be made of stones found on the site. The children can rearrange them in any set-up they want.



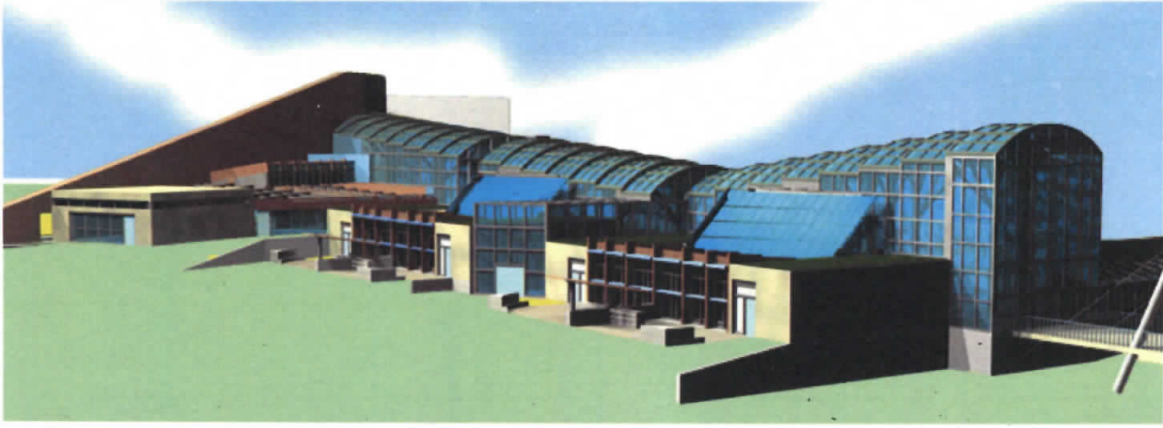
The greenhouse can also be dismantled leaving the bare structure. This can then be used for projects such as rebuilding the structure with straw bales.



The Greek-Auditorium pays homage to the founders of knowledge. It is built naturally into the site and has this view of the lake.



The earth wall frames the view to the meeting spaces. It helps create the feeling of entering a forest. This is an analogy for the scientist as described by Maria Montessori. The scientist goes into the forest, and sacrifices their entire day to learn from nature directly.



The meeting spaces/classrooms set along the organic and structural tree corridor are very different due to their Cartesian position, one side facing south the other north. The main difference is the access to the sun. Since facing south allows for the greatest access, these meeting spaces exploit the sun. The sun does four things for us, direct heat, direct light, more daylighting and electrical power. Therefore to be true south facing rooms, the spaces must appeal to all four. The north side does not have such options, however being a space for humans it needs daylighting (especially for growing children). Electrical power is not obtainable. As for heat, the spaces will still need to rely on their southern most walls to capture heat and radiate it into their space. Being that direct heat gain is difficult; the north classrooms are heavily insulated by earth. The purpose is to show the users what it means to build on the north side versus the south side.

