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The Poetry of Sustainability

Inhabiting the Landscape through Sustainable Design

Single Family Dwelling in Watervliet, NY

SarahJo Bell
Thesis Prep
Fall 2006
Advisor: Randall Korman
Committee: Timothy Stenson

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Preface

Our society is a dependant of the inevitably doomed industry of fossil fuels. We rely heavily on nonrenewable resources to maintain our lifestyles. Ethically, our relationship to the earth is unbalanced. In order to balance the scales of our future in architecture we must look toward sustainability through technology.

Over the past 60 years the world has been heavily reliant on the availability of cheap fossil fuels. All sectors of the national and global economies rely to a greater or lesser degree on the continuous supply of this finite resource. It is believed by a number of experts that the world's supply of crude oil will dwindle to negligible amounts within the next 30-50 years. The impact that this will have on global economies will be dramatic and possibly catastrophic. A shift to alternative energy sources and an economy based on sustainable resources is at present both economically and ethically necessary.

Sustainability, according to the Brundtland Commission in 1987, is defined as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs." It is a balancing act of efficiency and human requirements. As a global issue, sustainability can be defined as equilibrium of the creation and consumption of resources. Sustainability as it relates to architecture is where equilibrium must be met between the embodied energy of materials and construction, energy efficiency of the design, consumption of resources by inhabitants, and harnessing of natural renewable resources.

Technologies that allow for a sustainable architecture include geo-exchange systems, grey water reuse systems, composting toilets, photo voltaic arrays, wind turbines, solar water heaters, and soy foam insulation. When applied to an efficient design, these systems can help generate an environmentally responsive and ethically responsible architecture that contributes to the necessary effort to bring about equilibrium to our resource use.

Thesis A

The intention of deploying technology of sustainability should not only be a pragmatic one, but also a way to achieve a certain aesthetic or beauty. The idea that technology can be a determinant within the design process is at the core of this thesis. I maintain that the systems that we know to be typically pragmatic in their deployment can serve also as a catalyst of design. This thesis contends that technology can be a prime determinant of the form and language of an architecture that also provides for the functional and technical requirements of sustainability. In this way, the technology of sustainability has poetic possibilities.

Parallel Objective

The systems of sustainability can be applied tectonically in poetic form. Photo voltaic arrays can mimic elegant rooflines and create a rhythm for a building. Grey water reuse systems in conjunction with greenhouse soil box planters can show a powerful connection of consuming and renewing of resources. The sustainable technologies need to be implemented with both beauty and function as the twin objectives. To say that technology is all that drives a design is negligent. Architecture has relied upon precedents to provide a foundation from which the possibilities of new design can be launched. To this end, I intend to use the design principles of historic Shaker architecture as a guiding precedent.

The Shakers, although rigidly held to religious standards above and beyond the aim of this thesis, created a lifestyle that was harmoniously connected to the land, reducing their dependency on worldly necessities. Shaker architecture possesses an elevated understanding of proportion and placement of parts within the whole. These were critical to Shaker designers because of their philosophy about design. According to Sprigg, the author of "Shaker Built," the three primary motivations for Shaker design are; 1. If it is not useful or necessary, free yourself from imagining that you need to make it. 2. If it is useful and necessary, free yourself from imagining that you need to enhance it by adding what is not an integral part of its usefulness or necessity. 3. And finally, if it is both useful and necessary, and you can recognize and eliminate what is not essential, then go ahead and make it as beautiful as you can. With these criteria, Shakers were the originators of sufficient elegance. They had a true understanding of the bare necessities required for life and the beauty found in the simplicity of this idea.

Both the need for functionalism and a desire to create beautiful design make Shaker architecture a paradigm for this thesis. The historical significance of Shaker design is amplified by the site where the project will be located. The first Shaker village was founded in 1775 in the swampy area known as Niskayuna and now called Watervliet. To this day original Shaker architecture remains on the site. On the southern end of the site is where a direct translation of Shaker architecture will serve as a determinant of form and language for this thesis.

Thesis B

Determining the right systems to implement in a building depends on site specificities. This means using contextual forces to give a sense of place and meaning to the architecture. Kenneth Frampton expands on this idea in "Towards a Critical Regionalism." According to Frampton, Critical Regionalism should adopt modern architecture critically for its universal progressive qualities but at the same time should value responses particular to the context. Topography, climate, light, tectonic form, and the tactile sense all play roles in addressing the situational aspects of architecture. It is my intention, through an appreciation of the regional architecture of the historic Shaker village in Watervliet, to make aesthetic choices that will correlate to the basic philosophies of Shaker design.

These multiple issues of sustainable design, historic translation, and critical regionalism will be explored through the vehicle of the single family dwelling.

Client

The thesis will study the design of a home for a family of four with an annual income around $100,000. The parents are employed as a dietician and a personal trainer. The family has an interest in sustainability as not only an architectural and environmental attitude, but also a healthy way of life. The programatic elements that have been incorporated reflect this desire of healthy living through an active healthy environment.

Program

The building is not to exceed 1500 sq ft. and requires the inclusion of the following:

Food prep area: 150 sq ft
-cook top and oven separate
-industrial size refrigerator
-2 basin sinks
-20 sq ft counter top space
-Recessed spot lighting
-broom/tool closet
-seating area for 2
-operable window(s)
-access to greenhouse

Communal living area on first level: 300 sq ft
-reclined/cushioned Seating for 4
-dining table with seating for 4
-Hearth
-double height space
-views and access to pond
-cross ventilation
-natural lighting
-entertainment area (TV, sound system, etc...)
-library element (spatial incorporated at screen or wall)
-stairs to second level

Entry: 50 sq ft
-Durable flooring
-lots of light
-coat closet/ rack
-slightly elevated from ground

Water closet 50 sq ft
-composting toilet
-grey water collecting sink
-operable window(s)

Deck: 300 sq ft
-west side of house
-connection to dock over pond
-access to Hearth/outdoor cooking area
-partially covered
-built-in seating for 4

Tool shed: 50 sq ft
-accessible from outside only

Greenhouse: 200 sq ft
-hydroponics
-southern facing
-built-in tool storage unit

Bedroom 1 and 2: 100 sq ft each
-twin bed
-built-in storage unit
-desk/ work surface
-east facing operable windows

Master Bedroom: 150 sq ft
-double bed
-built-in storage units
-west facing operable windows
-access to second story deck (100 sq ft) over-looking pond
-access to bathing area

Split bathing area: 80 sq ft
-2 access doors (hallway and master bedroom)
-shower/bath splits room
-composting toilets on either side
-sinks on either side
-heated tile floor

Work/workout space: 200sq ft
-desk/workbench for 2
-weight bench
-sound proof floor system
-mirrors
-natural southern light
-treadmill
-stationary bike
-weight rack

Outdoor water spout- water is a symbol of cleansing life
Trees cleared for yard space
Composting area
Garden: 200 sq ft
- raised beds
- ground-embedded fence

Systems

Geoexchange Heating and Cooling

Geothermal heat exchange systems according to The Geothermal Heat Pump Consortium, Inc. utilizes the Earth's natural heat. Below the frost line surface of the earth there is a relatively constant temperature between 45° and 70° F. In cold months, the heat passes through a series of pipes, called loops, which are installed underground or submersed in a pond or lake. Fluid such as water or environmentally friendly antifreeze solution of potassium acetate circulating in the loop carries this heat to the home.

An indoor geoexchange system can then utilize electrically driven compressors and heat exchangers in a vapor compression cycle to focus the Earth's energy and release it inside the home at a higher temperature. This can be done using an air or water circulation system. Geothermal exchange also works to cool a building in warmer months be reversing the flow of the exchanger. This reversal of the compressor uses the same technology that is employed in a refrigerator which does not force cold air into the insulated section, by rather pulls heat out from the inside of it.

Geothermal heat pump systems are generally not evident to the eye in a finished building since the loops are embedded in the earth and the compressor is usually placed out of sight. They only become visible when heating and cooling costs are drastically lower than with conventional systems. The intention of this thesis though is to objectify this system and others so that they are a driving force of design of the home. Since the chosen site has access to a pond, the loops used will be a pond closed loop configuration. The fluid circulates through polyethylene piping in a closed system, just as it would in a ground loop configuration. The pipe may be coiled in a spiral shape to fit more length of pipe into a given amount of space. Pond loops used in a closed system have no adverse impacts on the aquatic life.

The climate of Albany, NY is well suited for a system of this sort because of the drastic changes in temperature that occur on a daily, weekly and especially seasonal basis. Having a constant source of regulated heat is an important component for a sustainable design. Putting a geoexchange system in a typical home is equal in green-house gas reduction to planting an acre of trees or taking two cars off the road. Carbon Dioxide emissions are also reduced since no combustion need occur with this system. Also by physically anchoring a house into the ground through and energy system, symbolic ties are being made to the symbiotic relationship that architecture and humans should have to nature. This premise of using only resources that can be replenished at an acceptable rate is at the core of this thesis.

Most people are making the same mistakes with water that they have made with energy: depleting nonrenewable supplies by using the highest-quality water for every task. Fresh, clean water is scarce, making up less than 3 percent of the water on earth, and all but three-thousandths of that is locked up in glaciers or icecaps or is too deep in the earth to retrieve. Residential water use accounts for 47 percent of all water supplied to the U.S. (http://www.rmi.org/sitepages/pid15.php.) Grey water reuse systems take non-potable water, collect, filter, and recycle it as toilet flushing water or for landscape irrigation.

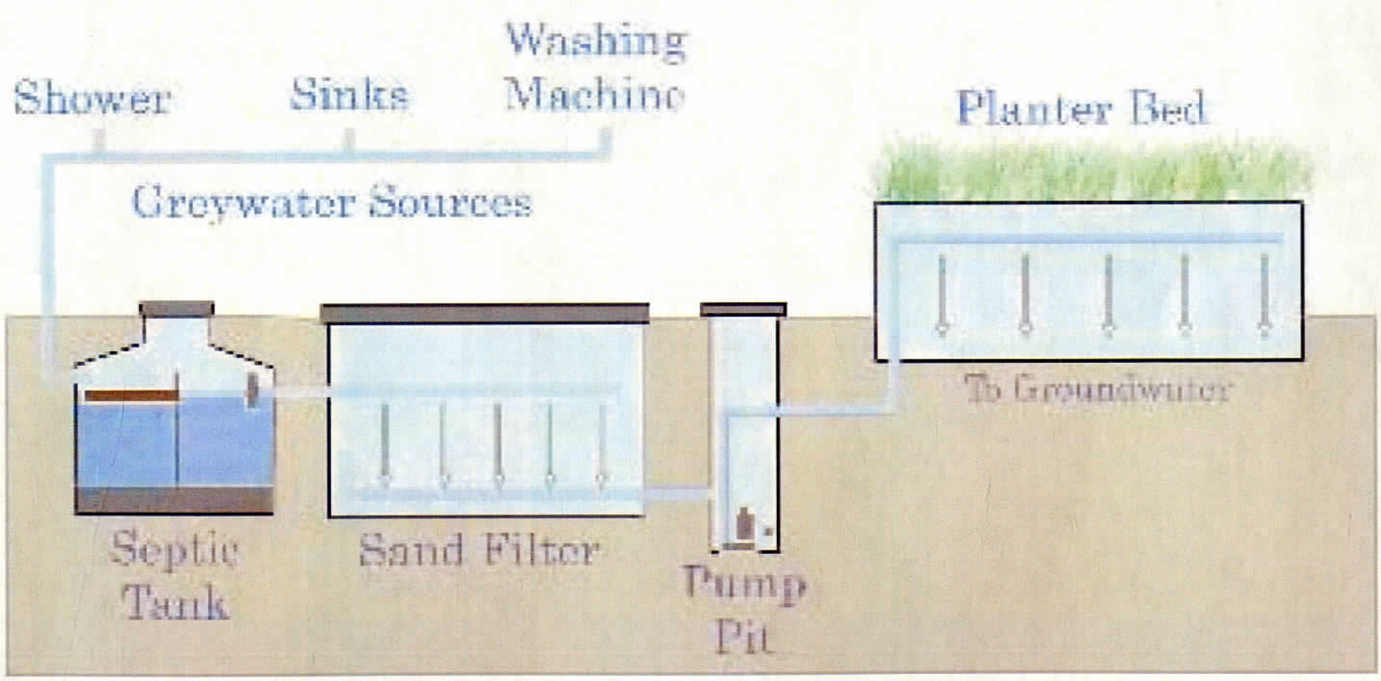
For a typical household, reusing grey water can provide fifty to one hundred gallons per day for outdoor use and toilet flushing. About 65% of domestic wastewater is grey water. As water from sinks, the washing machine, and showers is accumulated during the day, it is then distributed to a leaching chamber. In the case of this thesis, the leaching chamber will be a series of soil beds which provide filtration of the grey water and also serve as planters for year round vegetation growth within a greenhouse.

Two chemicals used to disinfect water are chlorine and iodine, with chlorine being more common. Not only is it readily available (as household liquid bleach or at swimming pool supply houses) and relatively inexpensive, but it is stable in storage and will, in time, vaporize from the water after disinfection. Organic material in grey water may combine with chlorine, and reduce the amount available for disinfection. For this reason, a filter or settling tank before the disinfection point may be advisable. Iodine is less affected by organic material, persists longer, and may be more effective at the high pH of grey water. Iodine is also fast-acting, requiring no more than two minutes to kill most pathogens.

Phytoremediation is the science of cleaning polluted soil and water with plants. The premise is the same as that of a wetland which uses layers of vegetation, soil, and gravel to filter contaminants. According to www.greywater.com, these planters have been in use since 1975 as a reliable purification technique. The soil bed has to be well drained to prevent water-logged areas from occurring in it where filtration would come to a halt. Therefore, its bottom would contain a layer of polyethylene "actifill" or pea gravel to provide effective drainage.

A layer of plastic mosquito-netting on top of the actifill prevents the next layer of coarse sand from falling through. On top of the coarse sand is a layer of ordinary concrete-mix sand, while the top two feet consist of humus-rich top soil. Another possible configuration for filtration uses a septic tank. Black water from toilets does not get filtered with this system because of the contaminants associated with it that could be exposed to new plant life.

Grey water reuse is applicable to this project because of the programmatic elements of a greenhouse and large garden as well as the environmental condition of the site which is on a protected area of natural wetland. By eliminating the need for a leach field for all household water, the need to clear more trees on the site is reduced. Preserving the surrounding natural landscape is an important part of maintaining sustainability.



Wind Turbines

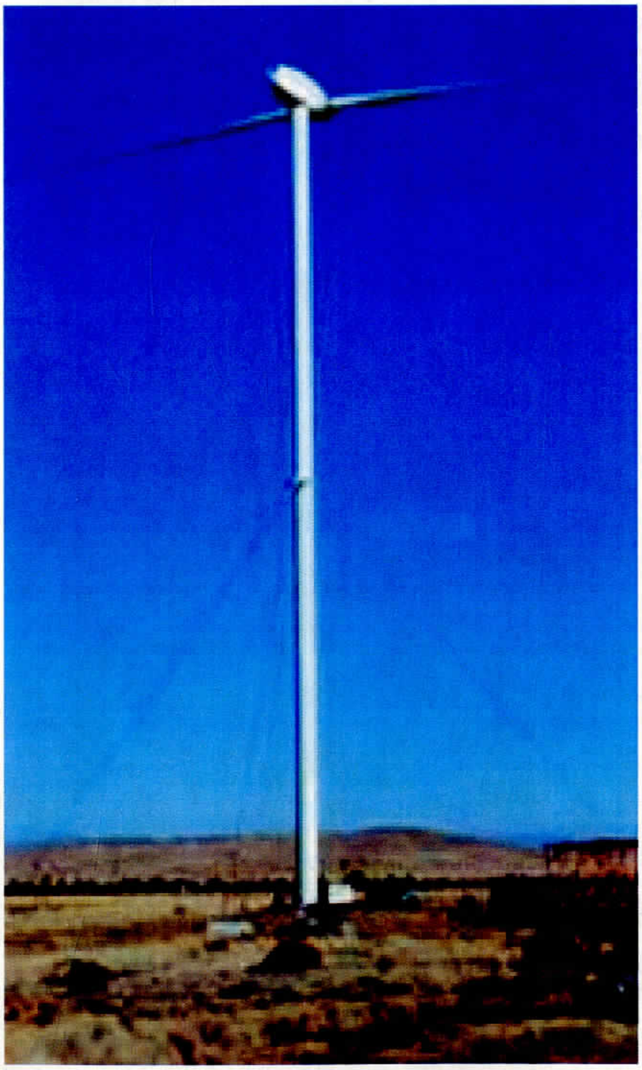
According to the US Department of Energy, wind turbines are a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Technology has allowed us to harness the wind's kinetic energy and transfer it into mechanical energy which is then further converted into electricity by a generator. Wind turns the blades, which spin a shaft, which connects to a generator.

There are two main types of turbines in wide use today. The horizontal-axis variety usually has two or three blades and operates "upwind" with the blades facing into the wind. (See image on following page) "Downwind" turbines are generally two-blade systems. The advantage of downwind turbines is that the wind can bend the tower and rotor blades in the direction it is blowing. (See image on following page) Upwind machines must resist bending, but downwind blades and towers can be allowed to bend. This means that downwind turbine blades don't carry as much load and can use less material. Downwind turbines capture about 97% as much energy as upwind three-blade systems, but the cost of two-blade systems is less. Since downwind turbines can bend with the wind, the tower can be supported by guy-wires and not be as bulky as with upwind systems. Also the towers can be taller at the same price as smaller upwind systems to take advantage of higher and more consistent wind conditions.

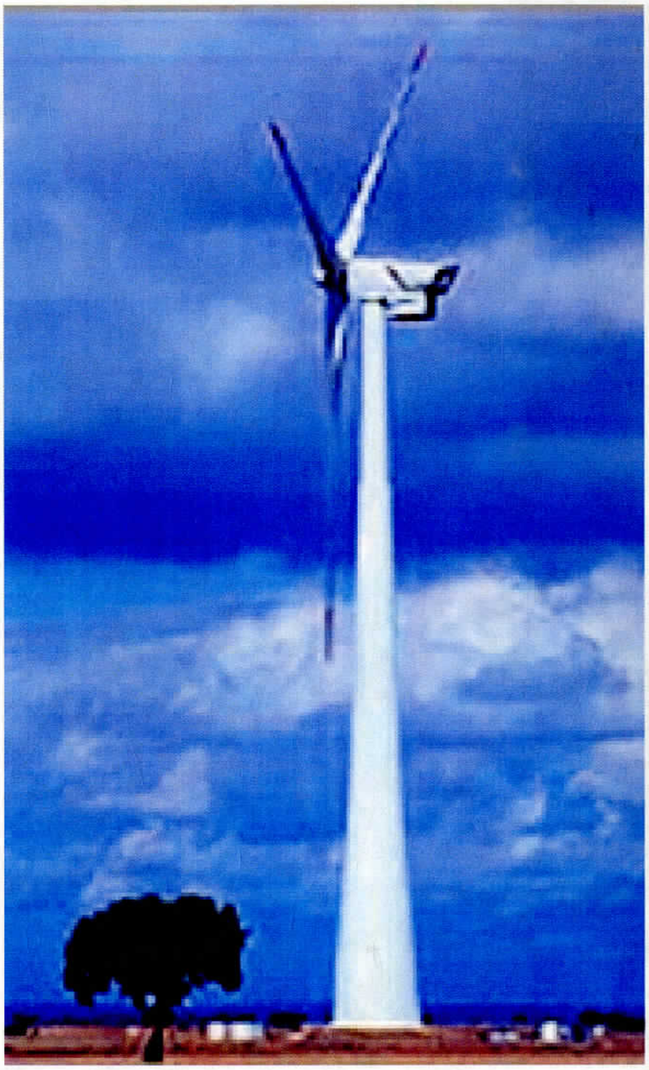
Turbines range in size of output of 7.5 kilowatts per hour at a constant minimum wind speed to as large as several megawatts. The average house requires about 2 kilowatts per hour. A constant wind speed of 8mph is required for enough kinetic energy to turn most small scale turbines. Turbines usually feature a controller that will shut off the machine when wind speeds exceed 65mph because these speeds may cause the generator to overheat. Wind power can create exponentially more energy than solar panels relative to the speed of wind, but there are few places where the wind is more reliable than the sun, and so many times wind turbines and photovoltaic cells are conjunctively used in what is often called wind/solar hybrid systems.

Heights of domestic scale turbines can range from 30 feet to 120 feet and the span of the blades is often 21 feet or more. The tower of the turbine must extend at least 15 feet above any obstruction.

The application of a domestic wind turbine on the Watervliet site would generate electricity for the projected sustainable house so that the natural landscape does not have to be tangled with power lines. According to the National Weather Service the wind conditions in the region of Albany, New York average speeds of 7 to 36 mph in the general direction of west/ northwest.



Downwind 2 BladeTurbine



Upwind 3 Blade Turbine

Photovoltaic Array

Photovoltaic cells are systems of solar panels that convert sunlight into electricity through photochemical properties according to www.solaqua.org. They were developed at Bell Labs in 1950 primarily initially for space applications. Photochemistry is the study of chemical reactions of molecules in electronically excited states produced by the absorption of infrared, visible, ultraviolet, or vacuum ultraviolet light. When the chemicals in the solar panel are exposed to sunlight, the molecules "jump" and cause the transfer of energy. This energy is then stored and sent to the home for electrical use.

Batteries make PV systems more useful when constant power is needed, but also require some maintenance. The batteries used in PV systems are similar to car batteries, but they're built somewhat differently to allow more of their stored energy to be used each day. The fluid needs to be checked in unsealed batteries periodically, and they must be protected from extremely cold weather. PV can be used for the operation of all electrical systems, including lights, cooling systems, and appliances. PV systems have few moving parts, so they require little maintenance. Many PV panels have a life expectancy of 30 years or more. The components are designed to meet strict dependability and durability standards so they can stand up to the elements (http://www1.eere.energy.gov/solar/photovoltaics.html).

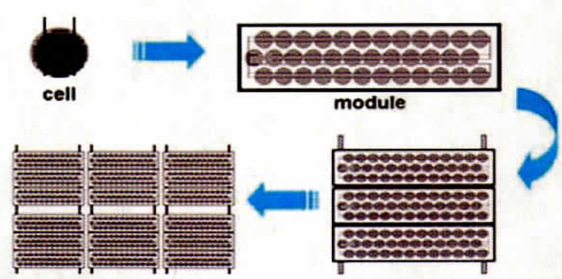
Photovoltaic cells come in numerous varieties of shape and size. (See Image ...) Many interconnected PV cells are called an array. Most residential systems require as little as 50 square feet (for a small "starter" system) up to as much as 1,000 square feet for larger systems. The size of the system determines the amount of energy produced. A typical one-kilowatt system would occupy from 80 to 360 square feet. An energy-efficient building requires a smaller PV system. When installed in conjunction with a domestic wind turbine, these renewable resources can provide for all the energy needs of an efficient house.

The cellular format makes photovoltaic arrays ideal for providing the rhythm of a grid, or modulus of building. The most useful configuration for the Watervliet sustainable house would be a roof mounted setup so as to eliminate the area of forest that would need to be cleared to accommodate a ground mounted system. Roof mounted panels on this site should be placed on southern-facing portions so as to capture the most constant sunlight all year round. (See Images below)

Rows of Photovoltaic arrays

Typical photovoltaic module

Prefab Glidehouse feature roof-mounted photovoltaic cells



Relationship of cells to modules to arrays

Solar Water Heaters

Solar Water Heating systems utilize storage tanks and solar collectors. The storage tanks need to be highly insulated so that they can retain the heat that the water absorbs. In two-tank systems, the solar water heater preheats water before it enters the conventional water heater. In one-tank systems, the back-up heater is combined with the solar storage in one tank.

There are three types of solar collector that are used for residential applications. The flat plate collectors are insulated, weatherproofed boxes that contain a dark absorber plate under one or more glass or plastic covers.
Integral collector-storage systems feature one or more black tanks or tubes in an insulated, glazed box. Cold water first passes through the solar collector, which preheats the water. The water then continues on to the conventional backup water heater, providing a reliable source of hot water. This system is not recommended for severe cold weather climates since the pipes are exposed and could possible freeze causing damage.

Evacuated-tube solar collectors feature parallel rows of transparent glass tubes. Each tube contains a glass outer tube and metal absorber tube attached to a fin. The fin's coating absorbs solar energy but inhibits radiated heat loss. (See Image on following page)

Regular maintenance on simple systems can be as infrequent as every 3–5 years, preferably by a solar contractor. Systems with electrical components may require some replacement parts after 10 years. The maintenance of these systems is virtually the same as with plumbing and conventional water heaters.

To size a system for a house a guideline of around 20 square feet of collector area for each of the first two family members is used. For every additional person, add 12–14 square feet if the site is in the northern United States. A small storage tank of 50 to 60 gallons is usually sufficient for one to two or three people. A medium storage tank of 80 gallons works well for three to four people. A larger tank is appropriate for four to six people.

By applying a solar water heating system to the Watervliet sustainable house, energy requirements would be drastically reduced and water heating costs would drop by 50% to 80%. The best location for the system to have the most solar gain would be on the south facing slope of the roof.

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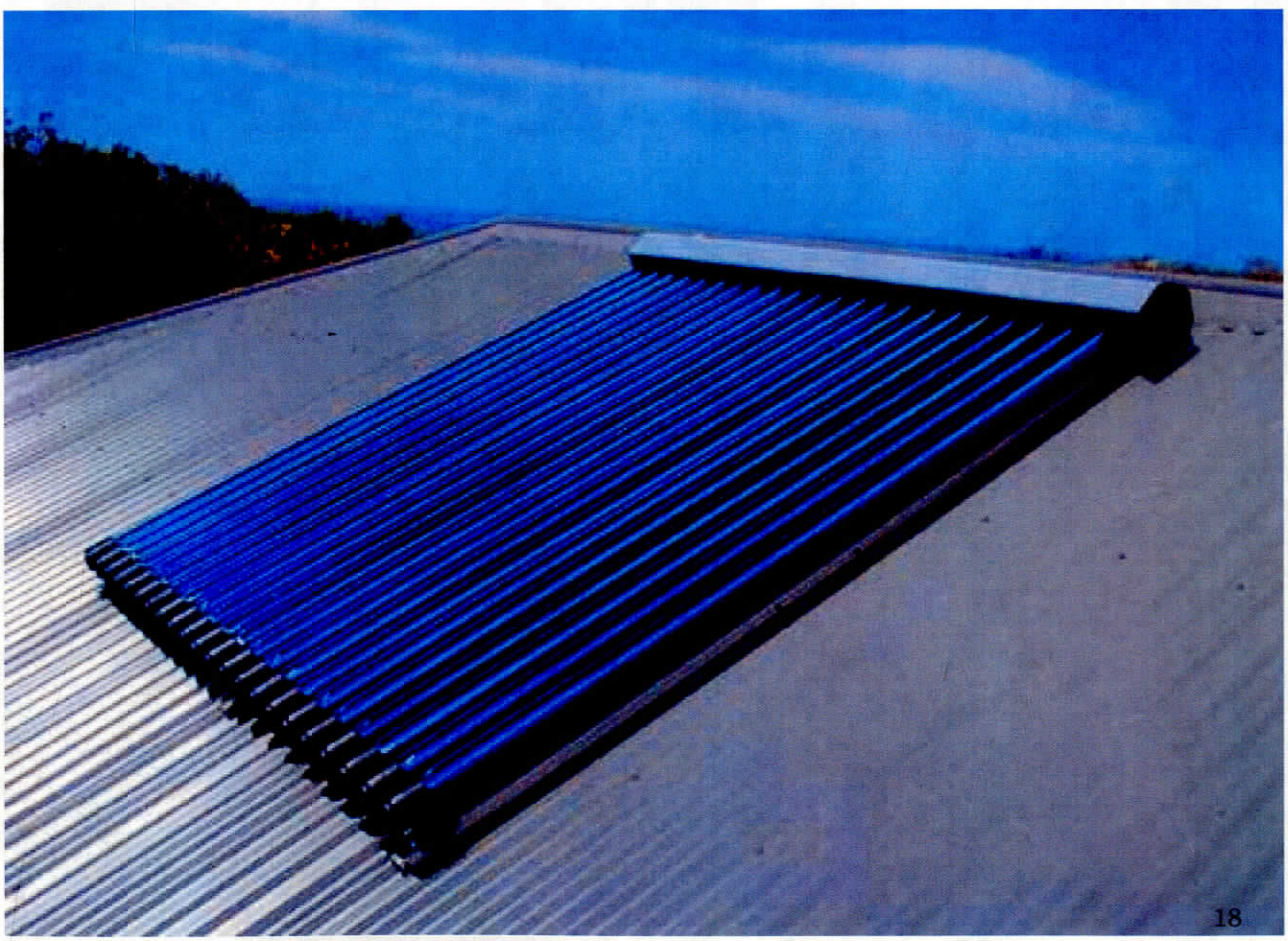


Composting Toilets

Composting toilets contain and control the composting of excrements, toilet paper and carbon additives. They are also referred to as dry or waterless toilets. They rely on unsaturated conditions where materials cannot be fully immersed in water. This is where aerobic bacteria and fungi break down wastes, just as they would in a yard waste composter. Sized and operated properly, a composting toilet can break down waste to 10 to 30 percent of its original volume. The end-product is a stable soil-like material called humus.

The prime objective of a composting toilet system is to contain, or destroy organisms that cause human disease (pathogens), thus reducing the risk of human infection to acceptable levels without contaminating the surrounding, or distant environment and harming its inhabitants. A secondary objective is to transform the nutrients in human excrement into fully oxidized, stable forms that can be used as a soil conditioner for plants and trees.

According to oikes.com, the main components of a composting toilet are a composting reactor connected to one or more dry toilets, a screened exhaust system (usually fan-forced) to remove odors, carbon dioxide, water vapor, and the by-products of aerobic decomposition, a means of ventilation to provide oxygen (aeration) for the aerobic organisms in the composter; a means of draining and managing excess liquid, and an access door for removal of the end-product.

Composting systems are usually either passive or active. Passive systems are usually simple moldering reactors in which excrement, toilet paper, and an additive is collected and allowed to decompose in cool environments without active process controls like heat, mixing, aeration. Active systems may feature automatic mixers, pile-leveling devices, tumbling drums, thermostat-controlled heaters, fans, and so forth. By making the process active, the size of the composter can be reduced, because composting efficiency is speeded up.

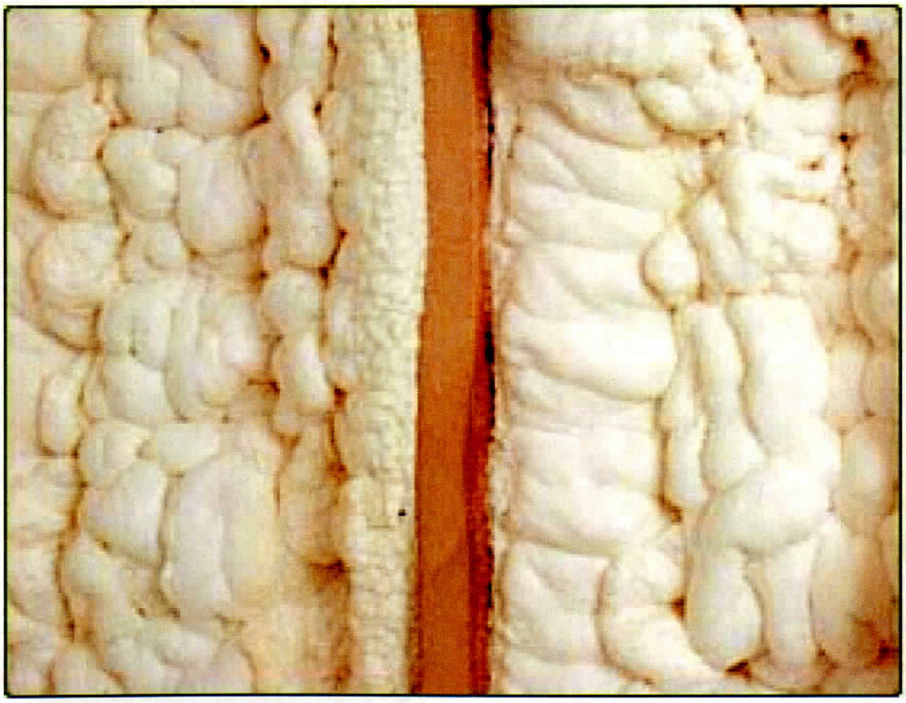
Using an active composting toilet system in the Watervliet sustainable house would enable the production of highly nutrient-rich fertilizer for the required garden and greenhouse. Also the site would not require the installation of a septic system with leach field therefore reducing the amount of trees that would need to be cleared on the site. When used in conjunction with a grey water reuse system, all the household water can be filtered through alternative methods to reduce stresses on the site and allowing the nature beauty to be preserved.

Soy Spray Foam Insulation

Soy Foam insulation is a polyurethane mixture of Isocyanate which acts as a catalyst and soy based resin. These components are combined under high pressure and heat and form cells or bubbles. The cells harden in place while they cool. The product contains no VOCs or ozone depleting chemicals and has a long life expectancy of 100 years or more. Because the foam sets in place there is no dust or hypoallergenic concerns involved with it.

Open cell soy foam insulation can achieve R-values of 3.5 to 3.7 per inch. This means that with a typical insulation allowance of 6 inches in a typical studded wall, the R-value can reach up to 22. More important than R value though is permeability. Permeability is defined as gaps that air can move freely through in an object. Permeability is one of the main reasons for heat loss in a typical home with loose insulation. In the case of fiberglass, an R value of 19 after permeability consideration may only be an R value of 10 or less in reference to actual heat loss.

Although costs for soy foam insulation is higher than conventional insulations, the benefit of a well sealed and insulated home outweighs the price.



Materials of Interest

For reasons of thermal mass for heating and cooling, fire resistance, and longevity, use recycled concrete in foundations and possibly as building structure, and specify fly ash or ground granulated blast furnace slag in cement. Specify either reusable form work or permanent insulating concrete forms which may contain recycled content. Concretes ability to be molded into forms makes is a valuable material to express structure and stability. By using different aggregates and drying techniques, many different textures can be created. The beauty of a polished concrete floor or walls can make a connection between structure and aesthetics.

Wood that is used should only be certified by the FSC and should be a rot-resistant wood species. Oriented strand board, agri-fiberboards, and fiberboards from post consumer newsprint instead of plywood should be specified. Wood is such a complimentary material to buildings sited in rural settings because of the obvious availability of trees and the fact that lumber takes much less embodied energy to produce than other materials such as steel and aluminum. Both the color and texture of wood evoke feelings of nature in its most elemental form.

For roofing and exterior wall panels use Zinc since it is 100% recyclable and uses one fourth the energy to produce than aluminum and half that of copper and stainless steel. Oak and Douglas Fir should not be in direct contact with zinc panels because it may cause the zinc to corrode at a faster rate than acceptable.

Windows should utilize triple glazing (two air spaces) so that heat gain and loss are minimized. Huge expanses of windows are a great advantage for buildings set in rural settings so that surrounding nature can be almost drawn into the house. They can also be advantageous to solar heat gain and daylighting of the interior.

Flooring options are extensive when desiring sustainable materials.
Bamboo is very hard and strong. It regenerates completely in three years, and requires minimum fertilizers or pesticides. Tile can be used in high traffic areas since the cost of replacing individual tile is less than having to replace full sheets of material. Cork floors are highly durable, easy to maintain, and come from benign renewable resources. Rubber flooring is made from 90% post consumer rubber like scrap tires. It is also highly sound absorbent making it ideal for areas requiring silence. The draw back to using rubber is the smell that can emit from it.

In conjunction to material of floor covering, the floors should utilize radiant heating and cooling as supplied by a geo-exchange system.

Shaker History

In 1774 a small group of English Shakers led by their founder, Mother Ann Lee, arrived in New York City. Two years later they settled on an aquired farm in Albany County in an area known by local Native Americans as Niskayuna. The Dutch settlers here called it Watervliet, and the town is now known as Colonie. The Shakers were also known as the United Society of Believers in Christ's First and Second Appearings and the Shaking Quakers because of their unconventional worship methods involving dancing.

Shaker's were a religious sect and were celibate by choice so there was no opportunity to pass their faith on to their children throughout generations. Instead they recruited members to maintain their numbers as well as adopting hundreds of children over the years. Family meant more than just blood relation. It was a tie of common beliefs and also of common living arrangements. Shakers had 4 basic beliefs that they lived by: 1. the confession of sins, 2. the virtues of the celibate life, 3. the equality of the sexes, and 4. the consecration of labor.

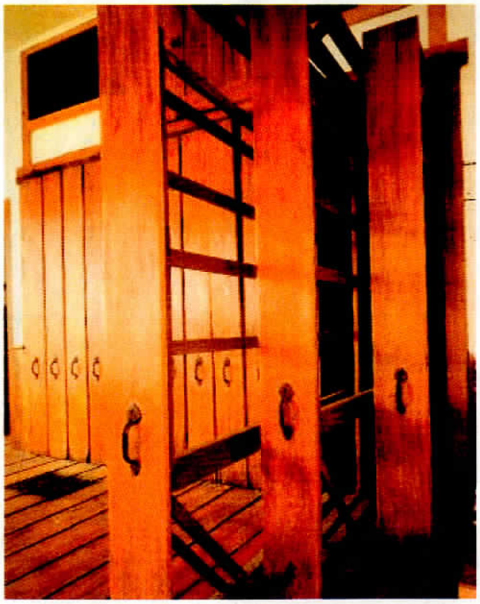
Aside from these beliefs, the Shakers also were known for their design sense. Both their architecture and furniture were exquisitely constructed, simply reductive, and well proportioned. The Shakers maintained an attitude towards their buildings that was no more sentimental than the attitude they had about their own human bodies. They believed that the body was only a vessel for the spirit. Once a body has grown frail and dies, the spirit simply moves on to another level of reality where the physical is not needed or useful. The program of some Shaker buildings over the years became obsolete and so the function of the building was altered so that the Space was still useful. Meetinghouses in the New York and New England are prime examples of this. When Shakers began incorporating large meeting areas within their dwellings, the original meetinghouses or worship spaces become unnecessary. These buildings adopted new program and this was not sacrosanct.

Form followed function. "In the Shaker world, the appearance of a thing or a person mattered only to the extent that it revealed the underlying function. Whatever did not interfere with function, served function. This allowed Shaker craftspeople a remarkable degree of freedom within what seemed to be very stringent restrictions. Placement of the useful components within space or an object was as important to Shaker design as knowing what was unnecessary. Because of this, Shaker design has an elevated sense of proportion and placement of parts of the whole.

Classic elements of Shaker design and Architecture include wrought iron latches, hinges, and handles, peg rails for storage of furniture like chairs, and built-in storage units made of wood with careful detail of drawer pulls and knobs. These storage units allowed Shaker designed spaces to remain uncluttered and organized. Shaker windows were beautifully crafted double hung frames. Despite being restricted to not include unnecessary embellishments, color was one flourish that was used to enhance Shaker design. Some Shaker craftspeople in the early and mid nineteenth century preferred to use wood stains rather than paints so that the natural grain of the wood was still visible and the material's properties were evident.

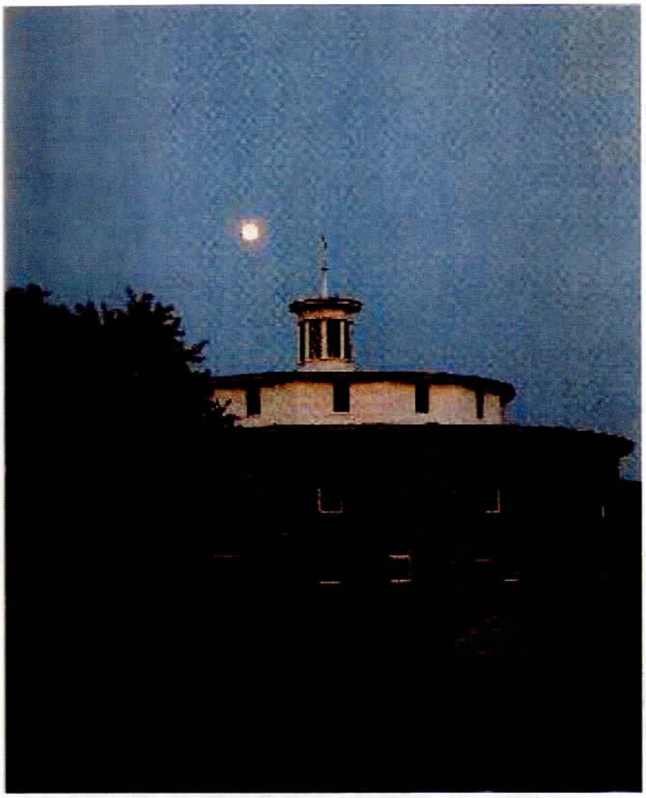
One of the most notable works of Shaker Architecture is the round barn in Hancock, MA. It was a dairy barn and the only known round Shaker barn. The hundred feet diameter barn had a specific program for each of the 3 stories; wagons, cattle, and manure. The core of the barn was designed for storage and easy distribution of hay as well as serving as a ventilation shaft. This shaft was specially designed to help prevent fire from spontaneous combustion in wet hay and to vent fumes from the nitrogen rich manure in the cellar.

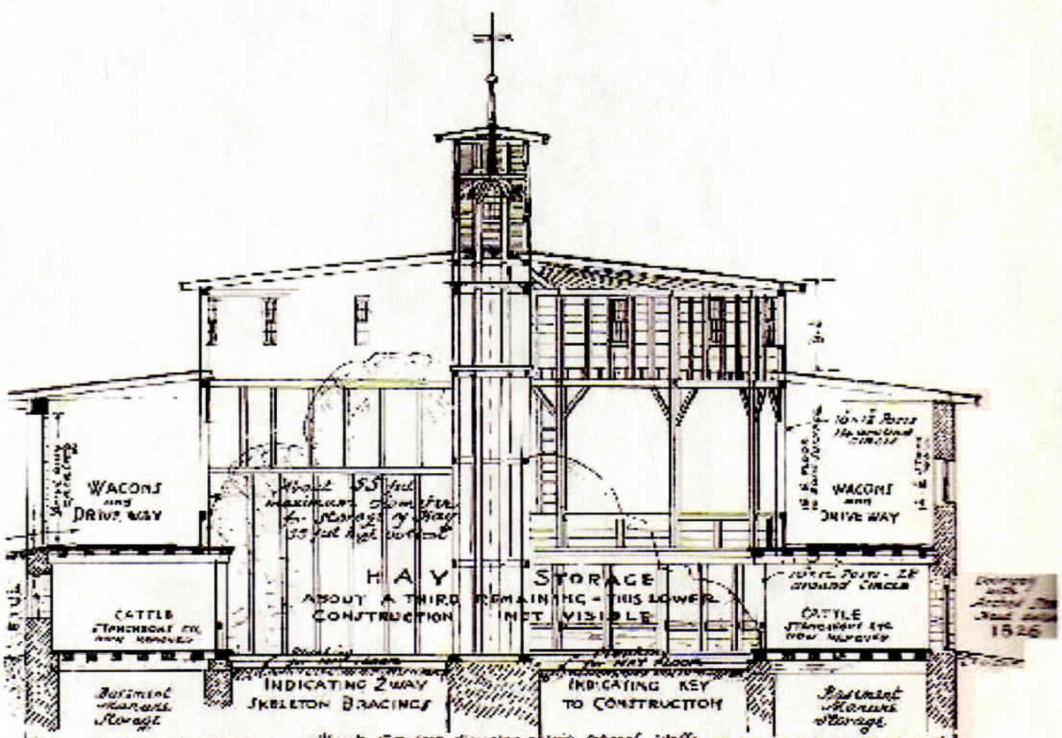
The structure of Shaker buildings was timbers in post-and-beam construction. The timbers were hewn by hand with broadaxes or sawn into shape at the mill.
They took months to prepare. On raising day, crews of timber framers hoisted the beams and fitted the carved tenons into their mortise holes.



Laundry drying racks

Attic with skylight and build-in storage



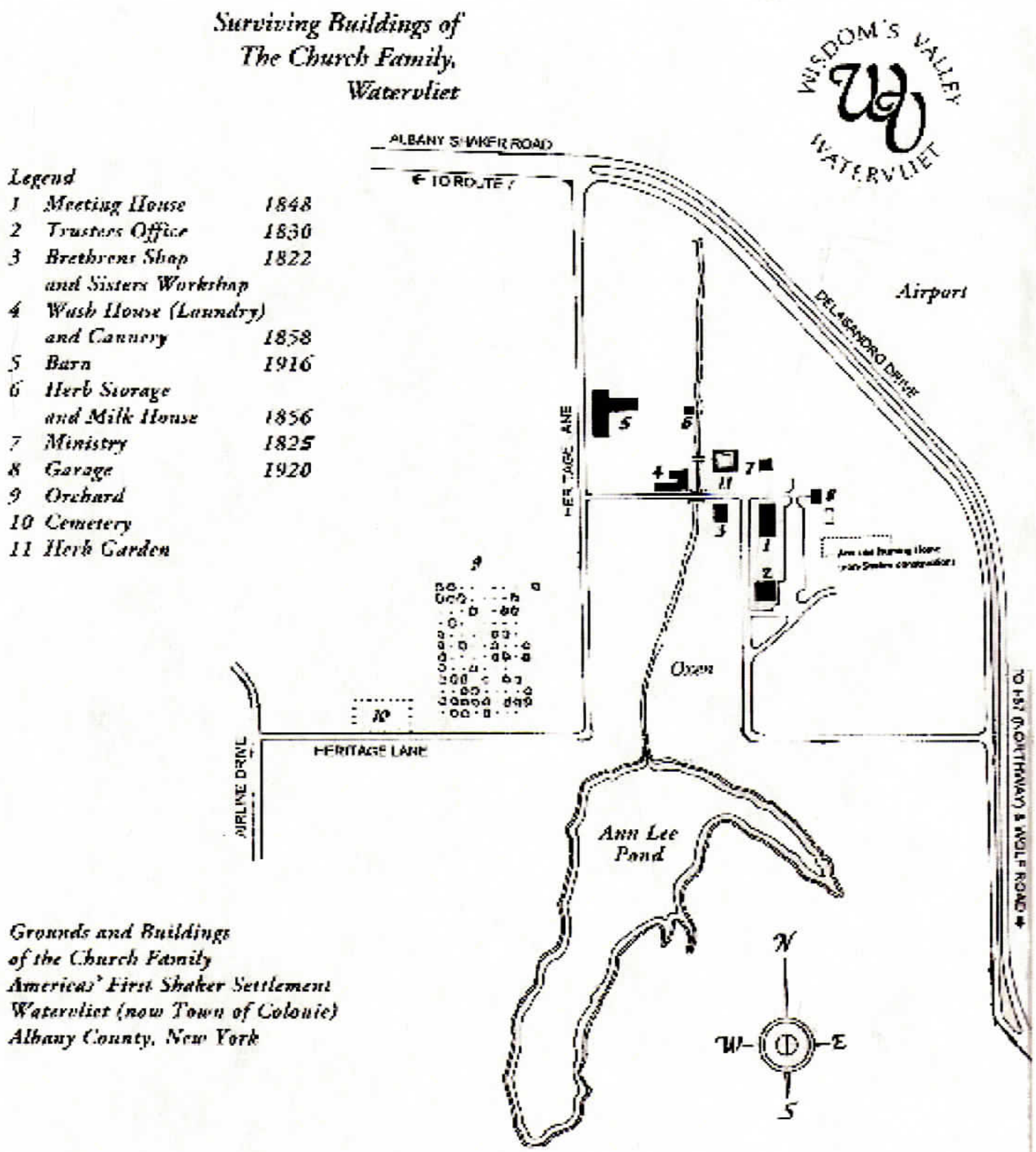


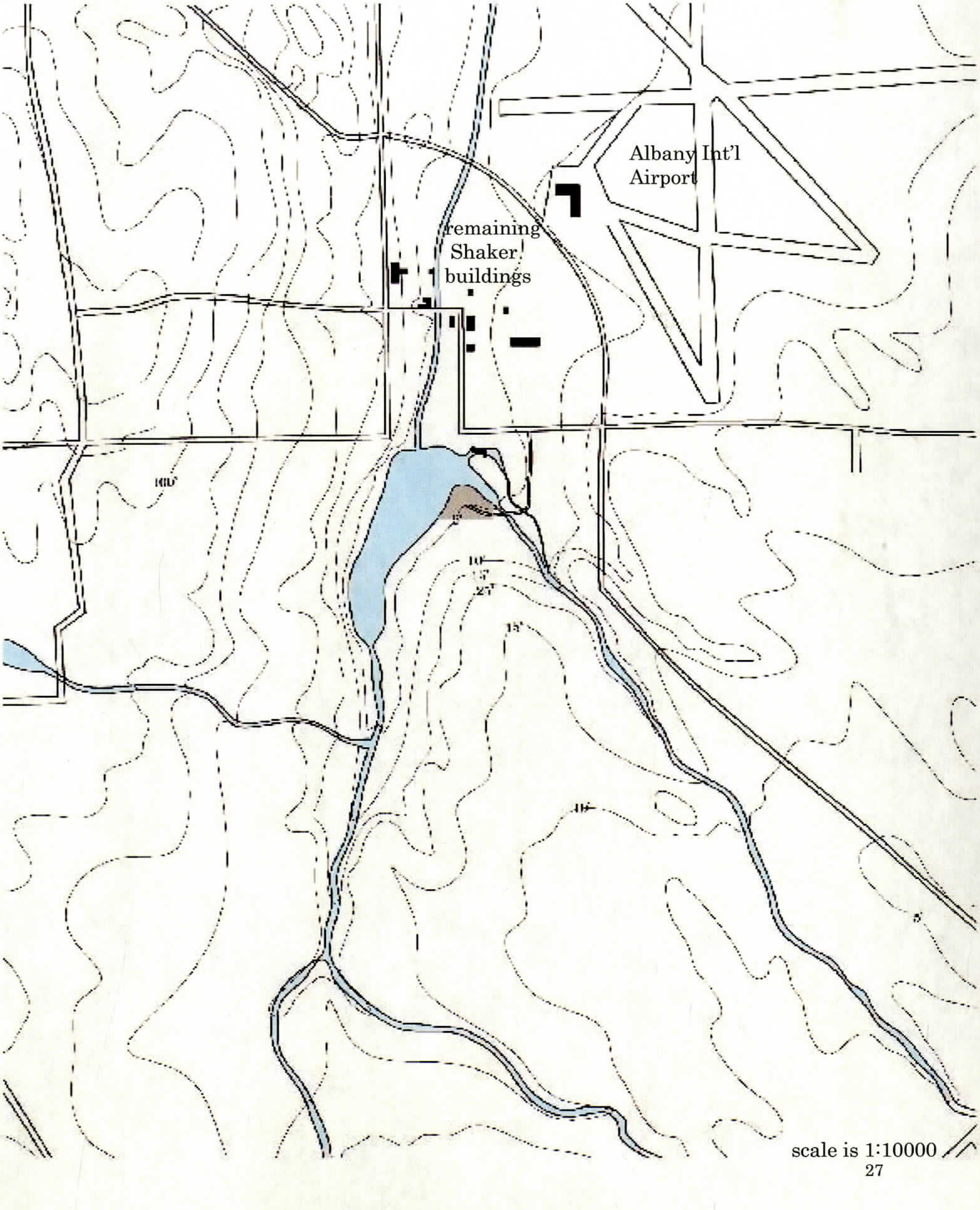
Shaker Round Barn in Hancock, MA shaker village

Interior of Round Barn, Hancock MA

Shaker Schoolhouse

The original Shaker Settlement which Ann Lee and her followers settled in 1776 was originally 200 acres, but after the community began to dissipate, land was sold off to the city of Albany. The site currently is maintained by the Shaker Heritage Society having located in the Church family area. There are eight original buildings remaining on the site as well as orchards, a cemetery, and herb garden. To the south of the main buildings lies the Ann Lee pond. The pond is surrounded by protected wetlands. Just south of this is a young, heavily wooded forest where this thesis proposes to build.





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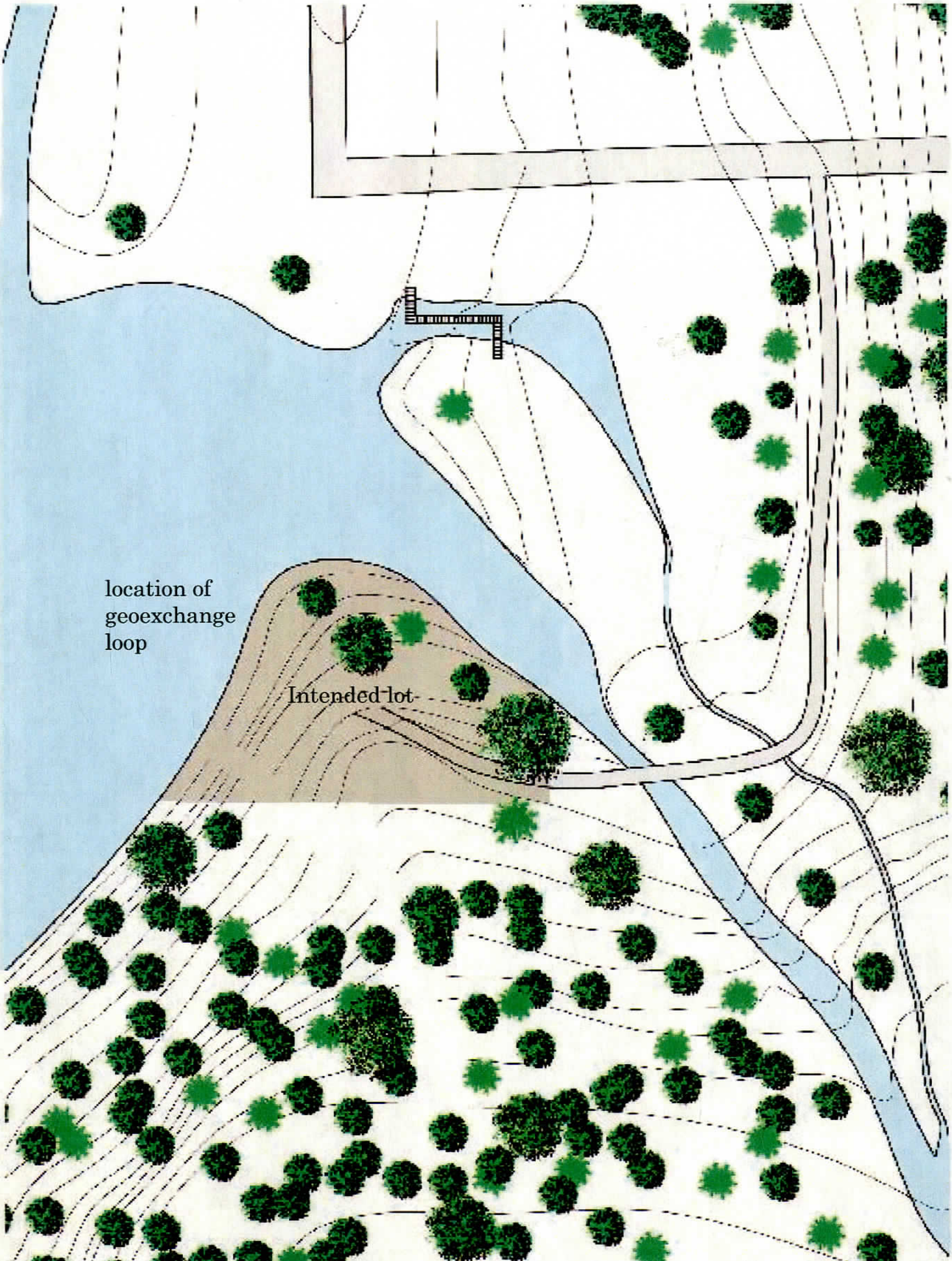
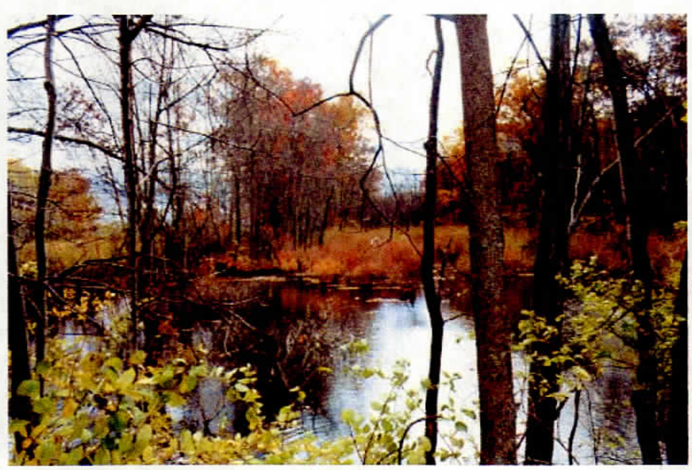


Scale is 1"=128'

"Wetland Mitigation Area Boundary No Disturbance Allowed Past this Point"

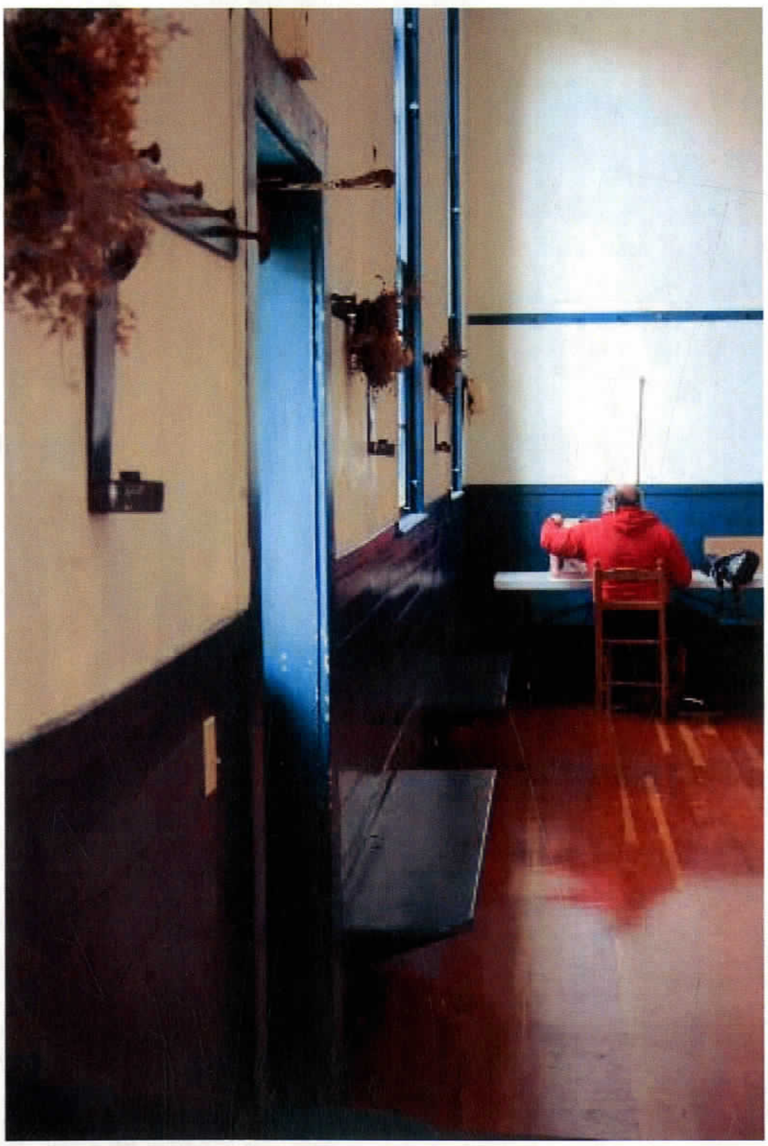


On site looking east

On site looking south

Watervliet Shaker Ministry Shop

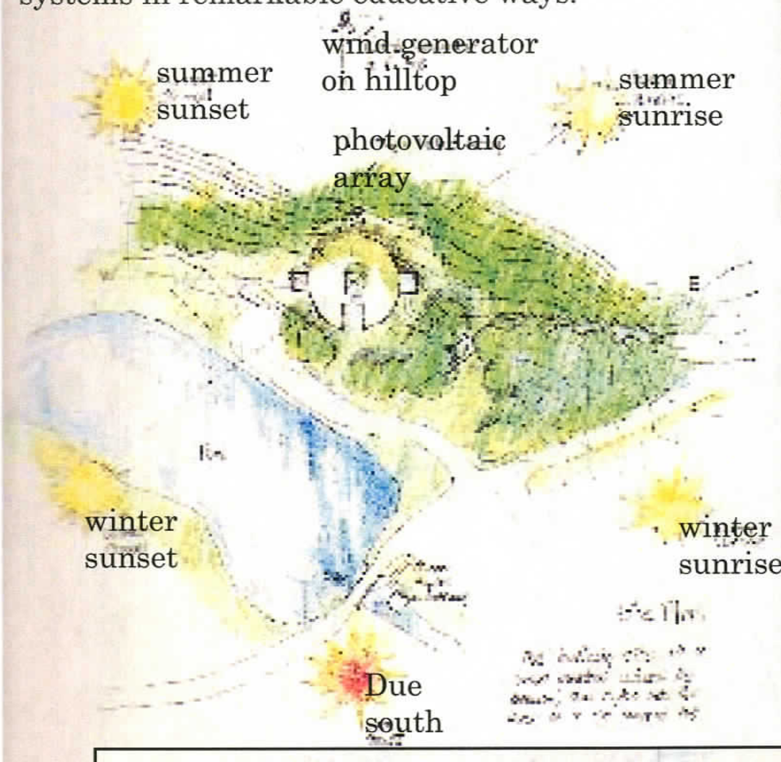
Watervliet Shaker Canery

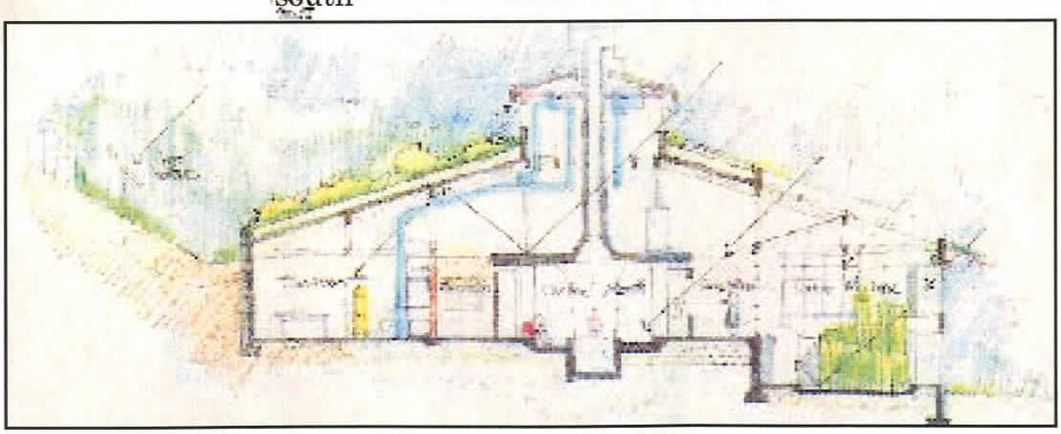


Interior of Watervliet Meeting Hall

Boyne River Ecology Center
Shelbourne, Ontario
Douglas Pollard Architects

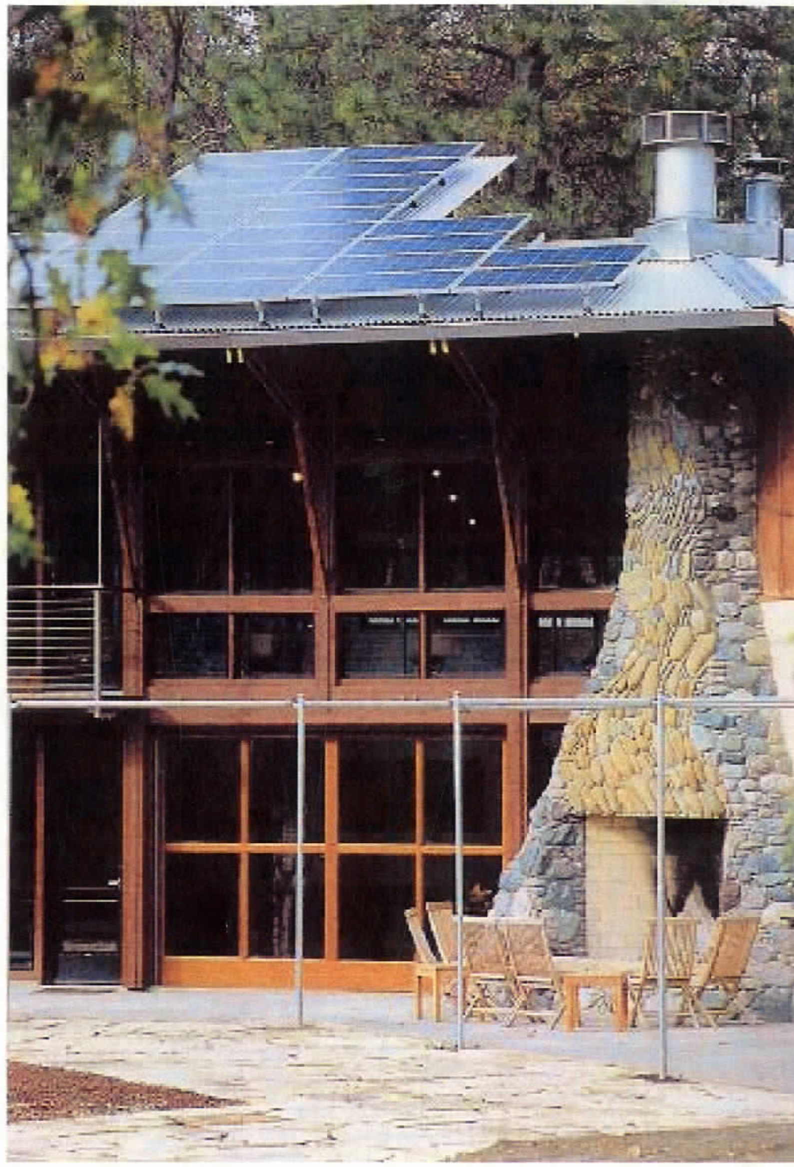
This center for ecological learning is 100% self-sufficient by creating its own power through a wind/solar hybrid system, heating through solar panels and radiators, cooling and ventilation through the use of a sod roof and a building envelope of high performance windows and insulation, as well as processing it's own waste with an in-house bioregenerative system. The space is centered on a large fireplace, but also utilizes its site by embedding into the hillside to create a thermal mass heat exchange. This building models the technologies of sustainable systems in remarkable educative ways.

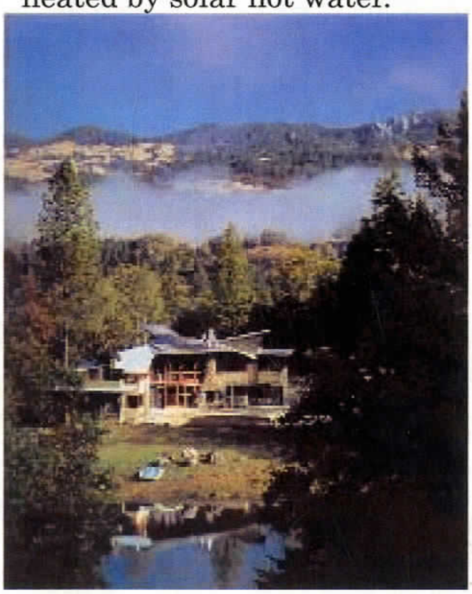


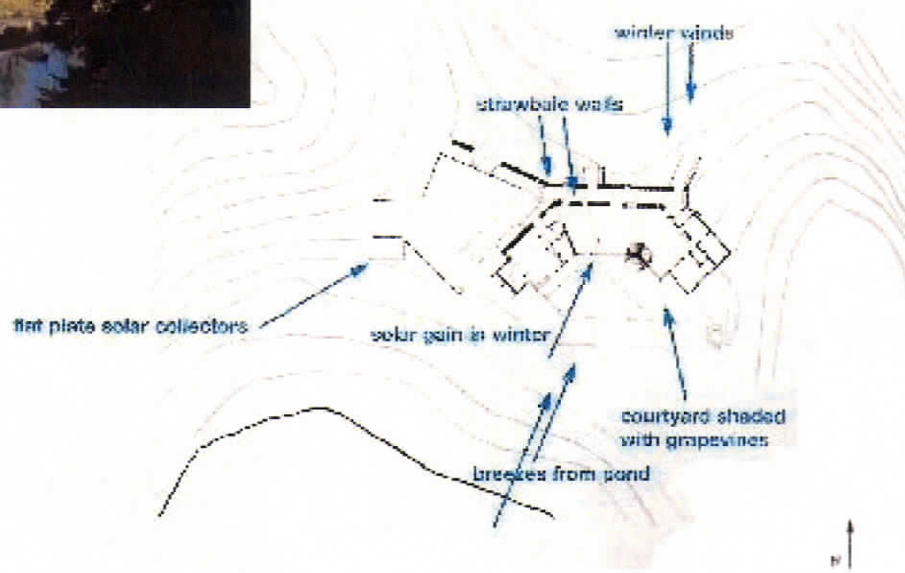


Barsotti Residence
Laytonville, CA
Arkin/Tilt Architects

This house represents the ambitions of this thesis in that it endeavors to be self-sufficient for energy. The design features a glazed frame for passive solar heat gain, Photovoltaic cells mounted on the roof which provide all electrical energy requirements, a large hearth for extra heating in the winter months, and non-loadbearing strawbale walls with post and beam construction for extra insulation. The radiant-heat floor system, domestic hot water, and outside patio are all directly heated by solar hot water.

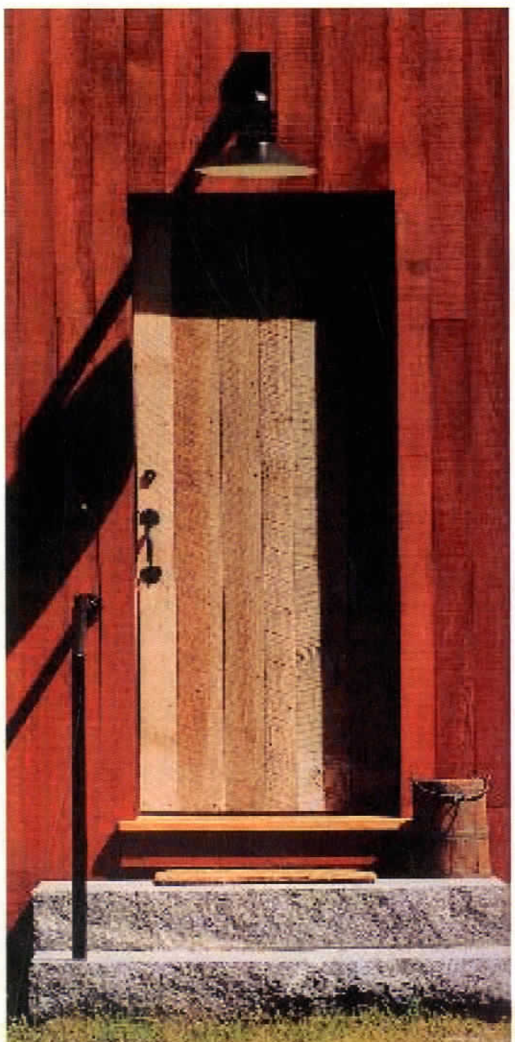


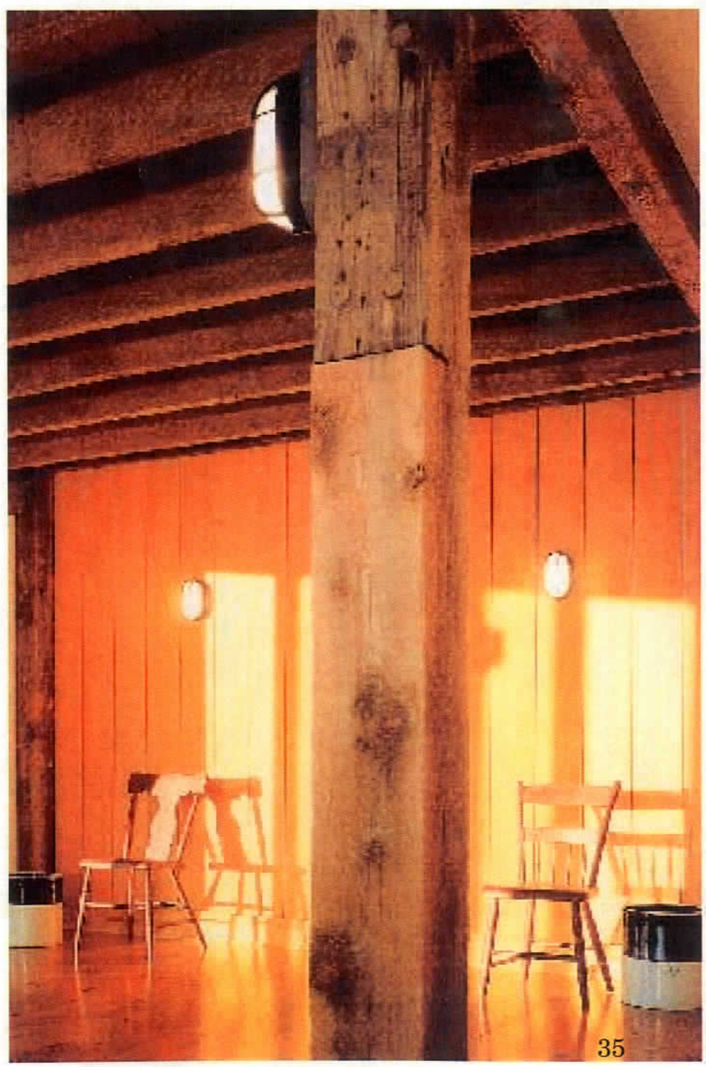




Killingworth Barn
Centerbrook Architects and Planners

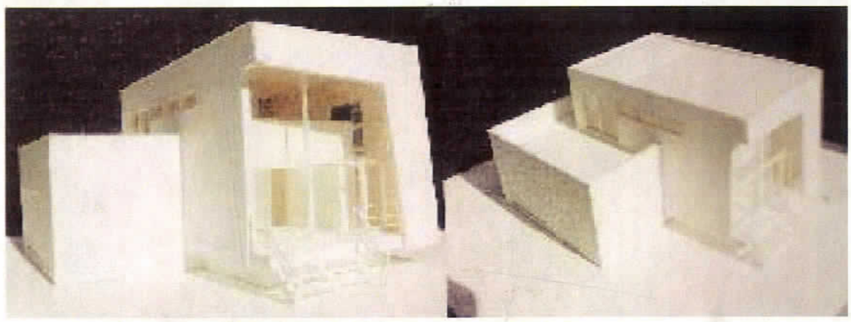
This barn turned house is a 1500 sq ft recycled space. The structural timber frame of this renovated barn is original. The siding and foundation are new, but a minimal trim and detailing were implimented to maintain the simple and economical style.

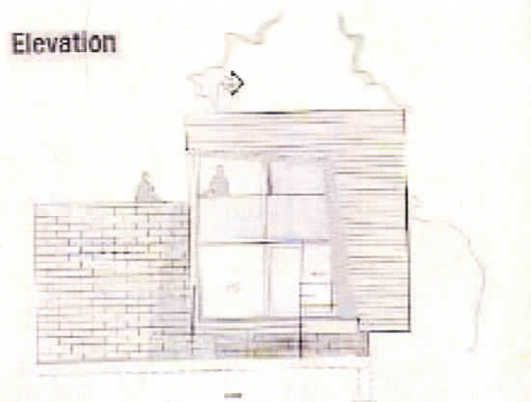




Carmel Guest House
Archi-Tectonics

This 1500 sq ft “box” house peels back to reveal a setback glass wall. The rough stone garage anchors the cantilevered box over the lakeside site. The interior utilizes a double-heighted space which physically and virtically connects the two levels to each other and the outdoors.

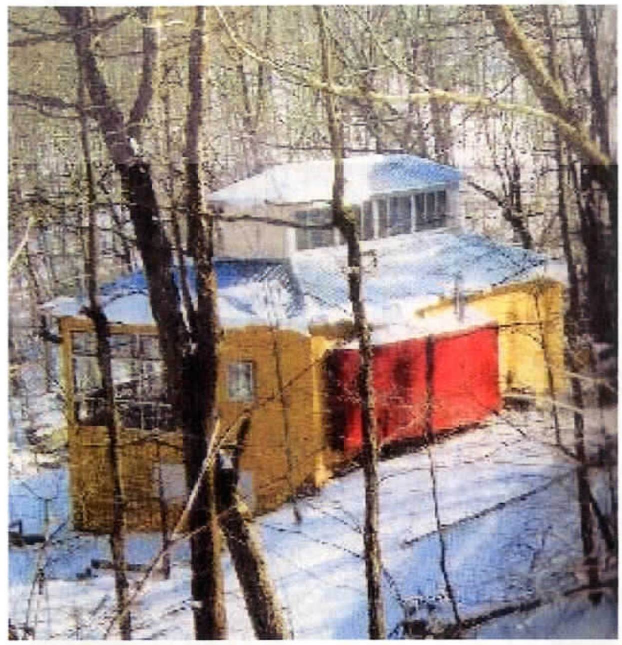




Ozark Cabin
Ozark Mountains
Joe Johnson Architect

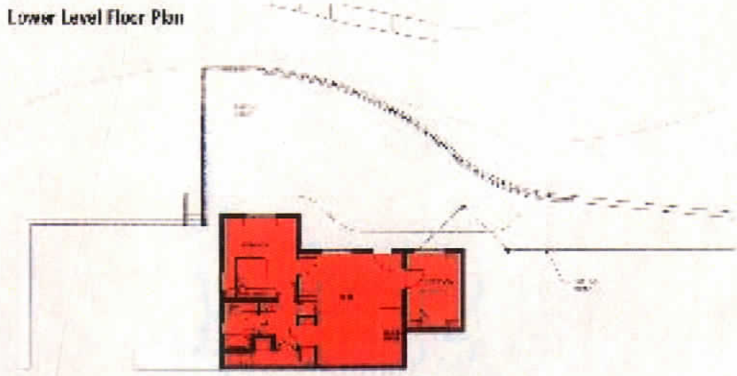
The views from this 1200 sq ft house are very important to the client. Therefore the north facade is almost entirely glass. The south facade features a monitor to capture passive solar heat and to provide natural daylighting.

Above Image is of the double-height kitchen as seen from the living area.



Top Image is view from south west.
Image above is north facade.

Lower Level Floor Plan



Upper Level Floor Plan

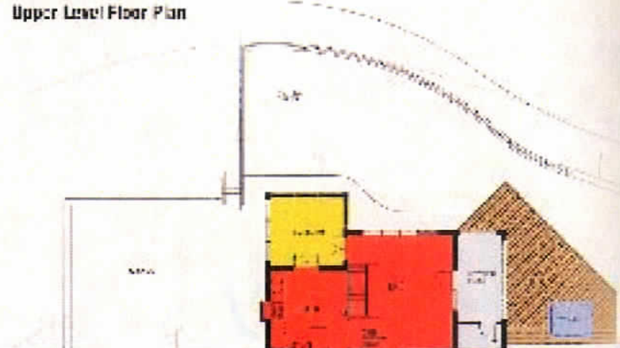
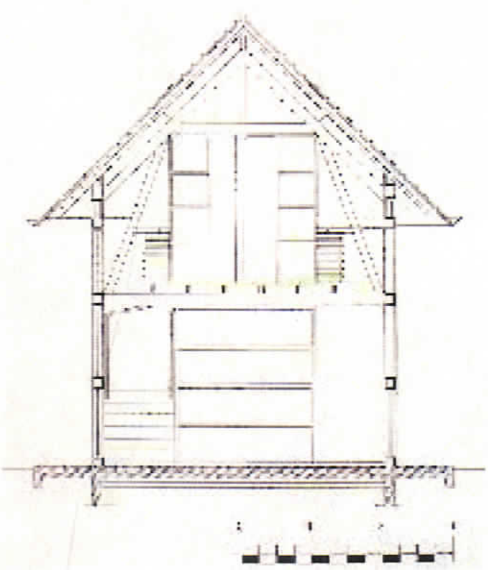


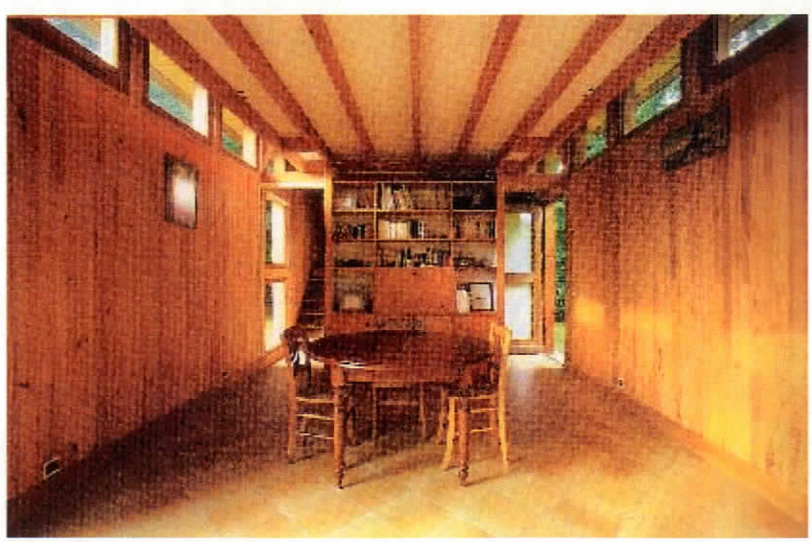
Image Precedents

Mourioux House
Creuse Countryside
Francois Depresle

This is the quintessential house typical of a child's drawing. The simple four wall timber frame construction rests on a concrete slab. The roof rests on stilts and supports a suspended mezzanine. The framed glazing of the salon is interrupted by the fireplace and chimney which splits the house in elevation along the ridgeline. The house measures 75 sq meters.

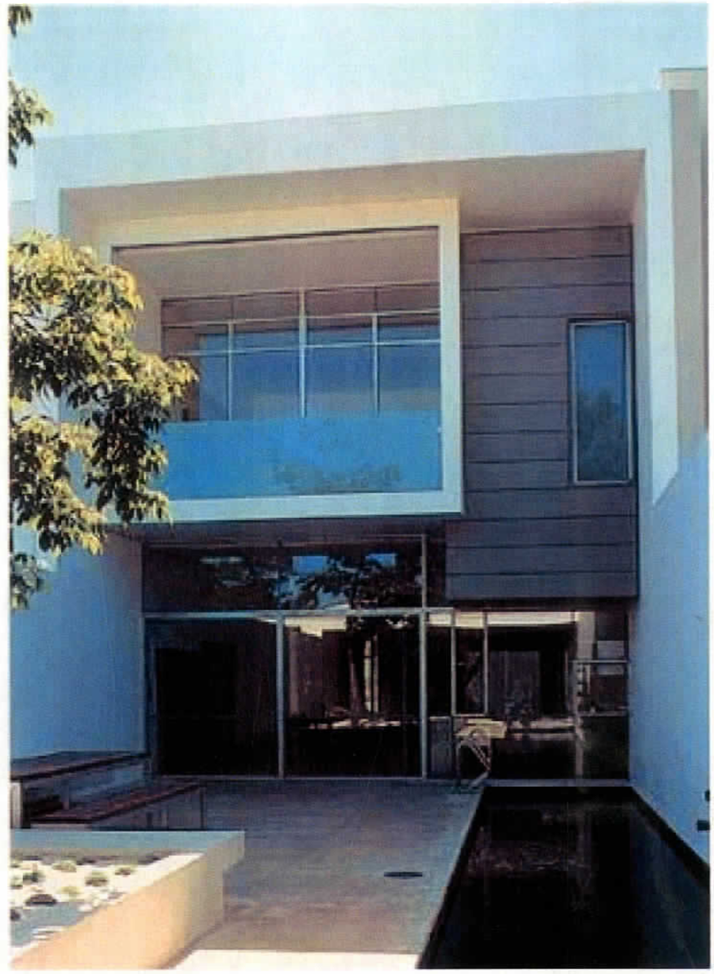
Clockwise: The above image is the front facade. The following image is the living area. Next image is the dining and storage area. Below is the section.





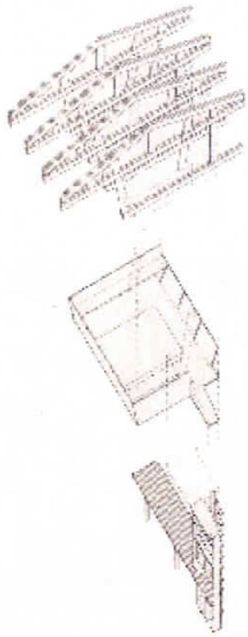
Family Dwelling
Sydney Australia
Mark Cashman

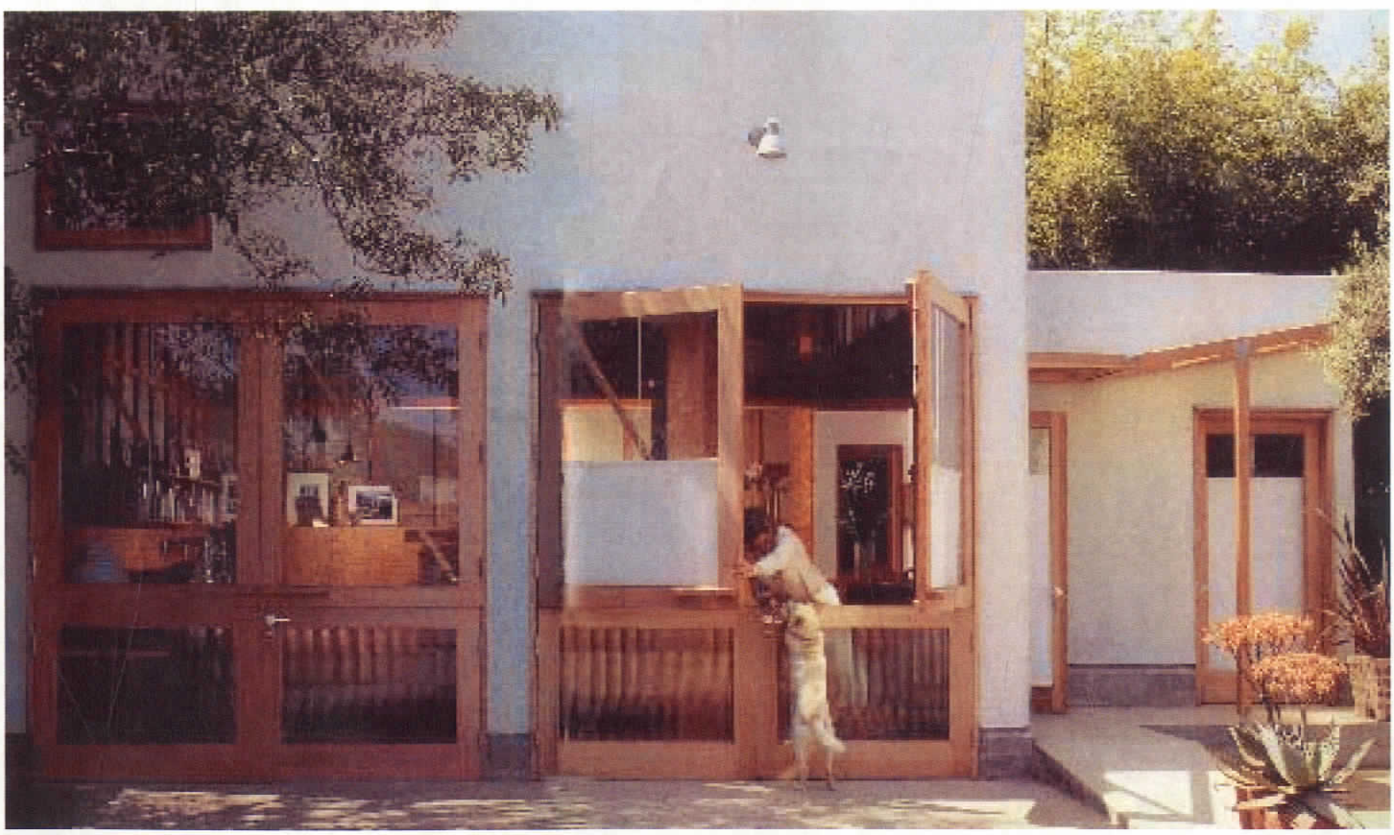
Interlocking Quarz-Zinc panels are employed as interior wall and ceiling surface as well as exterior wall surface. Zinc panels also are applicable to roofing. Rolled Zinc, when first installed, has a shiny metalic quality which over time changes to a natural semi-mat appearance. A patina forms over the surface which protects the Zinc from corrosion. A mineral pigment can be added to Zinc to give it a hue other than grey. Th reflective property of sheet Zinc can play an important part of spatial understanding in a small house. Zinc is also 100% recyclable and requires 50% the embodied energy to produce than stainless steel and 25% of that of aluminum. Zinc can be laid on a slope anywhere from 5% to vertical and is incredibly maliable, making it a truly versatile material. The life span of Zinc panels is about 100 years.



3773 Studio
Los Angeles, CA
Dry Design

This 640 sq ft studio replaced an existing garage. It is comprised of a series of vertical trays of different material. The base is poor concrete. The middle is a plywood loft hung from the roof trusses. The upper tray consists of a roof deck and garden. The design features an indoor and outdoor shower. The outdoor shower drains into a bamboo bed making the water use efficient.





Evaluation Criteria

This thesis should be evaluated based on the potential that it lends to a successful design process and the parallel methods of research used in studying sustainable systems and critical regionalism as it applies to the architectural and phylosophical ideals of Historic Shakers.

The expectation of the final project is one that sucessfully intertwines the two objectives and where sustainability can be easily identified as the catalyst of the design.

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