Living Off-The-Grid: Survival Techniques for Sustainable Living

DAY 5:
I wake up with uncontrollable shivering; the fire must have gone out. The sun comes up and I'm reluctant to go through another day. The hunger in my stomach begins, so my first chore is food. I stop and fuel up on more raspberries and cattails. The dreadful task of digging a hole, heating rocks, and boiling the water is next on my list. Throughout the day despite my soreness and exhaustion I feel more in tune with the natural rhythms of the forest. The days keep time in different ways; the early morning alarm clock of the birds as the sun pops up and burns the fog off of the lake and fields. The droning sounds of the cicada start from noon until evening. The mourning dove offers a calming song, as the belching from the bullfrogs begins to take over toward the evening. The crickets chime in with a constant chirp with a rhythmic order to end the day. For the most part of day five I walk around and enjoy nature in its chaos and beauty. I finish this hot day tired, beaten and sore but totally and utterly satisfied with a revitalized respect and connection with nature.

-5 Day Survival with Only a Knife

Introduction

Man and animal share a common trait: the primal instinct for survival. Over time, man inherited survival techniques from elders, acquired them by trial and error, by observing techniques used by animals, and the natural processes of plants. Regardless of how these skills are obtained, they are critical when it comes to the basics of survival: food, water, and shelter. Ultimately, the primal survival instinct has become diluted. In the U.S. we do not fear for our next meal, nor do we fear dehydration because of the convenience of a water spigot. Instead, we have an overabundance of amenities that take away our fear for survival and in turn we lose our appreciation of what the earth provides for us. A crucial factor to survival is the responsible use of nature; making use of every part of a resource and taking only what one may need. Today people all over the world, especially in the United States, sacrifice sustainability for luxury such as using air conditioning over natural ventilation. The approach many countries take with respect to resources is wasteful; buildings may facilitate massive yields of recycled material or can continue to become major waste problems. Author of *Defining an Ecology of Construction,* Charles Kibert writes, "It is estimated that as much as 90% of the extracted stock of materials in the USA is contained in the built environment, making it a potential great resource or a future source of enormous waste."[1] A stronger effort towards moving off-the-grid should be made from our current culture to establish a balance of giving and receiving; a primary principle in survival. Can these primal survival ideals influence a more sustainable design that will begin to take us off-the-grid?

In this paper I will begin by discussing opposing views on off-the-grid living and survival standards by defending the importance of implementing these sustainable strategies into building design. I will endorse my stance and discuss the wasteful use of resources in the built environment. I will describe how aboriginal tribes have lived sustainably by managing their environment as well as provide my own five day survival experiment with merely a knife. Next, I will compare sustainable concepts from LEED and Passive House. Finally, I look at methods for an off-the-grid lifestyle.

Antithesis: Technology = Power Over Nature

Many people are blinded by the false sense of security that technology provides. They believe technology and science has solved our problems of survival, and that we no longer require these skills or ideals anymore; "that technology will fix our problems".

This may be true to an extent, however, what cost are we willing to pay? The degradation of our natural resources seems to be the price. Author of *Encyclopedia of Environmental Science*, John Mongillo writes, "Deforestation is most severe in the tropical rainforest of Africa, Asia, Central America, and South America. About 45 million acres of tropical rainforest are cleared annually." [2] Other than deforestation, the rate at which oil is consumed is devastating, especially in the United States. According to the CIA World Factbook (2008 est.), the U.S. is ranked number one in oil consumption at 19,500,000 barrels per day (bbl/d). Compare this to third ranked China at 7,999,000 bbl/d.[3] The degradation of our natural resources is not the only problems people face.

Health concerns are becoming an issue from areas that are in close proximity within extraction of these materials. In Oklahoma, the entire community of Picher (Tar Creek) was contaminated as a result of zinc and lead mining. Reporter for *Time*, Margot Roosevelt writes, "In the past decade, studies have shown that up to 38% of local children have had high levels of lead in their blood- an exposure that can cause permanent neurological damage and learning disabilities."[4]

Some may argue that they do not want to forfeit their luxuries. I am guilty of this myself; I enjoy the small comforts in life. However, when I placed myself into the survival scenario, I was completely stripped of any comforts. Towards the end of the ordeal, even the simple use of a match would have been priceless. Perhaps we do not need to go to these extremes in order to rescue the environment, nevertheless, there will be a need for major changes including the sacrifice of some personal indulgences.

Wasteful use of resources

Our built environment has enormous negative impacts on the ecosystem such as poor air and water quality, erosion and solid waste.[5] Author of *Construction Ecology*, Charles Kibert notes:

> In the USA, construction and demolition waste accounts for the majority of industrial waste, amounting to perhaps 500 kg per capita or of the order of 136 million metric tons (MMT) annually.[6]

Developed countries such as the United States do not put a high emphasis on environmentally friendly practices such as the recycling of building material, water use, or by setting stringent requirements on waste disposal. Kibert writes that "American industry functions in an economy marked by a strong culture of almost pure market response, low levels of government intervention, and a history of cheap resources and low waste disposal costs."[7] This mentality and the voracity of pure economical gain is leading the world toward a dire situation. The earth's resources will not sustain us forever. Since the built environment accounts for a major portion of the extracted materials, we should discover more sustainable solutions in the methods and design of our structures.

Although building material recycling centers are a good beginning, governments need to create greater incentives for the proper collection of these materials. To assist in this process, manufacturers and designers need to produce materials that can to be taken apart more easily to simplify recycling. If greater incentives do not work, code or the government should mandate the recycling of building material. Sustainability should not simply be generated from a reward system, but rather exist as an ethos to follow in everyday life regardless of the motive.

Native Americans and Nature

The Waswanipi Cree are a group of subarctic hunters that are able to survive in a harsh climate by managing their land and wildlife. The Waswanipi originate from the Boreal Forest in Quebec, Canada. According to Harvey Feit, author of *Waswanipi Cree Management of Land and Wildlife*, the Waswanipi follow certain beliefs and responsibilities when hunting:

> The bodies of the animals received by the hunter nourish him, but the soul is reborn, so that when men and animals are in balance, the animals are killed but not diminished, and both men and animals survive.[8]

Two primary responsibilities are not killing too many animals, and using everything that is possible from the animal. The Waswanipi believe success in hunting is dependent on the careful adherence to the rituals of the previous hunt. In an area where much of the temperature is below freezing, hunting success is vital to the Waswanipi. In order to remain successful in the hunt, the Waswanipi will rotate hunting locations so they will not kill too many animals in any given area.

This kind of respect for nature is not limited to the Waswanipi Cree but is also found in many other aboriginal tribes. According to Kat Anderson, author of *Tending the Wild,* Native Americans "all over California, followed two overarching rules: Leave some of what is gathered for the other animals and do not waste what you have harvested."[9] Following this ethos, Native Americans of California, like the Waswanipi, have survived sustainably by managing their resources in order to promote the general well being for man and nature.

Native Americans are often romanticized as being perfect stewards of the environment. However, Native Americans are human and humans make mistakes. This holds true for the Cahokia people of southern Mississippi. The Cahokia built colossal earth mounds such as Monks Mound.[10] In order to construct these mounds, tons of earth was excavated from upstream. The combination of excavating major volumes of soil, burning and clearing of land, and rerouting river systems are mistakes that ultimately led to flooding that ruined the Cahokia's crops. This scenario repeated itself until the problem was realized and resolved. Charles Mann, author of *1491,* writes, "Cahokia's rise coincided with the spread of maize throughout the eastern half of the United States. The Indians who adopted it were setting aside millennia of tradition in favor of a new technology."[11] This example goes to show that through a time of growth we must acknowledge and fix the problems that may arise.

Synopsis of 5 Day Survival Experiment

Nature is a great classroom to discover how to survive sustainably within our environment. After completing this experiment, my experiences and observations helped to further my knowledge of how these survival ideals can be used for sustainable design technologies for buildings. For example, one method that people have used in survival situations to gather water is by constructing a variation of the evaporation still, invented by Dr. Ray Jackson and Dr. Cornelius van Bravel from the U.S. Department of Agriculture. (Fig.1) Two of these smaller scale stills could generate enough water for one person per day.[12]

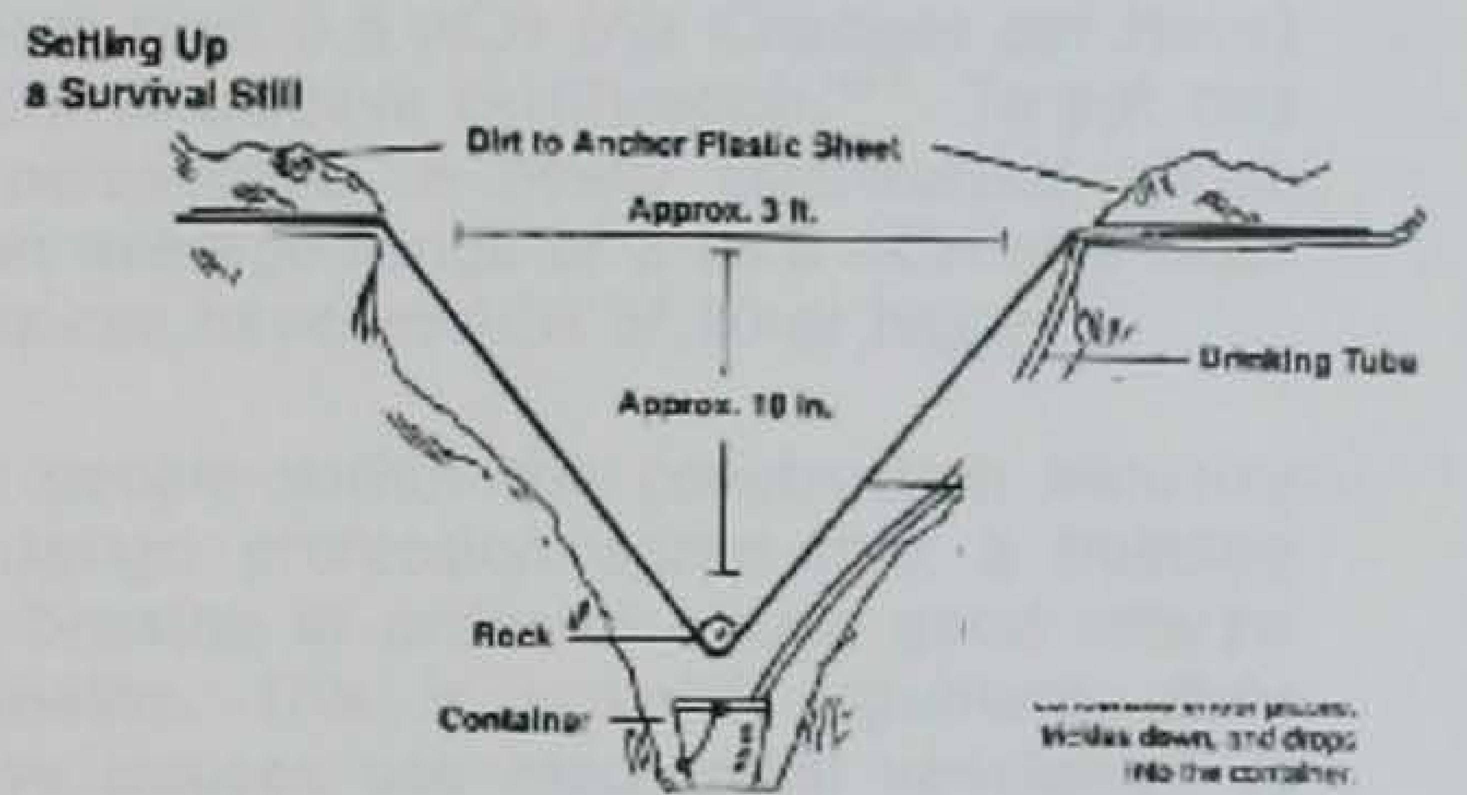


Fig. 1- Survival solar still

After experiencing a true survival situation, I understand why people are attached to certain luxuries they are unwilling to give up. Completing this experiment with just a knife, I feel that a couple of small luxury items such as fishing hooks and a metal container for boiling water would have made a world of difference. I also came to the realization that all of my senses seemed to have been heightened, especially my sense of smell. I felt as if I was able to taste the smell of the flowers as I came close to a field or could smell pine trees from a further distance (a true olfactory overload).

My hunger levels surprised me. Before I began this five day survival experiment I assumed that my hunger was going to be unbearable; it was bad, but not compared to the ravenous mad man that I thought I would be. I would venture to say that in today's age most people eat because it is readily available in large amounts; not because they are hungry. "True" hunger is rarely felt in the average middle class American. I have felt true hunger; it is very uncomfortable and plays on one's mind throughout the day. As I kept myself busy and attempted to capitalize on nature's flora and fauna, I was able to suppress these discomforts.

On the third day, I noticed a dramatic loss of energy due to stress and a lack of food and water. The bugs were relentless by attacking me as I was walking through the bush and biting me as I lay to sleep. Dehydration was a major factor that came into play (as I anticipated it would). Finding water and making it safe to drink was not only a priority on my list but a necessity. It was very time consuming preparing enough water for myself each day. As mentioned earlier with the heightened senses, the taste of things that were consumed had a very distinct flavor. The list and description of the edibles are as follows: Raspberries- sweet, soft and delicious, worms- slimy and crunchy with a dirt taste, Cattail bulbs- starchy but good, Cattail stem- mild cucumber taste, Day lilies- tangy but the bulbs were mild, Bullfrogs- tasted like chicken, Snapping turtle- absolutely wonderful, a combined flavor of chicken and fish.

My conclusion is that today, it is not feasible for people to give up all luxuries and comforts. However, this experiment does lead me to believe that there may be off-the-grid alternatives within reach of the public. We can still move forward, but in a different, environmentally-sound way: off-the-grid.

Scrutinizing LEED and Passive House Standards

Are we approaching sustainability with sincere objectives? Today it seems that "green" design has become more of a marketability strategy than a genuine concern for the environment. Perhaps seen as a fad, being "green" is beneficial, as it can begin to make people aware of sustainability issues. Green is a step in the right direction; however we should scrutinize standards and requirements used by programs such as LEED (Leadership in Energy and Environmental Design) and Passive House. Therefore, to acquire a contemporary point of view on green design, I began studying to become a LEED Green Associate as well as conducting research on Passive House standards. By analyzing these programs we may see possible benefits that can be offered, as well as faults in the systems.

Passive House (PH) is based on a simple yet stringent set of principles. The focus of PH is of conservation first by reducing demand as a way of maintaining the sustainability of resources. This is achieved through airtight construction, reduction of thermal bridging, increased insulation, high performance windows and doors, building orientation and the installation of heat and energy recovery ventilation systems. By following these standards, PH allows for up to a 90% decrease in energy from heating and cooling. For air tightness, Mary James, author of *Homes for a Changing Climate*, states, "At a standard test pressure of 50 Pa, a Passive House must allow no more than 0.6 ACH (Air Changes per Hour) in order to achieve certification."[13] To put this into perspective, a newly constructed house has an average range of 3 to 6 ACH and older homes can have an ACH of 10 or higher.

Many people within the construction industry and design profession agree that a building must breathe in order to obtain good interior air quality. This is a valid argument, thus Passive Houses use mechanical ventilation to circulate controlled volumes of air instead of indefinite amounts of air through infiltration. The ventilation system that PH uses is heat recovery ventilators and energy recovery ventilators. These allow exhaust air to transfer its original temperature to the incoming air without mixing together. Incoming air becomes pre-heated or pre-cooled before reaching the supply air into a home, which in turn, dramatically decreases the energy needed to cool or heat the air to the desired temperature. (Fig.2)

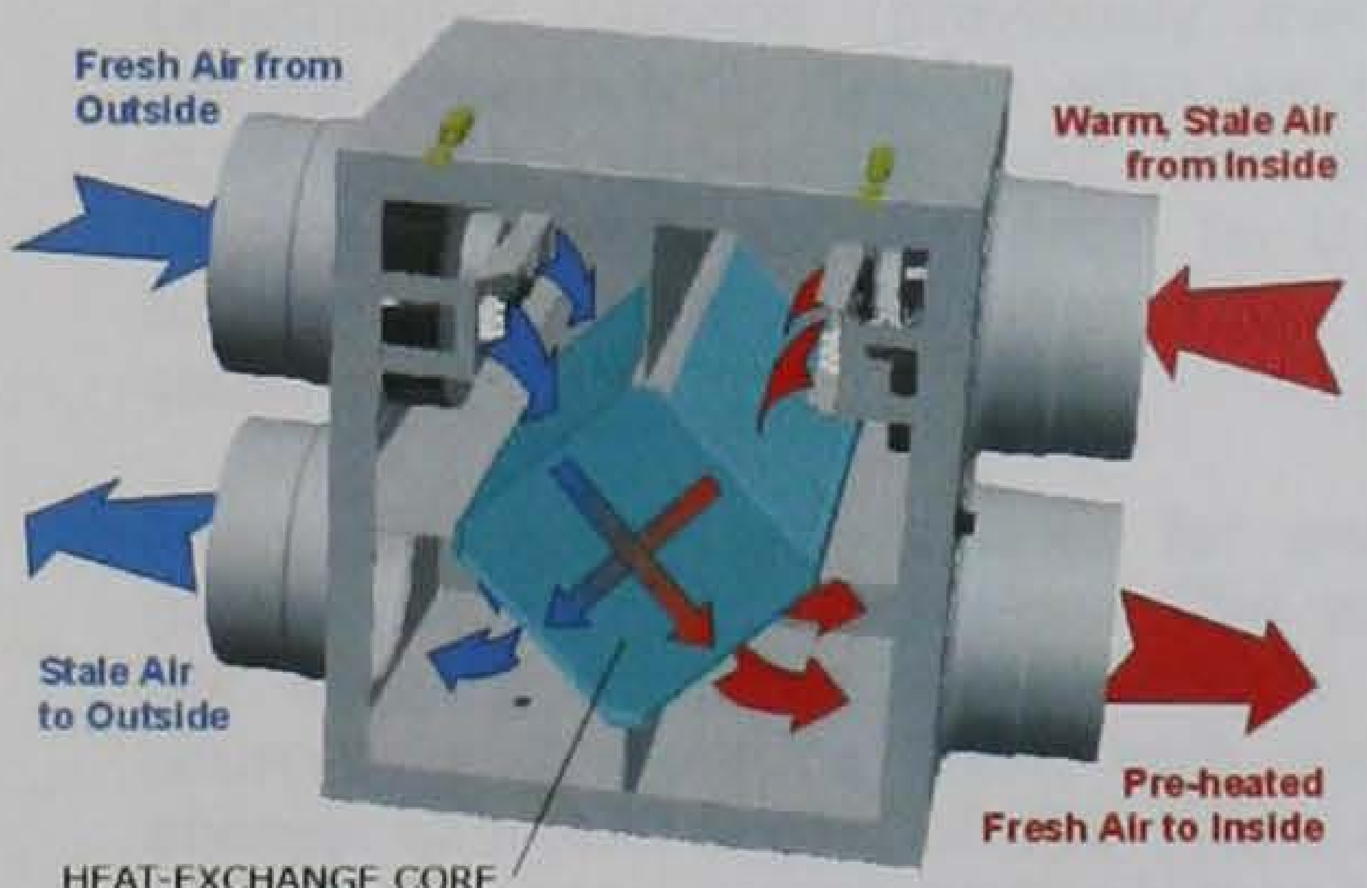


Fig. 2- Heat Recovery Ventilator (HRV)

One of the most popular ways of going green in the design field is by using LEED standards. LEED outlines many different categories for green design including; site factors, systems and energy impacts, material and resources, water management, and involvement in innovation. These categories have many sub-categories that allow design teams to combine different strategies in order to gain the points necessary to have the building become LEED certified.[14] The standards are not as rigorous due to the multiple paths a building can take to become LEED certified. For example, in the *LEED Reference Guide from the U.S. Green Building Council (USGBC),* WE Credit 1: Water Efficient Landscaping offers 2 points for reduction of 50% of potable water used for irrigation.[15] This standard does not seem strict enough, but it is a step in the right direction.

Both LEED and Passive House have standards that are beneficial to the environment. However, PH has a much more demanding set of standards that make it successful. Great Britain has realized this and is now demanding that all new buildings meet the Passive House standard, by the year 2013.[16] LEED has a broader set of categories, which may not be strict enough to make a major impact. Critiques such as Mireya Navarro declare that the rating system for LEED buildings is flawed and that some LEED projects have reported an increase in energy consumption.[17] However, LEED, (unlike PH), offers sustainable techniques apart from building construction, such as stormwater management. Passive House and LEED are working toward an overall more sustainable way of living. However, in order to achieve goals such as zero energy consumption, their efforts will need to be more extreme. The amalgamation of PH's strict energy efficiency standards and LEED's breadth of environmental categories, provide the ideology for an off-the-grid living scenario.

Off-the-grid

Going off-the-grid is a compromise between the extreme survivalist standards and the mediocre standards of sustainable design today. In order to truly live off-the-grid one must provide everything for themselves; from energy and waste management, to food and water. Placing people in this type of mindset is difficult; few people want to give up luxuries. But there are important aspects that can influence people toward this kind of lifestyle. One is the simple act of saving money by lowering energy bills. Even without being totally off-the-grid, one can make an initial investment and have it begin to pay off. However, this may be limited to people who can afford the initial investment.

In addition, with the economic and environmental instability of the world, the possibility exists that we may be forced into living in extreme conditions with no grid available. In a majority of their areas, third world countries are used to not having power, but if a crisis were to arise are most people ready? Some people desire off-the-grid communities in case of catastrophic events such as natural disasters, economic downfall, terrorism, or any other unforeseeable circumstances. There are even companies, such as Hardened Structures Hardened Shelters, that specialize in building fortified facilities for these types of disasters.[18]

The most important reason to move toward living off-the-grid is for the rejuvenation of the environment. Overpopulation and industrialization have brought the world's natural resources to the precipice of total diminution. Oil production for example is on a bell curve; the top of that bell curve is what some refer to as "peak oil". After reaching peak oil, there will be a steady decline in oil production. Consequently, industrialized, oil dependent nations such as the U.S. will begin to go into another depression or even worse. For those that do not believe in peak oil, there is evidence suggesting that an electromagnetic pulse from the sun is imminent.[19] This blast would knock out electrical grid systems leading to blackouts lasting months to years causing catastrophic damage (previously mentioned, natural disaster).[20] This is why we need to start being self-reliant and to use the environment responsibly in order for the Earth to heal from the devastation that we are causing.

There are many opportunities for people to gather energy to go off-the-grid. The goal is to get away from using non-renewable energy sources, and replacing them with renewable energy sources. Some of the more obvious choices for energy are: hydroelectric systems from moving water, wind turbines for collecting wind energy, and photovoltaic cells to collect sunlight. Other more innovative strategies have been used, for instance, a Mennonite community using a horse treadmill to turn a turbine and produce electricity (Fig. 3).

Fig. 3- Horse treadmill

There are also many ways to provide clean water for an off-the-grid lifestyle. If there is an opportunity to gather water from streams, ponds, wells or springs then that is a viable strategy to collect water, although purification systems may have to be installed. If all of the aforementioned systems are not available then rainwater and precipitation harvesting may be the answer. Rainwater employs a multitude of non-potable functions such as flushing toilets or irrigation and can also be utilized for potable functions such as drinking and cooking water. Additionally, there are ways to collect water from evaporation. For instance, in Kerala, India a research team has modified the solar still to provide potable water for people in need (one still generates two liters per day).[21] (Fig.4)

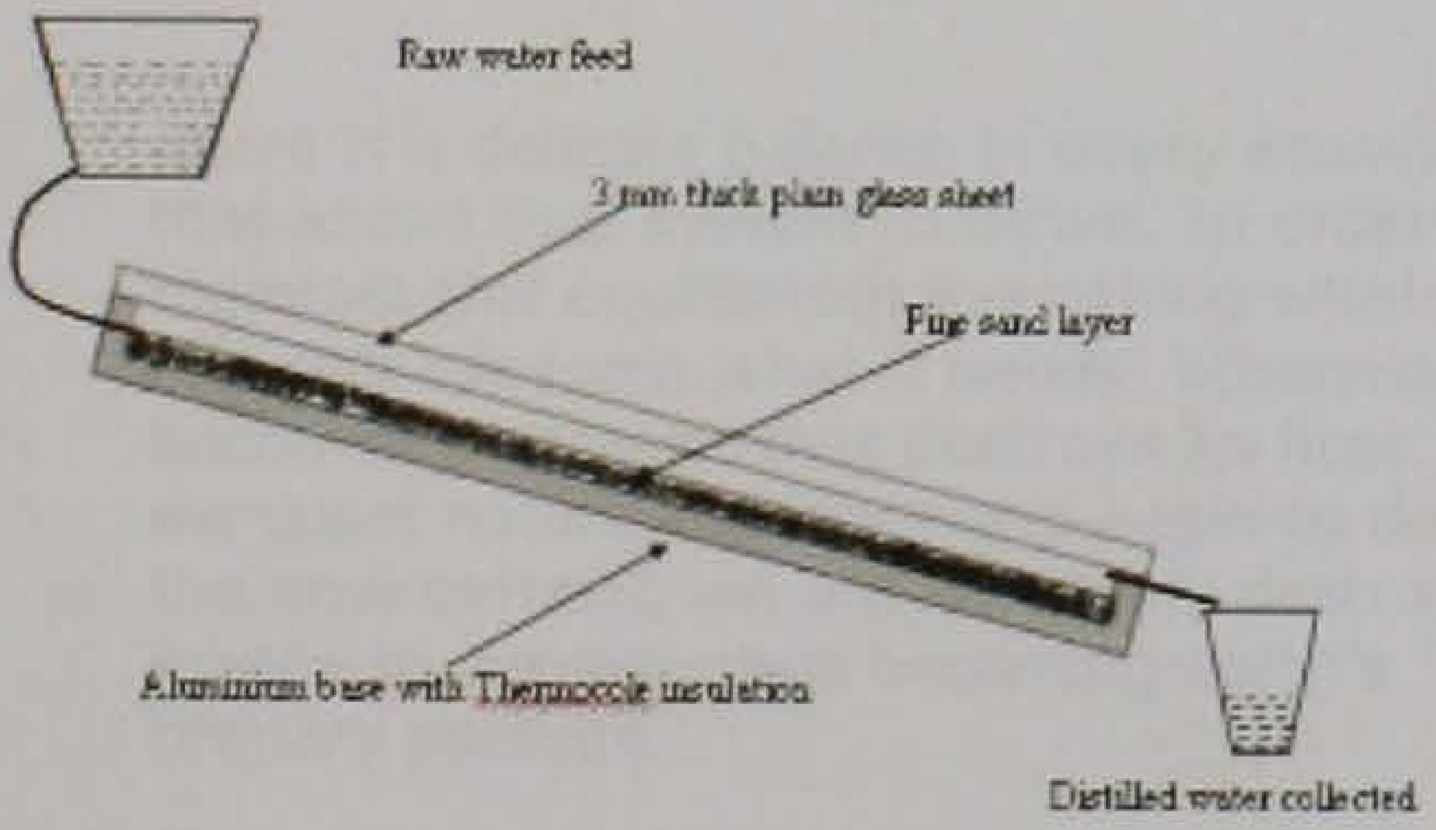


Fig. 4- Contaminated water is turned into drinkable water with this solar distillation still.

Water consumption for a person per day is approximately 1.9 liters.[22] [23] Therefore, this solar still can provide enough water for one person per day.

Perhaps the least glamorous aspect of living off-the-grid is waste management. The first step in dealing with solid waste is to recycle things that can be reused. Next, one could compost other organic waste by constructing a composting chamber or pile. As for human waste a septic system may be the way to go due to possible health department regulations. Alternatives are composting toilets, which rely on microbes and good ventilation to break down waste into compost that is odorless. Author of *Living Off The Grid*, Dave Black states, "Over 90% of the material going into the compost disappears up the vent as a gas or water vapor."[24] Other less appealing systems are transient toilets and latrines, which may cause contamination if not correctly managed. The transient toilet is basically a bucket with a seat attached and a plastic bag inside. While the latrine is a hole dug into the ground. Steps should be taken to provide some kind of sanitary solutions for washing the hands such as soap or antibacterial hand sanitizer.

Communities such as Safe Haven, in Spring City, Utah are creating a zero energy commune by implementing off-the-grid concepts. Safe Haven will implement sustainable techniques by building smaller, collecting rainwater, and using solar energy.[25] For example, members construct sustainable and inexpensive cob structures by mixing clay, mud and fiber. A cob structure can offer sculptural and functional forms despite ones preconceived image of a mud wall.

By working together and donating one to ten hours a week, members construct communal areas around the site. Future plans for the community include a commercial kitchen, dining area, greenhouse, library, classrooms, and more.

Conclusion

Nature can inspire better ways to design our built environment if we look to its purest form of survival and sustainability. I am not advocating that everyone should go off into the woods and live with a knife, nor become satisfied with existing green standards such as LEED. However, my experience in the woods has made me realize that we are too dependent on the grid. Going off-the-grid offers self sufficiency and is a reachable goal in our future. Theoretically many of the systems for off-the-grid living can work; however, there may be new ways for these systems to exploit existing grid infrastructures for a modern off-the-grid lifestyle. (Fig.5) The transition into this new sustainable lifestyle will become easier for the general public if we begin introducing these techniques into everyday life. Areas like suburbs may have a greater impact on the reduction to the power grid. By working together as a community, suburbs have the potential to go off-the-grid and actually produce more energy than needed. For new construction, building smaller, multi-functional spaces reiterates the concept of taking only what one needs and capitalizing on the full potential of a resource/space.

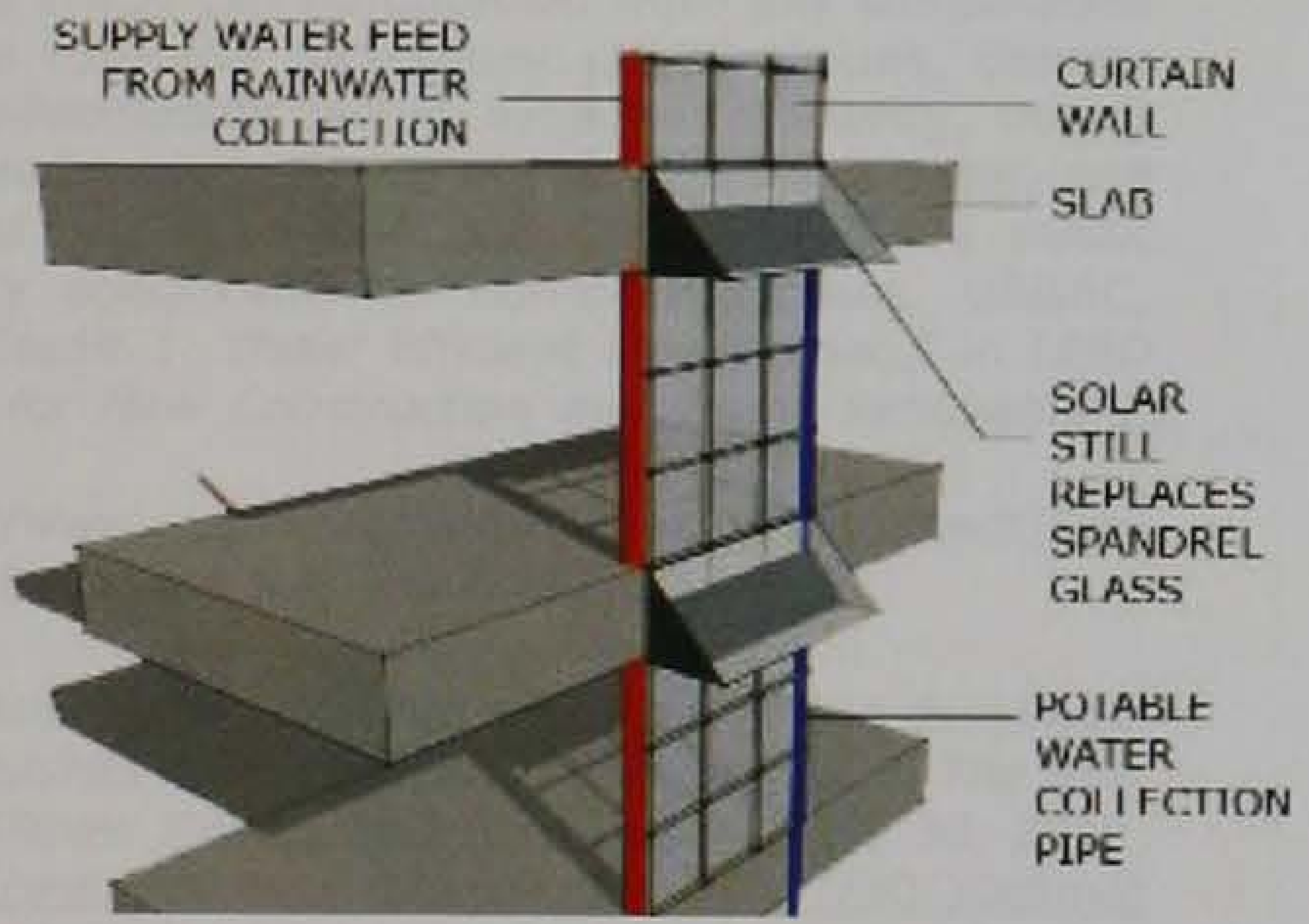


Fig. 5- Investigation on how a modified solar still may be utilized on a building.

There is a delicate balance in every ecosystem that allows that system to thrive. In order to maintain this equilibrium everything within it can only consume what it needs; otherwise it becomes a parasite that destroys its host. If we upset nature's balance and begin to destroy the environment, we will inevitably destroy our means to survive, thus becoming earth's primary parasite.

Image Credits

Fig. 1 - Photo from CO Division of Wildlife

Fig. 2 - Photo by Pride Heating and Air

Fig. 3 - Photo by Nick Rosen

Fig. 4 - Photo from Team Kerala

Fig. 5 - Sketchup model by author

Notes and References

1 Charles J. Kibert, Jan Sendzimir, and G. Bradley Guy, "Defining an ecology of construction," in *Construction Ecology: Nature as the basis for green buildings,* ed. Charles J. Kibert, Jan Sendzimir, and G. Bradley Guy (New York: Spon Press, 2002), 9.

2 John F. Mongillo, Linda Zierdt-Warshaw, *Encyclopedia of Environmental Science* (*Phoenix*, Ariz.: Oryx, 2000), 104.

3 CIA, *The World Factbook*, https://www.cia.gov/library/publications/the-world-factbook/rankorder/2174rank.html, (accessed August 1, 2010).

4 Margot Roosevelt, "The Tragedy of Tar Creek," *Time,* April 19, 2004, http://www.time.com/time/magazine/article/0,9171,612395-1,00.html (accessed May 6, 2010).

5 "The built environment significantly modifies natural hydrologic cycles, contributes enormously to global environmental change, has tremendous effects on biodiversity, contributes to soil erosion, has major negative effects on water and air quality, and is the source of major quantities of solid waste." See Kibert, 11

6 Kibert, 11.

7 Kevin M. Passino, *Biomimicry for Optimization, Control, and Automation*, (London: Springer, 2004), 14.

8 Harvey Feit, "Waswanipi Cree Management of Land and Wildlife: Cree Ethno-Ecology Revisited," in *Native People, Native Lands: Canadian Indians, Inuit and Metis,* ed. Bruce Alden Cox (Ottawa, Canada: Carleton UP, 1988), 76.

9 Kat M. Anderson, *Tending the Wild: Native American Knowledge and the Management of*

California's Natural Resources, (Berkeley: University of California, 2005), 55.

[10] "Monks Mound is 900 feet long, 650 feet wide, and more than 20 feet tall". See Mann, 292

[11] Charles C. Mann, *1491: New Revelations of the Americas before Columbus,* (New York: Knopf, 2005), 264.

[12] Larry Dean Olsen, *Outdoor Survival Skills*, (Chicago: Chicago Review, 1998), 68-69.

[13] Mary James, Mike Kernagis and Katrin Klingenberg, "Principles of Passive House Design," in *Homes for a Changing Climate: Passive Houses in the U.S.,* (Larkspur, CA: Low Carbon Production, 2009), 12.

[14] A LEED Certified building (lowest level) must earn 40-49 points and 80+ points for LEED Platinum (highest).

[15] This credit can be obtained from any combination of the following techniques: plant species, density and microclimate factor, irrigation efficiency, use of captured rainwater, use of recycled wastewater, and use of water treated and conveyed by a public agency specifically for non-potable uses. USGBC, "WE Credit 1: Water Efficient Landscaping," in *LEED 2009 for New Construction and Major Renovations*, 2009, http://www.usgbc.org/ShowFile.aspx?DocumentID=5546 (accessed July 14, 2010), 23.

[16] Climatewire, "Packed with Drafty Old Buildings, E.U. Pushes for Energy-Neutral Designs," in *The New York Times: Energy and Environment,* July 30, 2010, http://www.nytimes.com/cwire/2010/07/30/30climatewire-packed-with-drafty-old-buildings-eu-pushes-f-39095.html, (accessed July 30, 2010).

[17] "...of 121 new buildings certified through 2006, the Green Building Council found that more than half — 53 percent — did not qualify for the Energy Star label and 15 percent scored below 30 in that program, meaning they used more energy per square foot than at least 70 percent of comparable buildings in the existing national stock." Mireya Navarro, "Some Buildings Not Living Up to Green Label," *The New York Times*, August 30, 2009, http://www.nytimes.com/2009/08/31/science/earth/31leed.html?_r=2&th&emc=th, (accessed August 27, 2010).

[18] Hardened Structures Hardened Shelters, *Hardened Structures/Hardened Shelters,* (Virginia Beach, Virginia) http://www.hardenedstructures.com/introduction.asp (accessed August 13, 2010).

[19] Joseph, 1.

[20] "More than 100 million Americans could be affected by this blackout for months or years. Recovering from a future severe magnetic storm would cost $1 to $2 trillion per year-- ten to twenty times the cost of Katrina." Lawrence E. Joseph, "The Solar 'Katrina' Storm That Could Take Our Power Grid Out For Years," *The Huffington Post,* July 15, 2010, http://www.huffingtonpost.com/lawrence-e-joseph/the-solar-katrina-storm-t_b_641354.html (accessed August 13, 2010).

[21] The solar distillation still uses the process of evaporation and condensation to change tainted water into drinkable water leaving behind any contaminates. These experiments are prepared by the "Planet Kerala" team, which consists of individuals with various backgrounds ranging from anthropologist to agricultural engineers. They have constructed solar stills by acquiring locally available materials. Their solar still has a surface area of 7.5 ft2, and can produce 2 liters of drinkable water per day. Planet Kerala, *Locally Fabricated Solar Distillation Still For Drinking Water,* October, 2006, http://www.indg.in/rural-energy/technologies-under-rural-energy/solardistillation.pdf (accessed March 29, 2010).

[22] Mayo Clinic, "How Much Water Do You Need," *Nutrition and Healthy Eating,* April 19, 2008, http://www.mayoclinic.com/health/water/NU00283 (accessed March 25, 2010).

[23] An adequate water intake for young men and women (19 to 30) 3.7 and 2.7 liters per day. This intake of water includes the total intake of water from food and other beverages. Institute of Medicine, DRI, *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate.* Institute of Medicine (U.S.). Panel on Dietary Reference Intakes for Electrolytes and Water, (Washington, D.C.) National Academies Press, 2005), 73.

[24] Dave Black, *Living Off The Grid: A Simple Guide to Creating and Maintaining a Self-Reliant Supply of Energy, Water, Shelter, and More,* (New York, NY: Skyhorse Publishing, 2008), 157.

[25] Gina Barker, "Utahans Creating a Sustainable, Off Grid Community," *Deseret News,* August 13, 2010, http://www.deseretnews.com/article/700056382/Utahns-creating-a-sustainable-off-grid-community.html?pg=1, (accessed August 13, 2010).

Thesis Addendum

Transition

After much contemplation about the transition of my paper into my actual thesis project, I came to the conclusion of an off-the-grid community/learning center. I feel that education is one of the strongest ways to rectify many social, economic, and environmental problems. Education lays the groundwork for major social changes, especially in the implementation of sustainable ideals and strategies. By providing solutions that can directly help people remedy their financial and environmental difficulties, a change begins to take place by the empowerment of people. This empowerment comes from the independence gained through the self-sufficient techniques that allow one to become liberated from the grid. The community/learning center then acts as a node that can be placed within existing communities and neighborhoods to help influence sustainable ideals, thus giving a ripple effect of sustainable living.

Southside Slopes, Pittsburgh, PA

When it came to selecting a site for my project, I had certain requirements that I wanted the site to possess. I initially wanted my area to be within close proximity of water in order to make my "off-the-grid building" easier to get "off-the-grid". However, I then thought that it would not be fair due to the fact that most people don't have the luxury of having a close source of fresh water, therefore, I wanted the location to be void of rivers, streams, and springs that are in the immediate vicinity. I also wanted the site location to have the most effect on people; therefore I chose to place it in a suburban neighborhood as opposed to the city. Also, this particular neighborhood had some of the area's oldest homes that were not in great condition; thus giving the opportunity to help educate people about strategies that may help them, while at the same time, setting up an area that can begin to correctly construct new sustainable homes to replace the homes in disrepair.

Design Challenges

In order to do my thesis justice I felt that I literally had to get my building off-the-grid. So I outlined systems in the building as well as general living conditions that needed to be taken off-the-grid. In a basic survival situation one needs to address the following; shelter, water, food. In the world today we also have to deal with "luxury" systems such as waste disposal and power. So throughout designing, I needed to think about getting all of these systems off-the-grid. After establishing a baseline building of similar construction and size I began taking my building consumption off-the-grid. I will not go through all of the systems that I used but they are displayed throughout the rest of this document. After many scrupulous calculations, numbers, and research, my building was liberated from the existing grid of power, water, waste treatment, and even provisions of sustenance.

Parti and Other Design Concepts

Some of the key design features were generated from the existing site conditions as well as sustainable concepts. My main concept was derived from the orientation of the existing buildings in the neighborhood. The optimal building orientation for a sustainable building is to have the long side of the façade to face south, therefore taking advantage of passive heating and cooling strategies. However, most of the homes in the Southside Slopes area were oriented with a 74° (or 106° depending on direction) skew off the correct orientation. Consequently, I used a rotational concept with concentric circles radiating from a central node that acts as the heart and power center of the building. This center point houses the large wind turbine above, the rotating main entrance doors (idea power generated by man as one goes in), and the flywheel energy storage exhibit below. The rotation to "correct orientation" begins with an existing set of old stairs that I name the heritage stairs. The Southside Slopes neighborhoods have an annual StepTrek course up the slopes of Pittsburgh. This is to pay homage to the history of their area by recreating paths that many people have followed before them; these historic hillside dwellers traveled up and down the slopes to get to work in the glass factories and steel mills. I in turn, pay homage to this by keeping the "old" staircase on the site and create a grand staircase celebrating this tradition and the use of man power to travel to work. My staircase is an extension of the axis of the existing street but suggest the movement from vehicle to manpower.

Other design features include a 73° slanted blank concrete and stucco wall that grows out of the ground into the "correctly oriented" south facing wall. My reason for keeping the wall void of windows is to signify that not everyone has the ability to have a long south facing façade. The 73° angle represents Pittsburgh's summer solstice sun angle which is the highest sun angle for that area; the 73° angle would have blocked this "hot" summer angle (if I had placed windows on the façade). Instead I opted to put in a skylight; I designed a sunshade to block the hottest times of the day and year, yet all the while allowing the sun to enter at lower angles during the colder months and times of day. Many of the other design features contain sustainable concepts and aesthetics as well.

Comments

One comment was about how the building can begin to adjust itself for housing. I think that the future trajectory of my project would begin to include a housing aspect that can begin to embody the off-the-grid lifestyle. The community/learning center would then literally act as the community center providing a main base for people living in the community. It could take on larger task and act as the hub for extra power generation, wastewater management etc... in order to alleviate some of the housing needs.

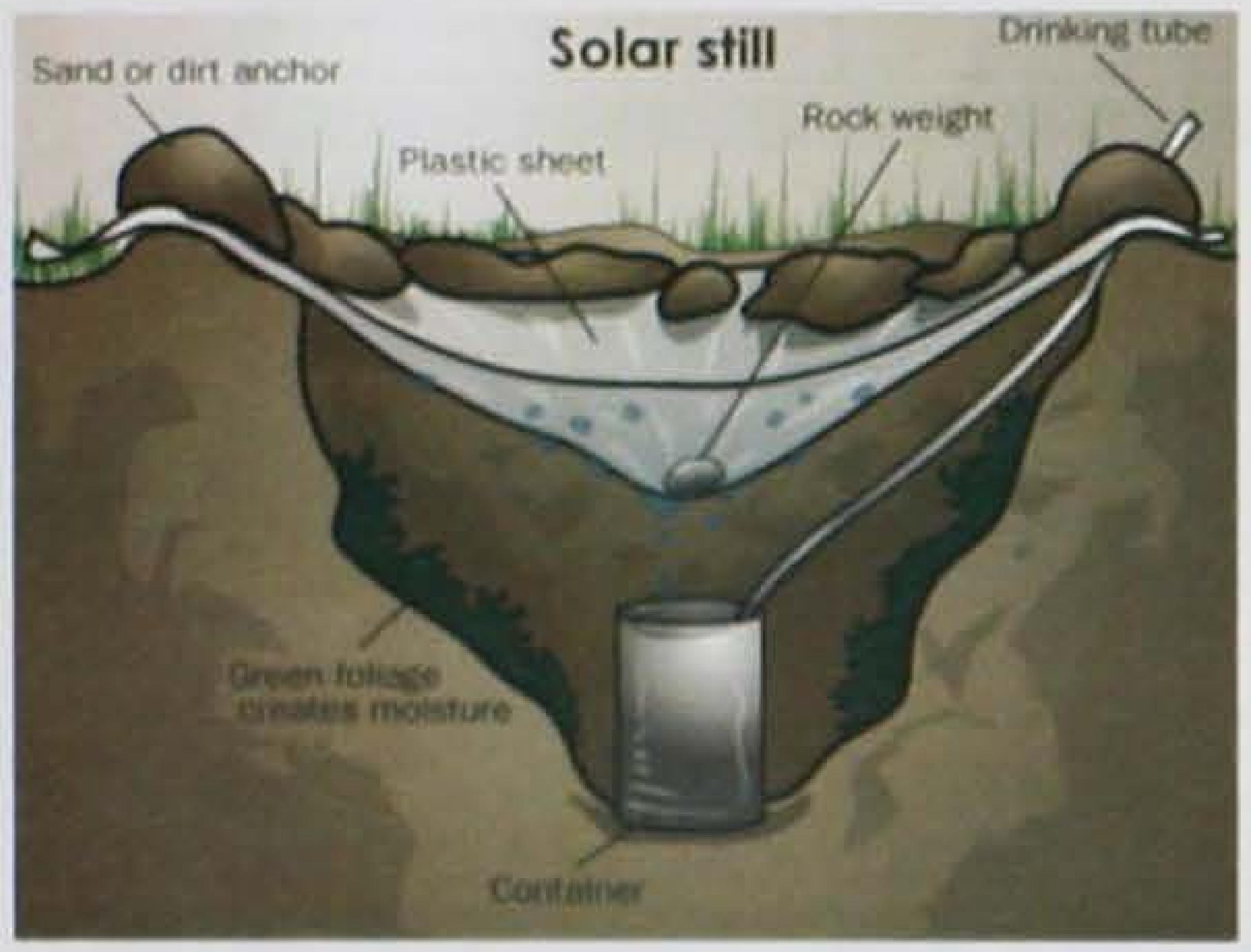
Another comment was if I thought about doing the same project but in terms of extremes, such as desert climates. I did consider doing this with extreme climates and believe that the project would have taken on different types of systems and possibly form. However, I feel that the fundamental concepts and ideals would have remained throughout the project, regardless of the climate.

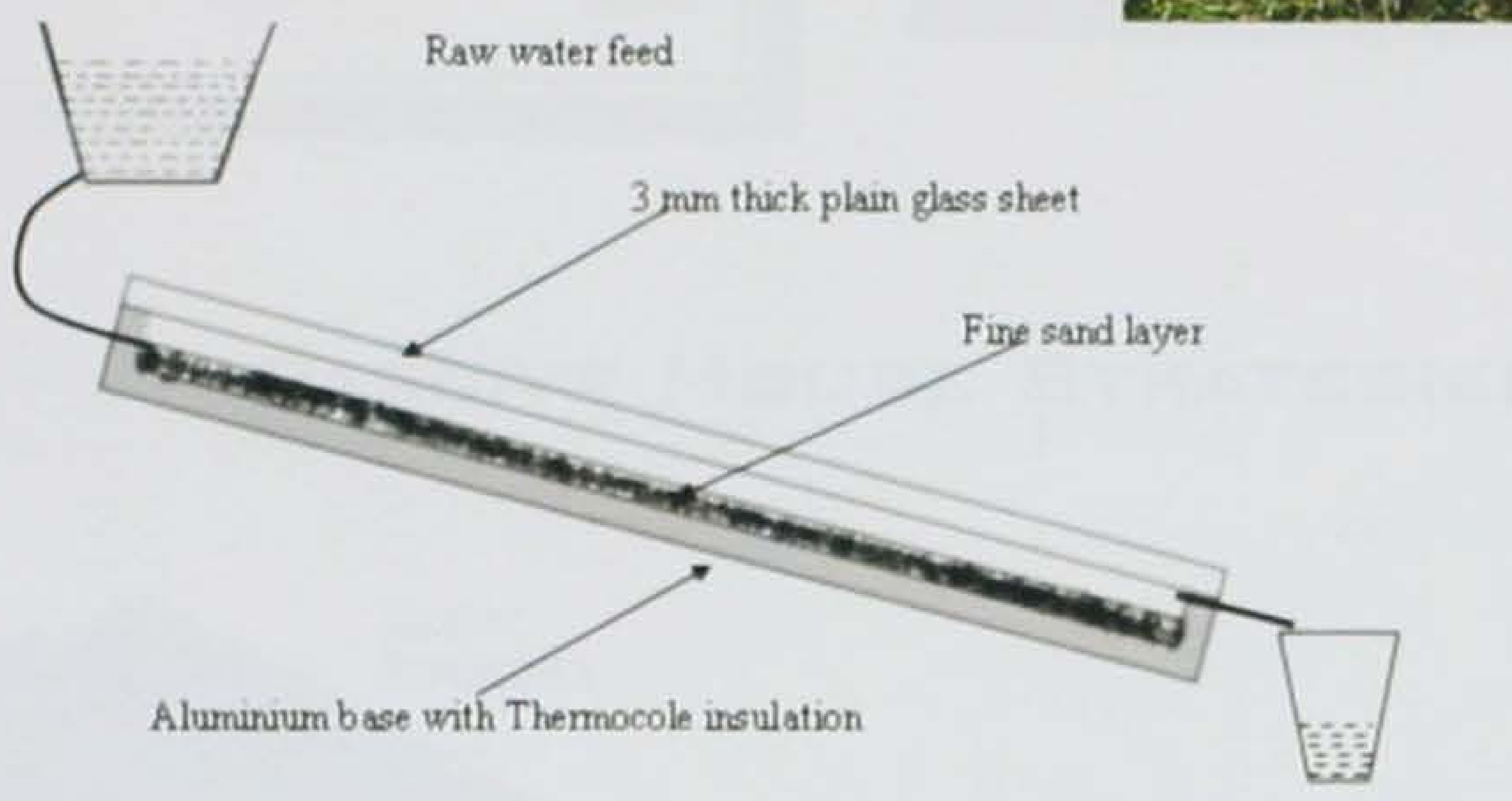
Conclusion

There is a survival saying that says you can survive: 3 minutes without oxygen, 3 hours in extreme exposure (without shelter/insulation), 3 days without water and 3 weeks without food. After researching and experiencing a survival situation, I find it kind of peculiar that in the wild the things that can kill you the quickest were the easiest for me to accomplish getting off-the-grid and the "luxury" systems such as energy, were the toughest to get off-the-grid. It is far easier to first reduce energy consumption rather than add systems (wind turbines and PV panels) to make up for the energy needed. In that respect, standards similar to those used in Passive House buildings, make the most sense in order to have greater impacts on reducing overall energy use. When everything is stripped down to the basics, survival ideals and sustainable self- sufficient design concepts are directly correlated.

-Thank you to everyone involved throughout this entire thesis process.

5 DAY SURVIVAL EXPERIMENT AND OTHER SUMMER RESEARCH





LEED GREEN ASSOCIATE EXAM


LEED GREEN ASSOCIATE

GREEN BUILDING CERTIFICATION INSTITUTE HEREBY CERTIFIES THAT

Ryan Baker

HAS ATTAINED THE DESIGNATION OF

LEED GREEN ASSOCIATE

BY DEMONSTRATING THE KNOWLEDGE AND UNDERSTANDING OF GREEN BUILDING PRACTICES AND PRINCIPLES NEEDED TO SUPPORT THE USE OF THE LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED®) GREEN BUILDING RATING SYSTEM™

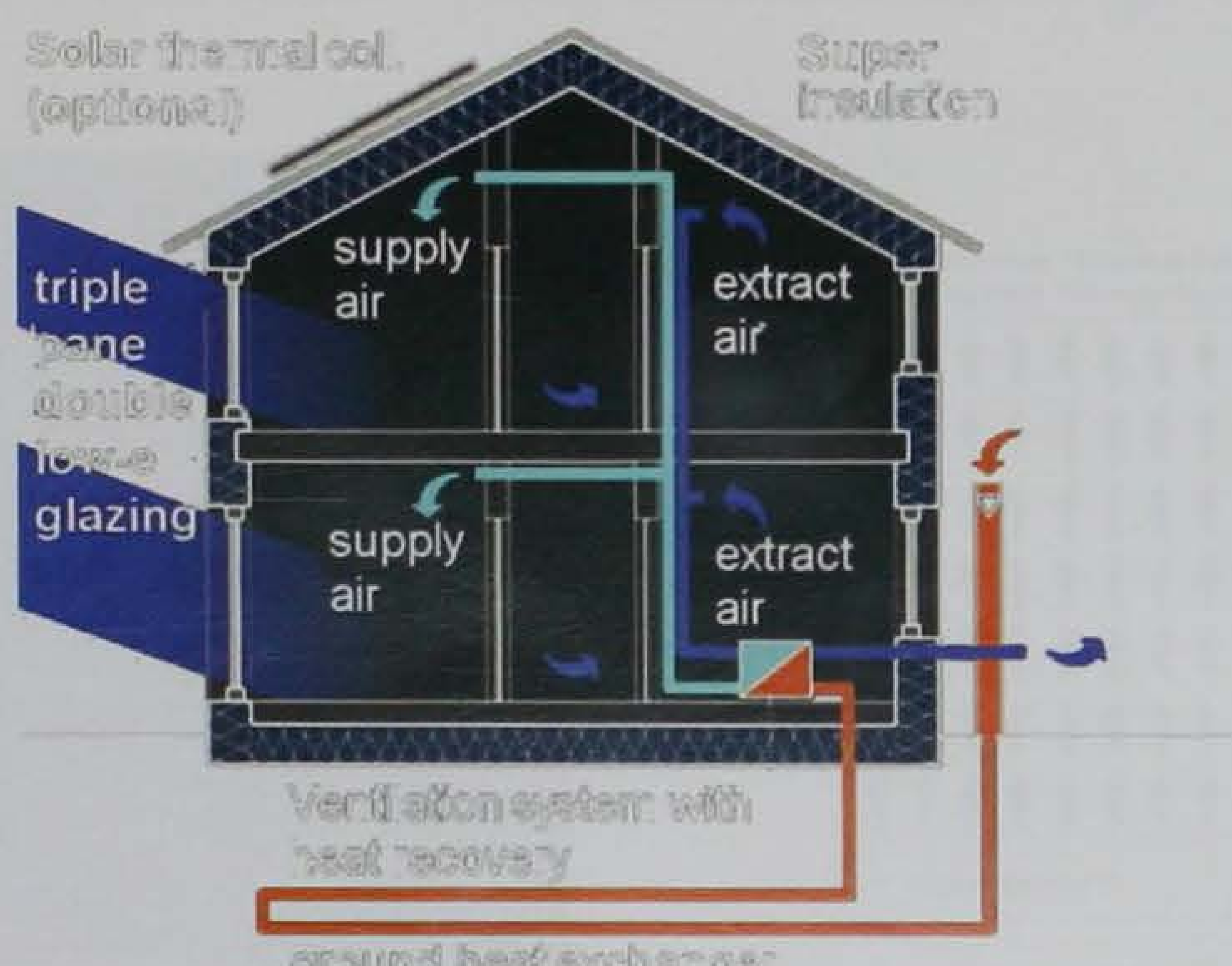
December 17, 2010

10644712

December 16, 2012

GBCI

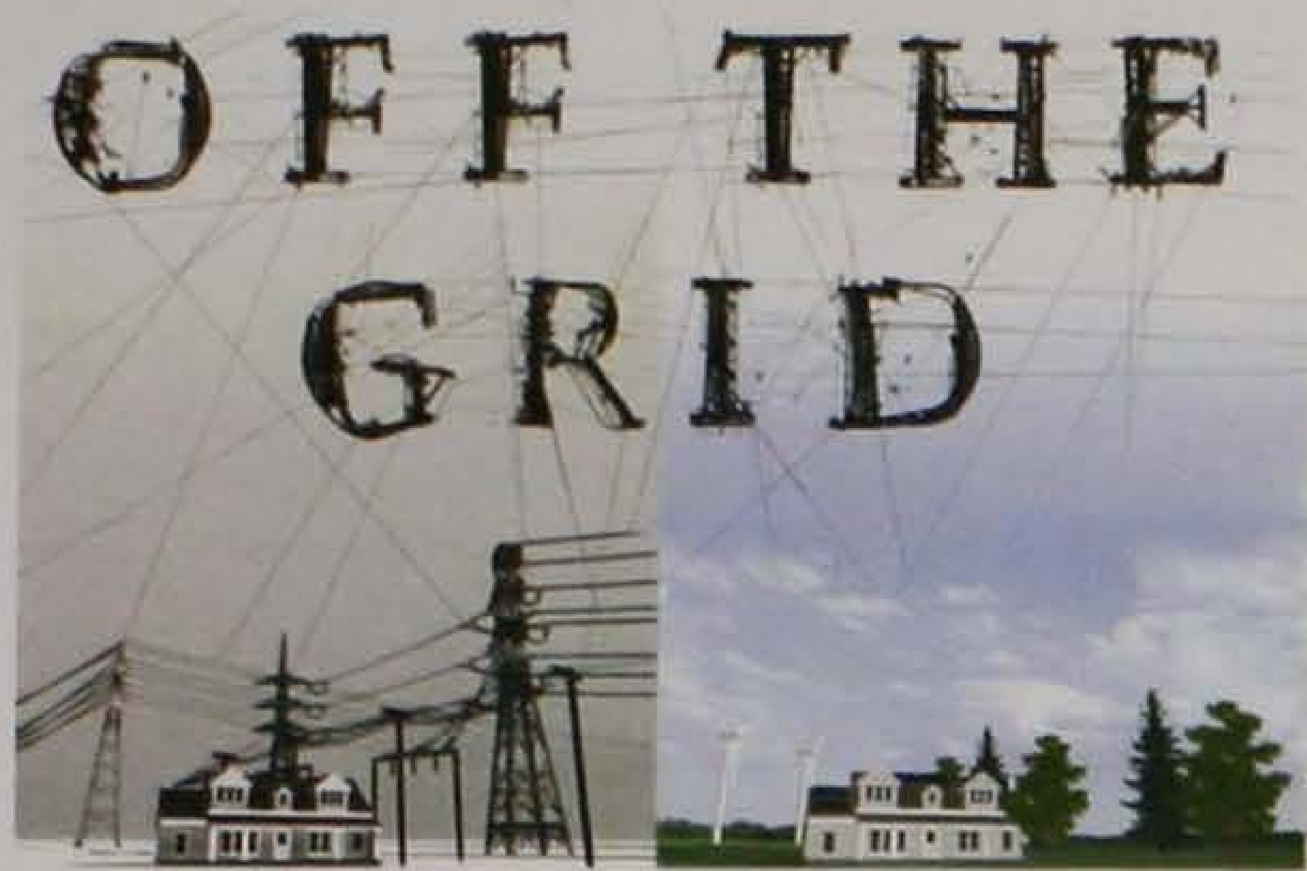
PASSIVE HOUSE STRATEGIES



PASSIVE SOLAR STRATEGIES PASSIVE SOLAR STRAT

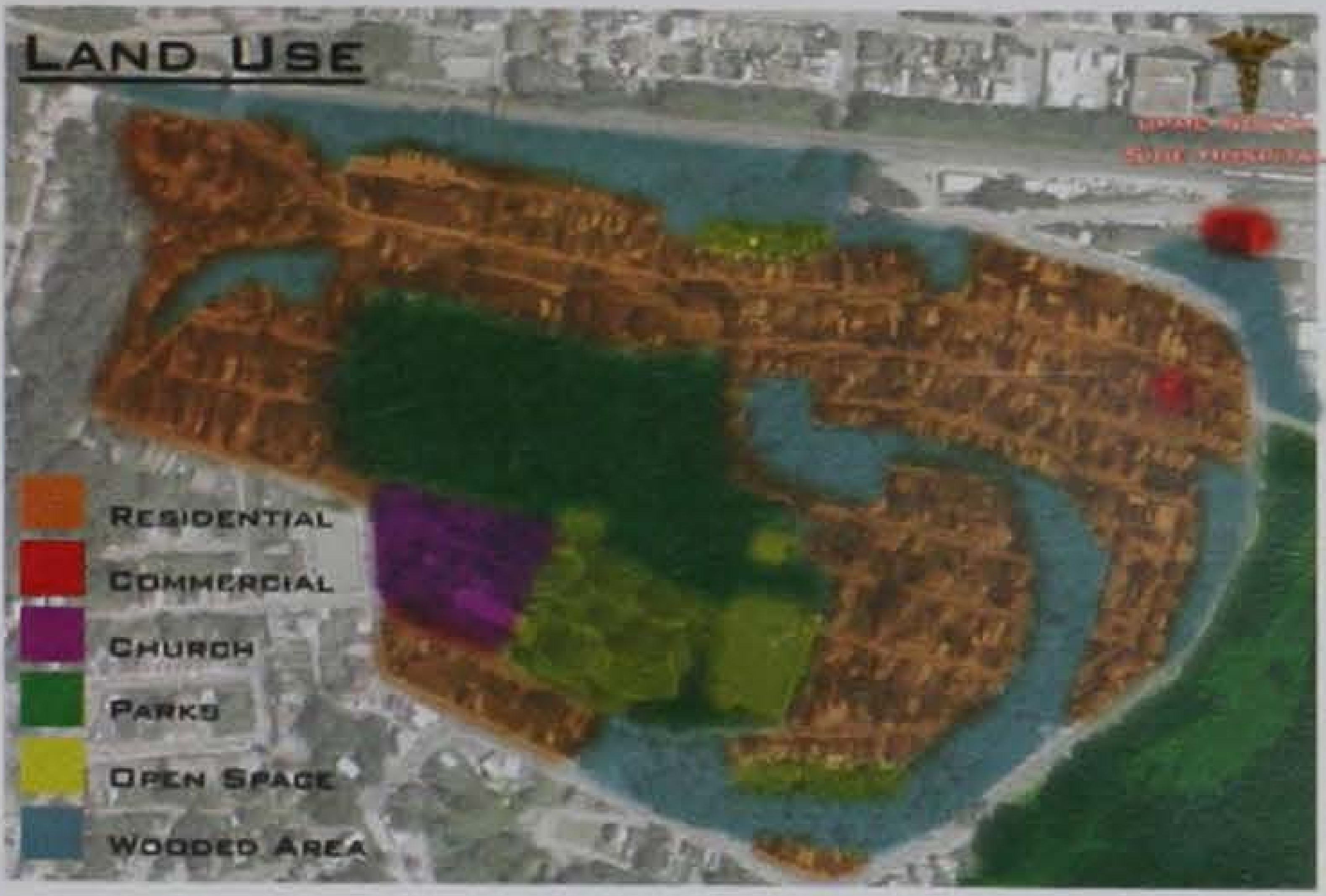
WORKING WITH THE ENVIRONMENT

Site Analysis- Pittsburgh, PA (SouthSide Slopes)

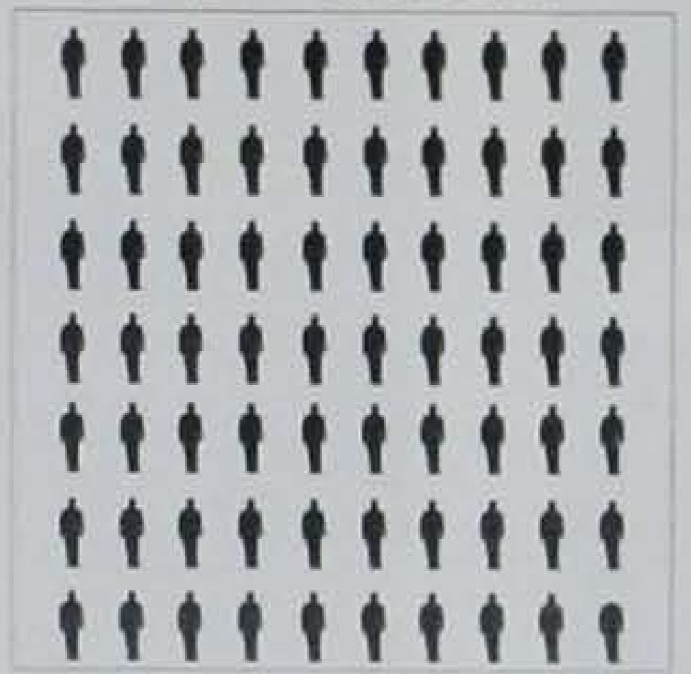


Wind Direction

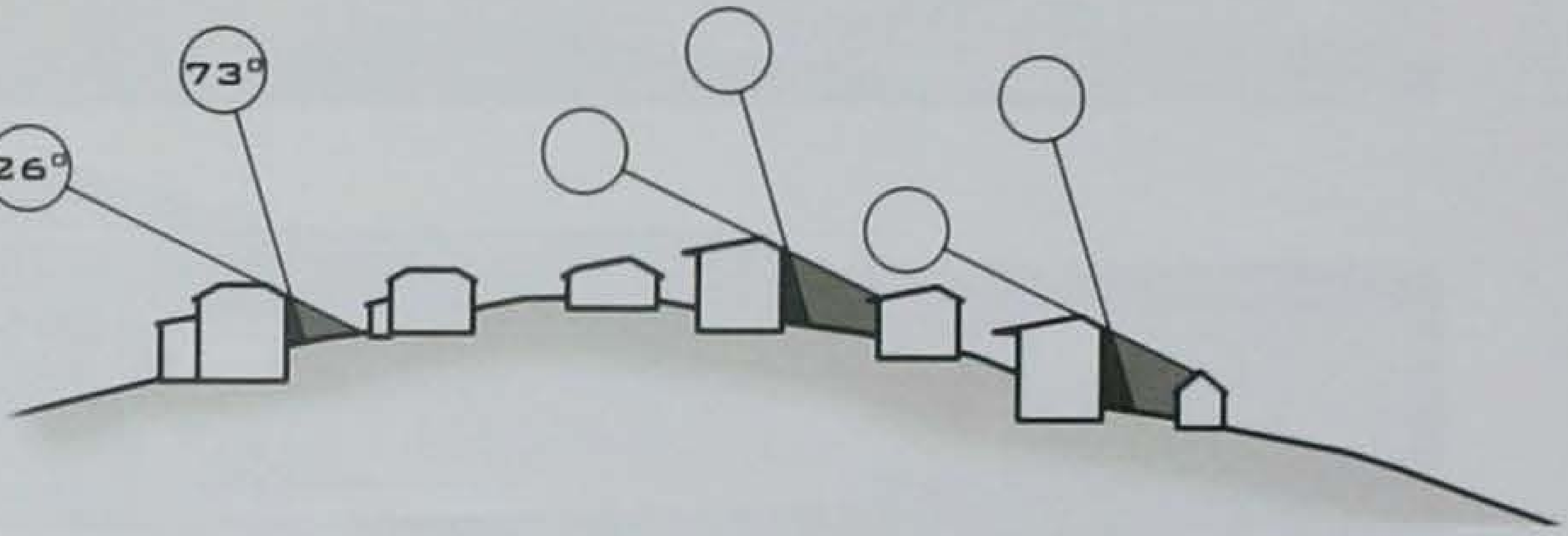
- Prevailing Wind January-December (SW)



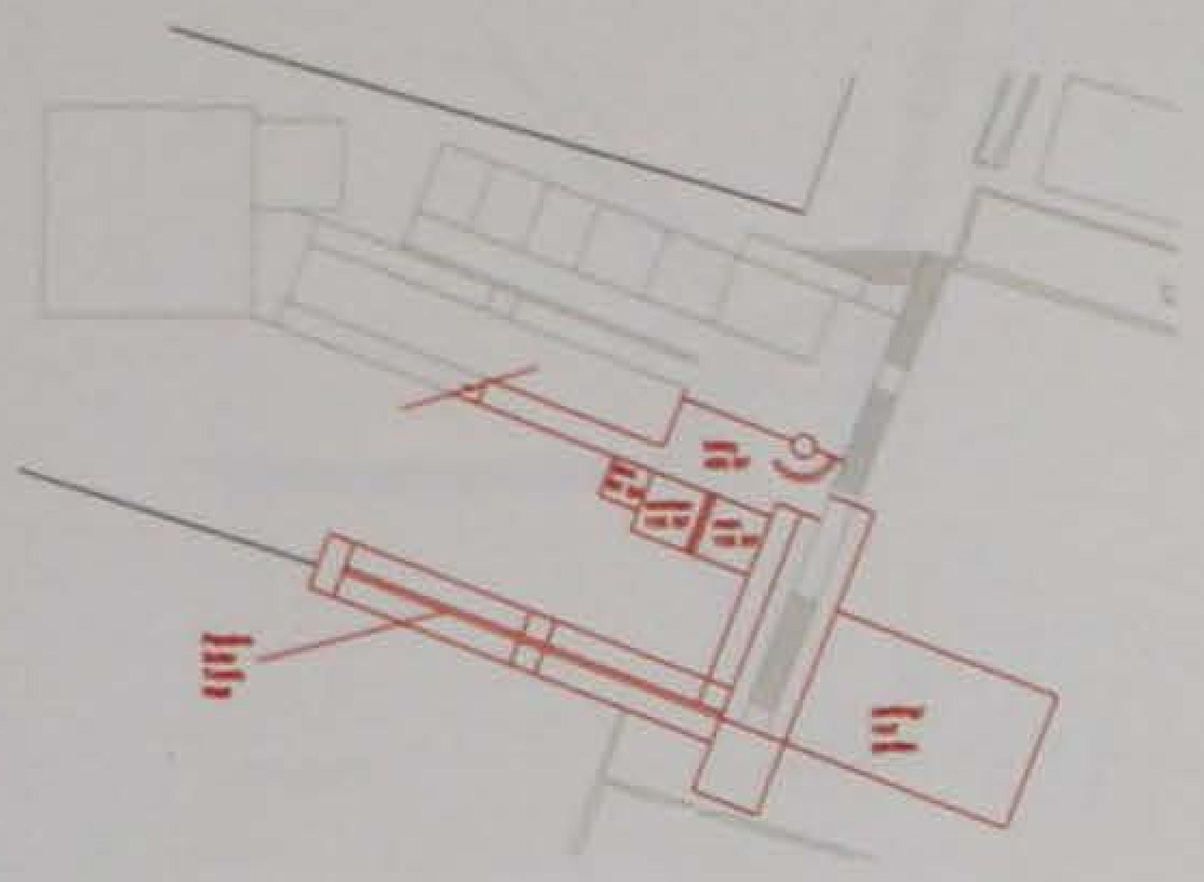
Southside Slopes Density
6,993 people/sq.mi.

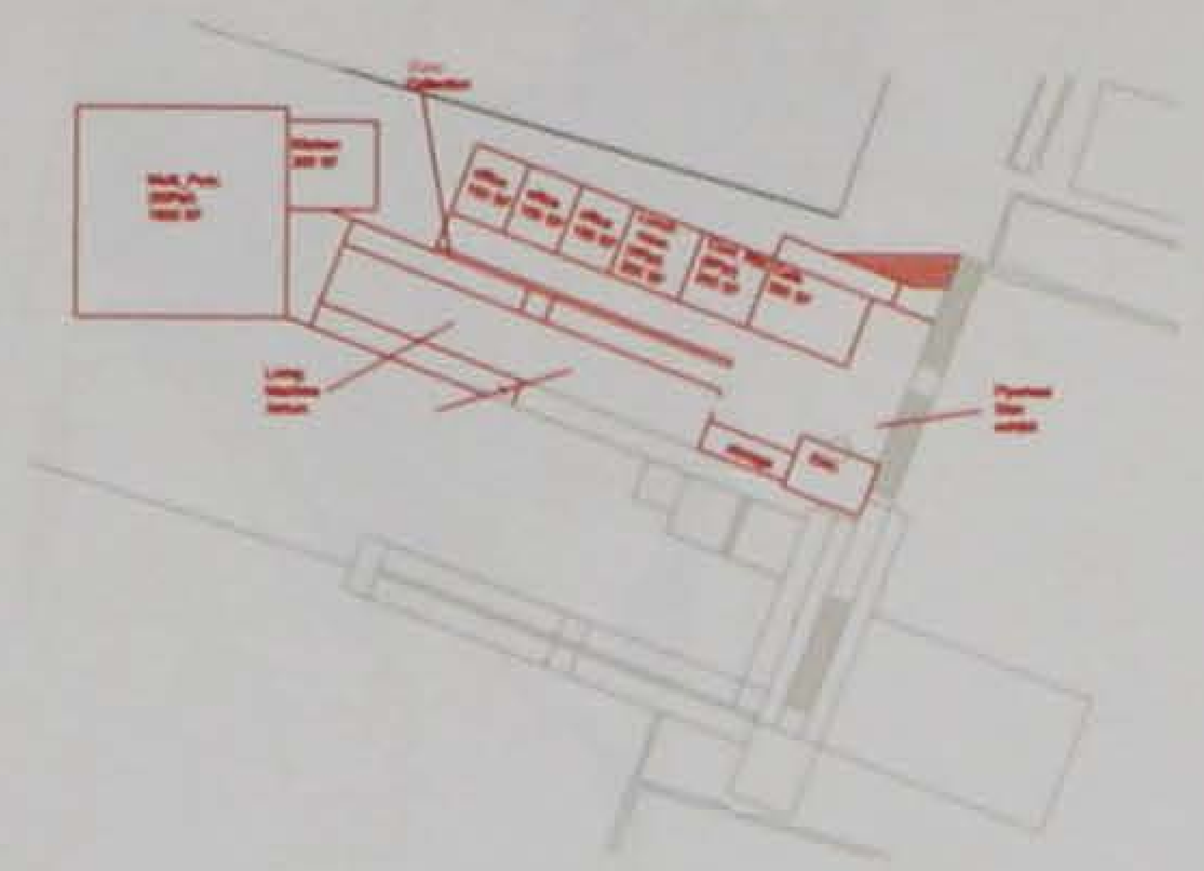


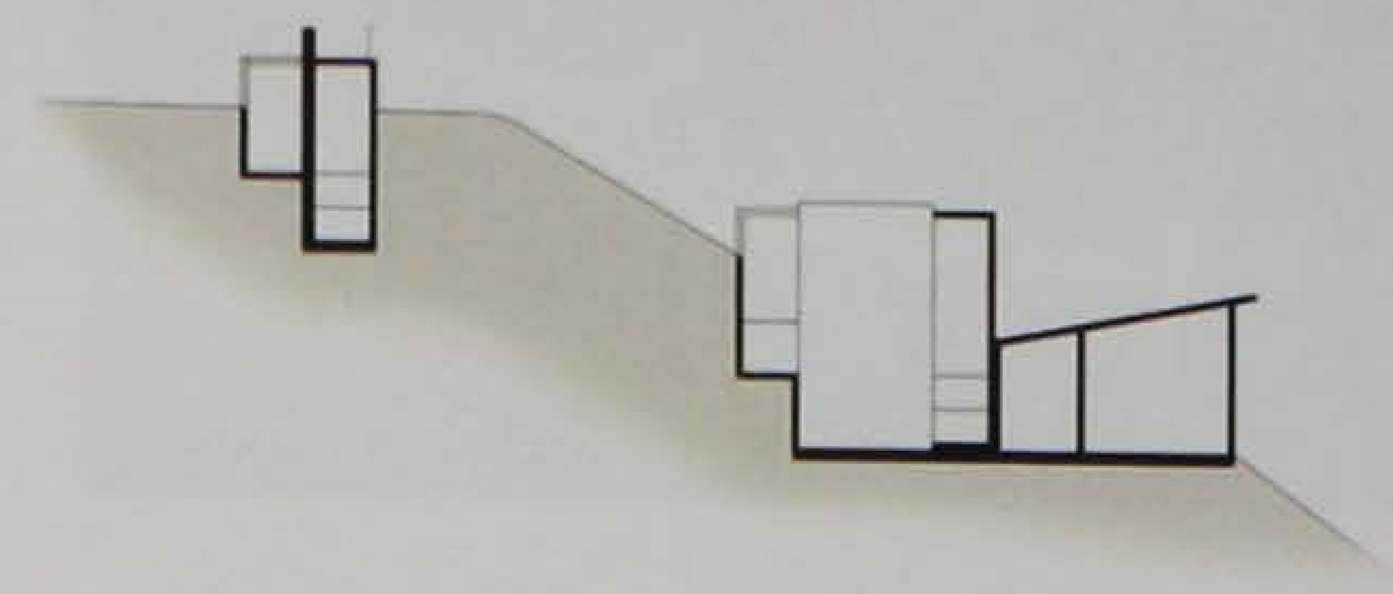
= 100 People

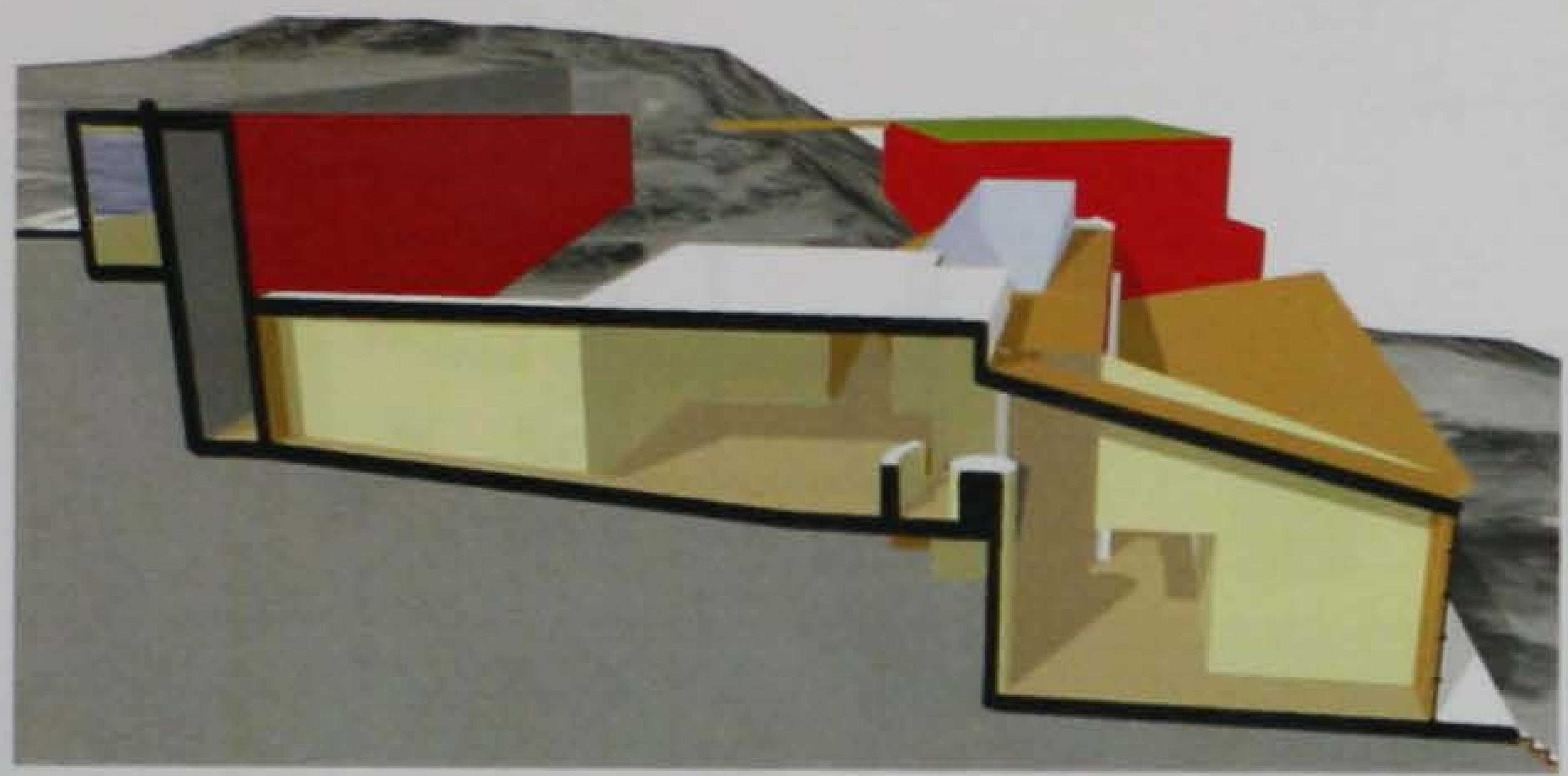


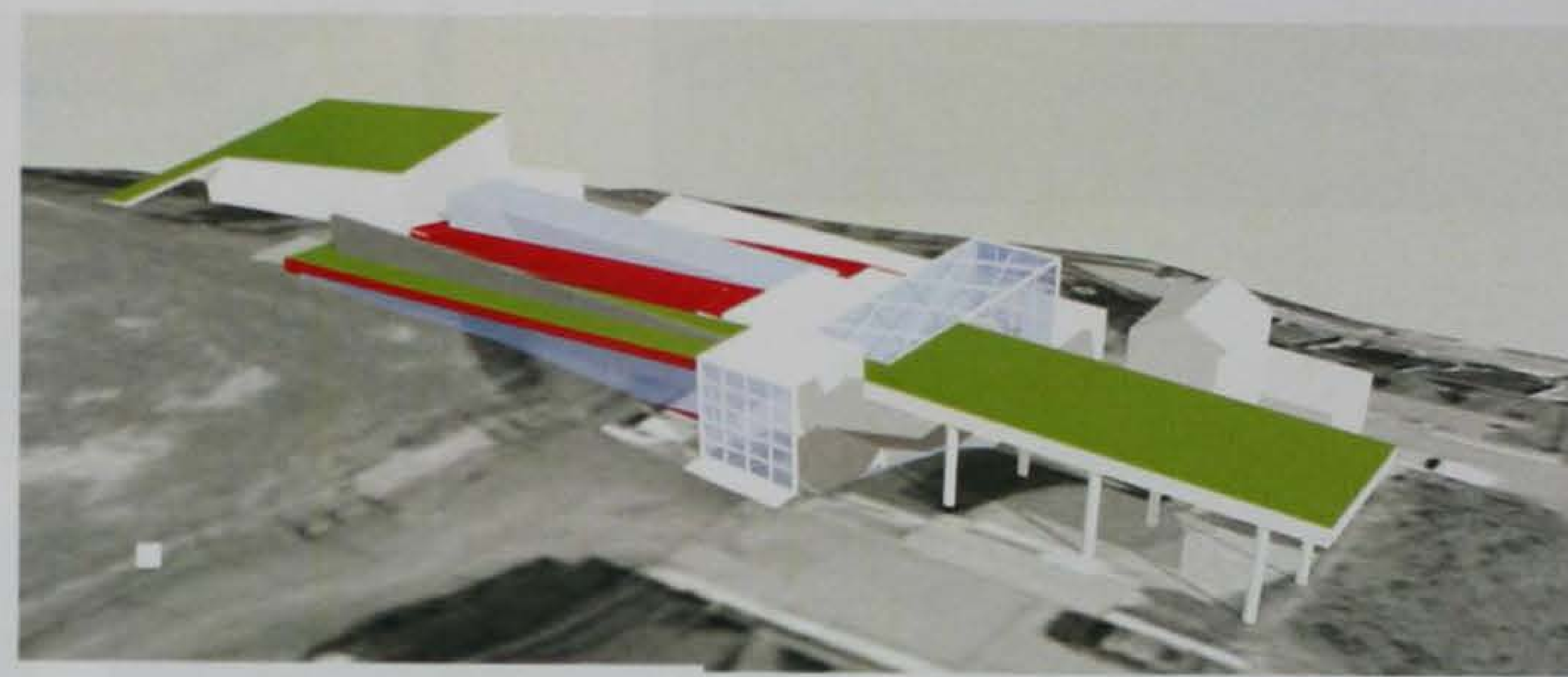
PROCESS DRAWINGS

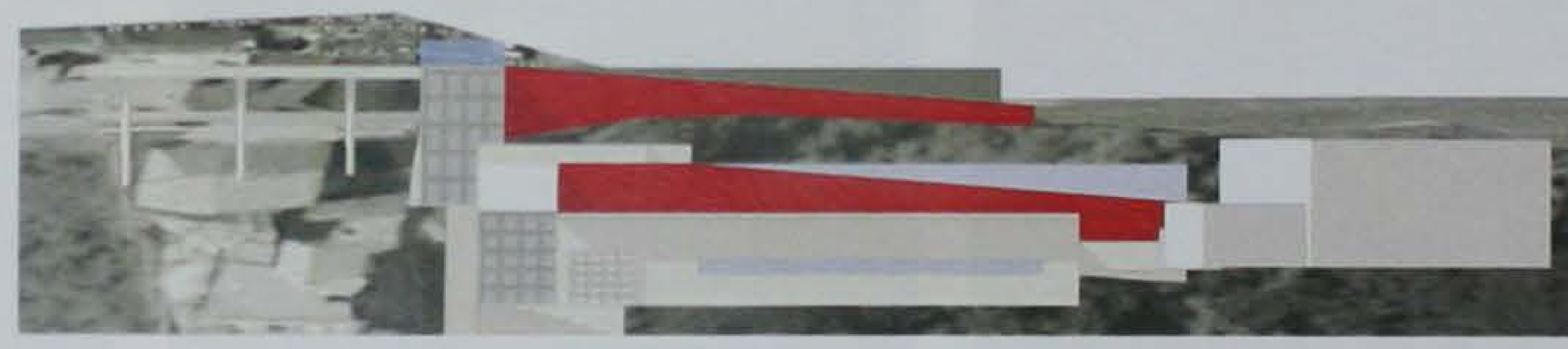




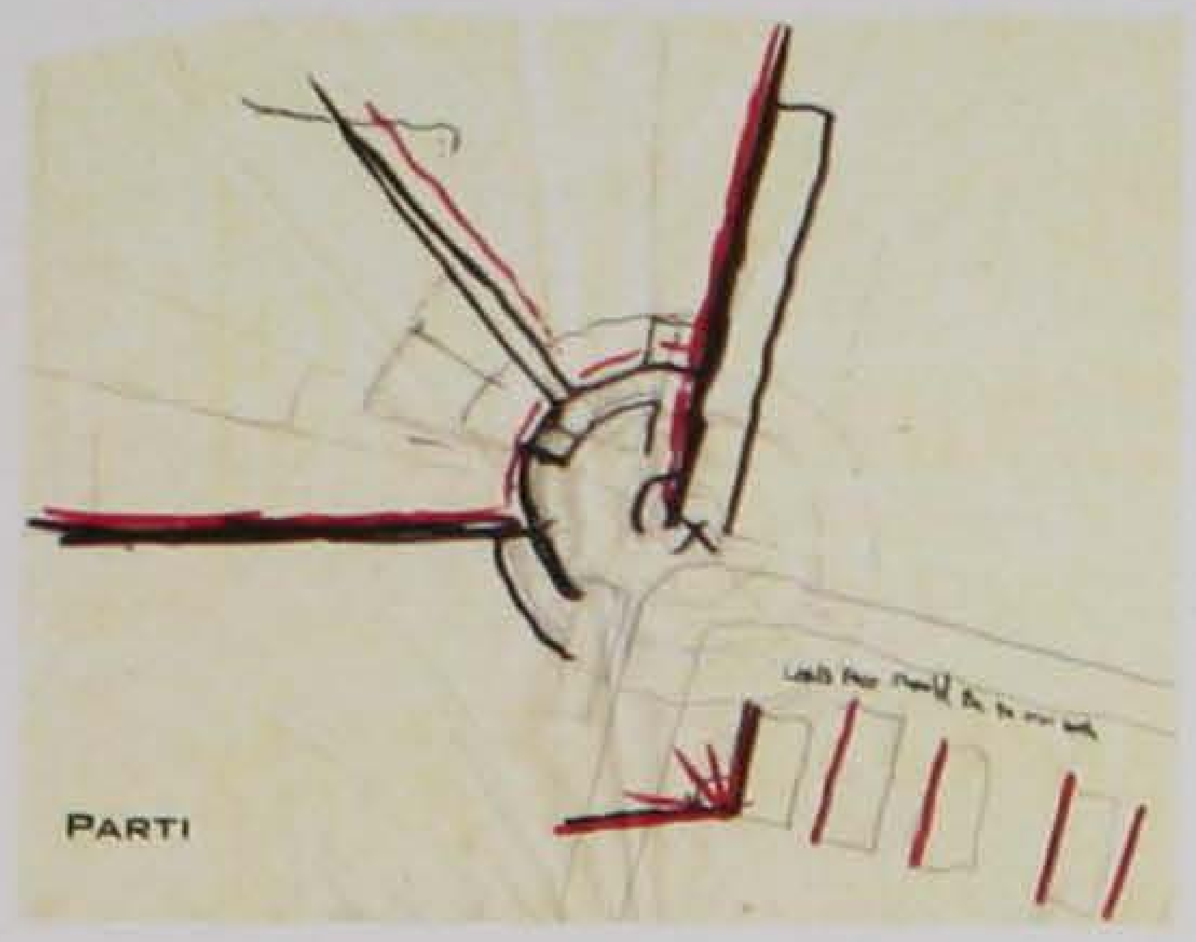


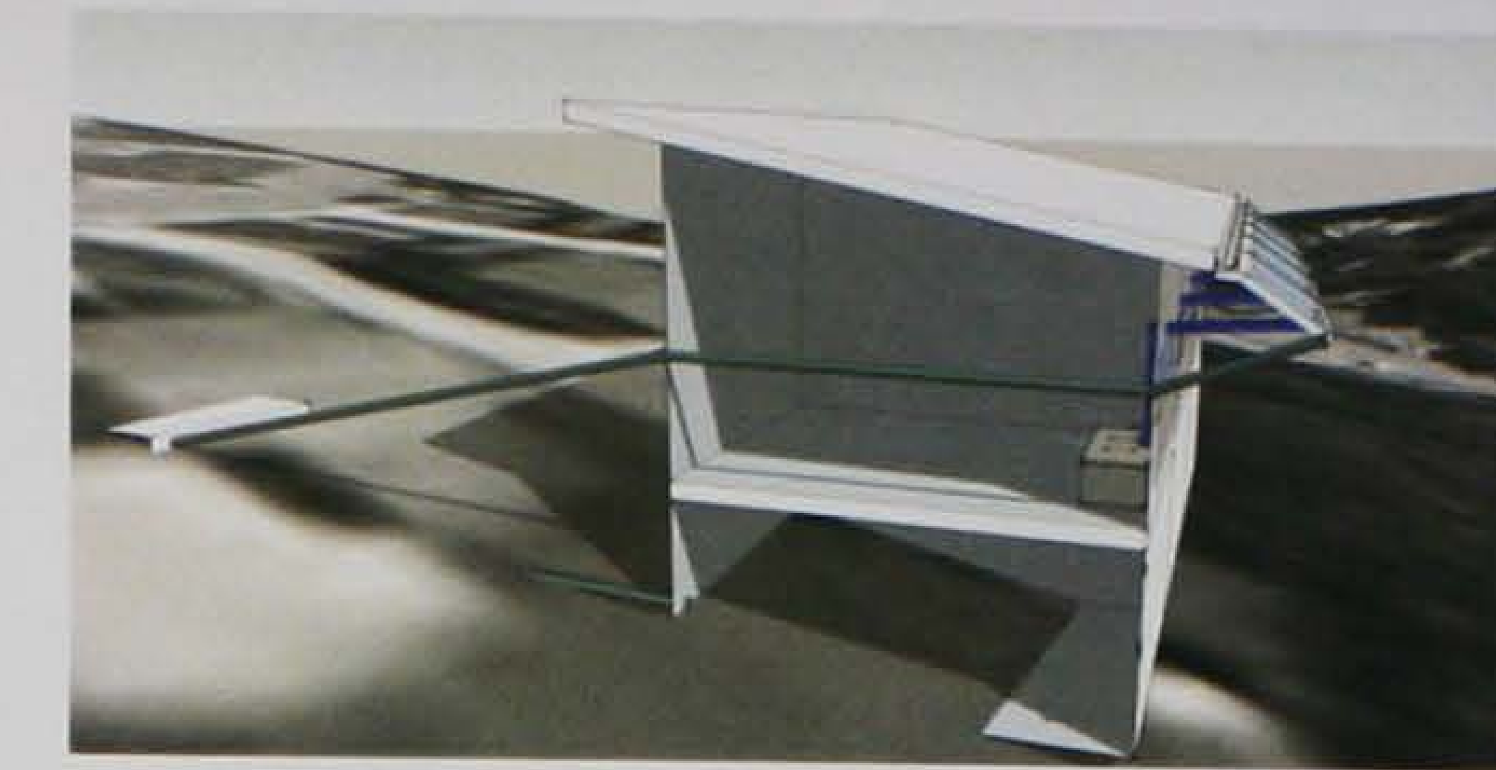


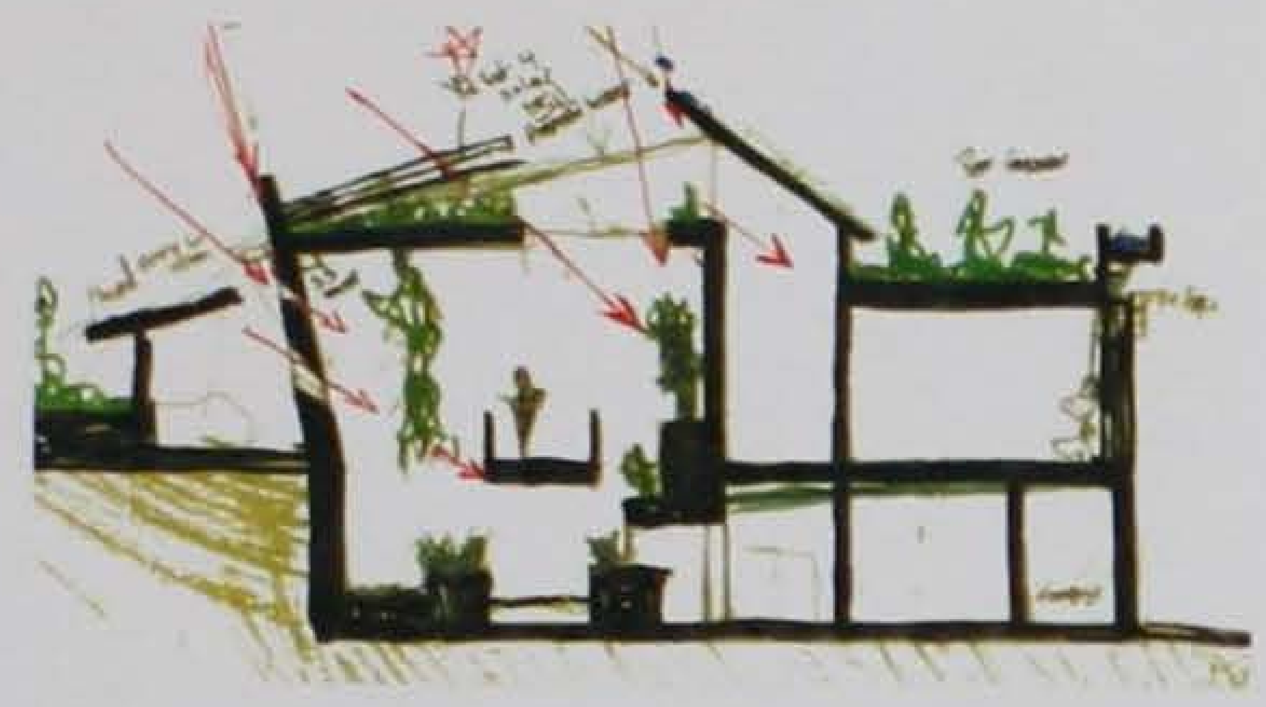


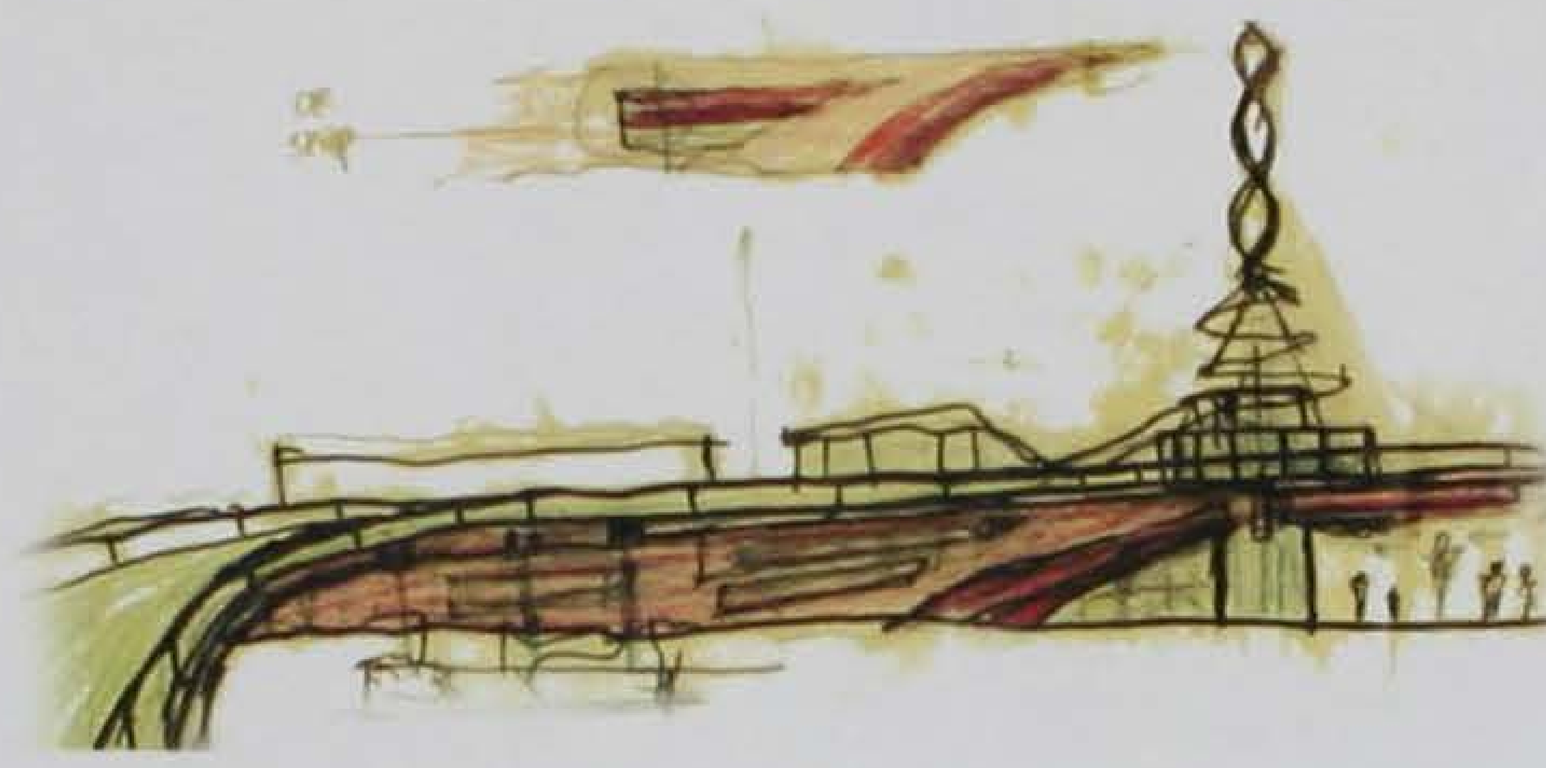


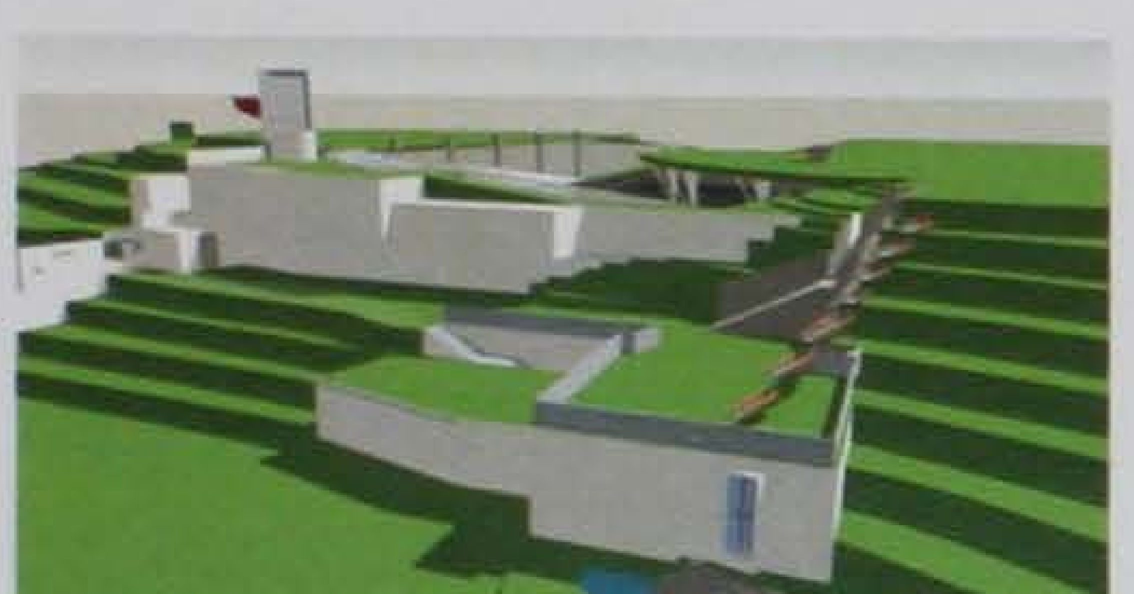
PROCESS DRAWINGS



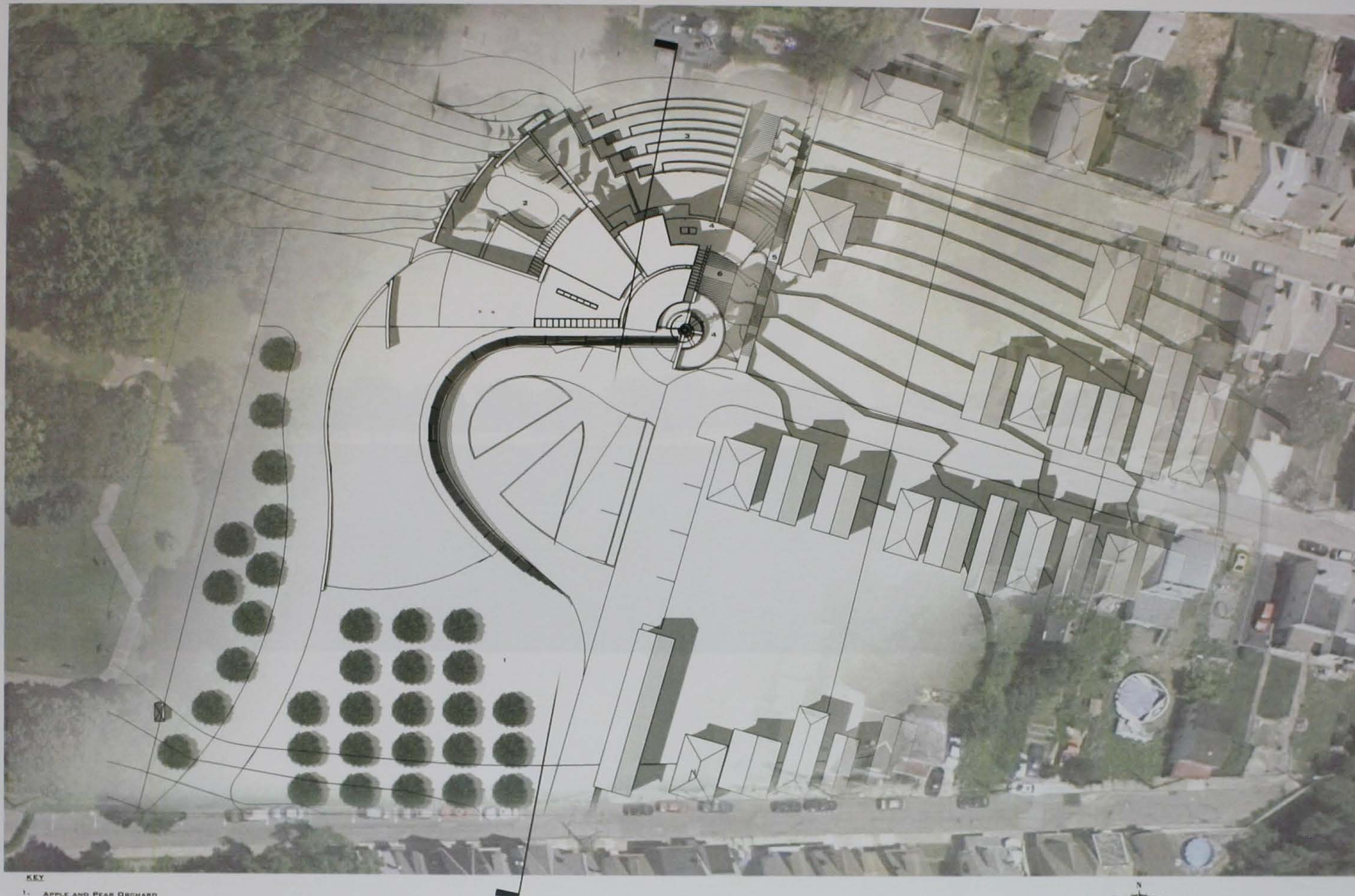









AREA PLAN
SCALE: 1/32"=1'-0"



KEY

1. Apple and Pear Orchard
2. Pond
3. Community garden
4. Observation platform
5. Heritage stairs
6. Celebratory stairs

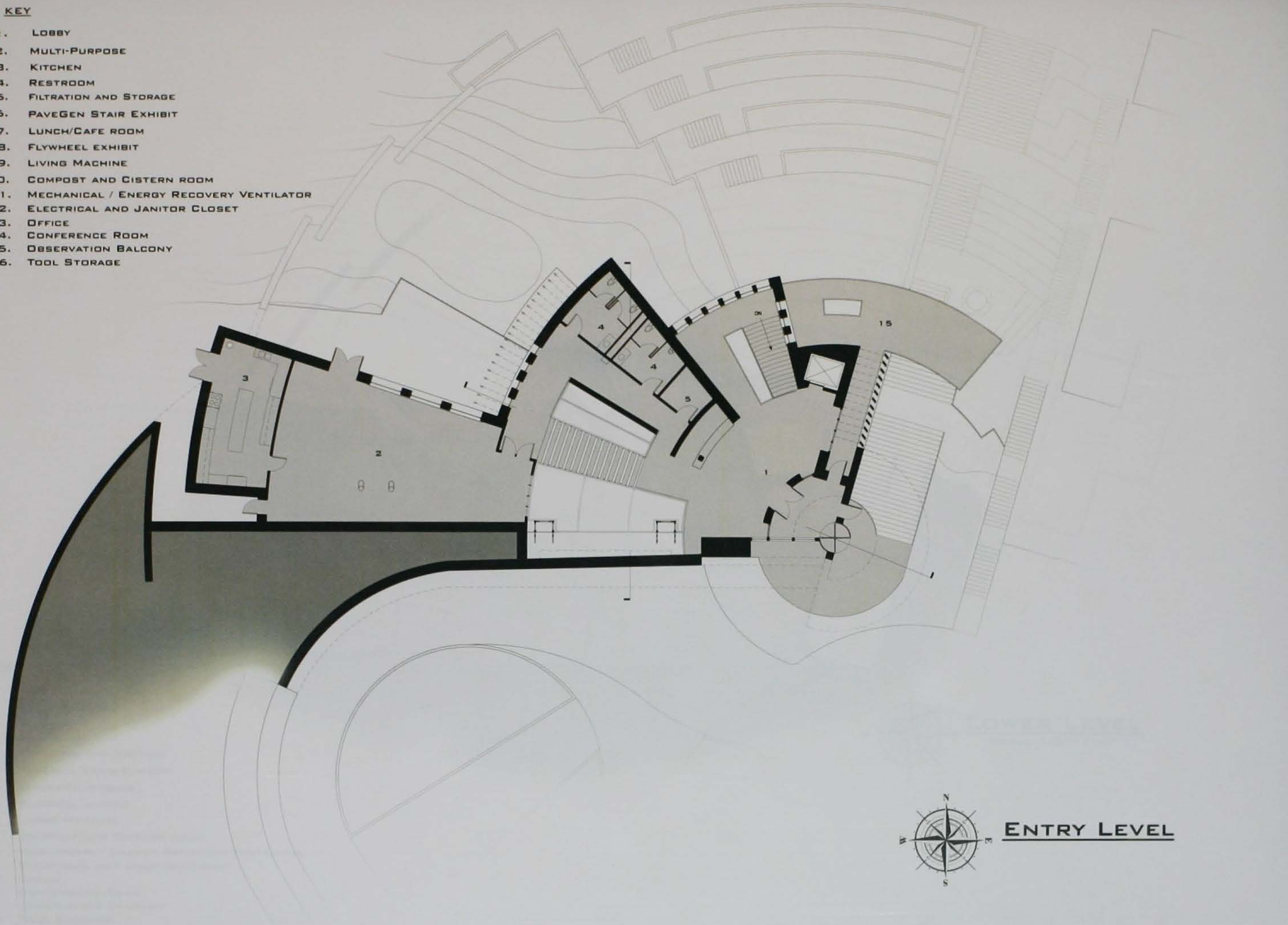
Site Plan

Scale: 1/16" = 1'-0"

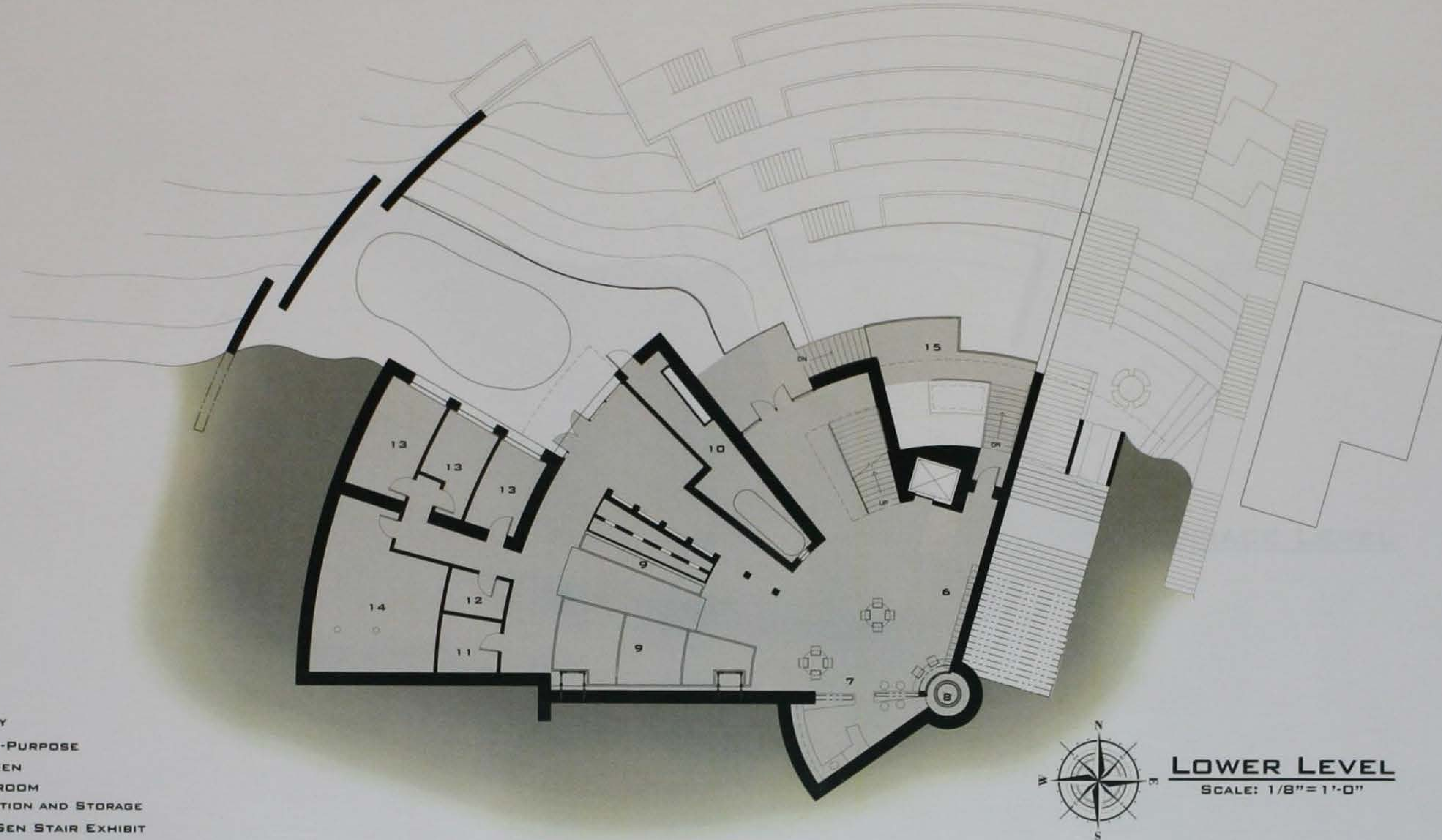
SITE SECTION

KEY

1. Lobby
2. Multi-Purpose
3. Kitchen
4. Restroom
5. Filtration and Storage
6. PaveGen Stair Exhibit
7. Lunch/Cafe room
8. Flywheel exhibit
9. Living Machine
10. Compost and Cistern room
11. Mechanical / Energy Recovery Ventilator
12. Electrical and Janitor Closet
13. Office
14. Conference Room
15. Observation Balcony
16. Tool Storage



Entry Level



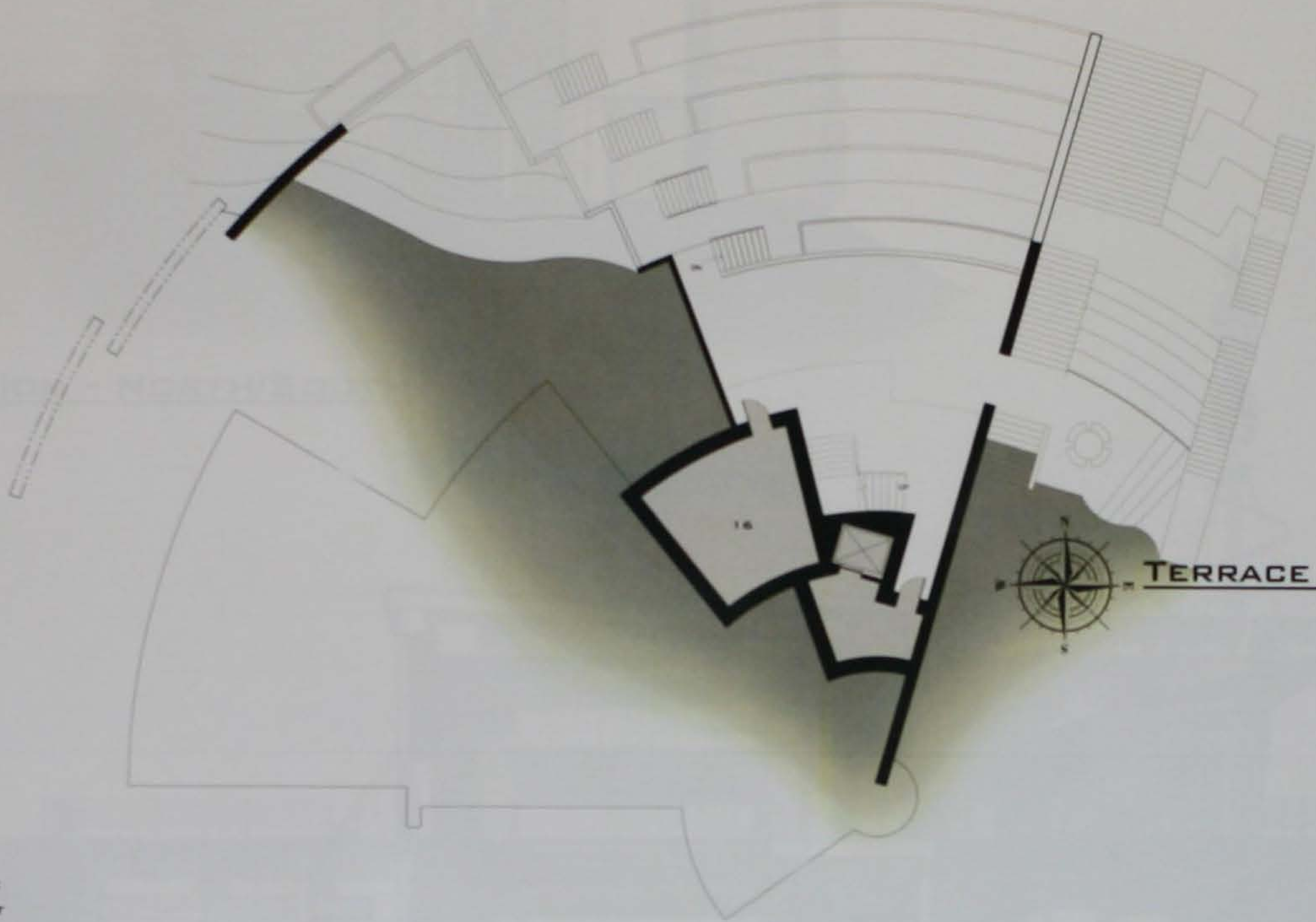
LOWER LEVEL

SCALE: 1/8"=1'-0"

KEY

1. LOBBY
2. MULTI-PURPOSE
3. KITCHEN
4. RESTROOM
5. FILTRATION AND STORAGE
6. PAVEGEN STAIR EXHIBIT
7. LUNCH/CAFE ROOM
8. FLYWHEEL EXHIBIT
9. LIVING MACHINE
10. COMPOST AND CISTERN ROOM
11. MECHANICAL / ENERGY RECOVERY VENTILATOR
12. ELECTRICAL AND JANITOR CLOSET
13. OFFICE
14. CONFERENCE ROOM
15. OBSERVATION BALCONY
16. TOOL STORAGE

TERRACE LEVEL



KEY

1. Lobby
2. Multi-Purpose
3. Kitchen
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6. PaveGen Stair Exhibit
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9. Living Machine
10. Compost and Cistern room
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12. Electrical and Janitor Closet
13. Office
14. Conference Room
15. Observation Balcony
16. Tool Storage

SECTION - NORTH/SOUTH

SECTION - EAST/WEST

Thermal

Passive House Insulation

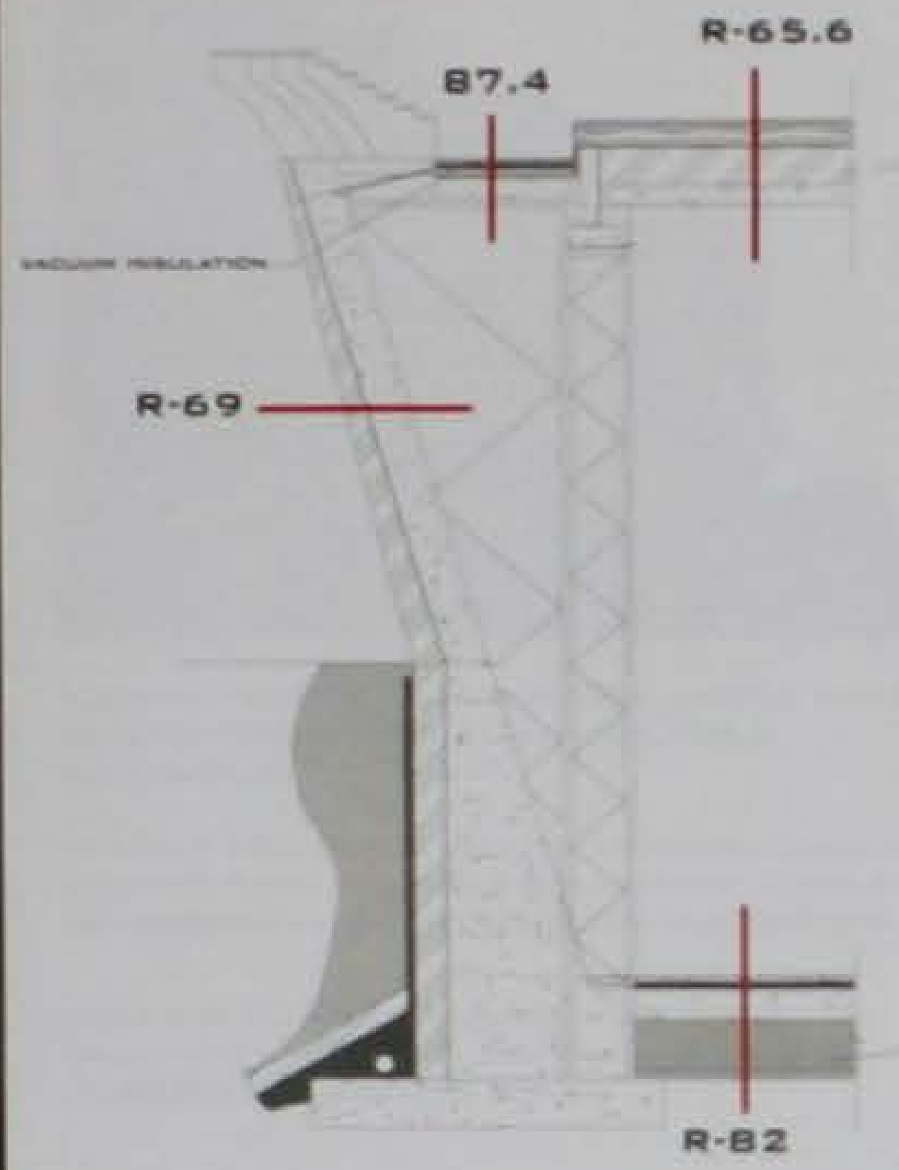
Airtight building shell ≤ 0.6 ACH @ 50 pascal pressure, measured by blower-door test.

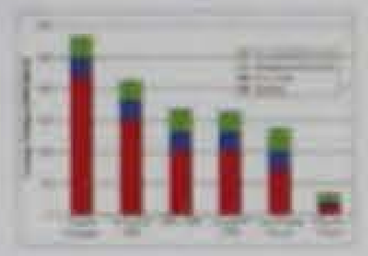
Annual heat requirement ≤ 15 kWh/m2/year(4.75 kBtu/sf/yr)

Primary Energy ≤ 120 kWh/m2/year (38.1 kBtu/sf/yr)

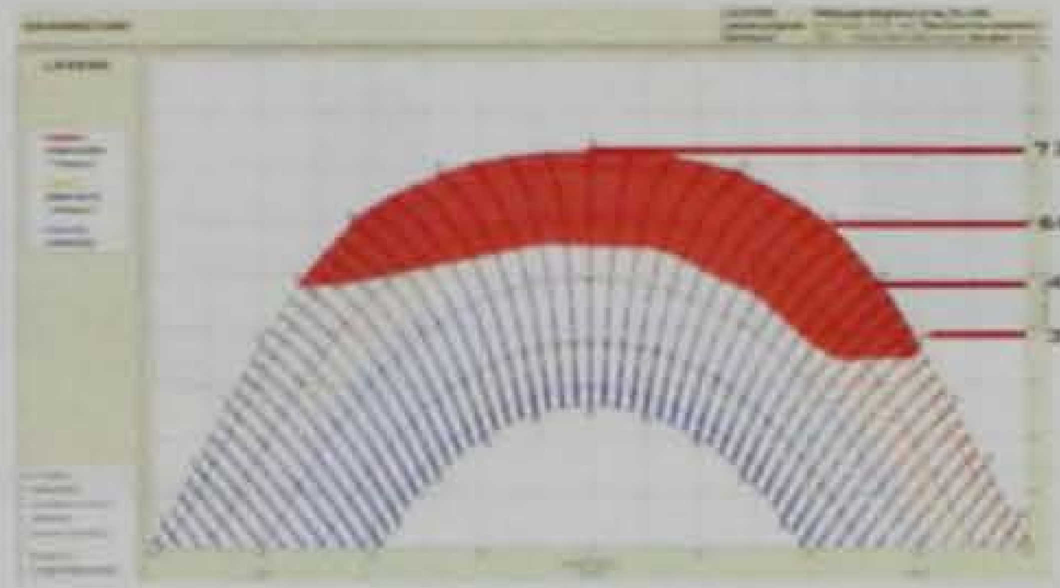
Ventilation system with heat recovery with ≥ 75% efficiency with low electric consumption @ 0.45 Wh/m3

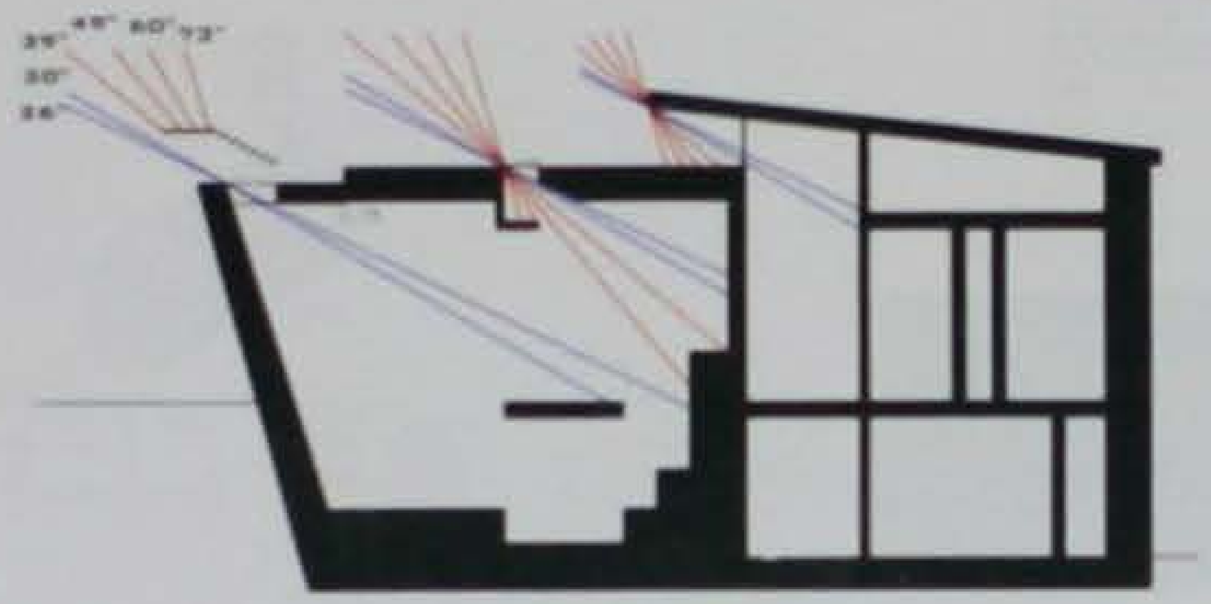
Thermal Bridge Free Construction ≤ 0.01 W/mK



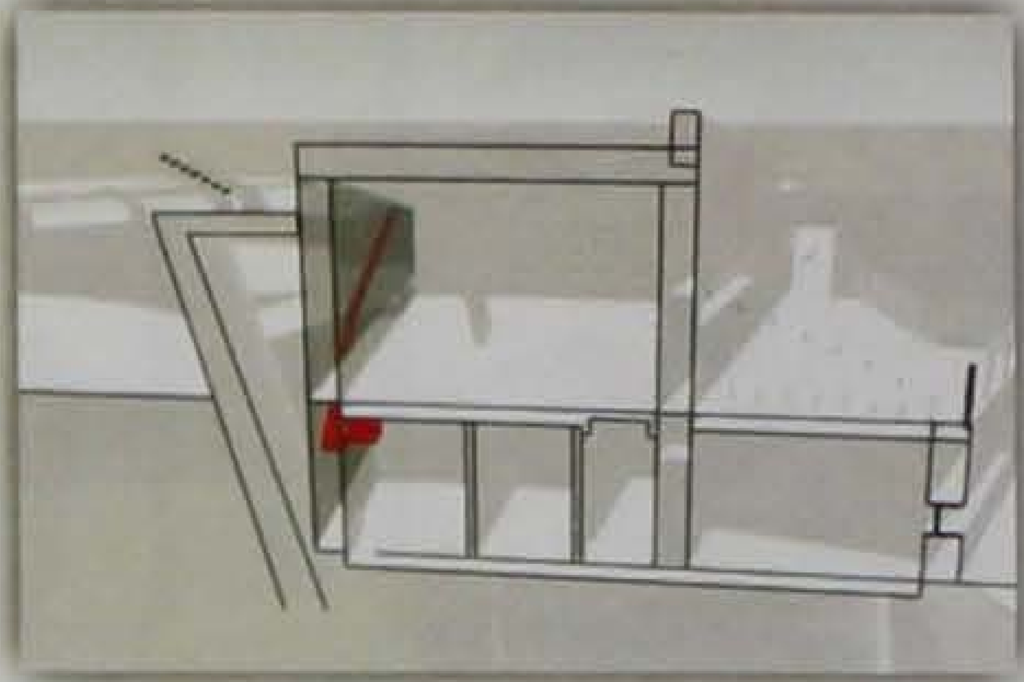


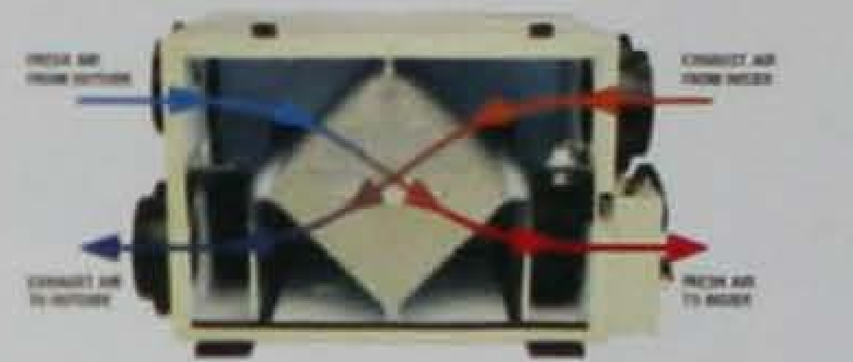
Sun Shading

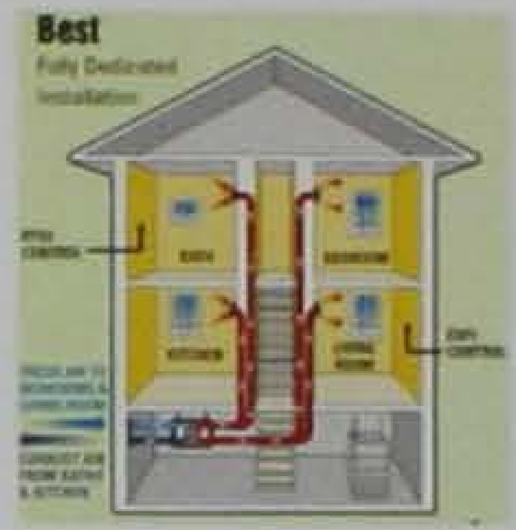




Energy Recovery Ventilator (ERV)

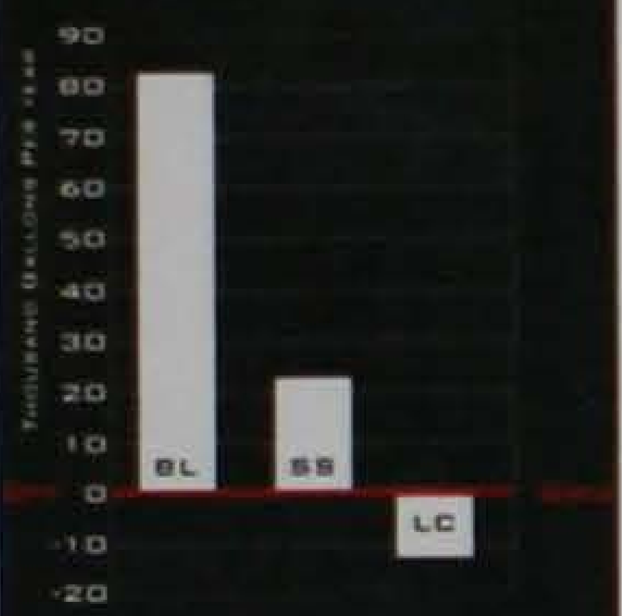






Mixed use ASHRAE standard of 20 cfm/ person with 30 people per day = 600 cfm.
Fantech light commercial ERV range (250-1100 cfm)

WATER

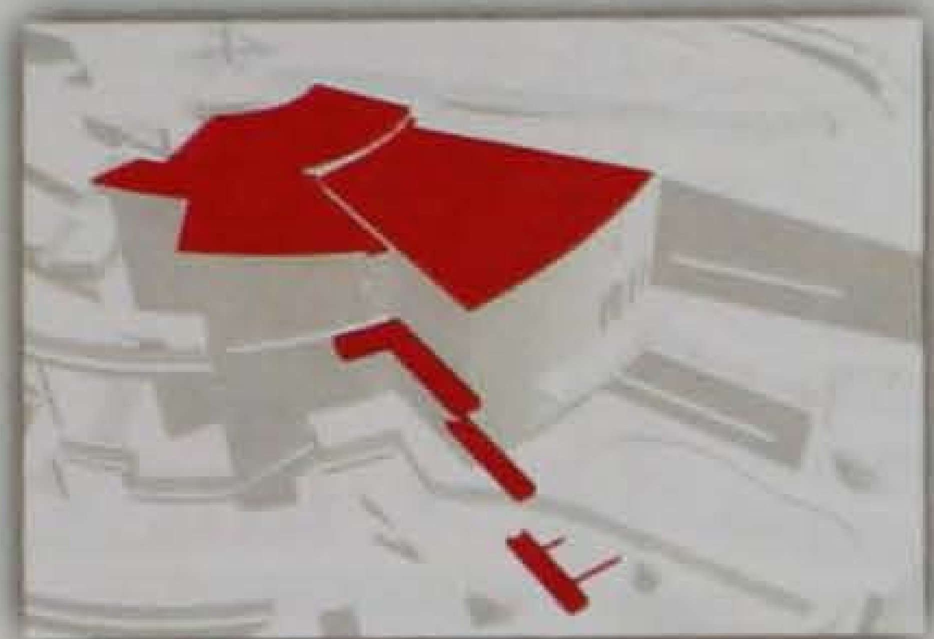


BL- Baseline water use for standard building fixtures

SS- Sustainable solutions using composting toilets and low flow fixtures

LC- Learning center with the rainwater collection system

Roof Collection



1972 FT^2 of roof area

(Roof area) x (in. per year / 12) x (7.43) x (.75)

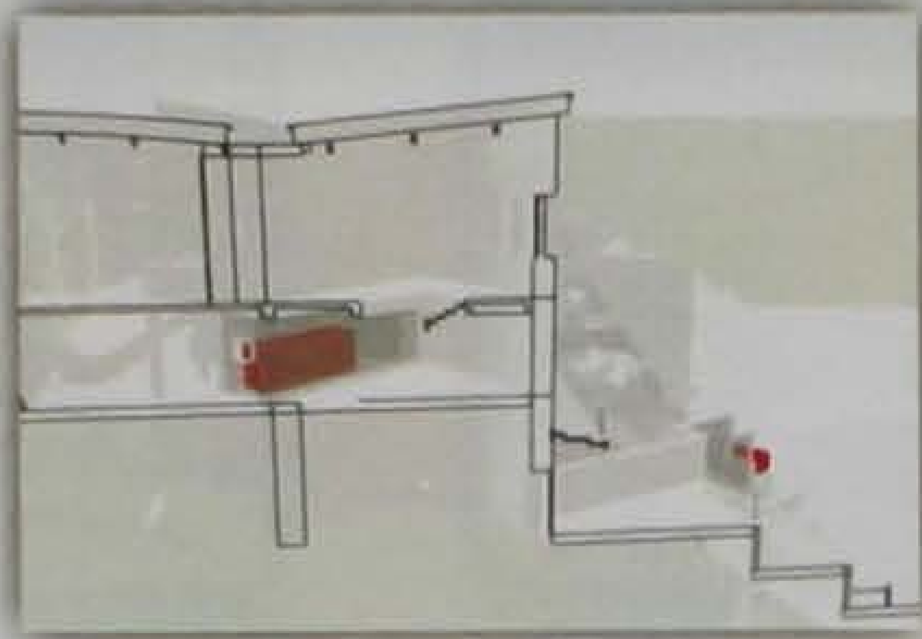
1972 x (37.4 / 12) x 7.43 x .75 = 34,248 gallons/year

Baseline Water consumption from toilets, sinks, drinking fountain and other = 82,582.5 gallons/year

By using composting toilets, waterless urinals and low flow sinks the water consumption savings from the baseline water use is 60,060 gallons/year

Learning Center water need = 22,210.5 gallons/year - 34,248 gallons harvested = -12037.5 gallons/year (extra)

Cisterns



Rotonics Manufacturing Inc. *1700 Gallons*

Permeable Surfaces

UNI ECO-STONE®

The Advantages of Using Permeable Pavers

- Increases the water quality
- Increases the quantity of quality water
- Reduces installation costs of drainage system
- Reduces storm water runoff
- Reduces flooding
- Reduces erosion caused by floods
- Preserves our stream beds and river banks

The Applications of Permeable Pavers

- Commercial and residential driveways
- Public parking lots
- Emergency vehicles access lanes
- Fire lanes
- Pedestrian paths
- Landscaping techniques
- Soil reinforcement and stabilization
- Irrigation techniques
- Increases storm water storage
- Promotes groundwater recharge
- Can sustain heavy loads

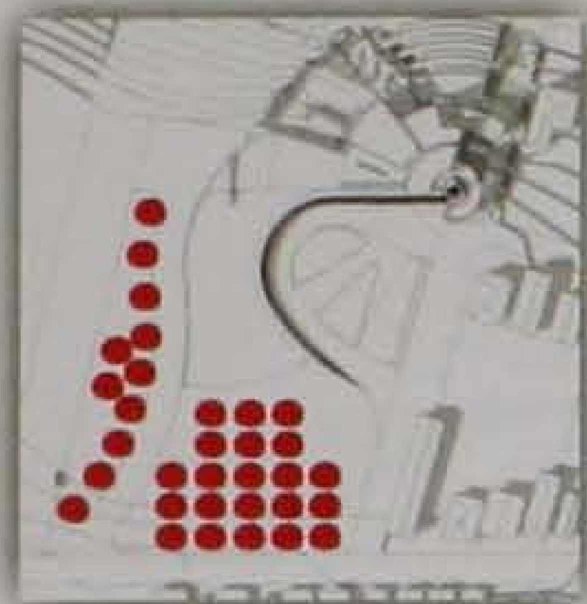
Geopave

Bioswales, Rain Gardens and Sedum Rooftops

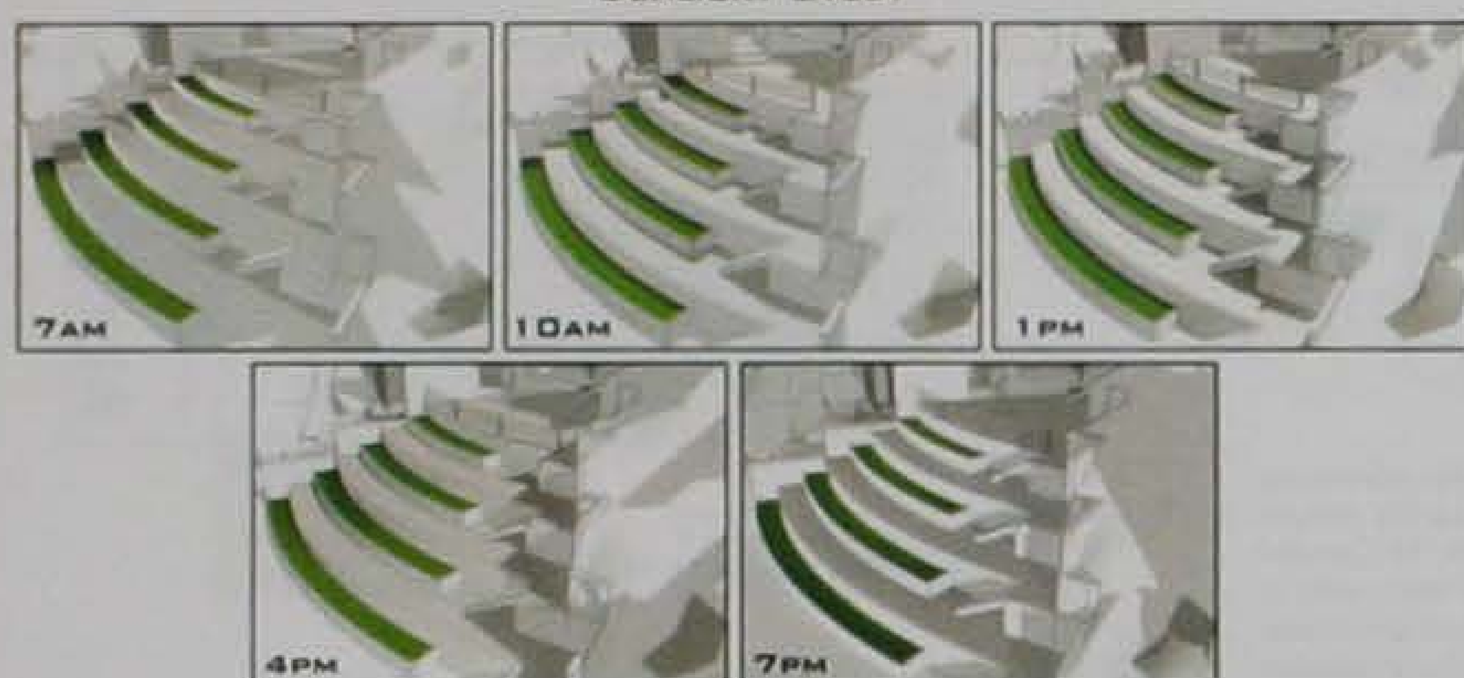
Sedum spurium 'Red Carpet' -turns deep burgundy in fall and winter.

Characteristics

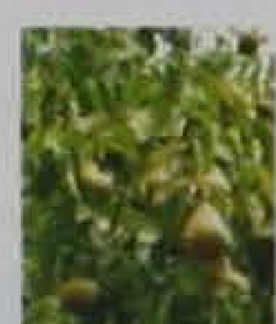
Orchard and Garden



Pittsburgh Growing Season - Begins May 30th
Sunlight Study



Standard apple tree=
15-20 bushels/year



Standard pear tree=
5-10 bushels/year

1 bushel = 42lbs.
16 apple and 16 Pear trees can yield about 384 bushels of fruit = 16,128lbs.

100sf of ground per person per season or 200sf per year

So the terrace garden (1200sf) can feed 6 people a year or 12 people per season

Pond

Bass

Catfish

Perch

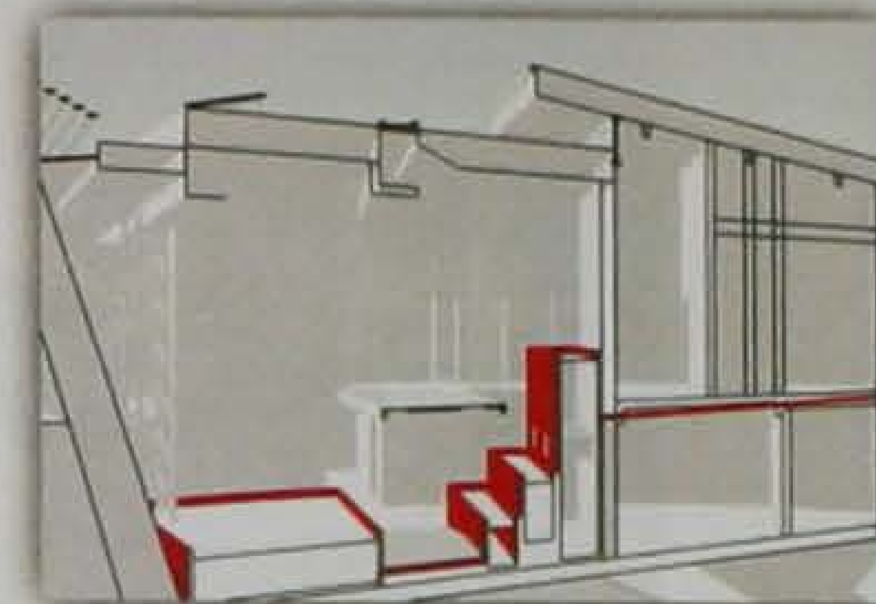
Bluegill

LxWxDx7.48=Pond gallons
Pond volume (3126) x 7.48 = 23,382.48 Gallons

1-5 gallons per pound of fish so about 2.5g

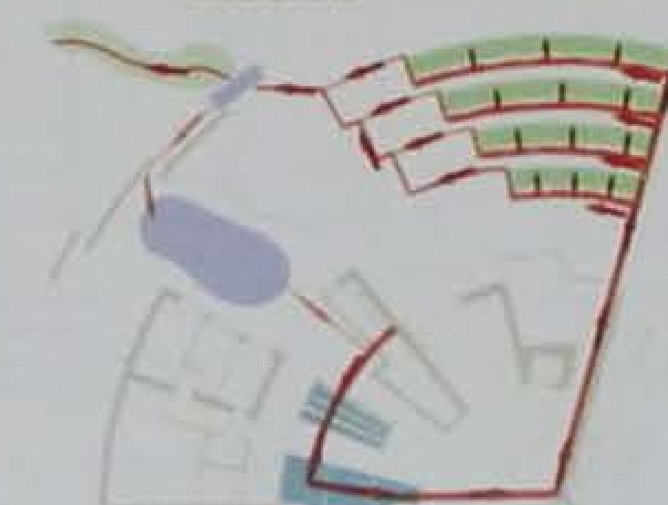
23,382.48 / 2.5 = 9353 lbs of fish

Living Machine

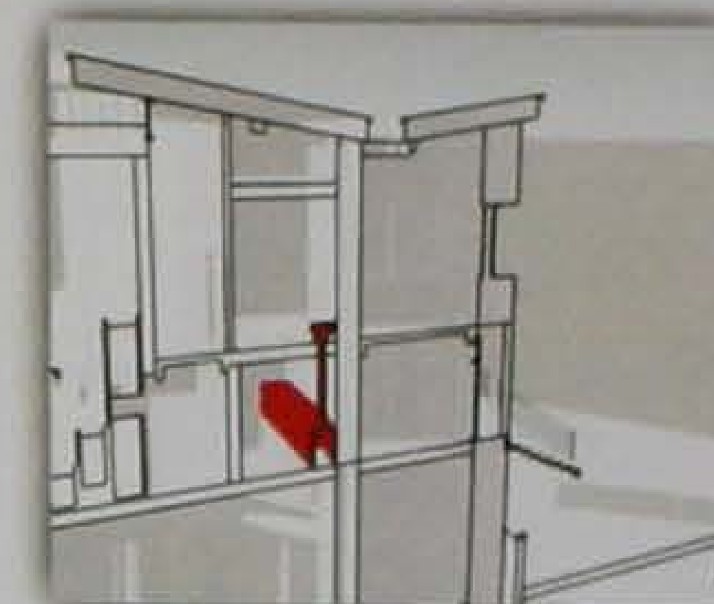


	Living Machine Tidal Flow Wetland	Living Machine Hybrid Wetland	[illegible] Subsurface Flow Wetland	[illegible] Subsurface Flow Wetland	Advanced Activated Sludge System
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Low	Low	Low	Low	High

[illegible]



Composting Toilet



Sun-Mar

3000 A/F NE

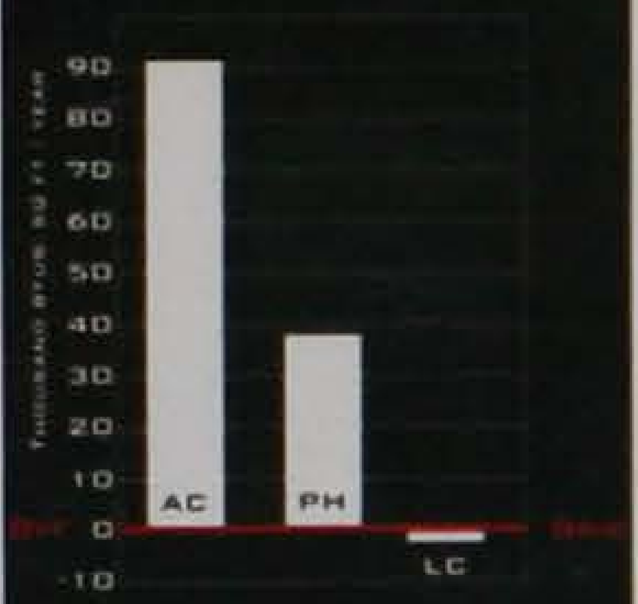
Features
Non-Electric Unit
Extra High
Capacity

[illegible]	[illegible]
[illegible]	[illegible]

Electric (if Applicable)

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

ENERGY



AC: AVERAGE FOR ALL COMMERCIAL (90,500 BTU/SF/YEAR)

PH: PASSIVE HOUSE REQUIREMENT OF < (38,100 BTU/SF/YEAR)

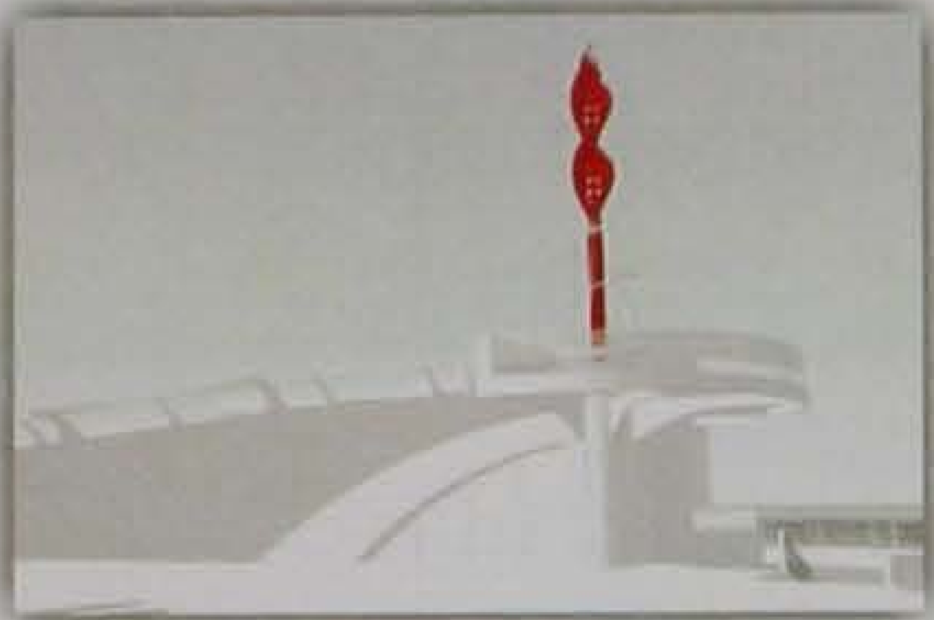
LC: LEARNING CENTER (-773.5 BTU/SF/YEAR)

LEARNING CENTER ENERGY USE = 3,331.4 KWH/YEAR

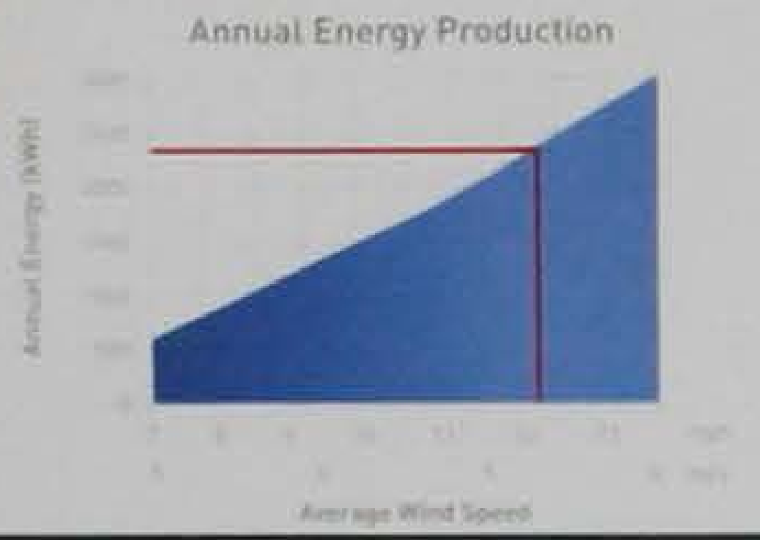
LEARNING CENTER ENERGY PRODUCTION = 4,803.9 KWH/YEAR

LEARNING CENTER EXTRA ENERGY = 1,472.5 KWH/YEAR (5,027,742.21 BTU/YEAR)

WIND TURBINE

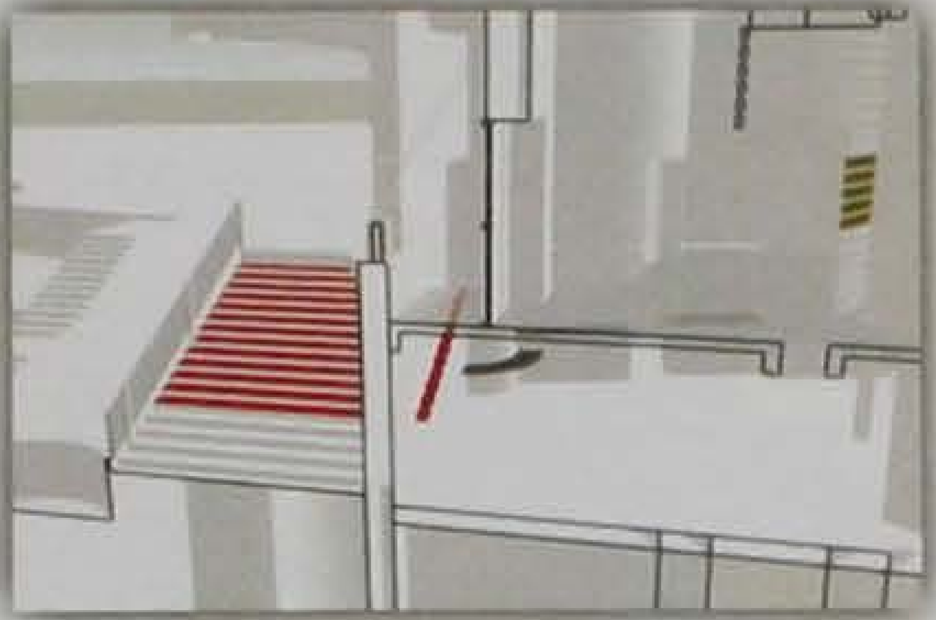


5 - 5.5 M/S = 12.3 MPH



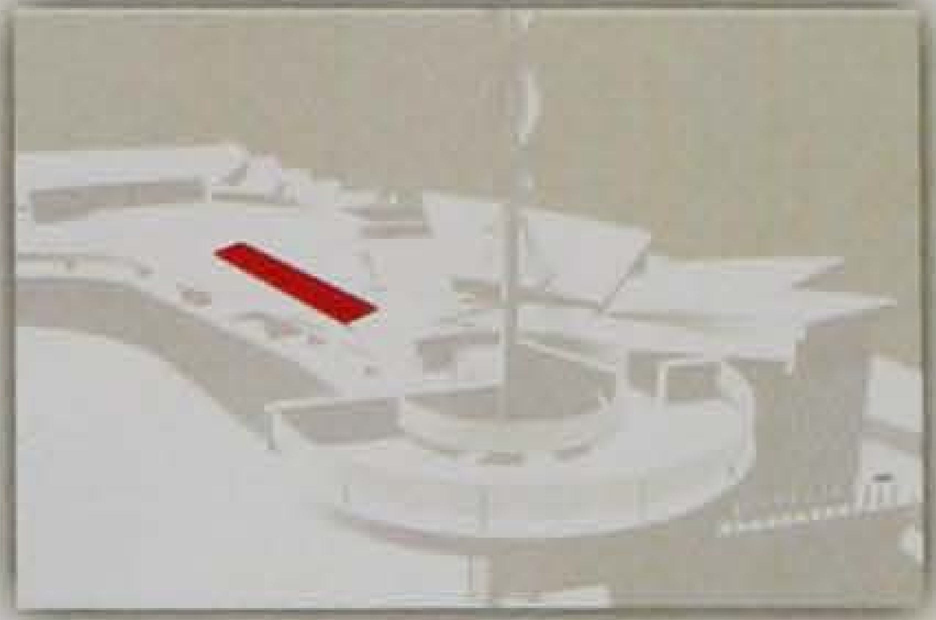
2300 KWH/YEAR

COMPRESSION GENERATION

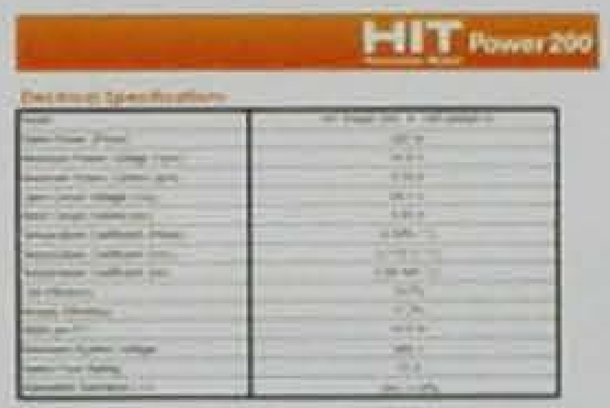


EXAMPLE: KINETIC ENERGY GENERATED IN THE PAVEGEN SLABS SITUATED AROUND A BUS STOP CAN, AFTER 5 HOURS OF ACTIVITY, PROVIDE ENOUGH POWER TO LIGHT A BUS STOP FOR 12 HOURS. AS MUCH AS 2.1 WATTS OF ELECTRICITY PER HOUR FROM THE FOOTSTEPS OF PEDESTRIANS IN HIGH FOOT FALL AREAS.

PHOTOVOLTAICS (PV)



SANYO



X= WATT HOURS/DAY
W= PANEL WATTS
I= SOLAR INSOLATION VALUE
E= PANEL EFFICIENCY

$X = \frac{W(I)}{E}$ $X = \frac{200(3.68)}{1.5}$

X= 490 WATTS OR .49KWH/DAY/PANEL
14 PANELS = 2503.9 KWH/YEAR

FLYWHEEL ENERGY STORAGE