Sustainable Design and Construction of a Library for Disabled Children of Jamaica

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Abstract – Jacob’s Ladder is a caring facility for disabled adults operated by Mustard Seed Communities in central Jamaica. In partnership with the Pennsylvania State University (Penn State), MSC hopes to create a site which will be used to educate both the local and international community about sustainability. Additionally, site planners are developing appropriate sensory stimulation systems capable of meeting the needs of the many future residents. After performing detailed community assessments, a library for use by both the residents and visitors to the site was designed. The library will provide large-scale sensory stimulation to the residents and serve as the focal point for guests to the site desiring to learn about sustainability. The library will house educational material and will incorporate green design features, such as being built from a recycled shipping container and supporting a green roof and solar array. As Penn State begins to implement more sustainable research projects on site, the supporting and educational material will be centrally located in the library where visitors will be able to observe and learn more about the future plans for Jacob’s Ladder.

Index Terms – Mustard Seed Communities, Jacob’s Ladder, sensory stimulation, library shipping container construction, sustainable design, green roof, photovoltaic, passive solar.

INTRODUCTION

Mustard Seed Communities

Mustard Seed Communities (MSC) is a non-profit community development organization founded in 1978 in Kingston, Jamaica by the Roman Catholic clergyman, Father Gregory Ramkisson. With a desire to serve the spiritually, psychologically, and financially poor living throughout Jamaica, MSC began creating places in which to care for, strengthen, and empower others. MSC locations quickly began filling up with disabled and abandoned children, homeless, pregnant teenagers, and individuals afflicted with HIV/AIDS. Currently, MSC operates eighteen “caring apostolates” located across Jamaica and within other countries such as the Dominican Republic, Nicaragua, and Zimbabwe.

Recently, however, the Jamaican government has enforced a law that states that organizations which operate children’s homes are not permitted to care for individuals above the age of eighteen because they are no longer considered children. Therefore, MSC had to begin looking for alternative solutions to caring for their young adults. As there are currently no facilities set up in Jamaica to care for these people, MSC began envisioning the creation of a new site which would be capable of housing many people from not only MSC, but other
organizations who are no longer able to care for these residents above the age of eighteen. This dream has resulted in the creation of Jacob’s Ladder.

Jacob’s Ladder - Overview

In 2004, the Jamaican Bauxite Institute, a division of the Jamaican government, leased out 102 acres of mined-out bauxite land to MSC in a town called Moneague. Located in central Jamaica amidst the Blue Mountains, the site consists of large mined-out pits resulting in extreme topography flourishing with natural vegetation. With a plot of land to build their new caring facility on, MSC began approaching outside institutions, organizations, and universities for help in planning the overall site development. In 2007, MSC approached the Engineering Department at the Pennsylvania State University (Penn State) for aid in furthering the development of the site. With help from Penn State, a vision to create a model community which demonstrated sustainability emerged. With the desire to make Jacob’s Ladder economically, ecologically, and socially sustainable, Penn State professors began recruiting students to help with the overall design.

Since 2007, Penn State engineering professors and students have been working on various projects throughout the site, including wastewater treatment, rainwater catchments and alternative energy installations. The ultimate goal for the site is to house 500 physically and mentally disabled residents along with the necessary staff to care for these residents. Figure 1 shows the current state of homes and cottages on the site. In addition, an agricultural
development plan will be created alongside the residential village to provide food for the site as well as generate additional income.

There are a few challenges to overcome with the design of the site. As a result of previous mining efforts, the site is defined by severe slopes and contours. This radical topography makes it difficult to build homes and infrastructure capable of caring for disabled individuals. In addition, the site is more remote than other locations which MSC has operated. Situated in central Jamaica, Jacob’s Ladder cannot rely on some of the resources readily available to other MSC sites, because of limited availability of supplies and shipping challenges. Resources which encourage mental and physical development are limited, and therefore more emphasis is placed on the caretaker’s ability to entertain the residents.

*Jacob’s Ladder - Sensory Stimulation*

Jacob’s Ladder provides a unique situation because the children arriving at the site are mostly coming from well-established sites, which typically have some form of sensory stimulation. Other MSC caring facilities have schools, sensory gardens, and rehabilitation centers which are used with the residents. In addition, many of these facilities are located in relatively developed regions, which lend themselves to more activity then Jacob’s Ladder’s remote location.

As evident by their existing caring facilities, MSC believes in creating non-institutionalized environments in which to care for their residents. During most of the 20th century, facilities were designed as multistory buildings capable of caring for large numbers of patients due to technological advances in medical science and building construction. This new trend moved further away from natural therapy techniques such as therapeutic gardens and horticulture therapy programs. In the last decade, however, it has been recognized that nature is an important component to holistic therapy and facilities are attempting to reintroduce natural sensory stimulation back into their programs. This new trend is one which MSC has always deemed important in the design of their caring facilities.

Additionally, MSC places an emphasis on creating intimate communities for the residents and atmospheres which promote individual discovery. Jacob’s Ladder is located in the rolling hills of the Blue Mountains and is surrounded by natural scenery. The residents’ homes are small 4-person cottages, and residents are encouraged to spend their days outside with other individuals. This structure will encourage residents to interact with others who may struggle with different disabilities than their own. In doing so, the systems that the residents interact with must properly meet the specialized needs of each resident’s disability. Therefore, large-scale sensory stimulation at Jacob’s Ladder must be capable of addressing multiple types and levels of handicaps. In addition, the system must be designed such that it can grow with the residents at the rate in which they are developing.

*Jacob’s Ladder - Sustainability*

Jacob’s Ladder also presents a unique look at the term sustainability. The first challenge is that the majority of people who will call Jacob’s Ladder home are disabled. Ranging from those bound to wheelchairs and beds, to those who suffer brain damage and mental disorders, Jacob’s Ladder includes a significant proportion of community members who are physically and mentally unable to care for themselves, let alone sustain an entire community. With this in mind, site planners must re-approach how they view Jacob’s Ladder’s sustainability.
The term sustainable development is most often defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. At Jacob’s Ladder, the current needs are providing housing and care for handicapped individuals above the age of eighteen. This requires food, energy, water, infrastructure, and caretakers. The future needs of Jacob’s Ladder will be similar to the current needs, only on a much larger scale. Whereas the site is currently caring for nearly 50 residents, the ultimate goal is to care for 500 residents, therefore increasing the needs by roughly tenfold. As a nonprofit organization, MSC relies primarily on donations to fund many of its caring facilities. Site developers therefore cannot rely completely on MSC to provide all the needs for the future generations of Jacob’s Ladder; an alternative approach must be developed.

Ultimately, Penn State must help MSC decrease the monetary needs required to operate Jacob’s Ladder into the future. In essence, Penn State hopes to lead MSC to become more self-sustaining in order to promote and demonstrate sustainability at the site.

**Problem Statement and Project Goals**

This project will investigate means in which to provide sensory stimulation to disabled residents of Jacob’s Ladder, while simultaneously demonstrating and promoting sustainability.

Jacob’s Ladder is a remote site with the intention of becoming a facility that will house and care for 500 disabled individuals. Due to the pressing demands placed by the Jamaican government, MSC must focus on constructing homes and infrastructure as quickly as possible to accommodate the future residents. This results in little attention being placed on the residents, and more on the physical construction of the site.

A problem that caretakers are currently facing is that there are too many residents to be cared for compared to the relatively small size of the staff. Because Jacob’s Ladder is a remote site, it is difficult for MSC to find enough caretakers to staff the site. Additionally, as more homes are built, there will be a steady increase in the number of residents who need care. There is currently minimal focus on providing stimulation for the residents that will help them develop both mentally and physically. Presently, caretakers group the children together during the day and sing to them, with few other resources to use with the residents. As the size of Jacob’s Ladder increases, this problem of being unable to properly care for the residents will grow unless efforts are made to provide resources for the children.

The second purpose of this project is to demonstrate sustainability and Penn State’s commitment to designing innovative and appropriate solutions for the developing world. Target groups that may visit the site include tourists, nearby Jamaicans, and local and international students. This project will attempt to highlight sustainable solutions to problems facing not only MSC and Jacob’s Ladder, but surrounding communities in Jamaica. It will also attempt to create a system aimed at showcasing multiple design features incorporated at Jacob’s ladder to the future guests who will visit the site.

In summary, this project will:

1. Provide sensory stimulation to the residents of Jacob’s Ladder with minimal reliance on external sources.
2. Demonstrate and promote sustainability through education to tourists, Jamaicans, and students.
**Shipping Container Library**

*Design Process*

In order to best meet the goals of the project; two trips were taken to Jamaica in January and March of 2008 to meet with stakeholders and discuss potential solutions. From these trips, a black-box model as shown in Figure 2 was created to visualize the inputs and outputs of the entire final system. Design ideas were then compiled and ultimately analyzed through a series of decision matrices.

![Figure 2: Project Black-Box Model](image)

First, an analytical hierarchy process (AHP) was used to determine the selection criteria weighting based upon the numerous customer’s needs. An AHP ranks the relative importance of the design criteria to one another. Next, all the design concepts for each category were given a score from 1-5 (5 being the highest) for each criteria. These individual scores were then multiplied to the final weighted values found in the individual AHP’s. These new weighted scores were then totaled for each criteria and a final value was determined. The concepts with the highest weighted scores indicate that they were the ones most appropriate for the final design. By considering the ranking found from the concept combination matrices, the final design was selected. AN AHP matrix and concept selection matrix was calculated for each design category: size, location, foundation, lighting, and cooling. Figures 3 and 4 show an example of both tables for the lighting category.
Reason for a Library

Sensory stimulation is most effective when specifically designed to meet the needs of an individual. Therefore, methods which would be applied to a child with Down’s syndrome would be different than methods used for a child with autism. A library adequately met these needs and provided the first step at large-scale sensory stimulation because it was capable of
addressing the needs of all types of disabilities. Children and young adults with mental or physical disabilities can both interact with books by reading them individually or listening to group readings from the caretakers.

A library would also allow for future construction around it in the form of a sensory garden, which could be built by mission groups visiting Jacob’s Ladder and in need of a work project. A library also reduces the dependence on external resources. Once the library is initially stocked with books, those books will then be able to sustain the residents for years to come. Constructing a library on site is a feasible task which could quickly be built and show Penn State’s commitment to the project.

Shipping Container Construction

A recent trend for alternative building materials has been to use recycled shipping containers for structural support in buildings. In many places, it is too expensive to ship empty shipping containers back to their supplier. In 2005, it was estimated that over 700,000 shipping containers were left sitting in U.S. ports alone. As a result, containers became readily available and relatively inexpensive compared to standard construction materials, and individuals began using them for buildings.

Over the past three years, stockpiles of shipping containers have declined 25% in most ports. However, architects had already begun to recognize the benefits of shipping container construction, primarily for their strength, durability and modularity. Officially referred to as Intermodal Steel Building Units (ISBU) when used for building construction, shipping containers are designed to stack up to 10 containers high and can carry an interior load of up to 50,000 lbs. Intended for traveling across seas, shipping containers are capable of withstanding extreme climatic conditions, which makes them a suitable solution for Jamaica because they will be able to withstand hurricane force winds and rain.

Role of the Library

The shipping container library will serve as the link between the sustainability research projects on site and the residential portion of Jacob’s Ladder operated by MSC. The library will do this by serving as:

1. a building which Jacob’s Ladder residents can go to during the day to read, be read to, and interact with hands-on learning activities, and;
2. the access point for which visitors to the site will go to learn about sustainable technologies and procedures.

Guests will be able to visit the library and learn about the various research projects Penn State is pursuing on site. Inside there will be educational display boards and material about the various research efforts at Jacob’s Ladder. In addition, the library will feature sustainable technologies such as solar and wind power, which visitors will be able to interact with firsthand.

Final Design Description

Overview

The final design for the shipping container library consists of one 20’ x 8’ x 8’ container located directly beside the chapel on site. Windows, air vents, and a door are built into the container. A ramp was built outside of the library to accommodate for residents in wheelchairs.
The library relies upon day lighting as the primary source of light, with plans to incorporate an electric light in the future. In conjunction with a second Penn State thesis project, six solar panels are mounted to the roof of the library. In addition, a 400-watt wind turbine is mounted on the side of the library. To help insulate the shipping container, a green roof is planted on those portions of the roof left uncovered from the solar panels. Air vents and windows are strategically placed to utilize natural breezes on site to help cool the building.

For one week in November 2008, six Penn State students and faculty traveled to Jacob’s Ladder to begin construction of the library. During the week, the container was primed and painted, windows and doors were cut into the walls, bookshelves were built inside, and the green roof frame was begun. Due to heavy rains, the foundation was unable to be poured prior to arrival of the shipping container to the site. Rather, a temporary foundation was constructed for the build week.

To complete the unfinished elements, a team of students from Penn State and Jackson State University traveled to Jacob’s Ladder in August 2009. During the trip the interior and exterior was painted and the solar panels, wind turbine, and green roof were installed. In addition, books that were collected from Pennsylvania were shipped down to begin filling the library. As research projects are added to the site, the educational and informational materials will be stored in the library for future visitors. Additionally, because the library is built beside the chapel, an adjacent sensory garden and reading area will be built for the residents. This garden will be capable of expanding as the number of residents increase. Mission groups will be able to contribute to the project and build small portions of the entire garden.

Location

To provide the greatest accessibility for the future residents and visitors at the site, it was determined by site administrators that it was most important for the library to be built in a central location on site. Future residents’ homes will be built surrounding the administration building and chapel. Therefore, it was decided by the designers that the library should be placed...
bordering the chapel. Jacob’s Ladder administrators then chose the specific location so that the library would complement future development and infrastructure.

The library was placed adjacent the chapel and connecting parking area. As seen in Figure 6, the library is located beside the main entrance to the chapel to the east. The northern face of the chapel will ultimately be made out of windows and overlook the rest of the site. To ensure that the view from inside the chapel remains unobstructed, it was important that the library be placed out of the direct line of sight north from the chapel. Placing the library on the eastern wall of the chapel ensures that the shipping container does not obstruct the main view.

The library is bordered by a stone wall on the western side and a road on the eastern side. A small strip of land between the wall and road will eventually be converted into the sensory garden and reading area for the residents. Future plans for enlarging the sensory garden will also be feasible given the chosen location. These gardens will help enhance the surrounding area, which will eventually be the focal point of Jacob’s Ladder.

![Location of Library Diagram](image)

**FIGURE 6**
**LOCATION OF LIBRARY**

By placing the library at this location, Penn State’s research efforts will be prominently displayed to visitors who may have an interest in sustainability and would therefore like to get more involved. It was also important for the library to be centrally located because it houses the alternative energy charging station for an onsite electric golf cart. This vehicle will be parked beside the library throughout the day to charge while staff are working inside the administration building.\(^{xxi}\)

**Lighting**

Because electricity costs are expensive, current daily operation at Jacob’s Ladder is during daylight hours from 6 a.m. - 6 p.m. Therefore, current use of the library will only happen during the day and will not need lighting at night. To maximize natural sunlight, the orientation of the building was aligned so that the main axis of the building is situated from east to west. This results in sunlight having to travel the least distance (8 feet) inside the building. Two 5’ x 3’ sliding glass windows are placed along the southern wall. Unlike many wooden windows at Jacob’s Ladder, the glass windows allow the library to be used even if the windows need to be shut because of rain. To protect against hurricanes, wooden shutters will be secured to the outside of the windows.
Because Jamaica is located near the equator, the sun is positioned high in the sky for most of the year. Therefore direct sunlight into the windows will not be as big of a concern and placing them on the southern wall is most appropriate. The windows are also placed on this wall because it is the side facing the administration building and direction that visitors arrive to the library. This allows guests to see inside the library as they approach the building, inviting them to step inside.

If Jacob’s Ladder staff decide in the future that they would like to use the library at times when day lighting is insufficient, then a simple electric light can be installed inside. This light fixture can receive electricity from the solar and wind powered charging system built into the library.

*Thermal Comfort*

By situating the library next to a solid wall of the chapel, wind is forced to blow onto the container and through the vents and windows. Two 5’ x 10” vents on the windward side of the building are placed 3 inches from the floor of the container, as seen in Figure 8. These vents consist of two downward sloping boards permanently attached inside a wooden frame. Plastic mesh is attached to the outside of the vent to help prevent rain from getting inside the library. On the opposite wall, the two windows are placed 3.5 feet above the floor. This design forces cooler air into the bottom half of the container while pushing warmer air up and out of the interior of the library. Together, these designs help provide airflow over both the inside and outside of the shipping container. Having a constant source of airflow also removes unwanted smells and paint fumes which may form inside the structure.
Working in conjunction with the second Penn State thesis project, the library also serves as a support structure for solar panels on the roof. The 260-watt array is combined with 400-watts from a nearby wind turbine to charge the electric golf cart on site. The panels are centered on the roof and cover a span of 14’ x 4’. Being slightly elevated off of the roof, the panels funnel wind down onto the roof to cool the regions not covered by the green roof. In addition, they shade the exposed roof from direct sunlight.

Green Roof

To provide insulation on the top of the container, which will be most directly affected by the sun, a green roof was built. The combination of soil and vegetation will act similarly to standard building insulation. An 8-inch perimeter of the roof is covered with the green roof while the center portion of the roof is shaded by the solar array. The cross-section of the green roof will consist of a drainage layer, filter mat, soil, and vegetation.

The drainage layer consists of broken bits of concrete blocks found from on the site. A layer of non-woven weed control fabric, acting as the filter mat, is then placed on top of the broken
blocks and stapled along the top of the wooden frame. This fabric ensures that when it rains, the soil will not be washed away. A mixture of sand, soil, and potting soil is then placed above the filter mat along with a variety of plants. All the plants are native to or commonly found in Jamaica and include plants such as Lantana, Plum Bago, and a variety of grasses.

When it rains, water lands both in the green roof compartments as well as on the parts of exposed metal roof. The water that falls in the green roof drains through the soil and eventually falls onto the roof. Because the container is used, the roof is dented, and therefore the water naturally puddles in various spots. Sun shining and wind blowing on the roof then helps to evaporate the water and blow it into gutters along the long edges of the container. Because the roof is made from corrugated sheet metal, grooves run along the length of the container to allow the rain that lands on the metal roof to run underneath the green roof compartments to the 20-foot sides and into gutters.
Roof Structure

To support the solar array and provide structure for the green roof, a wooden frame is built on top of the container. Shipping containers are designed to bear their entire load on the corner vertical supports. Therefore, the roof frame is designed so that it distributes all the weight on the roof to the four corners. The support frame is built from 2” x 6” and forms a 20’ x 8’ rectangle frame on the roof. Seven cross beams then span the inside of the frame. The five cross beams closest to the center are spaced 3’6” away from one another, the optimal distance to support the solar array frame, and used to support the solar array and narrow green roof along the border. Two additional cross beams are placed 8” from either end and used to support the green roof along the 8’ span. To permanently attach the wooden frame to the shipping container, metal brackets are attached on all four corners and secured into the container wall.

To frame out the green roof compartments, additional 2” x 6” are used to create an 8” border around the entire frame. The solar array will be supported by an additional 2”x4” frame which will be built off of the inner crossbeams.
The final design consideration for the roof was to evaluate the walls of the container. The corrugated steel used for the walls does not specifically bear any of the load on a container, but does provide rigidity for the entire structure. By cutting windows and a door into the container, the structural integrity of the walls was jeopardized. To compensate, two things were done as shown in Figure 12. First, the frames that were used to hold in the windows and door doubled as a way to increase the strength in the walls. Second, interior 2”x4” vertical supports were placed along the 20 foot span directly underneath the steel beam. Because the doorframe provided vertical support on the one side, only one additional vertical support was added on the south side. On the northern face, two vertical supports were each placed 2.5 feet away from the center of the wall.
**Interior Layout**

Figure 13 shows an aerial view of the inside of the library. Upon entering the container after its completion, one will immediately see the Penn State display boards on the opposite wall outlining plans for future development and describing the sustainable design elements incorporated into the library. On their left, visitors will be able to observe the multiple components required for generating electricity from the solar panels and wind turbine. This will include the batteries, inverter, charge controller, disconnects, and breaker box.

![Diagram of Library Interior](image)

**FIGURE 13**  
*Internal arrangement of library*

The electrical components were elevated above the vents to ensure that rain would not accidentally fall on them. A poster beside these components will demonstrate how the system works as a whole. Surrounding the bottom half of the library away from the air vents are bookshelves, which will house the books for the residents. A bookshelf directly beside the door will also hold additional books from floor to ceiling.

Because day lighting is used to light the interior, items that will be used most often were placed opposite the windows so that they would be best lit. This includes all of the educational display boards and material. In addition, the inside of the container has to create an environment conducive for larger groups gathering inside to learn about the sustainability projects. By using the entire 20-foot wall, multiple people are able to gather inside and read the boards comfortably.

All additional space is used for bookshelves for the residents. Because of the large number of residents, the staff and children will not actually read the books inside the library but rather take them outside to the attached reading garden. Therefore, it was not important to create a space inside where people could read the books for extended periods. However, a small table and chairs can be placed at the far end of the library if individuals desire to remain inside while using the books.
FIGURE 14
CONCEPT RENDERING OF INSIDE THE LIBRARY WITH BOOKS ALONG THE SOUTHERN WALL

FIGURE 15
CONCEPT RENDERING OF INSIDE THE LIBRARY WITH BOOKS, DISPLAY MATERIALS, AND ELECTRICAL COMPONENTS
**Surrounding Garden**

To provide an area for reading the books to the residents and to help enhance the appearance of the surrounding area, a sensory garden will be built adjacent the library. Figure 16 shows the current area surrounding the library and a concept of what the garden surrounding the library may look like in the future. This sensory garden could be expanded to include multiple design elements to engage the senses based upon the needs of the future residents. MSC is planning on building pavilions nearby the library, which will provide additional space for caretakers to read to the residents.

*FIGURE 16*
CONCEPT RENDERING OF FINISHED LIBRARY WITH ATTACHED SENSORY GARDEN AND READING AREA

**Construction and Implementation of the System**

From November 22-28, 2008, six Penn State students and faculty traveled to Jacob’s Ladder to begin construction of the library. Prior to the build team arriving at Jacob’s Ladder, MSC staff constructed the temporary foundation on site on which the shipping container was placed. This ensured that the build team could begin construction and modification of the container immediately upon arrival. For the majority of the week, the site experienced periodic rain showers that made it more difficult to perform certain tasks such as painting. Out of consideration for the residents, tasks that involved noise were scheduled for during the day.
From July 25-August 7, 2009, a mixed team of students from Penn State and Jackson State University in addition to a few non-students traveled to Jacob’s Ladder to complete the library. During this trip, most of the finishing touches were completed including the solar array, wind turbine, weather station, and green roof. By the end of the week, the library was fully functional and stocked with books for use by the staff and residents.

**Book Drive**

To provide resources for the library, multiple book drives were organized across the state of Pennsylvania. Neighborhoods, churches, and schools (elementary, middle, and high schools) were all involved in donating books to the project. From these efforts, 2075 children books were collected. A portion of these books were shipped to the site during the summer 2009 trip with plans to send the rest with a future group from Penn State.

**Conclusion**

Design and construction of the shipping container library successfully met the two project goals of promoting and demonstrating sustainability efforts at Jacob’s Ladder and providing a source of sensory stimulation for the residents.

The library will educate visitors about how green designs such as alternative energy, green roofs, and alternative building methods can be applied to their own lives, and marks the first on-the-ground commitment by Penn State to MSC. As more Penn State students and faculty begin work on projects at Jacob’s Ladder, the library will be able to accommodate the supporting material for these new research projects. In addition, the library will help centralize Penn State’s efforts onsite and will eventually be the access point from which guests will be able to visit the research projects.

The library meets the second project goal by serving as an appropriate large-scale sensory stimulation system at Jacob’s Ladder. Books can be used as a developmental tool regardless of the level or type of disability, and are capable of growing and adapting with the residents. Specialized forms of sensory integration can then be built upon the library, such as a sensory garden. Because the library will be stocked with donated books and materials, the library will minimize the amount of external resources needed to meet the needs of the residents. The progress that was made during both build trips was significant in solidifying the relationship between MSC and Penn State and will be built upon in the years to come.

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REFERENCES

i Brown, Neil, Steven Marshall, and Eric Sauder. "Mustard Seed Communities." Jacob's Ladder: A Sustainable Community for Disabled Individuals of Jamaica. Vol. 1. Oct. 2008. 2.
i Brown, Neil, Steven Marshall, and Eric Sauder. "Mustard Seed Communities." Jacob's Ladder: A Sustainable Community for Disabled Individuals of Jamaica. Vol. 1. Oct. 2008. 2.
iii Brown, Neil, Steven Marshall, and Eric Sauder. "Mustard Seed Communities." Jacob's Ladder: A Sustainable Community for Disabled Individuals of Jamaica. Vol. 1. Oct. 2008. 2.
iv Moran, Matthew. Telephone interviews. Nov. 2007 - Nov. 2008.
v Moran, Matthew. Telephone interviews. Nov. 2007 - Nov. 2008.
vi Epstein, Mark. "The Garden as Healer." Landscape NW. 1998. The Seattle Daily Journal of Commerce. 7 Sept. 2008 <http://www.djc.com/special/landscape98/10037844.htm>.
vii Brother Anthony. Personal interview. 12 Mar. 2008.
viii Moran, Matthew. Telephone interviews. Nov. 2007 - Nov. 2008.
ix Moran, Matthew. Telephone interviews. Nov. 2007 - Nov. 2008.
x "What is Sustainable Development." Development Education Program. 2001. The World Bank Institute. 22 June 2008 <http://www.worldbank.org/depweb/english/sd.html>.
xii Brother Anthony. Personal interview. 12 Mar. 2008.
xiii "What is Snoezelen MSE?" Snoezelen – Multi Sensory Environments. 2009. FlagHouse Inc. 5 Oct. 2008 <http://www.snoezeleninfo.com/whatIsSnoezelen.asp>.
xiv Lois Abdelmalek. Personal interview. 19 July. 2008.
xv "All About Shipping Containers." Intermodal Steel Building Units & Container Homes. 2008 ISBU Association. 2 Oct. 2008 <http://www.isbu-info.org/all_about_shipping_containers.html>.
xvi "All About Shipping Containers." Intermodal Steel Building Units & Container Homes. 2008 ISBU Association. 2 Oct. 2008 <http://www.isbu-info.org/all_about_shipping_containers.html>.
xvii "Why Use ISBU?" Intermodal Steel Building Units & Container Homes. 2008 ISBU Association. 2 Oct. 2008 <http://www.isbu-info.org/why_use_isbu.htm>.
xviii "Why Use ISBU?" Intermodal Steel Building Units & Container Homes. 2008 ISBU Association. 2 Oct. 2008 <http://www.isbu-info.org/why_use_isbu.htm>.
xix "Container Design." Container Handbook. Vol. 1. 2008. German Insurance Association. 6 Sept. 2008 <http://www.containerhandbuch.de/chb_e/stra/index.html>.
xx Sauder, Eric M. "Development of an appropriate solar and wind hybrid charging station for electric vehicles in developing countries." Thesis. State College, Pennsylvania.
xxi Sauder, Eric M. "Development of an appropriate solar and wind hybrid charging station for electric vehicles in developing countries." Thesis. State College, Pennsylvania.
xxii "Passive Cooling." Smarter Homes. 2008. New Zealand Department of Building and Housing. 18 Oct. 2008 <http://www.smarterhomes.org.nz/design/passive-cooling/>.
xxiii Sauder, Eric M. "Development of an appropriate solar and wind hybrid charging station for electric vehicles in developing countries." Thesis. State College, Pennsylvania.