

ECO-RETREAT CENTER DESIGN IN JUNGLE FARM, LIBERIA, WEST AFRICA

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ABSTRACT

Located in West Africa, Liberia is currently undergoing a reconstruction phase after 14 years of civil war, a war that ended in 2003. As a country, Liberia currently faces serious political, financial, administrative, and organizational problems that will affect its future in numerous ways. Since the availability of comfortable and sustainable spaces for organizations working on rebuilding the country is limited, the *Eco-Retreat Center* design project will help to fill this shortage, creating a new, sustainable retreat center that will be accessible to all who live here, or that come to visit and to participate in the rebuilding of Liberia.

Education and water availability represent other major problems in Liberia. An estimated 80 percent of schools, health service structures, water wells, and sanitation facilities have been either destroyed or abandoned since 1998. Energy, sanitation, and water systems are therefore in dire need, thus making them very important considerations in the development of any project in Liberia, as they will serve as a foundation for other sustainable techniques and development strategies in the reconstruction of the country. This design project seeks to do this, and through a sensitive site design that places buildings, rain harvesting elements, water towers, and more into a complex and severely constrained site, this project can become a model for sustainable redevelopment in West Africa and beyond.

From a sustainability standpoint, the retreat center will create a combination of ecological, social, economic and aesthetic places for educational and/or social events. The sustainable design strategies are reflected in the overall site design, materials selection, and through the use of specific stormwater management strategies. Specifically, the retreat center will preserve and restore native plants, use environmental friendly building materials, and manage water and energy that can be collected, balanced, and utilized in the long term. The design of the Eco-retreat Center will meet the needs of all the potential users and create an ecological and sustainable place that is connected to the existing ecological system and environment.

Through the use of site analysis, user- and resident-analysis, precedent studies, and historical analysis, the design team developed a detailed site plan, and then site-specific design proposals that meet the need of the client. The final result will be used by the client in both fundraising efforts, and as a guide for actual site development in Liberia, leading to the creation of an innovative and important Eco-retreat Center in West Africa.

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Finally, we would like sincerely to thank Stanton Jones, our project's advisor, who gave us tremendous help during the whole process of this project.



The Eco-retreat Center Design Project Team Members with the Family of Our Client (May 2014). Left to right: Dennis Aggrey, Vania Aggrey, Ying Li, Fei Dong.

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INTRODUCTION

The goal of this project is to provide Christian Revival Church Association (CRCA) with a design for an Eco-retreat Center to be constructed on the Jungle Farm property. The Eco-retreat Center will be open for any organization to rent for conferences, retreats, and training. It needs to hold eight hundred people for their eating, sitting, sleeping and recreational purposes with full sets of facilities. The client defined the number and function of the buildings as basic requirements. The project team worked in collaboration with Sustainability Without Borders (SWB) and the Christian Revival Church Association (CRCA) to design open spaces and locate key buildings by providing a master plan and supporting drawings to illustrate the design ideas.

Because the Eco-retreat Center will be a place both for organizations to rent and do activities, and for long-term, cost-efficient and educational purposes by implementing sustainable design strategies, which means the value of the Eco-retreat Center is to provide a pleasant meeting space for people to help promote the business and recovery of the country, and be an eco-friendly, people-oriented sustainable model of the country as well.

PROGRAM DESCRIPTION

The project site is an “L”-shaped property owned by CRCA currently called Jungle Farm, which is located in Liberia, West Africa. Now the property is fenced, and the clients have asked for a design of an Eco-retreat Center using this property that can hold conferences, meetings and other events, in order to help the country recover. For the final deliverables, the project team should provide the client a master plan of the Eco-retreat Center, as well as supporting drawings of the design of open space, the location of key buildings, conceptual design of the buildings, and building material suggestions. Specific requirements for the design of the Eco-retreat Center are listed below.

- The client requests key buildings of different functions for the Eco-retreat Center. All of the buildings should not exceed four floors. One of them is a teacher and pastor college, which should have long classrooms inside. For example, it could be a two-story building with six classrooms on each floor. An elementary school is also requested, which should hold 300 students in total with nine grades in nine classrooms. The elementary school could be in the same building with the teacher and pastor college.
- The client also requests a conference hall. The conference building will be the main building on the site. It should have a big conference room that can hold 800 people, as well as small meeting rooms around it inside. It will be a complex building, designed with cafeteria, laundry rooms and other facilities. The client has a preferred building shape for the conference hall – an octagon shape with eight columns. The conference building should have an indoor sports area on the third floor, and could also have a lifted basement that can catch natural light.

- Lodging space is also needed on the site. Three dormitory buildings with one to three floors are requested. One dormitory is for female visitors, one is for male visitors, and the other one is for VIPs and families. Each of the female and male dormitories needs to hold 375 people. The client hopes each room could be four people minimum and six people maximum, using bunk beds. So with the 375 capacity and three floors, there could be about 30-32 rooms on each floor. While, the VIP complex dormitory needs to hold couples or families, which in total 100 people, with 25 rooms that have balconies. The capacity for the VIP/family building is smaller because the rooms should be bigger and self-contained. The client requests that the three complex dormitory buildings need to be set separately due to cultural reasons.
- Other buildings include an administrative building, a big water tower, and several security towers. The administrative building is used as CRCA's office building. It could have a clinic inside, with conference rooms and department rooms. Building a big water tower aims to help provide running water for the whole site, and serve as a landmark of the Eco-retreat Center as well. Security towers are requested to be built at each corner of the site. They could incorporate with the entrances of the site for security reasons.
- Besides the buildings, other requirements are listed below. Five entrances are currently requested for the site. Two of them are for vehicles. Small cars use the front entrance, and big trucks use the back entrance. The parking lots for staffs and visitors should have at least 100 parking spaces in total and 150 parking spaces at most. The parking lots could be set in different areas of the Eco-retreat Center, and handicap parking space should be taken into consideration. For landscape, the client prefers to use open lawns with trees for the landscape. No bare yard should be seen on the site. Spaces for recreational areas are needed for both kids and adults.
- Lack of electricity and running water are basic problems happening in Liberia. Cooling and drainage are also big issues that need to be solved in the design.

BACKGROUND

Liberia lies in West Africa with Atlantic Ocean along the country's southwest. The southwest part is mostly flat and rolling plains, and the landscape rises to the northeast part with low mountains covered by tropical rainforests.

Liberia has a hot climate with heavy rainfall runs from May to October and dry and dusty winds blowing inland during the winter, causing many problems for residents. (Bateman, 2000)

The average annual rainfall is about 158 inches, and the average annual temperature is about 80° F with very little variation throughout the year.



Atlantic Ocean

History

The country, Republic of Liberia, was founded in 1822 by American Colonization Society (ACS), an organization which helped with the migration of freed African-American slaves to Liberia from the United States. (Accredited Language Services, web) By 1867, over 13,000 freed African Americans were sent by ACS to Liberia and they injected the native population with American traditional culture and notions, giving rise to a new national and racial supremacy, and political republicanism. (Wegmann, 2010)

Liberia declared independence in 1847, establishing its capital city Monrovia. With the investment assistance from United States since World War II and presidency by William Tubman, Liberia had great changes in the economy, politics, and social environment, resulting in its modernization in the 1940s. Later, two civil wars were launched in the country. The first Liberian Civil War was triggered by an insurrection against Doe's government in 1989 due to his government repression, which ended in 1996. The Second Liberian Civil War was launched in 1999 to against Taylor's leadership because of the use of diamonds and illegal timber exports until a peace deal was signed in 2003. Ellen Johnson Sirleaf became the president of Liberia in 2006 after the presidential election since the end of the civil war (BBC News, web), and is the first female president in Africa.

Economy

Liberia is one of the poorest countries in the world. More than 80% of the population lives on less than \$1 per day. While the income of most Liberians is low, for example, the income of a teacher is \$50 per month. The GDP of Liberia per capita peaked in 1980 at US\$496 (The World Bank, web). The country's nominal GDP was US\$1.154 billion in 2011, while nominal GDP per capita stood at US\$297, which ranked the third-lowest in the world (International Monetary Fund, web).

Foreign financial assistance and exports of natural resources give support to the country's economy. After the war, Liberia experienced economic ruin and remained without



Liberia Street View

electricity and running water, and small domestic market also inhibited economic growth. Due to foreign aid and investment inflow later, and the convenience for multinational corporations, Liberia is undergoing its economic upheaval. However, its health system and economic and political stability is recently fragile because of the outbreak of deadly Ebola, resulting in very little economic activity there.

Education

Liberia is one of the most undeveloped countries around the world. The official language in Liberia is English, and over thirty indigenous languages are also spoken within the country. (Accredited Language Services, web) Liberia has an estimated literacy rate at 60.8% (UNESCO, 2011). In some areas of Liberia, for children from 6 to 16 years old, primary and secondary education is compulsory and free of charge, though there is no strict enforcement of attendance. Due to the inadequate schools and supplies and lack of qualified teachers, the country's education is being hampered, and school attendance rates remain relatively low. Higher education in Liberia is decentralized. The largest and oldest university is the University of Liberia, which locates in Monrovia and opened in 1862. Also, Liberia only has two public Rural Teacher Training Institutes.



Liberia Primary School



Church Events

Culture

The culture of Liberia was infused by America-Liberian men. It has a long, rich history in textile arts and quilting as the settlers brought with them their sewing and quilting skills. Also, literature existed over a century ago, many prominent authors and contributed to the novel development. Festivals as Christmas, New Year and Independence Day (July 26) are three major festivities in Liberia (Robin et al., 2005). They are celebrated with feasting and merriment. People would exchange gift and dance together. Music and dance are Liberia's cultural heritage from one generation to the next.

Living

People live in poor conditions without clean water, sanitation and good quality shelter. They have been through 14 years of war. There is no electric grid. People who can afford it must rely on gasoline generators for electricity. Visiting the nearby community of Jungle Farm, houses are small and close together. They are



Play equipment for kids - generates energy while spinning

built with brick walls and metal roofs. There is no kitchen, no bathroom, and no electricity inside. If they need water, they have to go outside and use the hand pump away from their home. Cassava and fruit trees are grown in the property. For most Liberians, rice is the staple food. Liberians have eaten almost everything, from little insects to giant elephants. While the traditional crops also include Cassava and fruit trees.

Transportation

The country of Liberia is under reconstruction, as well as their transportation system. There are only two usable highways left after the war. One is connecting Kakata and Monrovia, and another one is connecting Monrovia and Buchanan. (Countriesquest, web) The public roads in Liberia were estimated 10,600 km (6,586 mi) in 2002, and only about 60% were paved and 25% are classified as all-weather. (Encyclopedia of the Nations, web)

There is no public transportation system in the country. Virtually only taxicabs and a few short-line buses are common carriers in Liberia.



Monrovia to Airport Road

Culture of organizing buildings

The freed African Americans also brought the American culture and recreated an American society. "Affluent citizens constructed two-story houses composed of a stone basement and a wood-framed body with a portico on both the front and rear, a style copied from buildings in the southern American states from which most of the emigrants came." (Library of Congress)

This culture is still affecting the city of Monrovia.

Many residential buildings are two and three-story constructed of wood and stone.



Vulnerable Coastal Settlements

Source:
<http://www.bbc.co.uk/staticarchive/fa4ada8a7f225e46b66c2a1e6ccb86d5b4260fdf.jpg>

Before the Americo-Liberian pioneers forayed into the hinterland, the majority of settlements were located along the coastal, and the mangrove swamps were around the stretch of land. These "Cango settlements" became widely known and developed into "the centers of trade commerce, education and politics in Liberia and consequently the hubs of socio-economic activities" (Ngafuan, 2010). These settlements provide a sense of livelihood and had an increasing popularity in both settler community and native population.

With the rapid urbanization in Liberia, there emerged unplanned, informal and 'illegal' settlements on both public and private land to hold the overwhelming urban population. Under this circumstance, the settlement was built in extremely poor quality and residents have no security of tenure. Because the residential buildings were built to accommodate the need of growing population, the land boundaries, plot sizes and shapes were not designed clearly (McAuslan, 2011).

Providence Island is in the north of the city center of Monrovia and is the first spot where freed African American first arrived in Liberia. The layout of city Monrovia is developed into a grid pattern. The downtown area of Monrovia became home to government buildings, including the City Hall, Temple of Justice, foreign embassies, hotels, etc. In the east of Monrovia is the Free Port, which became the city's industrial center. The Spriggs-Payne Airfield and the Robertsfield Airport are located along the edges of the city in the south, where used to be the older district of Congotown (Cities of the World).



Downtown Monrovia Overview

Source:

http://upload.wikimedia.org/wikipedia/commons/0/0b/Downtown_Monrovia_3348917715_67a2002529.jpg

In some areas, Liberian House was constructed on the highest point. Historically, no buildings appear to have been constructed to the south or west of the house. The placement of any new construction should consider the potential impacts on this viewshed.

CASE STUDIES

Three case studies were chosen and researched to help the team make design decisions for the Eco-retreat Center. Two of the projects were completed recently. Located right in the country, sites of these two projects are close to the location of the Jungle Farm property. The first project is the Economic and Commercial Counselor's Office of the Embassy of the P.R. China located in Monrovia, and the other one is the Fendell Campus of the University of Liberia. These two projects are both considered as good design projects in Liberia. By studying these representative local projects in Liberia, the project team learned more about the needs of local people, and the building materials and construction characteristics that are appropriate for the study area. In addition to those two projects, we also reviewed the case of Mary and Joseph Retreat Center, a project located in Rancho Palos Verdes, California. It was selected because the client loves the layout and design style of that project. It was chosen as the client's preferred case, serving as a precedent study for the Eco-retreat Center Design with a focus on its building arrangement and the design of courtyard and green space.

The objective of this review is to develop a sustainable design for the Eco-retreat Center, which would help the center to achieve its purpose for a long run.

All of the three cases were studied individually, and the review for each project can be found as follows.

I. The Economic and Commercial Counselor's Office of the Embassy of the P.R. China in Liberia

The Economic and Commercial Counselor's Office of the Embassy of the P.R. in Liberia is located in the new Liberian capital Monrovia Old Town Backstreet Congo, about 100 meters away from Chinese Embassy in Liberia. It is designed by China Institute of Building Standard Design & Research. Earthquake resistance rating of the building is a second level earthquake-proof in accordance with seismic design of buildings (GB50011-2001): fortification Class is C category, and the seismic intensity is 7 (0.1g). The building's design working life is 50 years.

The project has a total land area of about 13,794 m², with a total construction area of 2404.13 m². Within the site, there is a two-story office building with a floor area of 1087.27 m², and the height of the cornices of it is 9.2 m. The apartment building is also two-story with a floor area of 709.78 m². Its eave is 7.4 m high. The ancillary space is 403.84 m², with one floor, and its eave is 5.35 m high. The one-floor garage with a 5.1m high cornice has a size of 140.6 m², and it has one floor. The area of the swimming pool is 62.64 m². In addition, there are other facilities such as a new basketball court, several badminton courts, walled courtyard road, landscape green, outside, tanks, wells, etc. Finally, the structure of the buildings is reinforced concrete frame structure.

Topography

The project is located in the Liberian capital Monrovia Old Town Backstreet Congo, hilly to the north, and Sheman's Lake next to the south. The site is nearly rectangular shaped, with north-south length of about 120 meters and east-west length of about 110 meters (Photo 1). A large number of construction wastes was accumulated on-site. The construction can proceed only after the site was flattened. According to the site condition, during the construction process, abandoned buildings were removed, but parts of the left trees were preserved. For the design of the Eco-retreat Center, we may use a similar approach to deal with the topography of the Jungle Farm property.



Photo 1: Satellite picture of the site before and after design.

Source: Google Map

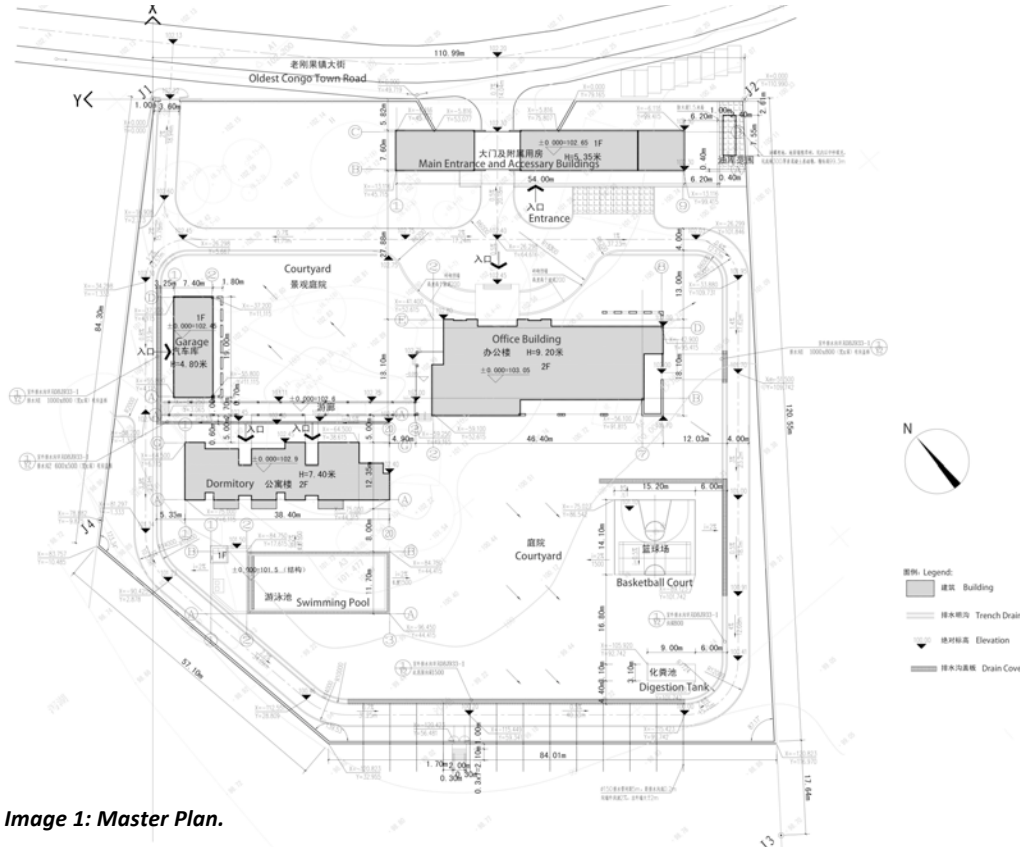


Image 1: Master Plan.

Source: Report of architecture design of the Economic and Commercial Counselor's Office of the Embassy of the P.R. China in Liberia

Architectural Style

The architectural style (Photo 2) of the economic and commercial counselor's office is a new Chinese style whose characteristics includes sloping roof, yard wall, gray roof tile, clean bright white building wall and wharf wall.



Photo 2: Economic & Commercial Counselor's Office. (Photo by Jidona Qiu)

Main Entrance

In the area of the main entrance, a water tower, a guardhouse, and accessory rooms are connected together to make as an impressive image for the whole cluster. The building cluster was designed to be a landmark. As the main entrance, these connected structures should function not only as a safety shield, but also as an attractive and unique landmark. The Chinese style water tower is much taller than its surrounded buildings. In addition to water supply, this design provided a sense of place and aesthetic value. For the Eco-retreat Center, we can apply a similar strategy to solve the problem of water storage, and water supply by providing sufficient hydraulic pressure. While building a water tower in the entrance area could help to create a sense of belonging and be a splendid landmark, the form, materials and appearance of the tower should be coordinating with other buildings on the site, such as school, conference hall, and dormitory.

Building Layout

Buildings with different functions are layout reasonably. To avoid the problem of disconnection a corridor was designed to link three main functional buildings such as the office building, the garage and the dormitory building together to be an organized cluster (Image 1). The corridor also plays a role as a shade structure from sun and rain protection. Shelters here have various forms, such as covers mounted to the wall of buildings. In short, the corridor is used as an extension of building space, and to connect those otherwise separated buildings. In Liberia, frequent heavy rains and exposure to strong sunlight is expected, so that is needed to connect nearby buildings to provide protections for pedestrians. . For the Eco-retreat Center, having a covered corridor would be a good solution for not only connecting dispersed buildings, but also a transition from buildings (hard landscape) to landscape.

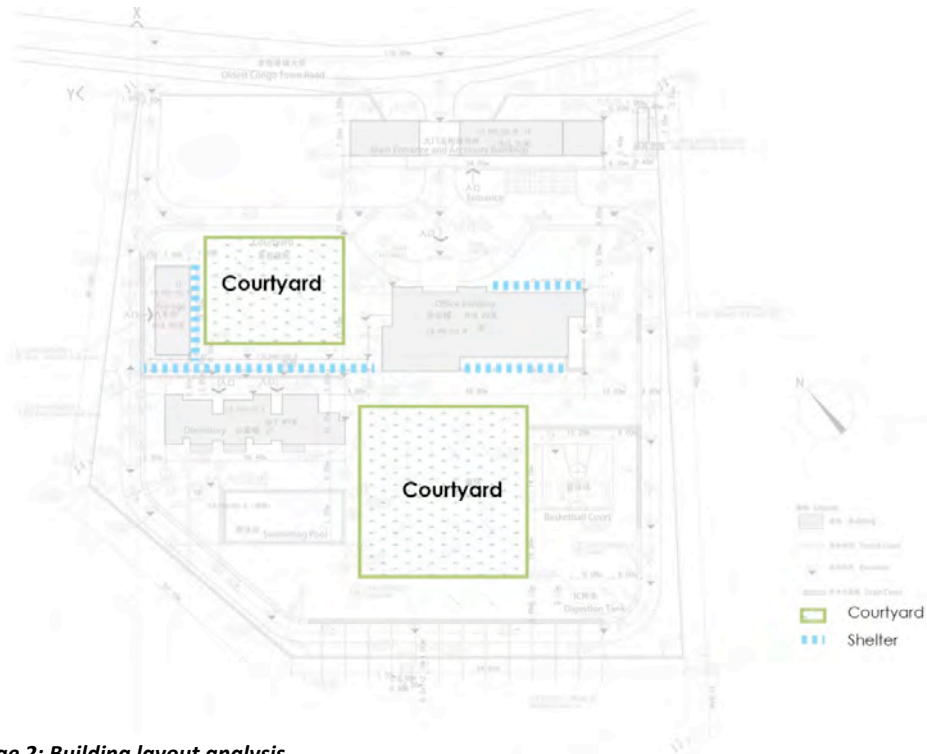


Image 2: Building layout analysis.

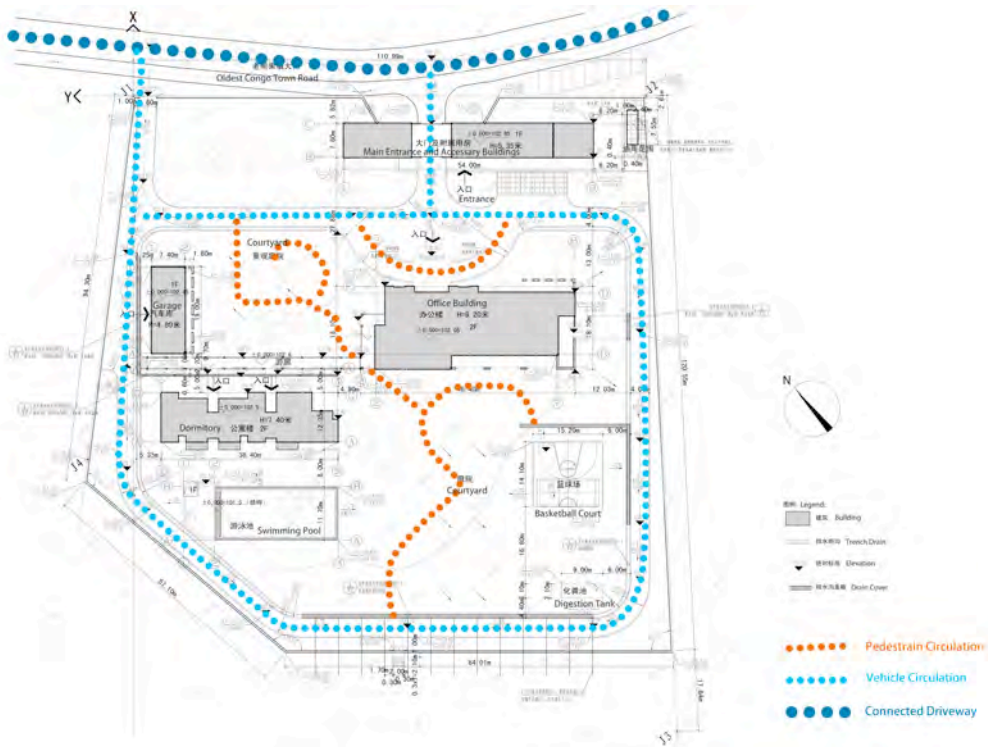


Image 3: Circulation analysis.

There are two courtyards enclosed by buildings and the corridor as shown in Image 2. Since the location and the surrounded buildings and facilities are varied, the functions and the levels of the privacy of the courtyard are different. The front yard near the main entrance focuses on how it looks while the backyard emphasizes how it works. The Eco-retreat Center could have a courtyard with multiple functions, and the level of privacy for individual sections in the courtyard could be different according to the location, nearby buildings and the people it serves.

Circulation

Pedestrian and vehicles traffic routes are separated as shown in Image 3. The driveway is along the fence. On the roadside, there is a garage, which is connected to other buildings by a corridor. In this case, traffic efficiency is set as the top priority. For pedestrian road, how users feel when they are in the landscape is much important. For this reason, paths are sinuous to make walking experience a comfortable and relaxed. For the Eco-retreat Center, it is better to separate vehicle and pedestrian roads for safety reason. Corridor based route would help pedestrians to feel more comfortable. The geometric shape of driveway and pedestrian paths should be decided to create an efficient and reasonable landscape.

Stormwater

Since there is no water system in Liberia, a stormwater system was created within the boundary of the project. Elevation in the center area of the site is higher than its surrounding area so that stormwater will flow into the trench drain along the driveway that is along the fence. For the Eco-retreat Center, stormwater should be drained and collected in a reasonable place according to the topography of the site.

II. Fendell Campus of the University of Liberia

The University of Liberia is one of the best universities in Liberia, Africa. The Fendell Campus of the University of Liberia is another site the project team visited while in Liberia, Africa. It is one of the biggest developmental projects in postwar Liberia. The construction took two years from 2008 to 2010. The project is chosen as a case study because it is a newly built project, and the Fendell Campus also serves similar functions as the Eco-retreat center project. Since the project team members are not architects, this case would help the team to have a sense of building forms, sizes and capacity. Knowing that, the project team could understand how much space a building takes, and then use the left open space of the Jungle Farm property properly. Thus, the building types, building capacity, green space, entrances, parking lots, and the arrangement of buildings and space were used as a reference for planning of the Eco-retreat Center.



Bird's eye view of Fendell Campus

Source:
http://tlcafrica.com/monrovia_2010/fendall_1.htm

The Fendell Campus (the plan view is showed in Image 4) locates along the Monrovia-Kakata Highway. It covers an area of 11 hectares, which is about three times bigger than the Jungle Farm property. It has 24,800 square meters of floor space, including the teaching and administrative building, dormitory buildings for students, apartment buildings for faculty members, a gatehouse, and a friendship tower. (Ir.china-embassy, web) Other support facilities, like water supply, power generation, and sports field are also on the campus.



Image 4: Google map plan view of Fendell Campus

Components on the campus:

- ① Main entrance
- ② Teaching and administrative building
- ③ Dormitory buildings for students
- ④ Dormitory buildings for faculty members
- ⑤ Gatehouse
- ⑥ China-Liberia Friendship Tower (water tower)
- ⑦ Sports ground

① Main Entrance

The campus gate (Photo 3) is designed in Chinese style. It looks large and splendid. It is the main gate and about 30 meters in width. When designing the main entrance for the Eco-retreat Center, the project team can consider the size of the gate of the Fendell Campus as an example. On the other hand, the client mostly concerns the safety issue of the property. Besides the attractive appearance, the main entrance needs to add security rooms above, two car lanes with control poles under the gate, and pedestrian entrances on sides.



Photo 3: Main entrance of Fendell Campus

2 Teaching and Administrative Building

The Eco-retreat Center needs a complex conference hall, which can hold meetings, as well as sports and food service. The building type and function are similar to the teaching and administrative building (Photo 4) on Fendell Campus of the University of Liberia. The teaching and administrative building is a four-storey building. "It is about 12,000 m² and houses an academic exchange center accommodating 360 attendants, 2 large classrooms with a seating capacity of 150 each, 27 classrooms, 4 audio rooms, 4 computer rooms, a five-roomed library, 63 offices, 3 research rooms, 8 conference rooms and 2 cafeterias." (Ir.china-embassy, web) Such mixed-use would save building materials, energy and add convenience for the daily function of the building for both the students and staffs. So when designing Eco-retreat Center, the mixed-use design method could be taken away, so that to achieve sustainability.



Photo 4: Teaching and administrative building

3 Dormitory Buildings for Students

There are four two-storey buildings of students' dormitory (Photo 5), which can accommodate about 1,000 students on the Fendell Campus. Two of them are female dormitories, and the other two are male dormitories. These buildings are designed with covered corridors outside around each floor of the building. Such design could help to provide shade and isolate the heat in the hot weather. Some lattice windows take the place of solid walls so that air can flow through the indoor environment. These are all particular design in Liberia to accommodate the hot and humid climate. Thus, when designing the Eco-retreat Center, the capacity and size of the buildings help the project team to determine the sizes of the dormitories in the Eco-retreat Center. The design ideas of outside corridor and lattice windows are good takeaways when designing buildings for the Eco-retreat Center.



Photo 5: Dormitory buildings for students

Source:
<http://lr.china-embassy.org/eng/sghdhzxxx/t720771.htm>

4 Dormitory Buildings for Faculty Members

The five three-storey staff dormitory buildings (Photo 6) contain 78 apartments of three categories. Some rooms are larger and have balconies. These are the VIP rooms. When designing the VIP dormitories of the Eco-retreat Center, the staff dormitories can be referred as an example.



Photo 6: Dormitory buildings for faculty members

Source:
<http://lr.china-embassy.org/eng/sghdhzxxx/t720771.htm>

6 China-Liberia Friendship Tower

The China-Liberia Friendship Tower (Photo 7) locates in the middle of the campus. Since it is a high tower, and it houses a huge water tank inside, it also has the function as a water tower, which is a requested element for the design of Eco-retreat Center. The China-Liberia Friendship Tower gives the project team an idea of designing not only a water tower but also a landmark with special meanings for the designed site.



Photo 7: China-Liberia Friendship Tower

Source:
<http://lr.china-embassy.org/eng/sghdhzxxx/t720771.htm>

On campus, there is also a powerhouse accommodating three 750KV generators, and a water-pumping house. Thus, due to the current conditions of Liberia, lacking water supply and electricity, for example, additional facilities, such as generators and water-pumping area are necessary to be taken into consideration during the design.

III. Mary and Joseph Retreat Center - Rancho Palos Verdes, CA

"I like the way the buildings are connected and the court yard. The grass and trees in the courtyard help create friendly and means of playing. I don't like one walkway in the courtyard. There should be two connecting North and South and West and East." "Create more than one walk way connecting North and South and East and West. The walk ways should have cover."

– by Dennis Aggrey

Mary & Joseph Retreat Center (MJRC, Photo 8) is located on a hilltop on the Palos Verdes Peninsula, California, from which visitors can have expensive overlooking of Pacific Ocean to the south. The retreat center has eight-acre beautiful gardens and green spaces around the buildings, creating peaceful spaces for relaxation and opportunities for personal and

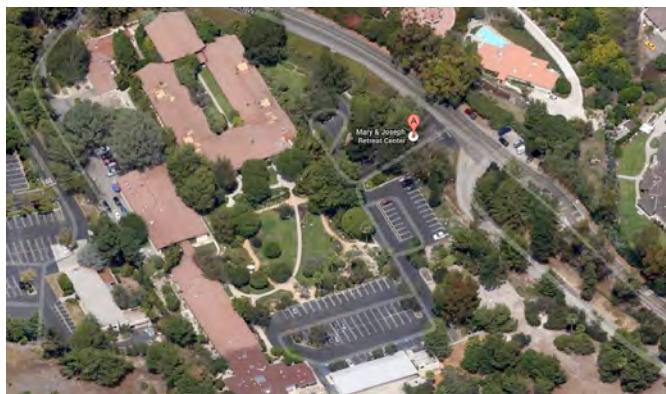


Photo 8: Google map plan view of Mary & Joseph Retreat Center

spiritual growth when visitors walk around in the natural setting of the site. The mission of Mary & Joseph Retreat Center is to “provide an environment of serenity, prayer, and natural beauty” (MJRC, web), and it espouses the value into its hospitality and proposed programs to best serve visitors during their stay in these lush grounds.



Photo 9: Buildings of MJRC

Source: <http://www.stjosephmarello.org/site/Portals/0/mountstjoseph.png>

Buildings of MJRC

The group of buildings (Photo 9) in MJRC forms a rectangular shape with a symmetrical layout. Buildings are located on three sides with one corridor connecting the entrance to act as a gateway to both sides of the buildings and help create interpenetrated spaces. A courtyard with grass and trees in the center creates a friendly space for recreation and means of playing. The one access way leading into backside of the buildings provides convenience for quick access. Also, red rooftops and red facades of the buildings make them pop out.

Walkways

The client showed great interest and preference of the buildings in MJRC and wanted to use it for reference when considering the form of buildings and walkways. They especially liked the way buildings are connected and the natural appearance of the courtyard with decorative trees. A courtyard in the center makes the space friendly and inviting, as well as providing spaces for activities, such as playing, resting, communicating. Also, the enclosed shape of the space contributes to a sense of safety. The features of trees and water delight and soothe the mind, which need to be well designed in the courtyard. Since there is a slight slope in our site with clay soil, which is suitable for plants, the combination of the fence, trees and roads can be considered to accommodate the buildings.

However, one walkway connecting the corridor to the building in the back may prohibit the accessibility to the side buildings. Thus, creating more than one walkway connecting the North and the South, the East and the West may be better for the connectivity of buildings and the possibility for more activities happening there. Walkways are recommended to have covers in order to accommodate with the rainy summer of Liberia. Organic and lightweight materials will be preferred.

What is more, because of the size limit, there will be complex buildings in our site with different capacities of meeting room to satisfy various needs and purposes, combining with dining rooms and cafes.

Landscape

For a retreat center, colorful and artistic landscape is visually stunning and more effective for relaxation. Plant materials of our site include low, dense, sparse lawn, flowers, and trees. Ideas for creating green spaces can be learned from MJRC for peaceful and relieved landscape.

Lawn as public space

There is a large tree (Photo 10) on the hilltop in MJRC with a bench for a rest. The lawn allows individuals and groups to gather in the space for reception, public events, and social activities. It also provides people with a peaceful and inspirational environment, conducive to a thoughtful exploration of oneself.



Photo 10: Lawn & Single Tree

Source:
https://www.facebook.com/MaryJosephRetreatCenter/photos_stream

Linear roads as semi-private space

Roads beside fences and walls form a linear space that can give opportunities to walk, stop, thinking and conversations. Trees along the road add to the serenity of this private space, which can be applied in our design when creating spaces near the site boundary.

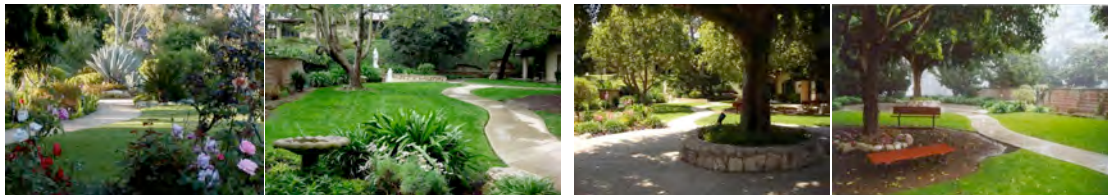


Photo 11: Curved road

Source:
http://www.angelusnews.com/imagescms/Regional-SP_1.jpg

https://www.facebook.com/MaryJosephRetreatCenter/photos_stream

Photo 12: Private space

Source:
<http://www.maryjoseph.org/images/retreat-inner-garden.jpg>

https://www.facebook.com/MaryJosephRetreatCenter/photos_stream

Curved roads and private space

Zigzag roads (Photo 11) lead people to explore the beauty of nature. Through this process, their spirits get refreshed. Seating spots (Photo 12) enables people to stop for some time and find their inner peace.

Landscape elements, especially plants and stones are encouraged to be placed in any spaces to form an atmosphere of peace and tranquility, giving visitors a fresh and naturally rejuvenating experience. Activities can be taken in harmony with nature as well.

STAKEHOLDER ENGAGEMENT

In order to better understand the culture and background of Liberia, and get more information about what our clients need and what people’s preferences for using the site, the project team conducted a stakeholder engagement plan in late April, 2014. The plan primarily includes two methods. One was conducting interviews with clients, professionals and potential builders; another method was to gain information from stakeholder survey forms produced by the project team.

Interviews

The project team conducted a series of interviews during May 2nd to May 13th, 2014, to understand the basic requirements of the project and collect information about constructions and nature conditions in a large environment. The interviewees include: the client, Dennis Aggrey, from Christian Revival Church Association; agriculture specialist, Ralph Hamm, from Gro Green; potential builders, Toufic J Haidar and Hassan Chawki Fawaz from SSF Entrepreneur Inc., and Jidong Qiu from China Chongqing International Construction Corporation (CICO). Some specific information about the interviewees and key findings from interviews is listed below.

Note: see **Appendix I** for the list of questions.

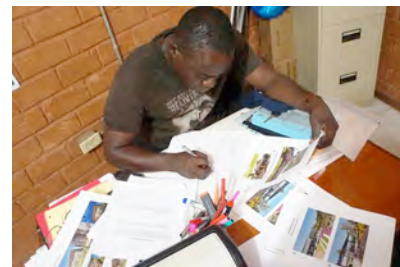
Interview with the client

Christian Revival Church Association

Interviewee: Dennis T. Aggrey

Title: Mission Director

The secondary client of the project is Christian Revival Church Association. The interviewee is the Mission Director of CRCA, Dennis T. Aggrey, who primarily holds the vision of the project. The interview questions (Appendix I) are related to the current site conditions, future surrounding environment, requirements for the project, project budget, and potential users of the site. Sample questions are: “What is the plan for the surrounding areas of the site?”, “How much is the average income of a Liberian?” and “Who are the potential users of the site?”.



Interviews: a series of interviews were conducted by the project team during May 2nd to May 13th, 2014.

From the interview, the project team learnt that the Eco-retreat Center Design project is a national wide project in Liberia. It has a great location near the main road between the capital city Monrovia and the Roberts International Airport, and it is also next to a Firestone company. The great location of the project site indicates its importance and convenience for visitors. New roads are planned to be built around the Jungle Farm property by the government in the coming years. Then the site will be located in a new center surrounded by new villages.

From Dennis, the project team learnt that the potential users of the Eco-retreat Center would be Non-Government Organizations (NGOs), Church Associations, and the Government. The NGOs would be the main users of the Eco-retreat center in the future. The users would include all ages. Thus, in another method of classification, it may include kids, students, teachers, staffs, visitors, etc. By knowing the potential users of the project, the project team could develop a comprehensive landscape design plan for different needs and usage for different groups of users on the site.

From the client, the budget of the project is unpredictable. The client will seek for funding after the design product is finished. Thus, the final deliverables would be a source to be used for seeking for supports. The potential funding would from a variety of sources, such as donations for the church from donors, donations from a website or a friend of the client. Since the client does not have a proposed budget and special requirements for the project, the project team will try to pursue a cost-efficient design plan to achieve the sustainable goals of the project.

Key findings

- The project site is located near to the main road between Monrovia and Roberts International Airport.
- The Eco-retreat Center project is a national wide project. Its potential users include Non-Government Organizations, Church Associations, and the Government. NGOs are proposed to be the main users for this project in the future.
- The project will seek for funding when the design product is finished. The potential funding would from a variety of sources, such as donations from donors from oversea, and donations from a website or a friend of the client.
- The requirements for the project and the needs of the client are mentioned in the Program Description Chapter.

Interview with local agriculture specialist

Gro Green

Interviewee: Ralph Hamm

Title: CEO

Gro Green is a landscape company for agriculture and environmental supplies and services. They help with irrigation system and provide advice for greenhouse. The CEO of Gro Green, Ralph Hamm, introduced the basic information of the company and some nature condition information to the project team, such as the soil condition and plant species of Liberia. The project team also wanted to learn about the native plants and the costs of plants maintenance. Sample questions are: "What does your company do?" and "Do you know the soil conditions in Liberia?". (Appendix I)

During the interview, Ralph mentioned that the greenhouse could also be used in Liberia for controlling the environment and insects. For the nature conditions of Liberia, he mentioned that most of the soil in Liberia is acidic (PH 4.5-5.5), and the soil type is loamy clay. Since the client requests good quality lawn areas on the site, the project team asked about the grass species that could be used for lawn area. While from Ralph, we learnt the country does not have seeds for lawn areas. Instead, they plant by lines of plants. Since Ralph is not very familiar with the local plant species in Liberia, but he said that the farmers work for the company might know more. But the project team did not get an opportunity to get in touch with the farmers during the stay in Liberia.

Key findings

- Most of the soil in Liberia is acidic (PH 4.5-5.5), and the soil type is loamy clay.
- Grass species for lawn are not produced by seeds in Liberia.
- Greenhouse can also be used in Liberia for controlling the environment and insects.

Interview with potential builders

SSF Entrepreneur Inc.

Website page: <http://ssfliberia.com>

Deputy Managing Director: Toufic J Haidar

Assistant CEO/Administrative Manager: Hassan Chawki Fawaz

SSF Entrepreneur Inc. is a local construction company, focused on road construction, and building of bridges and culverts. The managers are from Lebanon, Mideast. From the managers, the project team learnt most about what the company does. Their road construction primarily includes asphalt pavement and laterite road construction. They could provide the estimated cost of buildings or pavements after quantity analysis. They have a construction project of the white house (UCI) as a building construction example.

Some websites and local companies were provided by the interviewee as the following:

Staunch Machinery is a local company for machines, their website is <http://www.nahda.net/>.

Two big material companies are also introduced. Sethi Brothers and City Builders. They all focus on importing materials from outside Liberia. This information will give the project team a resource to refer to when doing the materials selection.

China Chongqing International Construction Corporation (CICO)

Website page: <http://www.cqcico.com/>

Vice Project Manager and Chief Engineer: Jidong Qiu

The project team of CICO is doing their construction of Economic and Commercial Counselor's Office of the Embassy of P.R. China in Liberia. The construction team has completed a lot of projects in West Africa, such as a primary school and a hospital in Cameroon, Parliament Building, office and conference building in Sierra Leone, which are China government-aided projects. Thus, this interviewee has a majority of knowledge of local materials. Sample questions for the interviewee are: "What kind of materials do you use for buildings in Liberia?" and "What are the local materials for roofs?"

From the interviewee, the project team learnt that there are two types of roof materials for the local buildings. One type is Iron-sheet tile, and the other one is color steel tile. The measurement of a color steel tile is usually 2500*800mm. They are both local materials that are adapted to the local weather condition and geographic characteristics of Liberia. For the roof slope, the most suitable slope is 15°, which is good for drainage. Because in Liberia, it frequently rains during the rain season, it is critical to think about an efficient drainage system for the buildings. In addition, a flat roof is not good for cooling down during the hot weather in Liberia.

The project team also asked about using green roofs, since it is a way for sustainable design. The green roof is also widely used by landscape and ecology designers. However, from the interview, the information was that it is rare in Liberia to use green roofs, due to its hot weather and plenty plant varieties.

For building materials, from the feedback of the interview, the most common building material is airbrick, which works very well in Liberia. Because the function of thermal insulation and insulating is outstanding, it is an optimum choice when selecting the materials for buildings in Liberia. The measurement of the airbrick is usually 100/200/300 (2"/4"/8" thickness)*400*20mm. There are two kinds of materials recommended for coating. One is the imported F-C paint, which looks good, but it is hard to maintain because it needs to be repainted several times after a period. The other one is local coating that works well in Liberia. This kind of coating has many choices of colors, such as yellow, white, and other colors. While, F-C paint and local coating are at the same price.

Lattice windows (Photo 13) are widely used in Liberia. Using lattice windows is a unique way for ventilation. There are various patterns of the lattice window in Liberia. Usually, a 1000mm high wall will be built with a 1500 to 800mm lattice window. Materials for lattice windows should be salt resistant because the salt fog is a common phenomenon happened along the seashore in the country. Wood, aluminum alloy and copper are feasible material choices for windows, while iron will be easily eroded by the salt fog, using of which is impractical.



Photo 13: Lattice windows of the Elementary School at Jungle Farm.

The interviewee also mentioned the cost of using imported materials will be high. Thus, with an eye to transportation cost, it is good to use local materials. An example is the local concrete paver with printed patterns. It looks good, and it is much cheaper than other stone materials that need to be imported to Liberia.

Some background information was also introduced from the interviewee. Since the Liberians start to reconstruct and rebuild their homes in recent years, the infrastructure system has not been well established yet. There are a lot of limitations of the usage of facilities in Liberia. One example is the landscape lighting, which can only be imported from other countries. Also, there is no fire lane regulation or any drainage system in Liberia currently. The country is also short of electricity, and usually, a generator can only provide a few hours' power supply in Liberia, so the electricity system is not stable. However, they have the trash disposal system. They set areas for trash and hire Trash Disposal Company to pick up the trash two to three times a week, which would cost \$30 per month.

Key findings

- *Roof-local material*
There are two types of roof material for the local buildings. One is Iron-sheet tile; the other one is color steel tile. The most suitable slope of a roof is 15°, which is good for drainage.
- *Architectural Material*
The most common building material is airbrick because the function of thermal insulation and insulating is outstanding. The measurement of the airbrick is 100/200/300 (2"/4"/8" thickness)*400*20mm.
- *Coating*
There are two kinds of materials recommended for coating. One is the imported F-C paint, which looks good, but it is hard to maintain. The other one is local coating, which has many choices of colors. F-C paint and local coating are at the same price.
- *Window*
Lattice windows are widely used in Liberia. Using the lattice window is a unique way for ventilation. Materials for windows should be salt resistant. Wood, aluminum alloy and copper are feasible material choices for windows.
- *Pavement*
It is good to use local materials, such as concrete with printed pattern, which is much cheaper than stone material that needs to be imported.
- *Facilities*
The landscape lighting needs to be imported. There is no fire lane regulation or drainage system in Liberia. The electricity system is not stable.

Stakeholder Surveys

To collect views effectively, the project team conducts two kinds of surveys during this process: The picture preference survey (**Appendix II**) is used to help the project team to narrow the typical cases and select particular ones as study bases in the research process of the project. The stakeholder questionnaire (**Appendix III**) is used for understanding the basic requirements from the stakeholders.

Stakeholders included in the surveys are:

Sam K Tabolo - Church Leader

DKG - Administrator

Emmanuel M. Jackson - Evangelist

Yassah J. David - Nurse

I G Washington - Jesus Film Technical

Vania Aggrey - Administration/partnership

Dennis T. Aggrey - Missions Director (the client)

Picture preference survey

The picture preference survey asked people to select their favorite images from the existing design examples, and the images they do not like with reasons. They will provide their opinions on how to improve the design. See the sample images (Image 5) below.



Image 5: Sample images for picture preference survey.

Depending on the survey results (Chart 1-2), 67% of the people who took the survey like Image 10, which is the Mary and Joseph Retreat Center (see case study III) in Rancho Palos Verdes, CA, USA. 100% of them do not like Image 3 & 4, one of the images is the conceptual design of Biomimicry Discovery Park, and another one is EL Monte Sagrado, Taos, New Mexico. Thus, the Mary and Joseph Retreat Center Case is selected to be used as one of the deeper research for the following design phases.

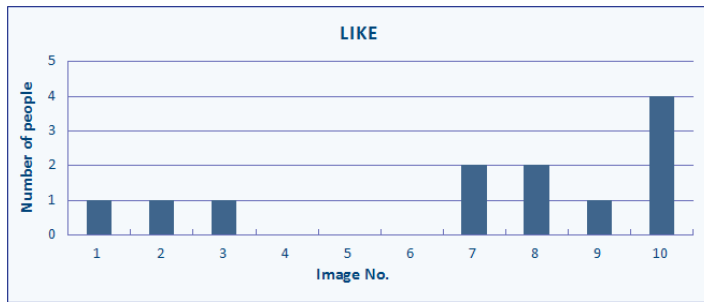


Chart 1: Images people like. 67% of the people who took the survey like Image 10 & 11.

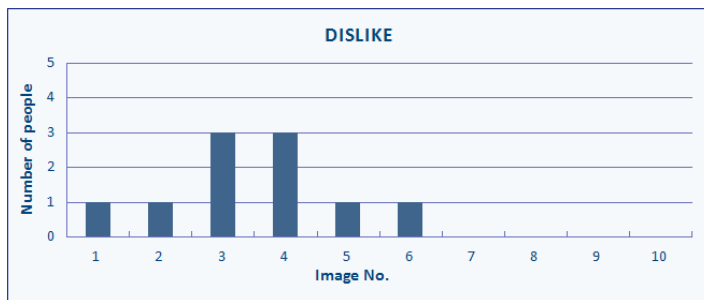


Chart 2: Images people do not like. 100% of the people who took the survey do not like Image 3 & 4.

The results the project team conclude from the picture preference survey are described in the following paragraphs.

It is obvious from the survey that people like a space full of green and flowers. While, the way it conveys nature does not have to look like “nature”, or should be real “nature”. The “nature” here indicates wildness, disordered places, and areas lack of maintenance and management. To combine the ideas of the nature and modern buildings, and to create a sustainable design for the entire site, is the primary summary of the survey results. We can see the way that the buildings are connected in the Mary and Joseph Retreat Center Case. The courtyard space in the middle of the buildings and the friendly arrangements of grass and trees in the environment also give an example of how buildings work with green space. They also give us an idea of how the buildings and landscapes could be combined together.

From the survey results, we can see the ideas from the stakeholders mostly focus on the needs of playgrounds and the selection of materials of buildings. Thus, including a playground for kids, a recreational center, and sporting centers in the design of the Eco-retreat Center should be taken into consideration. People also think that adding more interests for the site, such as creating educational spaces for visitors and using different ways to generate energy, will be good to help keep the retreat center a “cool” place to visit. Sustainable materials are also considered important for designing cost-effective and long-lasting buildings. The buildings should look modern but not “urban”. To achieve this, large green spaces could be arranged with smaller ones by well-designed patterns in between of buildings. The space should be open, but it should also be protected from extreme weathers, no matter hot or rainy days, by using covered paths as connections to connect different destinations.

Stakeholder questionnaire analysis

Since our client has purchased the land and is aiming to build an Eco-retreat Center, understanding the needs and desires of stakeholders are of significant importance in decision making at each decision node throughout our design process. To accomplish a human-centered design, we sent out stakeholder questionnaires to obtain information that will aid in creating a design that fits the special needs of users and conditions of the site. The content of the questionnaire is listed as follows:

- Users' characteristics: knowing the potential users will help us imagine their particular needs. The potential users of the Eco-retreat Center will be NGOs, government, churches, CRCA, teachers, pastors, and other guests.
- Existing site conditions: both constraints and opportunities will be taken into consideration from the perspective of vision, ecology, safety, and function, which should be either retained or enhanced in the design.
- Desired site character: stakeholders' advice on what the site should look like would provide valuable suggestions on how to connect the site to the context of the surroundings.
- Materials: know the types of materials that could be used will help us develop our design in a practical direction.

The results of the Stakeholder Questionnaire mentioned above are described in the following paragraphs and organized in Table 1.

The site has a lot of constraints to be designed. Visually, the site is slightly "boring" because the old school building and the church building are worn out. The community housing and present worship buildings are not in good condition, and there is garbage can in the site. The shape of the land impacts the visual continuity. Ecologically, Liberian heat, rain, possible flood from the swamp, as well as the poverty of community and theft constrains certain types of ecological functions. Also, the chemicals' use brings pollutant into the site.

In the security and sanitation aspects, the lack of safe drinking water, mosquitoes' bite and the poor condition of toilets cause malaria and sickness to people living in the nearby community. Regarding functions, the bad and bumpy road from the main road into the site, especially during the rainy season, cannot meet people's needs. There is no good building in site to support multiple activities.

The site also has a lot of opportunities to be explored. Visually, the site has a good ground for agricultural work, such as growing crops surrounding the bushes or rural areas can be an attraction. The playground and the yard will bring energy into the site. Also, the location of the site is accessible from all directions. Ecologically, the site is under a good environment with enough sunshine and light wind. The soil can support the well growth of plants, vegetables, and fruits. Once there is a security system, the site can be a safe destination for visitors. Regarding functions, the location of the site is in the area of city extension, which is close to the airport, RIA and Monrovia, resulting in an accessible place for multiple purposes.

Table 1 Constrains and Opportunities

	Constrains	Opportunities
Visual	Slightly “boring” for its old school, church building, community housing and garbage can; Shape of the land	Good ground for agricultural work; Playground & yards; Good location
Ecological	Liberian heat & rain; Possible flood from the swamp; Poverty of community; Chemical usage	Good environment; Good soil condition
Safety	Security; sanitation; lack of safe drinking water; malaria/sickness; mosquitoes’ bite; toilet	Security system
Function	Bumpy road from the main road to the site, especially during the rainy season; No good buildings on the site	Accessible location

According to Table 1. Most of the stakeholders showed their preference for informal style landscape and modern style buildings. They reported that they are pleasant to see green areas and water features, and the landscape should be very open. For the buildings, they showed interest in very light and bright building style, and one example is the Burundian porch (see Image #13 in picture survey). They also thought the building should be unique to Liberia with different styles. They particularly like the connected building group from Mary and Joseph Retreat Center (see case studies).

For the potential materials used for paving, fences, walls, and buildings, the surveyed stakeholders listed blocks, cement, vines, and flowers. At the same time, they pointed out that the materials need to be natural, light-weight and eco-friendly. For plant materials, they showed interest in low, dense, sparse, lawn and flowers, and gave an example of the Lodge at Chaa Creek (see Image #5&6 in picture survey).

In addition, a form of desired outdoor activities is attached in the questionnaire. The project team has calculated the votes of various activities (Table 2) to form an activities hierarchy, which can be a reference for creating activity spaces that will be fully used in the future.

The voting result of desired outdoor activities reveals that mixed-use spaces are needed, according to the space limit. Special attention should be given to place arrangement for both active and static activities, and for users with different identities. Planning as neighborhood-scaled community may be a solution for this. What’s more, scenic spots need be planned for sightseeing and wedding reception. As for circulation, meandering pathways could act as both learning spaces for the school and recreational spaces for positive social interaction.

Table 2 Votes of Outdoor Activities

	Season	
	Dry	Rainy
Barbecuing	● ● ● ● ● ● ●	● ● ● ● ● ● ●
Eating	● ● ● ● ● ○	● ● ● ● ● ○
Sitting/Relaxing/Reading	● ● ● ● ● ○	● ● ● ● ● ○
Gardening		
Trees	● ● ● ● ● ● ●	● ● ● ● ● ● ○
Flowers	● ● ● ● ● ○	● ● ● ● ● ● ●
Food	● ● ● ● ● ● ●	● ● ● ● ● ● ○
Entertaining		
Watching wildlife	● ● ○ ○ ○ ○ ○	● ● ○ ○ ○ ○ ○
Hunting	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
Recreation		
Badminton	● ● ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
Volleyball	● ● ● ● ● ● ●	● ○ ○ ○ ○ ○ ○
Croquet	● ○ ○ ○ ○ ○ ○	● ○ ○ ○ ○ ○ ○
Swimming	● ● ● ● ○ ○	● ● ○ ○ ○ ○ ○
Basketball	● ● ● ● ● ● ●	● ● ● ○ ○ ○ ○
Other Team Sports		
Soccer/football	● ● ● ● ● ○	● ● ● ● ○ ○
Kickball	● ○ ○ ○ ○ ○ ○	● ○ ○ ○ ○ ○ ○
Other Informal Activities		
Wedding reception	● ● ● ● ○ ○	● ● ● ● ○ ○
Campfire	● ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
Children activities	● ● ○ ○ ○ ○ ○	● ● ○ ○ ○ ○ ○
Graduation exercise	● ○ ○ ○ ○ ○ ○	● ○ ○ ○ ○ ○ ○
Library	● ○ ○ ○ ○ ○ ○	● ○ ○ ○ ○ ○ ○
Social gathering	● ○ ○ ○ ○ ○ ○	● ○ ○ ○ ○ ○ ○

Note: ● Endorse ○ Oppose

Evidence from the stakeholder questionnaire reveals that specific interests and suggestions need further consideration in achieving the success of our project. It reveals huge need of improving the existing conditions, especially of buildings and roads that have worn out. Based on the excellent condition of the ground, we can use plants to create different spaces, from open, semi-open to private, which can be accommodated to various activities for different user groups. Issues like poor hygiene and theft need to be improved by creating well-organized spaces, as well as flows of materials and energy. Stormwater management is a main issue in this site since the rainy season is long, and water needs to be conducted from building areas to green spaces by a series of infiltration and purification process, so an effective strategy of managing the water is needed.

All of the stakeholders showed great interest in modern buildings and natural landscape, so we will go deeper into case studies and seek solutions to combine the styles in a coherent way. Although we may focus on designing a unique building, elements can be extracted from traditional buildings in Liberia, which will avoid creating an arbitrary building that conflicts the context. To achieve this, we will need to cooperate with architecture experts.

In summary, this section summarizes the key findings collected from the interviews and survey forms mentioned above. The structure follows the sequence of the questions on the stakeholder questionnaire. The interview and survey results will help the project team to have a better understanding of the country of Liberia and the Jungle Farm property. The knowledge gained from the interviews is very useful for knowing local materials and finding the best way to use them under the special weather conditions in Liberia. The answers from the stakeholder questionnaires help the project team to have a sense of what kind of place people like, what facilities they need and what landscape environment they feel comfortable. All of those ideas could be taken into considerations while making design decisions.

The Background of the project, Case Studies chapter, and the Site Analysis chapter all use this Stakeholder Engagement chapter as a reference and basis so that to do a comprehensive analysis and research before the design phase.

SITE ANALYSIS

In order to plan and design a functional and sustainable Eco-retreat Center for Jungle Farm property, understanding the context and current site conditions is necessary to the following design process. Thus, a site analysis was conducted to address multiple aspects of the Jungle Farm property at different scales, from a national perspective to specific characteristics of the site. The current site condition is introduced, and different scenarios are created to be analyzed from a variety of angles. This process led to a further planning and design decision, which satisfies the needs of both the environment and human being.

Location & Context

The Location

Liberia (Figure 1) is a country located in West Africa, with longitudes 7°30' and 11°30' west and latitudes 4°8' and 8°30' north. Three other countries border it: Sierra Leone to its west, Guinea to its north and Ivory Coast to its east. The country covers a total area of 43,000 square miles, includes 360 miles along the coast of North Atlantic Ocean. (The World Bank, web) Monrovia is its capital city and the Jungle Farm property (Figure 2), which is the project site, just locates on the main road between Monrovia and Roberts International Airport. That is considered a “great location”, for its convenience to Monrovia and the airport, and adjacency to a Firestone company, cited from the client, Dennis Aggrey.



Figure 1: Location of The Republic of Liberia. Liberia is located in West Africa, along the coast of Atlantic Ocean.



Figure 2: Location of Jungle Farm Property. The Jungle Farm property is located on the main road between Monrovia and Roberts International Airport.

Climate & Environment

The climate of Liberia is hot and humid. The southern region has an equatorial climate, where has a large amount of rainfall throughout the year. While, the northern part, where the Jungle Farm property locates, is strongly influenced by the West African Monsoon. (UNDP, web) Due to the tropical monsoon climate, a year is divided into wet seasons and dry seasons. The rainfall comes mainly from May to October, which means the design site needs protection from concentrate and heavy rains during that season.

The temperatures in Liberia are higher along the coastal area than inland. As for Monrovia, which is located in the coastal area, the temperature usually ranges from 64°F to 90°F, and the average temperature of a year is 80°F. In the whole country of Liberia, on average, the warmest month is February with an average temperature of 82°F, and the coolest month is August, with an average temperature of 77°F. (WeatherSpark, web) Since the Jungle Farm property is located near the coast, the average annual temperature is similar to Monrovia, which has hot weathers in February and cooler temperature in August. Thus, the Eco-retreat Center also needs protection from hot weathers when making design decisions.

The wind directions are various in Liberia. The wind is often out of the southwest (Figure 3), which takes 15% of the time during a year. It also comes from the northeast, which takes 8% of the time, and 9% from the south. The wind speeds vary from 0 mph to 14 mph, which is considered as calm to moderate breeze. Understanding the wind directions and speeds will help the project team to design comfort space in Eco-retreat Center with proper and adequate airflow through the property.



Figure 3: Wind Directions. The wind mainly comes from the southwest.

Since Liberia is near to the equator, it receives much sunlight due to its location. The shortest day of a year is December 21st with eleven hours and forty-six minutes of daylight, and the longest day is June 20th with twelve hours and thirty minutes of daylight. (Figure 4, WeatherSpark, web) The sun position is almost in the sky above, and the sun path does not change much in different seasons. Thus, it influences the sunlight for the designed site more from east to west during a day than from north and south in different seasons.



Figure 4: Sun Path. From left to right: Dec 21st, Mar 21st, Jun 21st, and Sep 21st.

Source: <http://www.suncalc.net/#/6.2662,-10.3523,8/2015.09.21/12:43>

The current environmental issues of the Liberia include deforestation and soil erosion of the tropical rain forest, reduction of biodiversity, and the pollution of coastal waters from oil residue and raw sewage. (Liberianobserver, web) Properly Designing the Eco-retreat Center would be an effort to help to solve some of the current and emerging environmental problems of Liberia. There is also an opportunity to serve as an example to educate visitors so that to be a long-term beneficial circulation for the environment of the country, and to the world.

Jungle Farm Property

The design site of the Eco-retreat Center is the existing Jungle Farm property. It is originally used as farmland. It is in a rural area, which has a distance from the capital city, Monrovia, and it is currently surrounded by bushes, and planted with cassavas and fruit trees. The site locates on the south side of an existing thirty feet road, and on the southeast of the site is an existing community with poor condition houses. For now, the site seems isolated and hard to get into since it is far away from the city, and it still has a relatively long distance from the main road to the airport. In addition, the secondary road to the site has not been constructed yet so that it is hard to be found for first-time visitors. By now, very few people visit the site unless some who live in the nearby communities. The site before construction looks natural and undisturbed, except some bushes were cleared from the site.



The site before construction looks natural and undisturbed, except some bushes were cleared from the site.

Existing Conditions

The project site (Figure 5) is a six-acre land fenced with twelve feet tall and four inches wide walls boundary including five entrances. One of the entrances is in the middle of the north boundary. It is the main entrance to the site with two small vehicle lanes and pedestrian entrances. Another one is facing the main entrance, and it is a one-car lane entrance with a pedestrian entrance for the nearby community. One entrance is located on the northwest corner, and it for trucks or other large vehicles. The other two are pedestrian entrances for neighbors. Bushes surround the current site, and a swamp is on the west to the site. In the coming ten years, proposed streets, alleys and new residential communities will surround the site. The existing road is the main street for both current and future use. There is a thirty feet proposed road planned by the government going through the site, which will divide the site into two parts. Depending on the design solutions, negotiations, and possible changes could be applied in the future if necessary.

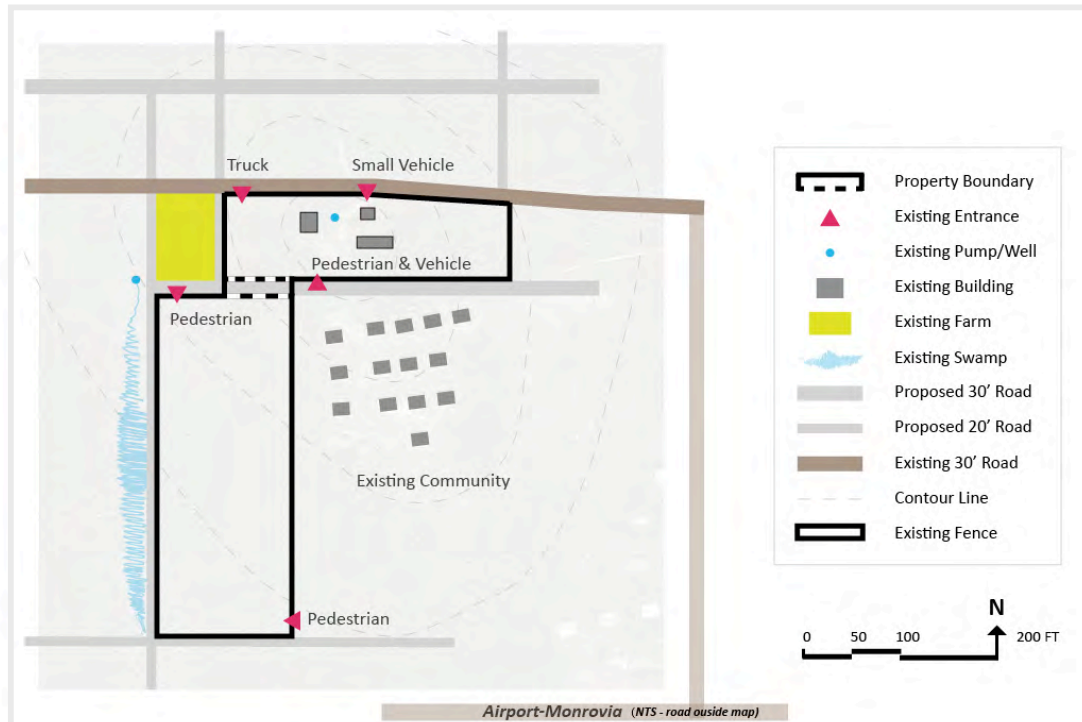


Figure 5: Site Inventory: existing site conditions and proposed roads.

On-site Structures

There are three existing buildings on the site, and all of them are temporary and will be removed from the site in the future. One of the existing buildings is an elementary school, and the others are used as shelters for construction. On-site structures also include a hand pump in the middle of the upper part. An existing well, which is never dried up, is located outside the property boundary on the west.

Soil Condition

The soil in the project site is healthy by observation. The soil type of the project site looks like loam-clay. It has sands and gravels on top, which creates a permeable surface. From the soil profile photo taken from the site (Photo 14), the soil is very rich in organic matters (O horizon), which contributes to increasing water-retaining capacity and providing nutrients. (Soils, web) That means most of vegetation will be replanted easily and grow fast and healthy if properly chosen on the site.



Photo 14: The soil profile of the project site.

Existing Plants

Most of the existing plants on the site (Photo 15) are fruit trees, such as Sawsaw, Mongo trees, Bush gradpea, Cola nut tree, Pawpaw, Banana, Breadfruit, Coconut tree and Palm trees. Part of the ground was used as agriculture land before construction, planted with cassavas. All of the existing plants can either be removed or replanted. The client has already

planted some Coconut trees outside along the property boundary and have some plants cultivated in a nursery.

Topography and Drainage

The current site is not level, and there is a big difference in elevation between the highest part and lowest part of the ground. The area around the mid-east corner of the site has a higher elevation than the rest area. The east part of the site is much lower than the northwest area. Thus, in the rain season, if it rains heavily, the soil will be saturated, and then the surface runoff will flow into the east and southwest area of the site. Therefore, the soil in those areas will be wetter than the higher part of the site.



Photo 15: Existing Plants.

Fences of the Property

The project site has already been fenced with twelve feet tall and four inches wide walls (Photo 16). No entrances are left for proposed roads. Proposed fences and entrances will be built when the proposed road are into use. The number and size of the entrances could be changed during design, while the fewer changes, the better.



Photo 16: Existing Brick Fence.
(Photo by Dennis Aggrey)

Neighborhoods

Bushes and an adjacent community (Photo 17) surround the Jungle Farm property. The bushes are natural and undisturbed. There is also a swamp on the west of the site. When designing, considering the relationship between the wetland and the site is necessary. The adjacent community is on the east side of the property. It holds around fourteen houses, and the houses are all one-storey buildings with poor conditions. They have small and dark inside. Now it is easily accessible from the community to the site. While, in the next ten years, there will be new residential communities built up. People have purchased the land already and they will build houses around the site. Then there will be only two entrances left for the community. Safety will become an issue for the redesigned site. Currently, children who live in the community are going to the elementary school on the site, and the teachers of the school are also living in that community.



Photo 17: Nearby Community Housing.

Constraints & Opportunities

Water Sources

Since Liberia lacks running water and sanitation system, getting the full use of the existing water sources is a good solution for the project site. There are two wells (Figure 6) located in

or nearby the site. The locations of the wells might be a constraint when planning the locations for a water tower and buildings. Thus planning to build new structures within a reasonable distance to the wells would be a solution to future design. The potential location for a water tower should also be inside the boundary and near the wells. The benefit will include reducing the cost of materials used for water conduction and helping with water supply to the water tower and the proposed buildings.

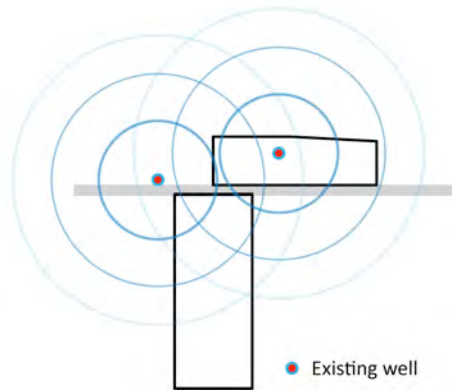


Figure 6: Existing Wells. Buildings could be built near the existing wells for future water supply.

Topography and drainage

From the topography of the site, the surface water flows to the lower sites (Figure 7) on the south and east. Thus, the lower areas of the site have more potential to collect rainwater and runoffs for water usage in the future. The collected water could be used in many ways, such as irrigation and drinking. These areas are also potential to be designed into rain gardens with established water harvesting systems. Bioswales would be good options to be designed with parking lots on lower sides (if it uses an impervious pavement), relatively flood prone areas, as well as other possible, impervious surfaces in future design. The locations of the buildings should also avoid potential flooding areas.

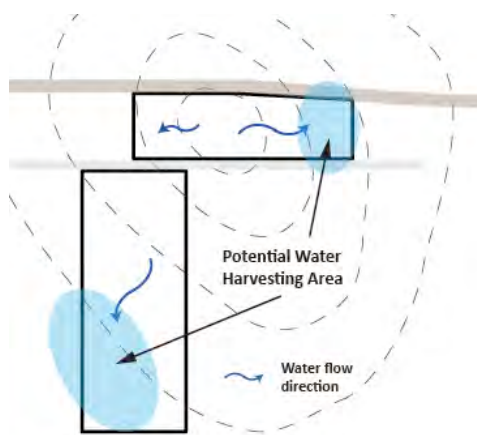


Figure 7: Water Flow Direction and Potential Water Harvesting Area. The lower areas have more potential to collect rainwater for future use.

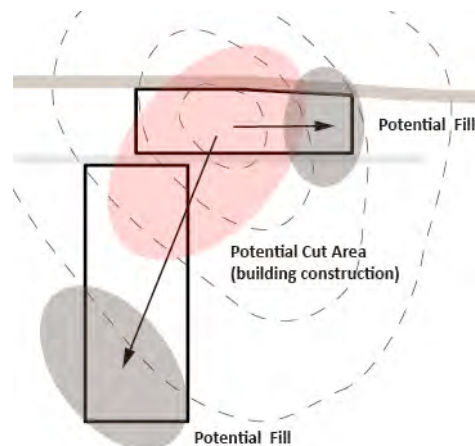


Figure 8: Potential Cut and Fill Area. Locating the cutting soil from constructions into lower areas to balance cut and fill.




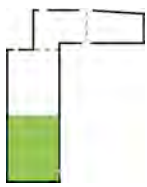
Another limitation is that the topography map is not very specific, the project team cannot provide an exact cut-and-fill map, but the areas for cut and fill could be estimated. Considering locating the cutting soil from constructions into lower areas to balance cut and fill (Figure 8), it will also be a good solution to reduce the overall elevation difference and slope within the site.

Function Zoning & Space Analysis

How to arrange the space of landscapes and buildings to make it a comfortable place to live and visit is an important subject for this “L”-shaped area. The method of analyzing the space location for the required buildings is to compare the advantages and disadvantages of each location for different building functions. The buildings are categorized into different functions, including education, conference, and living. The space between buildings is also analyzed in this part.

The site is divided into four parts while planning. The following location analysis chart (Table 3) illustrates the characteristics of each location for different building functions.

Table 3: Location analysis

Zone	Type of Bldgs.	Pros	Cons
	School	near to the main entrance and the community entrance; less traffic	low-lying; have a distance to the lower part of the site
	Conference Center	near to the main entrance; can be seen from the main road	low-lying; have a distance to the lower part of the site
	Dormitory		noisy; low-lying; have a distance to the lower part of the site
	School	near to the main entrance; convenient to other place	traffic on the site
	Conference Center	near to the main entrance; can be seen from the main road	too narrow to meet the requirement of both shape and area
	Dormitory	convenient for visitors to find their place to live	near to the main road; truck entrance; noisy; traffic on the site
	School		a distance to the main entrance; traffic on the site; may separate activity and conference area
	Conference Center	center of the site; quiet	away from the main entrance; may not be seen from the main road
	Dormitory	center of the site; quiet	
	School	quiet; less traffic; next to the community entrance	far away from the main entrance
	Conference Center	very quiet	far away from the main entrance; may not be seen from the main road; cause more traffic on the site
	Dormitory	less traffic passing by; very quiet	far away from the main entrance, not convenient for visitors

Zone Orange is next to the main entrance and one of the community entrances. It has relatively less traffic than other areas inside the property boundary. Therefore the Zone Orange is a conspicuous part of the site, and this part is safe and convenient for both visitors and neighbors. The disadvantage of Zone Orange is that the lowest elevation of the site is located in Zone Orange. Flood issues may occur if the current topography stays the same,

and the ground is paved with impervious surface. Another issue is that, because it is close to the main road, traffic noise will also be a problem for Zone Orange. Also, since the site is in an "L"-shape, it is difficult to connect the Zone Orange and the Zone Green well.

Zone Yellow is also next to the main entrance. As it is better connected to the other parts of the site, it seems more important than the Zone Orange. Since it has a higher elevation than the surrounding area, it has little chance of the flood problems. It may also face the problems of the traffic noise from the adjacent main road, and there will also be traffic inside passing the area, as well as service trucks. The space in Zone Yellow is also limited to built buildings with large ground areas, such as the conference hall.

Zone Blue is relatively quiet compared to the Zone Orange and Zone Yellow. Because it has a distance to the main entrance, it seems more private than the northern part of the site. The only entrance to Zone Blue is from the adjacent farm, and it is a private entrance only for pedestrians, which will not cause too much traffic. Since Zone Blue is in the middle of the site, there will also be some traffic passing through this area, which may be a disadvantage for Zone Blue.

Zone Green is the most inside part of the property. It will have the least traffic and be the quietest place in the site. Another community entrance is connected to Zone Green, which is a private entrance only for people. Since Zone Green has a distance to the main entrance, it will not be suitable for elements that bring traffics, the conference hall, for example. It is not convenient for visitors to find, and it will cause more traffic inside the site.

In Summary, Zone Orange is good to be a school education and recreational area. Zone Yellow is suitable to be an open space with small ground area buildings such as a water tower or a gatehouse. Zone Blue is suitable for conferences and meetings. Zone Green is suitable to be a living space for its quiet and private surrounding environment.

STORMWATER MANAGEMENT

During the process of rapid urbanization, more and more natural land covers were converted to impervious surfaces, such as driveways and roofs of buildings, which may generate more polluted runoffs than natural surfaces. Although the ratio of impervious surface in Liberia is much less than that in the developed countries, the developed land proportion will keep increasing while recovering from its second civil war. In this case, stormwater with a significant amount of pollutants such as debris, chemicals, and dirt would appear before entering into a sewer system or a sea natural water system. Thus, in order to make the water cycle sustainable, we should reduce, control and prevent harmful stormwater runoff through a variety of strategies that can improve water quality and reduce or control flooding and erosion. Managing stormwater is necessarily in this project. Stormwater Management is a body of knowledge used to understand, control and utilize waters in different forms within the hydrologic cycle (Wanielista, M., 1993). In the project of Eco-Retreat Center Design, stormwater management is important due to the property's unlevelled topography and the complex surrounding environment. Four elements for stormwater management and the introduction of rainwater harvest will be discussed in the following paragraphs.

Elements for Stormwater Mangement

Wetland and wet ponds

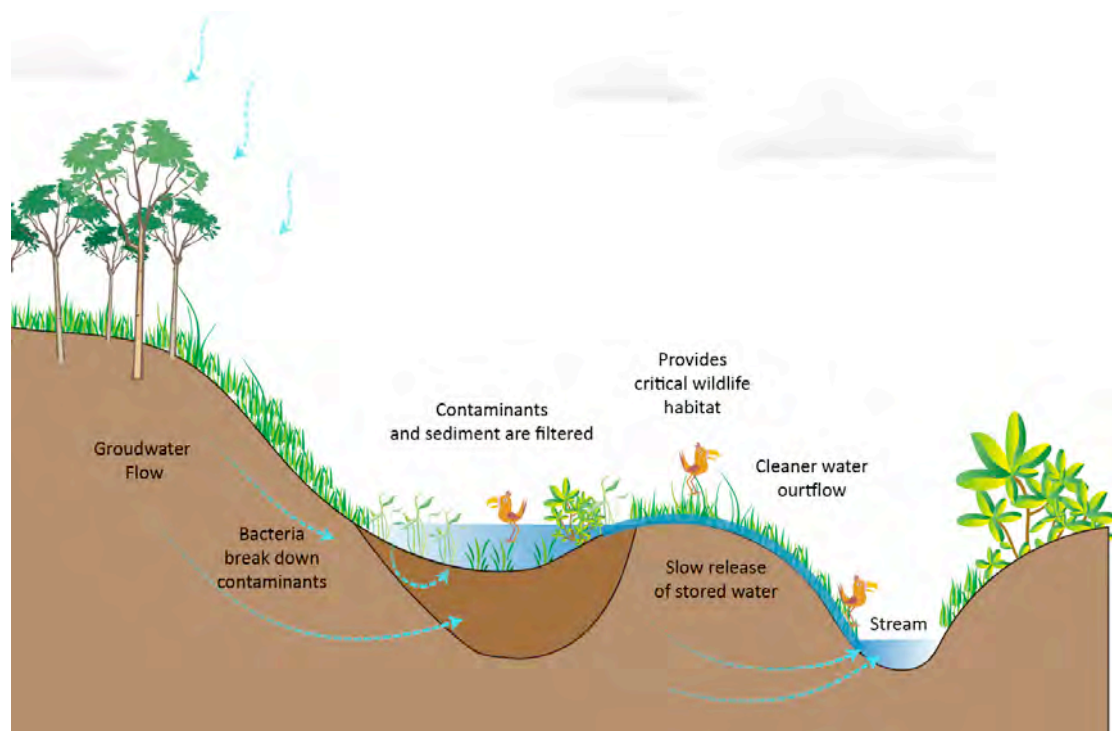


Image 6: Function of Wetland.

Wet ponds, also named as stormwater ponds or retention ponds, typically look like an ordinary pond, except that they are designed to manage stormwater. Unlike natural ponds, wet ponds have a standardized design. Wet ponds or wetland can manage water quantity, as well as improving water quality. Wetlands use settling and bioremediation to clean water

by absorbing or removing pollutants from the stormwater. (*Bioremediation is a process using biological organisms to reduce or remove pollutants from water.*) Benefited from the efficiency of bioremediation, wetlands are among the most effective stormwater management practices in regards to its high stormwater pollutants removal rates. In addition, wetlands can provide ecological and aesthetic value (Image 6) because they are often companioned by various and special species of trees, shrubs, flowers and grasses, as well as wildlife species.

Rain gardens

Rain gardens are vegetated surface depressions that are often located at low points in project sites to regulate natural hydrological cycles. In specific, they use plants and soils to remove pollutants from surface runoffs, and allow groundwater recharge to happen by water infiltration. In this way, they can significantly increase the hydrologic efficiency in highly urbanized areas. Runoffs can be collected in the areas near buildings, parking lots or other areas with a high ratio of impervious coverage.

Rain barrels can be used to collect rainwater from rooftops. The collected water can be reused during the long dry period that is common in tropical areas. While, due to its long rainy season, using a rain barrel is not a practical solution in this area, but it can be used for educational purpose, still.

Filter strips

Filter strips are buffer areas that are vegetated designed to capture runoffs from nearby impervious surfaces. They can slow down the runoff speed, trap sediments and other pollutants, and provide the function of absorption. (Leeds, R., Brown, L., Sulc, M., & VanLieshout, L., 2015) Turfgrass is usually planted in the filter strip, and native plants are more effective at removing nutrients. Thus, it is best to apply filter strips on gentle slopes and using native plants, for they can reduce the runoff speed and maximize the potential for absorbing runoff and filtering pollutants. (Daley, R., 2003)

Permeable paving

Permeable paving is one of the most effective solutions for reducing the quantity of surface runoff. It also helps to reduce runoff pollutants. (Shackel, B., Ball, J., & Mearing, M., 2003) Impermeable concrete and asphalt would lead to large quantities of surface runoff rather than soil infiltration. While, using porous pavement or paving stones might cost more than the conventional method, but it will increase the value of the property by lowering the risk of flooding caused by heavy storms in rainy seasons.

Rainwater Harvest

Harvesting rainwater can reduce the needs and demands for a water transport system that might alternate natural water cycle and local environments. It is one of the most useful strategies to reduce domestic water use. (Ling, E., Benhan, B., 2014) In Liberia, which is a tropical country, water recycle is necessary to save water resource due to its long dry seasons. Rainwater can be collected and stored in rainy seasons and to be reused in dry seasons so that the problem of seasonal water shortage can be mitigated.

Water can be collected from direct rainfall, street runoff, or rooftop rainwater, especially for the design of the Eco-retreat Center. By using a rainwater harvesting system, rainwater can be directed to a desired place where rainwater will be filtered and stored for later use.

A rainwater harvest system usually consists of six basic components (Image 7): catchment surface, gutters and downspouts, screens, first-flush diverters, and roof washers, cisterns. (Porter, D., & Persyn, R., 2010) A delivery system and sometimes a treatment system may also be required to work together with the harvest system. Gravity will move rainwater from catchment areas such as rooftops, paved areas and natural land surfaces to a different location like gutters and downspouts, and then to screens that is determined by the amount of debris and intended use of the collected water. Water will be stored in a cistern. It is best to use non-reactive, opaque materials in the cistern. The cistern should be periodically cleaned to inhibit algal growth. Finally, a treatment system is needed if captured rainwater will be used for potable water instead of irrigation and toilet flushing water.

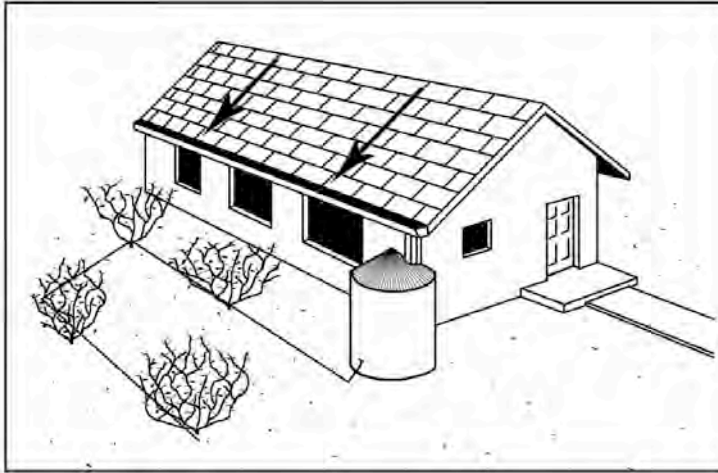


Image 7: A rainwater harvesting system with roof catchment, gutter, downspout, and storage.

Source: Rainwater Harvesting, 2010

The most critical and special part of a rainwater harvest system is the storage device that is not included in a regular stormwater system. A wide variety of water storage containers, such as rain barrels, rubberized bladder tanks, or large plastic water storage tanks, can be used in a rainwater harvest system.

In water-stressed areas with a long period of dry seasons, a well designed, built, and maintained rainwater

harvest system can provide supplemental water to mitigate the problem of water shortage. In rainy seasons, diverting and storing part of the storm water can help with alleviating the impacts of surface runoff on the local environment, and reducing energy consumption.

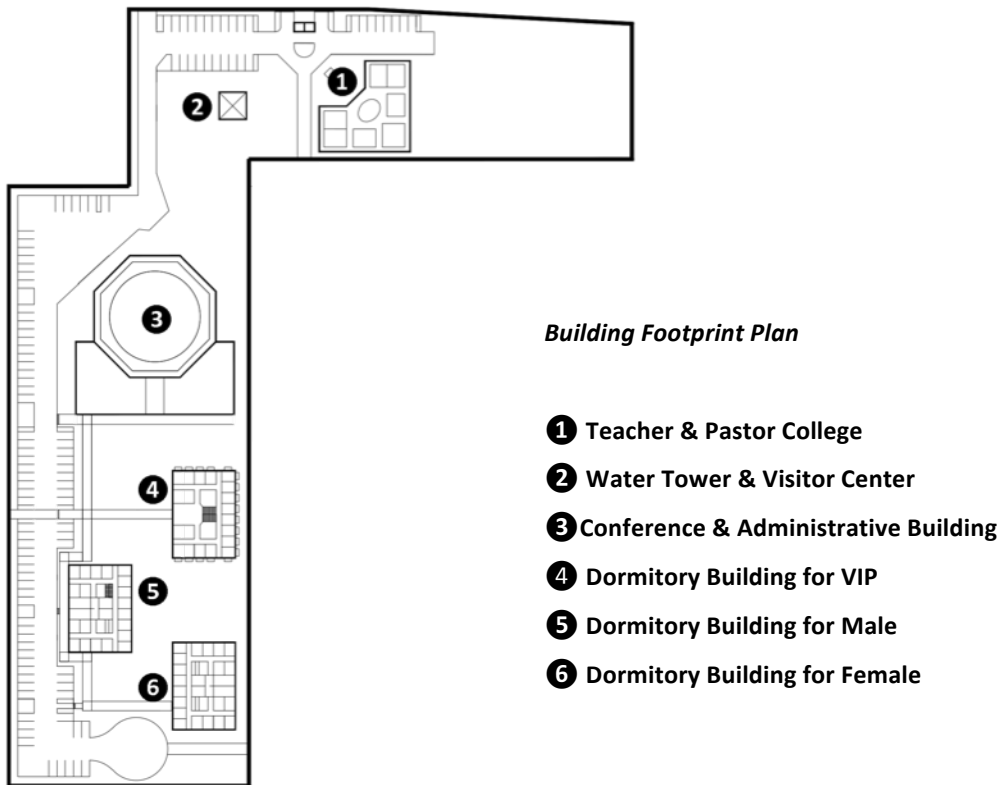
In conclusion, the design for the Eco-Retreat Center should consider how to manage stormwater in or even outside the site. In Liberia, paved surfaces and building have increased during the past few years, and this trend would like to continue. For now, governments in this country do not pay much attention to stormwater management systems. Successful examples of other many developed and developing countries suggested that governments should take stormwater management into consideration as soon as possible to address problems like urban flooding and seasonal water shortage. As mentioned before, an effective stormwater management system will bring benefits to local communities through enhanced environmental protection and energy saving.

DESIGN OF BUILDINGS

To make better use of the space in the Eco-retreat Center, the function, shape, form and organization of the buildings are considered in the design to increase the space utilization rate and rationality, and to keep the connectivity in and between the buildings. The project team briefly designed the building size and layout based on the requirements of each building's capacity and function.

Building Size

According to the requirements of the client and the size and shape of the property, the project team developed a footprint plan for buildings, as well as a rough interior layout for each building. The function and capacity of buildings are various. All of the buildings should be less than four floors, according to the needs of the client. Each floor area of the buildings was decided roughly due to the required capacity.



Teacher & Pastor College

The teacher and pastor college should hold 300 students in total, and part of it could also be used as a primary school with nine grades. The project team designed a two-story building with 6-8 long classrooms on each floor. Each classroom will hold 20-30 students. The area of each classroom is around 500 square feet. The total area is 7800 square feet on each floor.

Water Tower & Visitor Center

Referring to the typical design of water tower, we designed a 130 feet tall water tower in the site. The floor area is 900 square feet so the base of the water tower is large enough to be utilized as a visitor center or powerhouse.

Conference & Administrative Building

The conference and administrative building is a complex building on the site. It is an octagon building with three floors. It can accommodate 800 people in a big conference hall with small meeting rooms around it. The first and second floor of the building could be used as an auditorium. The third floor (or basement) of the building could be used as an indoor sporting area. Restaurants and café could be located on the first floor of the building. The area of the conference building is 15,000 square feet. Since the client also requested offices for staffs, so the conference and administrative building was designed as a 9,400 square feet complex building in total.

Dormitory Buildings

The dormitory building for male or female should hold 375 people. Each room could hold 4 to 6 people. For VIPs and families, the building only needs to hold 100 people. Using a typical floor plan for reference, three dormitory buildings were designed by using circular passage connecting rooms on both sides. Although the area of each room is the same in dormitory building for male or female and VIPs, the furniture and layout are different. The total area of each dormitory building is 6,600 square feet.

Architectural Space, Form & Organization

“Architecture, in brief, is a set of building blocks depicted in an architectural model, and a specification of how those building blocks are connected to meet the overall requirements.”(Building Blocks, web) As we can see in Figure 9, in Eco-retreat Center, building blocks with similar and related function are connected. Building blocks are connected to each other and organized in a specific way to form various unique architectural spaces. Each space specifies the scope and approach that will be used to address a specific problem. Forms and organizations of buildings in the Eco-retreat Center were designed to address specific problems to make it affordable, energy-efficient, and sustainable.

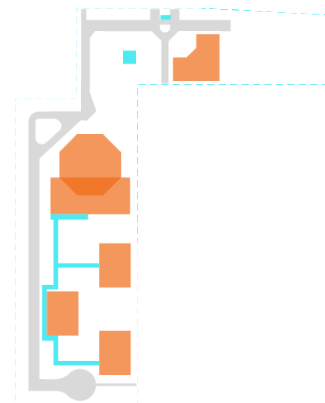


Figure 9: Building Blocks in the Eco-retreat Center.

Architecture Form

L-shaped

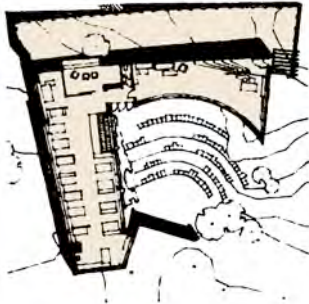


Image 7: The Architect's Studio, Helsinki

Source: *Architecture Form, Space and Order*,

A building has an L-shaped configuration will establishes a corner of itself, encloses a field of outdoor space to relate to its interior space, or shelter a portion of outdoor space from undesirable conditions around it. (Ching F. 1979, p134)

The Architect's Studio (Image 7) in Helsinki uses an L-shaped form to enclose elements. The studio is used as an amphitheater for lectures and social occasions. Rather than forming a passive space whose form is determined by the building that encloses it, the studio's design has a positive form that pressures the form of its enclosure.

In the design of the Eco-retreat Center, an L-shaped building (Image 8) was designed to serve as a teacher college. It will separate its architectural space into different sections, and each of the section will have its own function. The L-shaped configuration can stay alone in the space, and it is stable and self-supporting. In addition, it is flexible in terms of space-defining elements since it is open-ended.

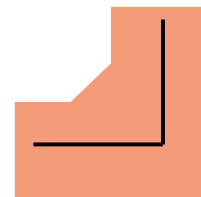


Image 8: L-shaped building

Four Closure

Four closure (Image 9), is possibly the most typical and strongest type of spatial definition in architecture. Its space is naturally introverted as the field is totally enclosed. The enclosure may consist of arcades or gallery spaces that promote the inclusion of surrounding buildings into their domain and activate the space they define.

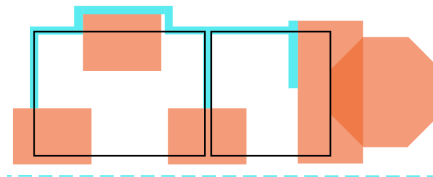


Image 9: Four-closure space

Four closure examples are also shown in the case studies (Image 10). In the case of the University of Liberia, dormitory buildings enclose a field of relatively private space, which is a semi-private space that is connected to a nearby public area. In contrast, in the case of China Embassy, the corridor and the group of buildings work together to form a rectangular courtyard with a symmetrical layout. This enclosed courtyard has its own functions and is separated from its surrounding public areas.



Image 10: Four Closure Space Cases (Case Studies)

For this project, the enclosure consists of garden spaces that promote the inclusion of surrounding buildings into its domain to make it a relatively private space. At the same time, the corridor structure plays a role in sheltering visitors from burning sunshine and continuous rain if connected to buildings.

Building Organization

“... the basic parts of a house can be put together to make more than just basic parts. They can also make space, pattern, and outside domains. ” (Moore, C., & Allen, G, 1974, p148) In the project of Eco-retreat Center Design, buildings can be organized to form various spaces such as interlocking and common spaces.

Interlocking Spaces

An interlocking space is a concatenate spatial relationship results from the overlapping of two spatial fields and the emergence of a zone with shared space (Image 11). When two spaces overlap in this way, each part retains its identity and definition as a space. The interlocking parts can merge with one of the two spaces, and thus become part of that space’s volume. (Ching F. 1979) For the Conference Hall building in the Eco-retreat Center the main structure is an octagonal building that would be used as a meeting room and gym as required by the client. The rectangular part is the subsidiary structure that would be an administrative building. The interlocking part could be a transitional area linking the primary functional areas (conference and sports) and the recreational areas (café and restaurant).



Image 11:
Interlocking spaces

Spaces linked by a common space

As shown in Image 12, “two spaces that are separated by distance can be linked or related to each other by a third, intermediate, space. The visual and spatial relationship between the two spaces depends on the nature of the third space with which they share a common bond” (Ching F., 1979, p186). In Figure 7, the two black circles represent the shared spaces for the conference building, the reception area and teacher college. The common spaces make all elements an integrated whole.

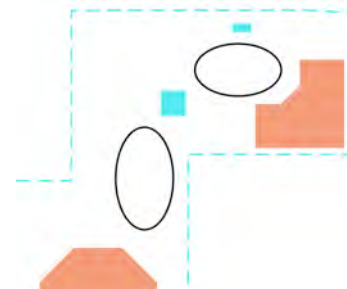


Image 12: Spaces linked by a common space

In summary, designing the building form and layout in a functional way will help the project be constructed in a sustainable way so that to create pleasant experience for users.

MASTER PLAN

The Eco-retreat Center Master Plan (Illustration 1) shows how the property was designed into a functional and active space. With showing the connectivity and organization of space, the Eco-retreat Center brings comfortable living and social life for visitors. All the greeneries and settings of the Eco-retreat Center meet the needs of the client, the users, as well as the country. The Eco-retreat Center Plan will help to bring an ecological friendly model in the country of Liberia.



Illustration 1: Eco-retreat Center Master Plan.

DESIGN DESCRIPTION

The design goal of the Eco-retreat Center in West Africa is not only to provide CRCA a pleasant meeting space for people to help promote the business and recovery of the country, but also be an eco-friendly, people-oriented sustainable model of the country. During the design process, minimizing the impact to the original environment, finding solutions for the constraints and addressing the opportunities of the property are what the project team thought, so that to create an ecological friendly retreat center for long-term sustainability. The sustainable strategies used in the design will be specifically introduced in the following chapter, *Sustainable Design Strategies*.

In this chapter, drawings and renderings will be used to illustrate the design of the Eco-retreat Center. A master plan will show the general layout plan of the buildings and site planning decisions, giving people a sense of how the design organizes the space of the Eco-retreat Center. Focal design areas are also selected to be described with detailed drawings and illustrations to analyze and value the functions of the design solutions.

Site Planning Analysis



Figure 10: Building Layout based on Function Zoning and Space Analysis.

Building Layout

As knowing the basic features of buildings, the project team came out with a building layout plan as shown in Figure 10. The plan is developed based on the analysis in the *Function Zoning and Space Analysis* from Site Analysis chapter demonstrated previously. Since there

are four zones (Zone Orange, Zone Yellow, Zone Blue, and Zone Green) are created to be analyzed according to its location and surrounding environment with pros and cons, four functional spaces are fit into the different zones, including recreation space, education space, meeting space, and living space.

As it was analyzed before, Zone Orange is good to be a school education and recreational area. Because of the topography of the site, the school building is located at a higher elevation across Zone Orange and Zone Yellow. Since it is next to the main entrance and one of the community entrances, it will be convenient to be accessed and hold the frequent traffic for students who come to school from the communities outside daily. Also, Zone Orange has relatively less traffic on the site than other zones. Thus, a sports field, including a basketball court and a soccer pitch, is designed with the school building on the east in Zone Orange for recreational purpose and safety consideration.

Zone Yellow is suitable to be an open space with small ground area buildings such as a water tower or a gatehouse. In the design of Eco-retreat Center, a water tower is located in Zone Yellow. According to the conspicuous location and the function as a connection point for the northern and southern part of the site, Zone Yellow is a suitable place for the water tower that works as a landmark for the Eco-retreat Center. Also, considering the efficiency of the water tower, the potential location for a water tower should be inside the boundary and near the wells, which is Zone Yellow. The benefit will include reducing the cost of materials used for water conduction and helping with water supply to the water tower and the proposed buildings, so that it can provide running water to the whole site with less difficulty.

Zone Blue is suitable for conferences and meetings due to its quiet and center location of the site. Thus, the complex conference and office building is designed in Zone Blue. Also, the front entrance of the building is facing an events reception open space. This part will be a gorgeous central space of the Eco-retreat Center.

Zone Green is suitable to be a living space for its quietness and the private surrounding environment. Thus, three dorms are put here individually according to the project requirements and the culture of Liberia. In the culture of Liberia, the male dormitory and female dormitory should be put separately for privacy. Considering that the female dormitory should be the most private building of the Eco-retreat Center, it is put at the south end area of the site in Zone Green, so that few people would pass by this building. While, the VIP dormitory building will be built next to the conference complex building in Zone Green, for its convenience to the conference hall, adjacency to the courtyards, and a good view of the potential wetland park on the west.

In summary, there will be six buildings in total on the site. Also, considering the safety issue, there will be several security towers located at each corner of the site (Figure 11) based on further needs of the Eco-retreat Center.

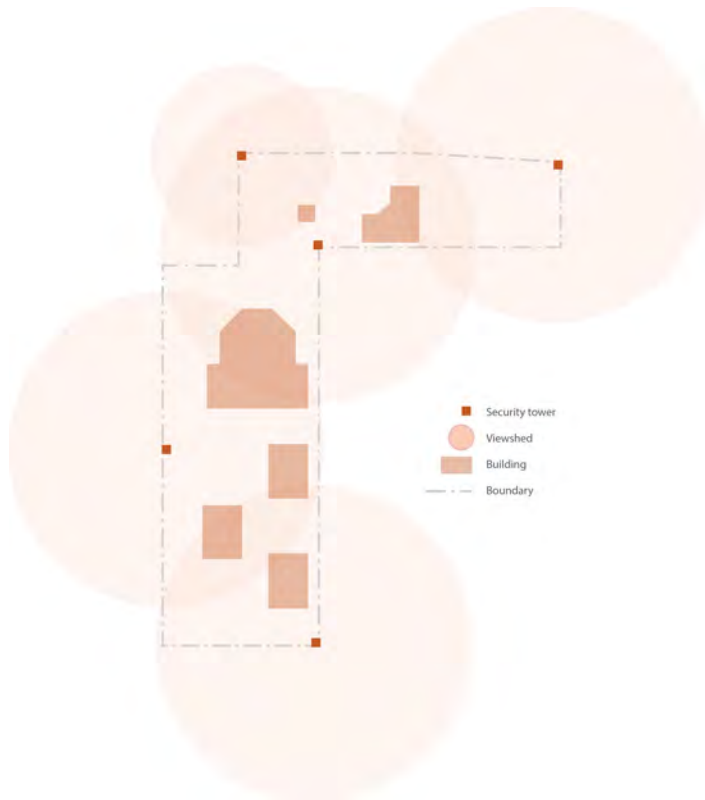


Figure 11: Security Tower Location and Viewshed.

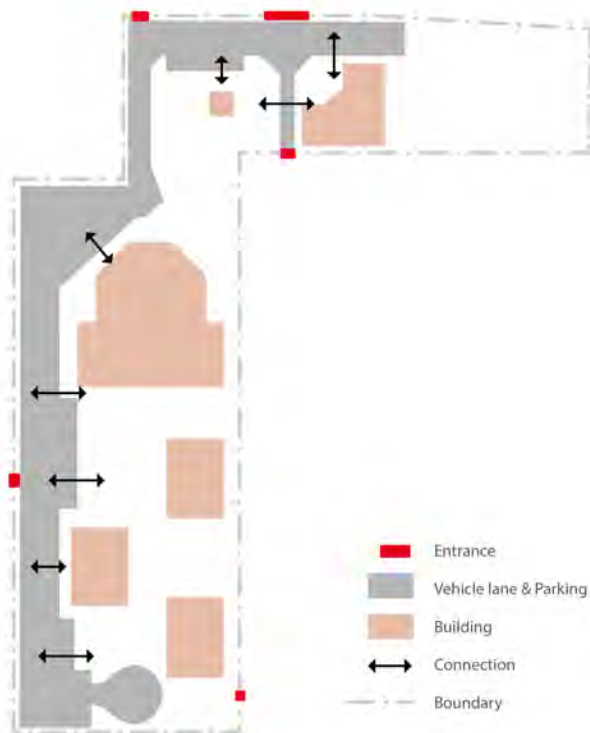


Figure 12: Planning of Vehicular and Pedestrian Space.

Space Function

In order to create safe and continuous spaces, vehicle traffic is separated from pedestrian traffic. Thus, the space of the Eco-retreat Center is divided into two parts (Figure 12) based on the different transportation methods needed for the site. One part on the west is for parking lots and vehicular lanes, and the other part is for open lawns, gardens, and pedestrian walkways. The driveway is designed along the fence with entrances, with several parking lots on one side or both sides of the driveway. Such design would help to accommodate the needs of the parking space, 100 to 150 spaces based on the design requirement, which is relatively a large number compared to the size of the property. What is more, the layout would also help to save space and leave more opportunities for human activities and ecological landscapes on the site. The entryways to the pedestrian walkways are created equal distance along the parking lot. People will feel safe and enjoy their leisure time walking through the site. Thus, the design format will give people a comfortable and safety experience while walking or driving on the site.

Circulation – Service trucks

Figure 13 illustrates the circulation of the service trucks. The trucks may include fire trucks, the garbage truck, post office vans, and the vehicles for other services. Since there is an entrance reserved for large vehicles, when designing, the turning radius of large vehicles was taken into consideration. As shown in Illustration 2, the turning radius is designed in 45'-0" with a landscape island in the middle. The service entrance road is 20'-0" wide and a loading zone is designed at one of the entrances of the conference building. Dumpsters could be put at the corners by the boundary wherever is necessary, and garbage trucks could either collect garbage outside the boundary or inside due to the preference of the client. This short service circulation design would help to reduce the disturbance to the activities in the Eco-retreat Center, especially to keep the quietness and privacy of the living space inside the property.

Circulation – Small vehicles

In the design of the Eco-retreat Center, two entrances are left as car entrances. One is the main entrance, and the other is a community entrance. (Figure 14) The double-lane road with a parking lot is 25'-0" wide, and the width of the single-lane road is 12'-6" minimum. There are two loading zones designed, one is at one of the entrances of the conference building, the other is at the entrance of the teacher college. Because enough turning space is designed (Illustration 2) at the end of the driveway, the west part of the circulation could also be used for large vehicles if necessary, such as the emergency service vehicles.

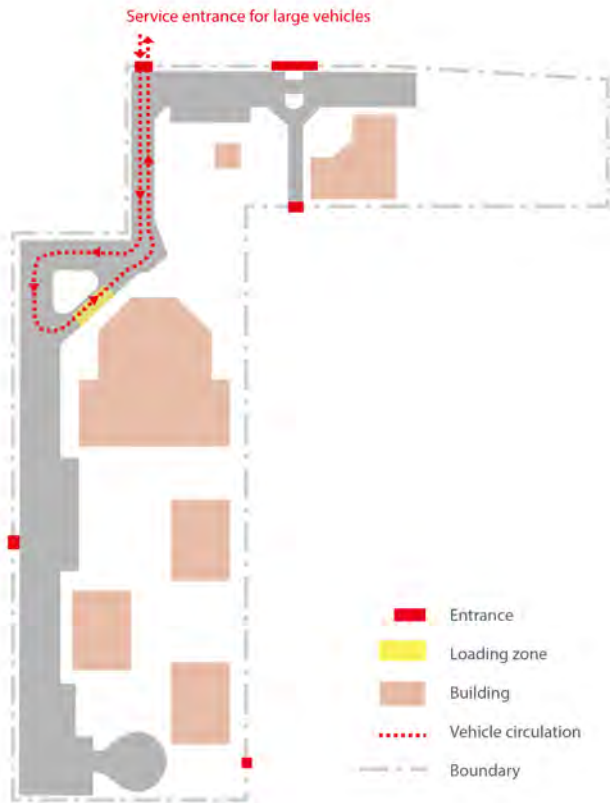


Figure 13: Circulation of Service Trucks.

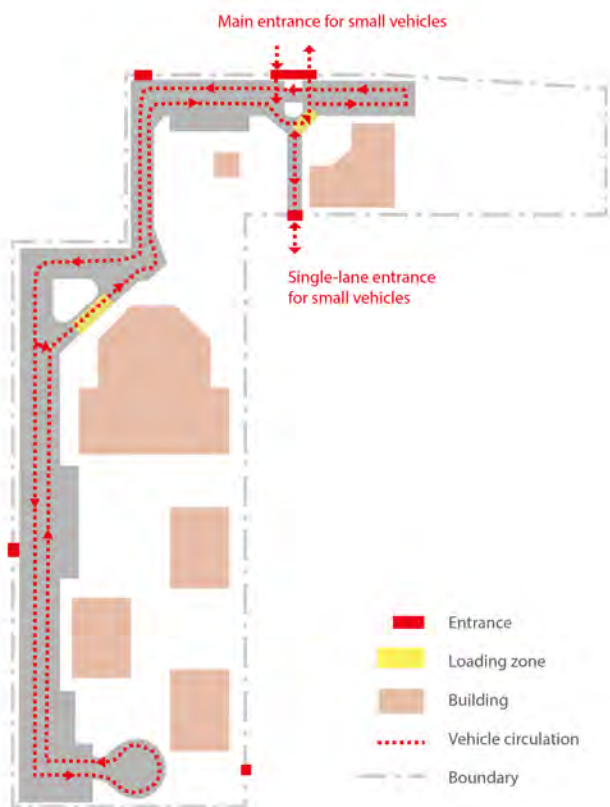


Figure 14: Circulation of Small Vehicles.

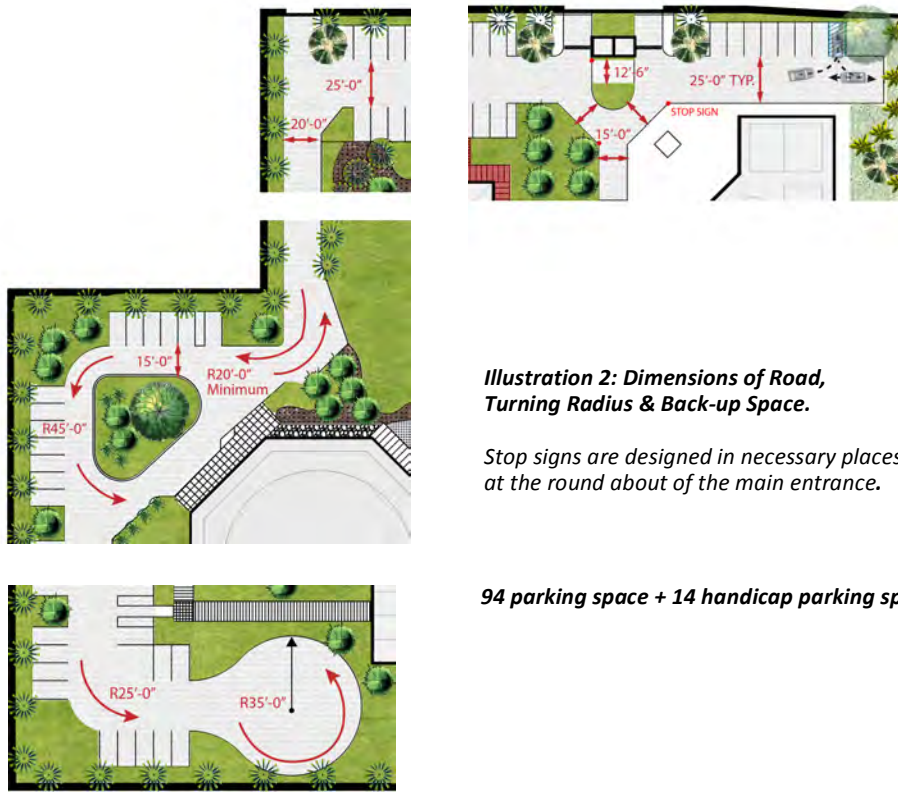


Illustration 2: Dimensions of Road, Turning Radius & Back-up Space.

Stop signs are designed in necessary places at the round about of the main entrance.

94 parking space + 14 handicap parking space

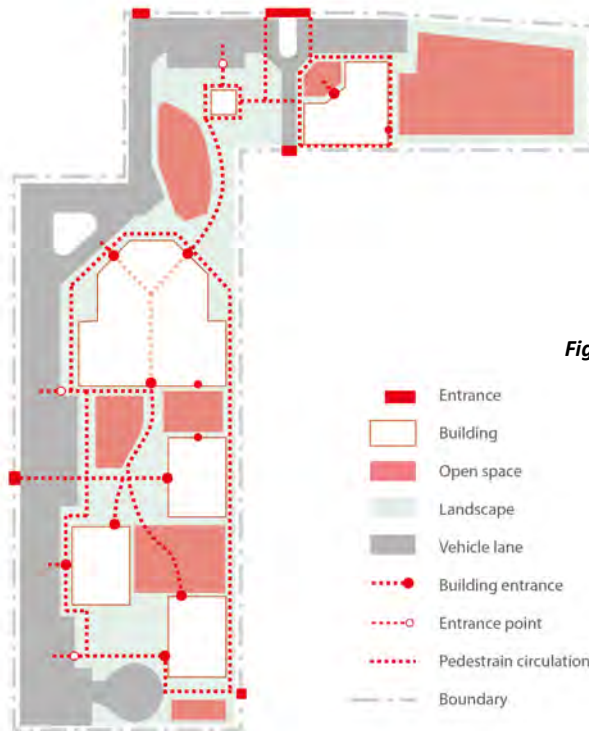


Figure 15: Circulation of Pedestrian Walkways.

Circulation – Pedestrian walkways

The pedestrian walkway connection is shown as in Figure 15. To enhance the connectivity between buildings and outdoor spaces, we designed multiple walkways as learned from the MJRC case study. In this way, people will have options to experience various spaces while walking to their destination. With the design of barrier-free access, everyone can use the walkways. The connection method of walkways includes using covered corridors, inside building corridors, crosswalks and open lawns or activity space. The walkways cover the entrances of all the buildings and are easily accessible to the nearby open space on the site, creating valuable experiences for people while they are walking through the Eco-retreat Center.

Building entrances

Teacher & Pastor College

The teacher and pastor college is a building located near the main entrance to train prospective teachers or pastors. Its main entrance is facing a mini plaza with the flag pole, and the plaza will be used as a gathering place for the students. So an area of pavement with certain pattern is designed. Different paving materials, planting materials are applied to differentiate this area at the main entrance of the Eco-retreat Center. There is also a back entrance connected to the outdoor classroom and recreational areas.

Water Tower & Welcoming Center

The water tower and welcoming center is next to a parking lot near the main entrance, as a landmark for the Eco-retreat Center, so people come to the Eco-retreat Center will see this outstanding building. Visitors may come into the welcoming center to check in or ask for information about the Eco-retreat Center. The appearance of the entrance of the welcoming center should be beautiful and attractive. The building entrance is facing north and surrounded with planting areas and connections to other buildings.

Conference & Administrative Building

The complex of conference Hall and administration building is the most important building in the Eco-retreat Center. It is located in the center of the site. Three entrances are designed to provide connections to all other buildings. The main entrance, facing a parking lot, is mainly for people who drive. There is a big island of planting area that will create a beautiful view for the conference hall and leave a good impression for visitors. A big paving area next to this building is designed to accommodate a big flow of visitors. So it is easy for people to get into or get out of the building. Another entrance, which connects to the events reception area, is a platform made of timber. It is a transition area from building that is a hardscape to planting and lawn area that is a natural area. The last entrance of the conference hall is the one that connects to an outdoor café and a courtyard, so this entrance is also important for circulation. When people finish their work, they can go to the outdoor café or the courtyard for relaxation, or they can go to their dormitory to take a rest. The corridor connects this building to parking lots and dormitory buildings, so people go to these places without exposing to harmful sunlight or heavy rainfalls.

VIP Dormitory

The dormitory building for VIP only has one entrance, which is enough to accommodate the people flow. Since the entrance is facing a parking lot, visitors can find their way to the dormitory easily. Moreover, the entrance is located in the planting area, which is close to courtyards. It will bring beautiful scenery while walking toward the entrance of VIP dormitory.

Regular Dormitories

Similar to the dormitory building for VIP, regular dormitory buildings have the entrances to courtyards. Thus, people can walk to the courtyard easily when they want to take a walk or do some other activities. In order to separate the dormitory buildings for males and females and avoid bringing troubles and more traffic, both dormitory buildings have a second entrance near roads where a loading and unloading zone is located. It is convenient for people who drive to get into the dormitory buildings from the parking lot. A rain garden between these two dormitories has a lot of beautiful plants that are water tolerant provides an attractive view and supplies an educational opportunity for students.

In conclusion, all of the entrances to the dormitory buildings are have both functional value and visual value. They not only meet the requirement for accommodating people flow, but also have an appealing view.

Functional Zones

In the design process, we believed that the site would be more sustainable and meet the challenges if it could provide multiple ecological, cultural, and social functions, as well as creating various experience. By defining the purposes and functions of different spaces, the designed site can be divided into five zones (Figure 16): Recreation Zone, Education Zone, Welcome Zone, Conference and Reception Zone, and Living Zone.

Recreation Zone

Recreation Zone is an open-air space designed for both active and passive recreational activities to promote physical health of users. The location and accessibility of Recreation Zone reveal that there will be a considerable number of people coming to this space. According to the results of stakeholder analysis, soccer and basketball are the most popular sports for potential users. Therefore, we designed a soccer field and a basketball court here to cater for widespread public demand. Since the soccer field is near the school, it is accessible for students to serve as a playground for running, walking and games with trees planted as a natural boundary. Users can enjoy the surrounding scenes in a safe environment. Also, considering the huge precipitation in wet season, the soccer field can provide ecological functions and help with stormwater infiltration and conduction.

Education Zone

Education Zone consists of the school building, outdoor classrooms and a parking lot. It is designed to provide educational support. The entry of the school is a plaza facing the main

entrance of the property, so it is convenient for students to enter the school space directly from the main entrance, which will protect them from the traffic on the site. The plaza will be a gathering space for social interactions. To the east of the school building is an area for outdoor teaching activities, feature structures observed on the site can be placed here as cultural heritage and conservation. This zone also has several parking spaces to accommodate daily use for the east part of the site.



Figure 16: Function Zones.

Welcome Zone

Welcome Zone includes the main entrance with a guardroom and the visitor center. The water tower will be located above the visitor center to provide daily water supply in the future. Creating attractive scenes is critical in this zone, since this area gives visitors the first impression of the site and welcomes them into the property. It is also a transitional area to guide visitors in exploring the core areas.

Conference and Reception Zone

Conference and Reception Zone is a core area of the site for formal conferences and informal gathering activities. The large octagonal-shaped conference hall is located in this zone to provide space for conferences with a capacity of 800 people, which is also connected to the administration building with multiple sizes of meeting rooms and offices. The conference hall has an indoor gym and a basement to accommodate people's needs for indoor exercises and storage. Events can be held on the reception lawn just in front of the conference hall, which is convenient for carrying out a series of conference-related activities and promote social engagement. A green island is designed in front of the building entrance to orient the circulation. At the back of the building group, a café area is proposed for people to have a talk and enjoy their leisure time over the meal.

Living Zone

Living Zone aims to create a clean and comfortable space for people to stay and spend time in a leisurely manner, containing dorm buildings, rain gardens, and several activities nodes. Three dorm buildings are designed for different user groups, include VIPs, male and female visitors. They are connected by covered walkways to create an enclosed courtyard in the center. Curved stepping roads go through the courtyard, leading people to some private spaces and gathering nodes. We designed a rich diversity of plants in this zone in order to create a quiet space, as well as solving ecological problems, like stormwater collection and management. Also, as the dorms are close to the swamp, this zone also promotes the interaction between nature and human beings.

DETAIL DESIGN

In the detailed design stage, we created three detailed plans for three specific areas, including main entrance, outdoor café and parking lot, and produced several perspectives to show the design alternatives all over the site.

Main Entrance



Illustration 3:

WELCOMING ZONE DETAIL PLAN

NOT TO SCALE



This detailed plan of welcome zone (Illustration 3) aims to show the layout of main entrance, visitor center, and the pave pattern of the plaza in front of the school building. The main entrance (Illustration 4) includes a guardroom and a flag rock with the property name, Eco-retreat Center, which defines the boundary of the site. The paving materials used for the plaza is mainly bricks, aiming to create a more ecological environment by increasing filtration and provide a safer for children. Flowerbeds facing the main entrance are made of local flower species, which bring energy and delight visitors by showcasing the most vivid characteristic of the site.



Illustration 4: Main Entrance.

Visitor Center

Visitors will see the visitor center with water tower on top (Illustration 5) once they enter the property. It is surrounded by a rich diversity and layers of plant species, and has a clear symmetrical layout, forming a delightful space for people and natural habitat for wildlife. Water tower is integrated into the visitor center because of limited space, which is used to store water and provide water supply and irrigation to the entire site. Green bricks as eco parking lot paving are placed here that penetrate into the surrounding green space.



Illustration 5: Visitor Center.

Reception Lawn



Illustration 6: Reception Lawn.

Open space in front of the conference building is a large lawn that can be used for reception, gathering, sightseeing and rest, creating a multifunctional space. It requires low maintenance and can support all kinds of activities. A pavilion is located here that is easily accessible to serve as a shelter, as well as a visual center.

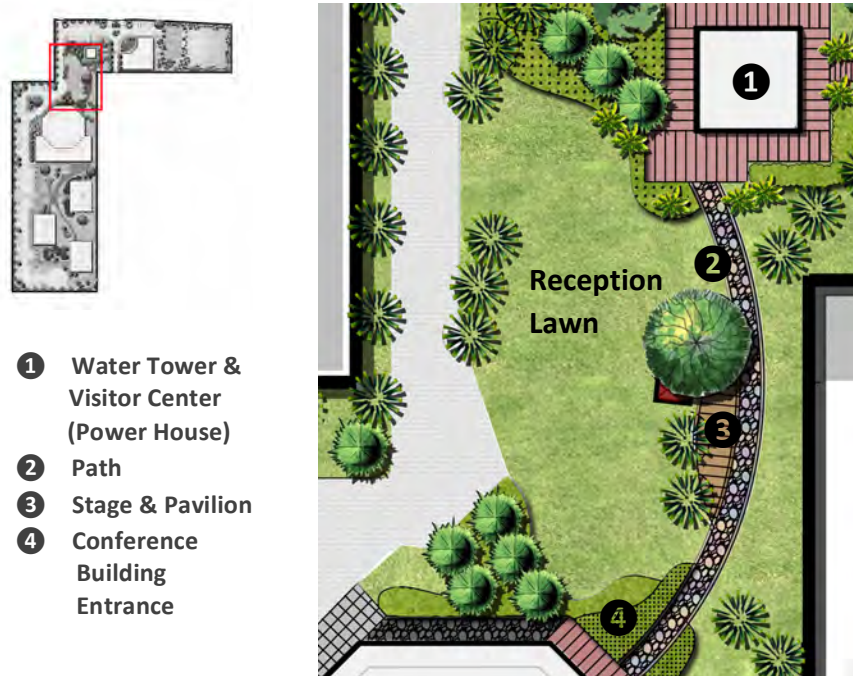


Illustration 7: EVENTS RECEPTION ZONE PLAN

NOT TO SCALE

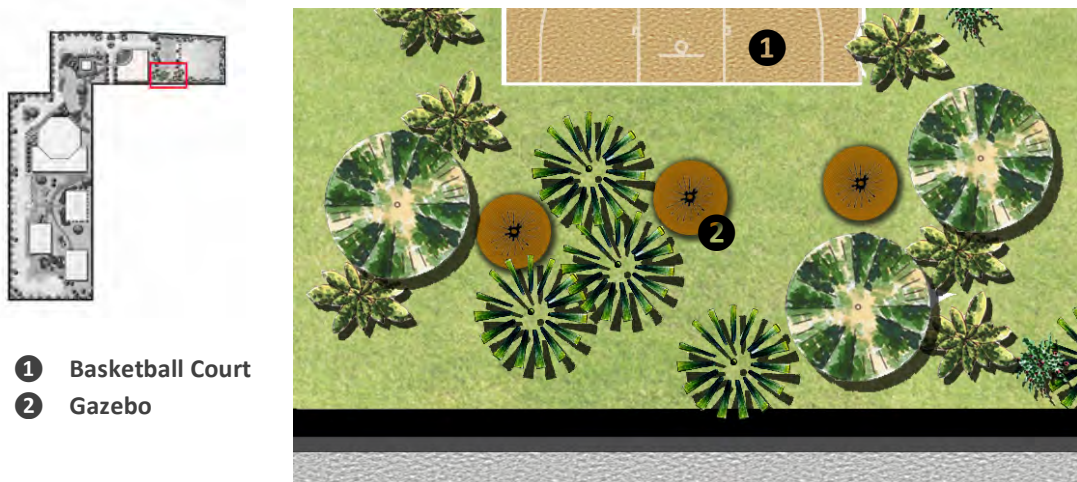


Outdoor Classroom



Illustration 8: Outdoor Classroom.

The outdoor classroom area (Illustration 8-9) to the east of school building provides a feature space that utilize local structure, gazebo, as a cultural heritage to facilitate education in a cost-efficient way. They gazebos are accessible to everyone who wants to be close to nature.



- ① Basketball Court
- ② Gazebo

Illustration 9:

OUTDOOR CLASSROOM PLAN

NOT TO SCALE



Garden Space

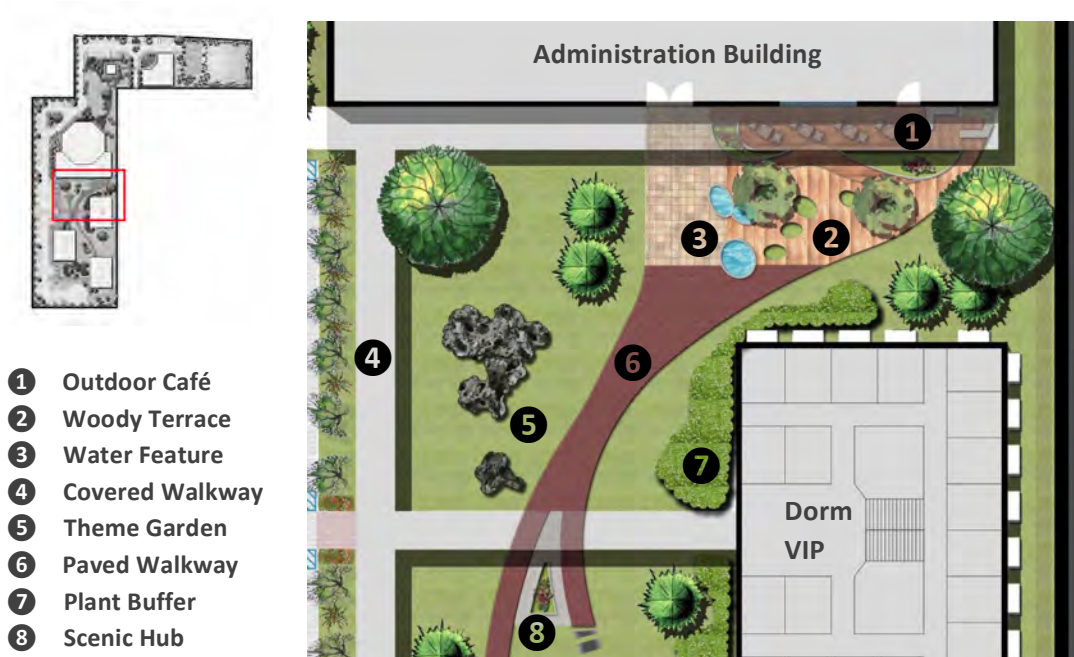


Illustration 10:

GARDEN SPACE DETAIL PLAN

NOT TO SCALE



Illustration 11: Outdoor Café.

The outdoor café area (Illustration 10-12) is a space where people can spend time in a leisurely manner. The natural elements, like plants and rocks are placed here to achieve natural effects and create transitional space between conference hall and the dorms. Since Liberia has many rock resources, so a large piece of rockwork is placed to add fun to the space. Also, clients had requested for

water feature, we choose to place it here because this element not only contribute to the modern look of the site but also help to moderate the hot climate from the sustainable standpoint. Water makes the space more comfortable and creates a landscape to attract as broad population as possible. The elevated wood platform and roads give visitors a touch of nature and leave space for micro-ecosystem under it.



Illustration 12: Outdoor Café Section.



Illustration 13: Theme Garden

Corridor



Illustration 14: Scenic Hub.

Corridor, as an extension of building, connects several important functional buildings in the Eco-retreat Center such as the conference hall, a dormitory for VIP, and two separate dormitory buildings for male and female residents. Furthermore, the corridor is critical to pedestrian circulation it links building's entrance, parking lot and courtyards together. In this way, no matter the weather – sunny or rainy, it is convenient for

people to walk through the corridor from one building to another and avoid excessive exposure to direct sunlight or heavy rains. Moreover, since the corridor is connected to the parking lot, it is easy for visitors who want to drive themselves to find their way into buildings. As a shade and shelter structure, the corridor is a great solution for enhancing connectivity and a useful strategy for people to move between buildings.

Courtyard



Illustration 15: Courtyard.

Courtyard in the dorm area aims to create a quiet and peaceful space where people can relief and rejuvenate their body, mind and sprite. Natural elements are also used here to create low-maintenance and cost-efficient landscape, but the quality of experience meets the mission of ecological design. It accommodates further developments of the natural assets over time.

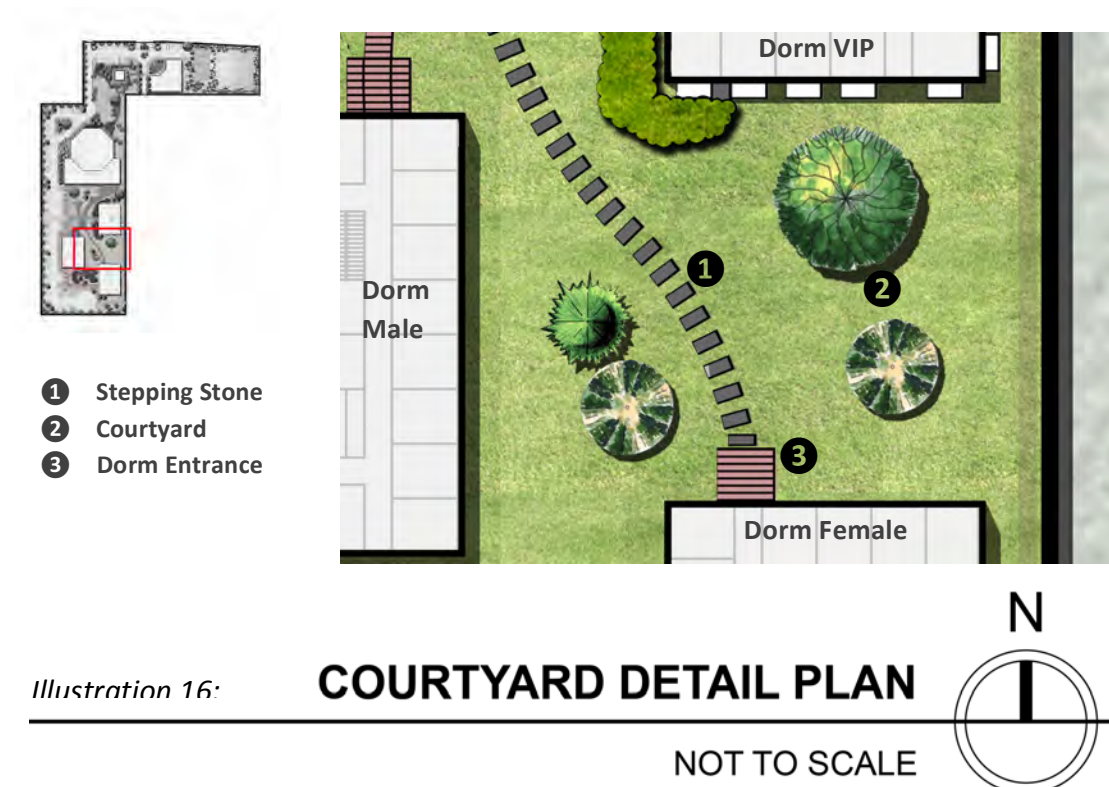


Illustration 16:

Community activity area



Illustration 17: Community Activity Area.

A community garden (Illustration 17-18) is proposed near the gate to the local community, providing daily exercise and recreational facilities to promote the physical and mental health of visitors. This area also allows the access of vehicles when necessary.



Illustration 18:

Parking Lot

The detailed plan of parking lot area (Illustration 19) gives a suggestion for the connection from the parking lot to the nearby structures and the wetland to the west of the site boundary. Permeable concrete was recommended to be implemented here to guide stormwater runoff and allow filtration. Since the spot has a relatively large slope, water will be conducted through the bio-swale to an underground storage tank. The water stored during storms will be used for multiple purposes, especially for water supply in dry seasons in Liberia. Handicapped parking spots were also considered to make the site accessible to everyone.

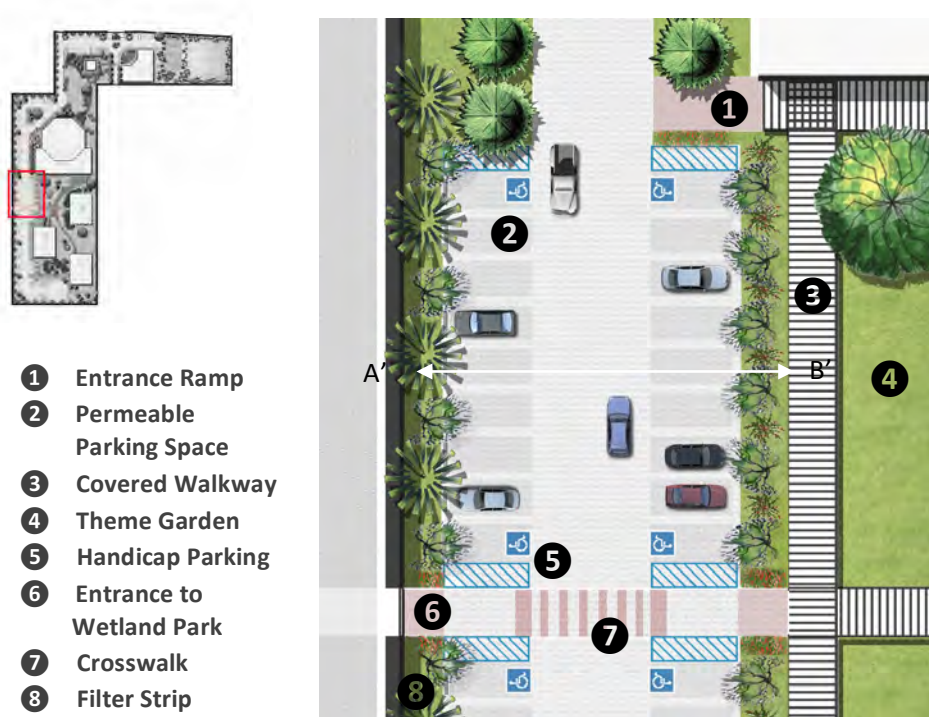


Illustration 19:

PARKING LOT DETAIL PLAN

NOT TO SCALE



Illustration 20: Parking Lot Section.

Wetland Park Connection



Illustration 21: Gate to the Wetland Park

Since the existing wetland outside the site boundary is a good destination for people to get close to nature, the project team took advantage of the wetland and created connections from the site to this natural resource, aiming to have the site better fit into its surrounding environment and afford a richer variety of activities for visitors.



Illustration 22: Eco-retreat Center Bird Eye View

We always keep in mind the project's mission to design with nature and apply sustainable strategies that may work well for the site. These detailed designs provide design suggestions and can serve as a starting point for future development.

SUSTAINABLE DESIGN STRATEGIES

“Sustainable landscapes are responsive to the environment, re-generative, and can actively contribute to the development of healthy communities. Sustainable landscapes sequester carbon, clean the air and water, increase energy efficiency, restore habitats, and create value through significant economic, social and, environmental benefits.” (ALSA, web)

For the Eco-retreat Center design, the sustainable strategies are applied in three ways, from the aspect of society, economy and ecology. The three aspects are inner connected, but they all have specific design decisions to address. Society is taking the consideration of people, who are the users of the site. For the Eco-retreat Center, the users may be students, teachers, visitors, and the staffs. Functions and connections of different space, culture value, education value, aesthetic value, level of comfort and accessibility are all necessary thoughts to be concluded into design. For Economy, the materials used in buildings and other built structures should be cost-efficient to achieve long term and minimum impact on the environment. That means to balance the following three aspects. They should cost less, need little maintenance, and in good quality and could last for a long time. Energy saving is also a part of Economy, including regulating temperature, ventilation, and natural lighting. For Ecology, the use and management of plants and water illustrate it. Proper plant selection would save habitat for wildlife. The reuse of water, attempt to reduce stormwater runoff, and the use biofilters and rain gardens, will all benefit the ecological system of the site.

The sustainable design strategies in this case are discussed in three aspects. One is Materials Selection, including plant materials suggestion, building and pavement materials selection; one is Stormwater Management Strategies, and another one is the connectivity of experience in the site.

Materials Selection

Building Materials

According to the result of the interviews in Chapter 4, the project team learnt the cost of using imported materials would be high. Since there is a number of good local materials could be used for construction, for sustainable standpoint, the project team suggests using local materials for the Eco-retreat Center. In this way, it could be a cost-efficient solution for the client, and the local materials are also easier to get than imported ones. While, imported materials could also be considered as needs if necessary, for the whole country is under reconstruction, imported materials are also available from the merchants in the country. Also, considering the extreme weathers in Liberia, calm wind, heavy rainy days and hot days, materials are preferred to help air circulation in the buildings and thermal insulation when being selected. A materials palette is shown in Table 4.

Conference building, college & dormitory buildings

According to the answers from the interview, the most recommended materials for the buildings in Liberia are airbricks made from cement. For buildings that demand a lot of materials, blocks are easier to get in Liberia than other materials (Dean Snyder, Jane Malone) and the client does not need to worry about lacking materials. Air bricks (Photo 20) can be inserted in the construction of building walls and/or blended with surrounding concrete blocks. Because the function of thermal insulation and insulating is outstanding, it is an optimum choice when selecting the materials for buildings in Liberia. Air bricks would serve as ventilation holes, contributing to the natural cooling of the building in hot days.



Photo 20: Air Bricks.

There are two kinds of materials with the same price recommended for coating. One is the imported F-C paint, which looks good, but it is hard to maintain because it needs to be repainted several times after a period. The other one is local coating that works well in Liberia. This kind of coating has many choices of colors, such as yellow, white, and other colors. Adding coating to the buildings will bring a clean and seamless surface, which will help the buildings be durable in the long-term.

Stones can be used for the lower part of dormitories, which will create a unique style and form a solid foundation for the dormitory buildings. Using stones will also reflect the cultural heritage of Liberian Architecture brought by early migrants.

Eco-bricks (Photo 21) made from the compressed earth and cement are renewable and locally-sourced materials in Monrovia, Liberia. This material allows the walls of the building to "breathe" so that to keep the buildings naturally cool and to contribute to the building performance. Also, it matches the style of the conference hall and school that are constructed from blocks, and it will provide a consistent visual appearance of buildings.



Photo 21: Eco-bricks.

Visitor center, guardroom & covered walkway

For small size structures, sustainably harvested timber (Photo 22) can be used. They are renewable and locally-sourced materials in Monrovia, Liberia. It forms a cooling system for buildings as a whole. The texture gives a feeling of nature, especially combining with surrounding plants. Also, timber has a lower cost due to high availability and cheap



Photo 22: Timber.

Source:http://www.finehomebuilding.com/CMS/uploadedimages/Images/Homebuilding/Articles/021192mcEX-05_lg.jpg

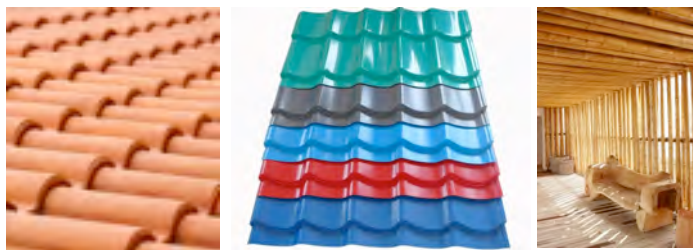


Photo 23: Clay Tiles (left), Color Sheet Tile (middle), Bamboo (right).

Source:
<http://mediashower.com/img/559/clay%20tiles%20on%20a%20roof.jpg>
http://img.diytrade.com/cdimg/1759438/25610518/0/1335142682/Color_Coated_Steel_Roof_Tile_Profiled_sheet.jpg
<http://www.yatzer.com/assets/Article/2768/images/Babylonstoren-yatzer-25.jpg>

production cost, and it does not require special tools. “It is light-weighted and easy to handle even for people with a low level of construction experience” (Andrea Stein, eHow). Other types of local wood could also be considered as alternatives.

Roofs

From the case study of China Embassy, the project team learnt clay tiles (Photo 23-left) and color (iron) sheet tiles (Photo 23-middle) are suitable local materials for the roofs of buildings. They are both renewable and locally-sourced materials in Liberia. The tiles can conduct water very well in rainy days. The gaps of layered tiles serve for ventilation underneath the roof.

Bamboo (Photo 23-right) can be used for the cover of walkways. Currently, bamboo grows widely in Liberia, but it is not being used wisely as a natural resource. Using it in an innovative way will utilize its decorative feature for more sustainable and cost-effective structures.

Windows

Local lattice windows (Photo 24) can be used for buildings, which would let more air go into the buildings and have a natural cooling effect. Lattice windows are widely used in Liberia. Using lattice windows is a unique way for ventilation. Materials for lattice windows should be salt resistant for the salt fog is a common phenomenon happened along the seashore in the country. Wood, aluminum alloy and copper are feasible material choices for the windows.



Photo 24: Lattice Window.

Paving Materials

Potential paving materials from the surveyed stakeholders include blocks, cement, vines, and flowers. At the same time, the stakeholders pointed out that the materials needed to be natural, light-weighted and eco-friendly.

Roads and parking lots

Concrete is the most common material used for roads in Liberia. It looks good, and it is much cheaper than other stone materials that need to be imported to Liberia. Considering the intended use and public demands of the site, permeable concrete (Figure 17) can be applied for a long-term use for drive ways and parking lots combined with stormwater drainage systems on the site. Another way for paving parking lots is to use bricks with green slots (Photo 25). From the ecological design purpose, it allows for bio-filtration and temporarily



Photo 25. Pavers.

Source:
<http://www.tececo.com.au/images/photographs/permeconcrete/PerviousPavement.JPG>
 Source:https://farm5.staticflickr.com/4016/4644576073_2ebe7a5972_m.jpg
<http://ww1.prweb.com/prfiles/2008/06/05/534354/SolomonColorsBrickform1.jpg>
<http://www.onekindesign.com/wp-content/uploads/2013/11/House-at-Jardin-del-Sol-Corona-y-P-Amaral-Architects-01-1-Kindesign.jpg>

Table 4: The Material Palette of Buildings and Pavement

Building materials

Conference hall, school



Concrete block



Air brick

Dorm



Eco-bricks



Stones

Visitor center, guard room, covered walkway



Wood (timber)



Roof



Clay tiles



Color sheet tiles



Bamboo

Window



Lattice windows

Paving materials

Road & parking lot



(Colored) concrete



Permeable concrete



Green Bricks

Platform



Timber

Stepping roads



Rock and Aggregate



Stones



Stones and gravel

collection of water within the space, which will have huge savings by reducing the needs for stormwater infrastructures. What is more, colored concreted (Photo 25) or concrete with printed patterns are also local materials found in Liberia, and these materials can add visual interest to the site by providing changing colors or patterns.

Platform

Liberia has a rich forest resource of timbers. Timbers could also be used in pavement (Photo 25) in addition to buildings, and they can provide a glorious look and the feel of nature. The benefits include: they are resistant to salt fogs and moisture; low maintenance is needed; Timbers as the pavers could be used durable over decades of exposure to weathering. Finally, they are recyclable and environmental friendly materials. While, when using timbers as platforms, the foundation of the stage need to be lifted up, so that to minimize the result of erosion from the moisture in the soil.

Stepping roads

Liberia has aggregate (Photo 26-left), gravel, rock, and stones (Photo 26-right), use these materials for stepping roads will provide a natural touch for pedestrians. Also, these materials fit with the soil and has less impact on the natural ecosystem.



Photo 26: Rock & Aggregate (left), Stones & gravel (right).

Source:

<http://www.naturescape spa.com/wp-content/uploads/2011/07/Irregular-Pathway-with-River-Rock.jpg>
<http://cdn.c.photoshelter.com/img-get/10000f5f5c5.ecRA/s/600/600/D338049.jpg>

Plant Material Suggestion

To achieve ecological benefit and sustainability, planting native plants on site plays an important role for the environment. Native plants will help to preserve the local habitat so that to protect wildlife. They usually have showy flowers, abundant fruit, and seeds. Native plants usually grow well and require little maintenance when grown on proper soils under the right environmental conditions. (NCSU, web) Using native plants will benefit the ecological community and help save the natural heritage for future generations. Thus, the existing native plants on site are considered the preferred plant materials. While, because of the limited knowledge and research resource about the plants in Liberia, the plant selection



























Figure 26: Woody Plants Suggested in Different Height


is based on the research of the existing on-site plants and plant materials used in the case study of the Economic and Commercial Counselor's Office of the Embassy of the P.R. China in Liberia.

The plant materials are selected based on different categories: large trees, medium trees, small trees, shrubs, decorating herbs, and lawn species. Each plant species has its characteristics, pictures, and potential planting areas suggested in the following columns (Table 5). Not all the plants listed below are native plants. The list only gives people a sense of how the space looks like with different type of plants. But in future plantation, client could choose similar native plants from a local nursery so that to take the place of plants listed below. Heights of the plants are illustrated in Figure 26.

Table 5: Plants Materials Suggestion

	Potential planting area	Species	Image	Characteristics
Large trees	Isolated planting; shade tree 	Mango tree <i>Mangifera indica</i>		Native to southern Asia; 30' to 100' high, 100' to 125' in width (NTBG, web)
	Around sports ground; courtyard 	Kola nut <i>Cola acuminata</i>		Native to the tropical rainforests of Africa. The evergreen tree grows to 60'.
	Around sports ground; courtyard tree; low spots 	Oil palm <i>Elaeis guineensis</i>		Native to west and southwest Africa. 27' - 65' tall. Requires adequate light and soil moisture, can tolerate temporary flooding or a fluctuating water table.
	Isolated planting; courtyard tree 	Canary Island Date Palm <i>Phoenix canariensis</i>		Native to the Canary Islands, 33–66' tall, 30-35' spread, slow growing until trunk reaches full width, then speeds up.
	Along the boundary; plant in line 	Coconut <i>Cocos nucifera</i>		Native to tropical eastern regions. It grows 60-100' tall and 20-30' wide.

Medium trees & Small trees	Entrance; reception garden; plant with flower beds 	Breadfruit <i>Artocarpus altilis</i>		Native to New Guinea. Flowering tree. Average mature height 50' and width 22'. It provides food and shelter for important pollinators or seed dispersers such as honeybees, birds and flying foxes.
	Parking lot 	Umbrella Tree		Small tree with a broad spread
	Reception garden; around sports ground; courtyard 	Pawpaw <i>Asimina triloba</i>		Large shrub or small tree 10-40' tall / 15-20' tall and width.
Shrubs & Herbs	Add diversity; entrance; around sports ground 	Banana <i>Musa x paradisiaca</i>		Plantain is native to Southeast Asia and India and cultivated in tropical and subtropical regions. A large herb can reach a height of 20 to 25'.
	Entrance; corridor decoration; flower beds 	China rose <i>Hibiscus rosa-sinensis</i>		Native to East Asia, bushy evergreen shrub or small tree growing 8–16' tall and 5–10' wide. It has brilliant red flowers.
		Canna Lily <i>Canna</i>		Tropical flowering plants.
	Shell ginger <i>Alpinia zerumbet</i>		Native to eastern Asia, grow up to 8 to 10' tall.	
Lawn species	Soccer pitch; courtyard; reception garden	Zoysiagrass <i>Zoysia</i>		Better shade and cold tolerance, dense, and slow growing.
		Bermudagrass <i>Cynodon spp.</i>		Very poor shade and cold tolerance; need intense maintenance

		St. Augustinegrass <i>Stenotaphrum secundatum</i>		Very poor cold tolerance; best shade tolerant warm season grass
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(Image Sources:

<http://us.123rf.com/450wm/xjbxjhxmxjbxjhxmx1203/xjbxjhxmx120300044/12751693-mango-tree.jpg>

<http://www.da-academy.org/images/buddha1.jpg>

<http://www.officialpsds.com/images/thumbs/Palm-Tree-psd45861.png>

<http://sunflirt.nl/wp-content/uploads/2014/04/canary-date-palm.png>

<http://4.bp.blogspot.com/-WFIIID3gGd6s/UGj9sYtus9I/AAAAAAAAeUc/UOBNyCHyi4E/s400/coconut01L.png>

http://i.allday.ru/f6/dc/e6/thumbs/1331807298_3d-breadfruit-tree.jpg

http://blog.behnkes.com/wp-content/uploads/2010/05/Asimina_triloba_5-b.jpg

<https://0.s3.envato.com/files/75367996/01.jpg>

<http://westonnursery.net/wp/wp-content/uploads/2015/02/canna1.jpg>

<http://www.lawncare.org/wp-content/uploads/bermuda-lawn-care-tips.jpg>)

Stormwater Management Strategies

Stormwater management is one of the most important sustainable strategies used in the design of the Eco-retreat Center project in West Africa. There are a few critical issues that need to be taken into consideration in the stormwater management system design. It is important to control stormwater runoff to reduce the potential of flood and erosion. Also, rainwater has the potential to be harvested and reused to make water supply sustainable. In the design of Eco-retreat Center, a comprehensive stormwater management plan is necessary to handle surface runoff problems caused by the presence of artificial land surface and terrain difference across the site. A water harvest system is also preferred being designed for further water storage and usage. Various design solutions were applied to surfaces with different characteristics to management stormwater effectively within the site. An underground rainwater harvest system is applied in the design of Eco-retreat Center.

Stormwater Runoff

There will be two distinct kinds of land surfaces on the designed site: permeable surfaces and impermeable surfaces. Permeable surfaces are primarily nature areas with plants. It also includes permeable paving areas, such as the parking space. While, buildings, paved roads, and plazas will create impermeable surfaces. Impermeable surfaces could alternate the normal ecological cycle of water because such surface will block soil water infiltration. In this case, more rainwater will be evaporated so that ground water recharge will be negatively affected. To minimize the impacts of impermeable surface on the water cycle, implementing a carefully designed drainage system for the Eco-retreat Center to control the stormwater runoff is very important. Areas are also selected and designed with permeable surfaces for groundwater recharge and water harvest to keep the ecological function of the water cycle.

According to the existing topological condition, rainwater is guided to the lowest point in the site from the upper land. In specific, overland flow will start from the main entrance and the

events reception area and end at the southwest corner and the northeast corner of the soccer field. At the lowest point, stormwater will be collected and reused to improve water usage efficiency and make water supply system more sustainable.

In addition to this general stormwater runoff design plan, different surfaces on the site of Eco-retreat Center were treated with different surface runoff management strategies. (Illustration 23) For impermeable ground pavements, the surface runoff will be led to the surrounding planting areas, such as lawn areas and the filter strip. That will help reduce runoff speed and preserve natural water cycle better by increasing soil water infiltration. For impermeable building roofs, rainwater will fall on the roofs and flow to the nearby gutters and go downward to a water harvest system.

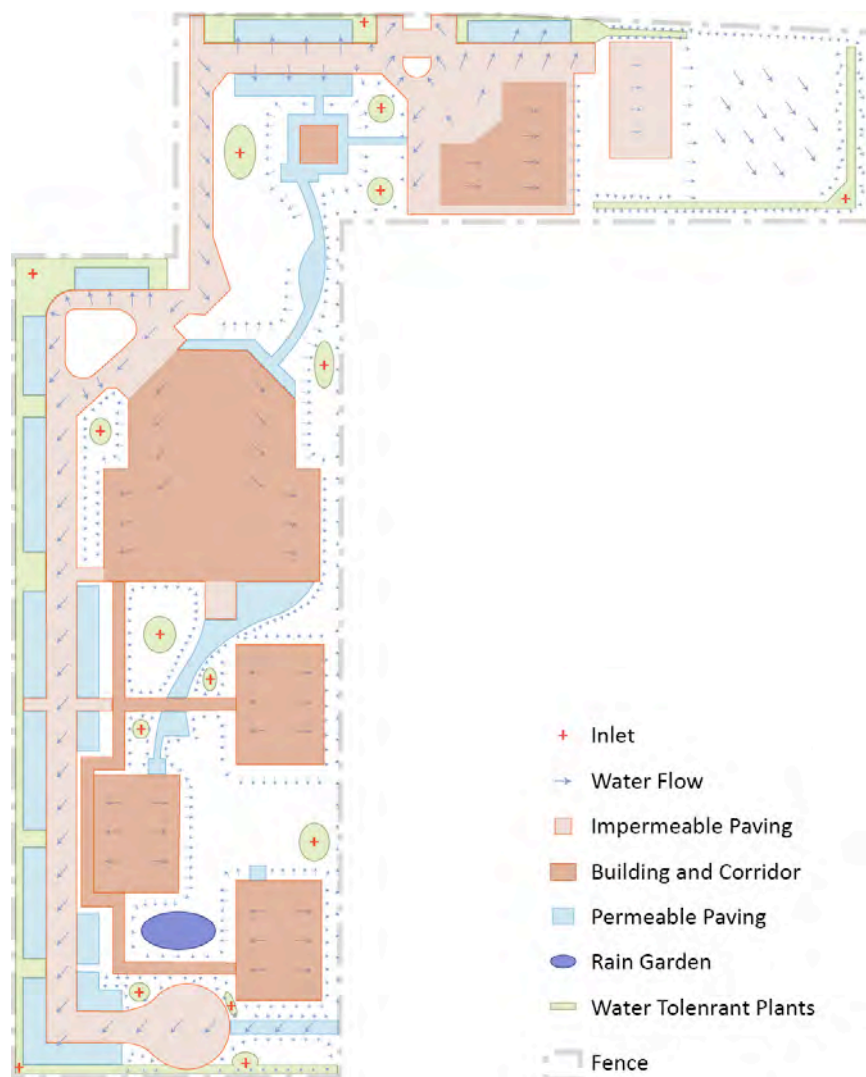


Illustration 23: Stormwater Runoff Directions.

For permeable surfaces including the permeable pavement and the planting areas, selected solutions of managing stormwater were used as mentioned in the chapter of *Stormwater*

Management Strategies, such as using permeable concrete for hard surfaces. One of the aims of using permeable surfaces is to reduce the potential for flooding and erosion near the constructions like buildings and fences. The stormwater will flow from the areas near the buildings and fences to a nearby low point where a drain inlet will be located. Another purpose is to collect part of the overland flow for future reuse, whereas the remaining water will either infiltrate to help groundwater recharge or evaporate to help promote the water cycle.

An example of using the permeable pavement to achieve such function is the parking lot. (Illustration 24) The function and composition of the permeable pavement are described in Illustration 23. In the upper side, part of the rainwater will infiltrate. The excessive surface water will flow to the lower permeable part, which will collect the water into a buried pipe and conduct it to an underground water storage tank. The filter strip will help to infiltrate the overflow from the parking to the groundwater.

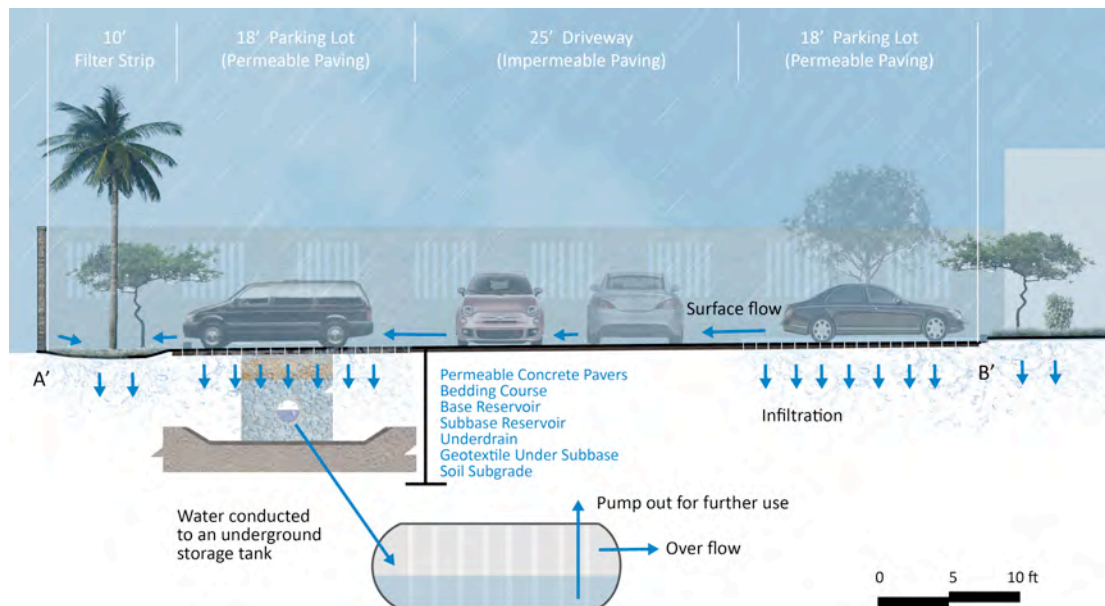


Illustration 24: Surface Runoff & Water Collection in Permeable Paved Parking Space. In the upper side, part of the rainwater will infiltrate. The excessive surface water will flow to the lower permeable part, which will collect the water into a buried pipe and conduct it to an underground water storage tank. The filter strip will help to infiltrate the overflow from the parking to the groundwater.

Water Harvest

Water harvest systems are designed as a part of the stormwater management plan. There will be two separate rainwater harvest systems installed in the Eco-retreat Center: a system for collecting rainwater from the rooftops and a system for collecting part of the infiltrated surface water.

A rooftop water harvest system (Illustration 25) was designed to collect rooftop precipitation. When rainfall hits on the roof, water will flow to the nearby gutters and go downward to a pre-treat facility where rainwater will be cleaned by a leaf filter and a downpipe first flush diverter. Once the rainwater is filtered and cleaned, it will be stored in a rainwater cistern that has three outlets. The first outlet will be connected to an automatic pump, which will deliver water. The water will be further filtered during the process to a header tank for later use for appliances and fittings. A second outlet will be connected to a hand pump, which will be located in the lawn area for education or plant watering purposes. The last outlet was designed to conduct the water overflow from the cistern. Because of the filter devices installed in the rooftop rainwater harvest system, it can help filter out pollutants from the runoff before it drains into the ground. Water collected in this system could be mainly used as domestic water for the residents living in the dormitory buildings.

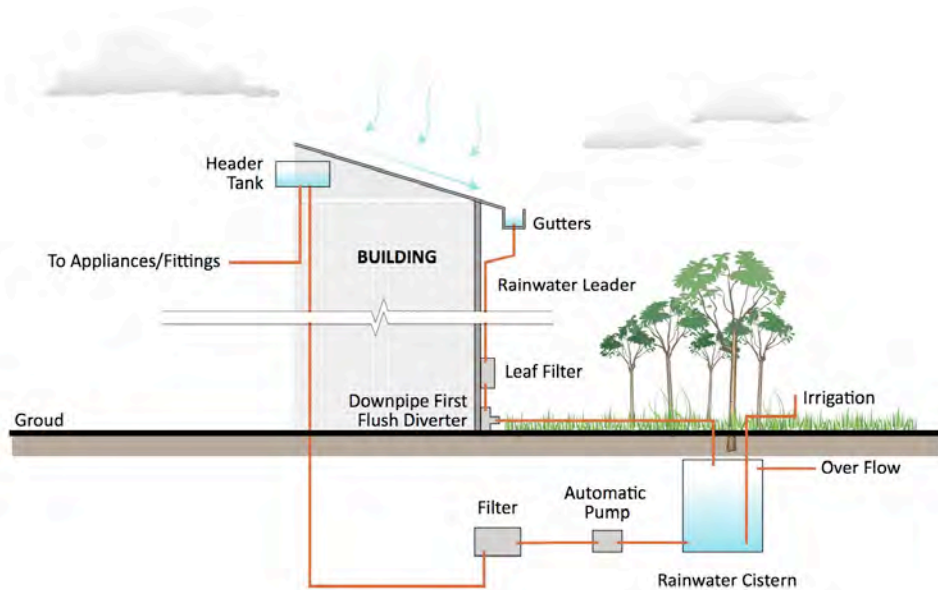


Illustration 25: Roof Water Harvest. When rainfall hits on the roof, water will flow to the nearby gutters and go downward to a pre-treat facility where rainwater will be cleaned by a leaf filter and a downpipe first flush diverter. Once the rainwater is filtered and cleaned, it will be stored in a rainwater cistern that has three outlets. The first outlet will be connected to an automatic pump, which will deliver water. The water will be further filtered during the process to a header tank for later use for appliances and fittings. A second outlet will be connected to a hand pump, which will be located in the lawn area for education or plant watering purposes. The last outlet was designed to conduct the water overflow from the cistern.

Part of the surface runoff will be collected and treated via the surface water harvest system (Illustration 26). Water from each low point will be directed to an underground storage tank that is connected by pipes. As soon as the surface water drains into the water harvest system, it will be filtered and cleaned by certain devices or bio techniques before being stored in a cistern. This system will be connected to a water tower that provides hydraulic pressure for the whole system. The system is designed to collect a large quantity of water during rain seasons so that the stored water can be used for drinking, irrigation or other purposes during dry seasons.



Illustration 26: Surface Water Harvest.

Thus, according to the stormwater management strategies introduced in the previous chapters, the project team planned to complete the stormwater management design solutions for the Eco-retreat Center. The design of the Eco-retreat Center will not only be able to keep the balance of the water cycle, but also recycle part of the water for daily use.

People Oriented Design

Functions

To meet the needs of different user groups, including government, students, guests, and local residents in nearby community, different functions of spaces are designed. For example, Recreation Zone is designed to accommodate the needs of exercise and activities for students in daytime and visitors in the night; Reception Zone is designed to hold various formal events and activities, as well as providing a comfortable space for conferences; and the community area provides an active space for local residents for daily use and has a radical positive impact on the local community. Also, with the design of barrier-free access, spaces are accessible to everyone, including people with disabilities.

Connectivity

Corridors and shared space connect the buildings and outdoor spaces, and vehicle flow is splitted from pedestrian flow, making the user experience continuous and fluid. The application of multiple walkways increases the connectivity between spaces. Linear roads and curved roads are combined in the design to allow users to have various experiences from private space to open space while walking toward their destinations. For example, the curved walkway linking the welcoming center and the conference building with diverse native plants on both sides guides visitors to explore the core area from the main entrance, and get to know the eco-friendly and vivid characteristics of the site.

Adaptability

To maintain the landscape at acceptable levels while allowing for future development, lawn areas are used which would accommodate the growth of the natural assets in the site. Designs are responsive to the environmental context of the area. For example, the covered walkway linking the Reception Zone and Living Zone prevent users from burning sunshine and continuous rain under the hot and humid climate in Liberia, and make them feel comfortable while walking underneath. The materials used for structures and buildings are mainly eco-friendly, cost-efficient and durable. We also selected plant species that have adapted to local climate and have the potential to create natural habitats for wildlife.

Human Behavior and Social Activities

Everything in the project site is designed to serve people who will use the site, live in the building, see the landscape, walk on the path, drive on the road, etc. When designing a site and creating a space, designers will think about how might different groups of people use the place, how would they behave, and what kind of activities they are going to have. It is often difficult to meet the demands of all individuals, so designers often will exploit representative activities to let most of the visitors enjoy the place.

Listening

The project site is surrounded by natural landscapes: there are different types of wildlife habitats, such as a swamp, a rainforest and rivers. Various wild animals like monkeys, birds, and frogs can be found around the proposed Eco-retreat Center. Liberia is the home to a large number of bird species, among which songbirds are “professional singers”. There are a large number of wild tropical plants near the site that can make fairy beautiful sound: when wind blows, people can hear leaves wavering. Since most tropical plants have broad leaves, even breeze blowing can make a sound. In the long rainy season, listening to the pitter-patter is another interesting indoor activity. What’s more, the pedestrian paths in courtyard and lawn area have rocks and stones on the two sides. When walking, stepping on rocks and stones, people can hear a sweet sound.

Smelling

Smelling is another relaxing and diverting activity. During the rainy season, people can feel the moist, fresh air and smell flavors of the soil; while, in the dry season, people can smell light aromas of the grassland. During the flowering season, people can enjoy fresh flower scent; when fruits are born, people can smell a fruity flavor. Fragrant plant species along the path, scattered in the courtyard reception area, playground and parking lot, will enrich the sensory experience. People can smell the nature while standing on paths or sitting in the outdoor café.

Watching

A pleasant visual appearance is the most basic requirement for a landscape design. Although every place on the site should be beautiful, the main entrance and reception area that will give people the first impression of a place is the top priority among other things. Landscape in the courtyard is designed in accordance with quiet activities. Various plant species with different colors in the rain garden play a role in stormwater cleaning and storage. At the same time, these plants provide a natural landscape for that location. Trees with a big canopy in the parking lot will provide shade for vehicles. These trees have high trunks so that they will not block the view. Watching others playing, walking and talking is another interesting activity. There are lots of seats in varied forms in the Eco-retreat Center. People can take a seat while watching other people or enjoying the beautiful scenery. Since different areas in the center will have different views, people can have different visual experiences. The courtyard area is a relative private and small space, so people standing there will have a sense of safety, but sight view would be partially blocked. On the contrary, there is a big lawn in the reception area that has a low level of privacy but an open view.

Learning

A successful design is one that is not only beautiful but also meaningful so that people can learn from it. Visiting the Eco-retreat Center project, people can learn the culture of Liberia, and the sustainable strategies used for the design. For example, the form of the outdoor classroom is a group of gazebos, which is a cultural element in Liberia that can remind people of Liberian history. It is also designed for learning outside the classroom. People can learn different things when they are playing, basking in the sunshine, or experiencing the nature. People can learn the concept of sustainability from the design of the rain garden, green parking, etc. Signage will be installed to encourage people to learn how relevant strategies work for stormwater management and energy saving.

The Eco-retreat center will not only be a beautiful place to view, but also be a multi-sensory garden. People can listen to, smell and learn from this nice place. Certainly, they can explore the Eco-retreat Center in their way to find out more surprises.

CONCLUSION

This project has aimed to provide a sustainable design of an Eco-retreat Center in Liberia for Christian Revival Church Association (CRCA) to serve as a sustainable and attractive gathering place for people working on rebuilding the country. The focus of the project was on identifying and solving problems on the site, and proposing sustainable design ideas to minimize negative impacts and maximize visitors' experience within all the constrains. Overall, the team has designed a multi-functional Eco-retreat Center by using sustainable design strategies. We developed eco-friendly concepts in terms of material selection and stormwater management, and created a people oriented design for the property.

The team went through a process of background research, case studies, stakeholder communication, and site analysis in order to gain a better understanding of the site and stakeholders, as well as some preferred practices in similar sites that can be learned from and inform design decisions while designing in detail. The data was being collected through the entire project period, including on-site observation, stakeholder interviews and meetings, and consistent communication through emails. Because the site is currently under construction, frequent communications contribute to exchanging updates on both sides and making the design consistent to the changes on site.

The deliverables produced for the project are developed over the past 14 months, including a project report and visual works. The report is a documentation of research, methods, analysis and recommendations, which is the basis of design decisions and can be used for future reference. Visual works include a master plan, detailed plans and illustrations of several focal areas all over the site showcasing envisions of the Eco-retreat Center, which will give audience a better understanding of the spaces created and design strategies applied. All the work explains how the sustainable design strategies were implemented using different design techniques and can serve for further development and evaluation of environmental impacts, human experience and sustainability of the site.

However, there are still some opportunities to take the design from the team to move forward.

Energy generation

Due to the scope of our project, we did not dive deep in developing methods in energy generations. Since Liberia has exceptional advantages in natural resources, such as solar energy and wind power, we highly recommend our client consider utilizing these renewable energies because they are clean, effectively infinite and support electricity generation and natural cooling, which will better achieve the sustainable goals of the project and bring more benefits for the local community, like stimulating local economies, saving money and manpower in new installations while meet the energy demand. Although, for now, renewable energy generation cost more than other energies, the implementation of these techniques will have a long-term benefit for the environment, economy and society. With the development of innovative technology, solar and wind energy will be more efficient and cost competitive, and eventually become a trend in use of energy strategy. The identification of potential sites would be a good start in the next phase.

Architectural design

Since all of the team members are specializing in Landscape Architecture, we lack professional knowledge in internal design and architectural structure. Therefore, we

recommend our client work with local architects or engineers who are familiar with local policy and characteristics of local buildings to push the design further in detail so that the buildings can be better adapted to local climate and last for a long time. The buildings can also take advantage of the energy efficiency of the surrounding environment and have options for non-toxic features.

Stormwater management plan

Regarding how the stormwater will be conducted or managed in site and how to make the connections to urban sewage system smooth with minimal environmental impact, grading plans are needed before implementing the stormwater techniques. Because we did not get much information of topography, the current site topography map is rough and less accurate. What's more, the site is currently under construction, an updated version of site topography will be significantly important to secure the desired performance of stormwater management strategies.

Native plants

The information of native plant species was mainly collected during site inventory, and it was not enough to achieve high plant diversity as to maintain ecosystem services. In order to facilitate the further development of the natural environment in the site, we recommend our client collect more information on suitable plant species that are drought-tolerant, cost less and require low maintenance, which will also perform well in creating potential habitat for wildlife. A better and sustainable planting design could be approached with the help of local gardening specialists. As requested by our client, there are many lawn areas designed in our project, our client will have a base to assess the suitability of the natural assets and make it more diverse and eco-friendly by investigating and using eco-lawn made with native grass species, which will reduce the cost of maintenance and energy but still hold up to moderate traffic and have the potential to create habitats.

Farmland

Our client purchased the farmland to the northwest corner of the property a few weeks ago. Due to time limit, we were not able to integrate this area into our design of the project. Therefore, future development of site design need to take the farm land into consideration and try to merge the space into the current design by using consistent design concept and techniques.

Culture and religion

African culture is very unique and our understanding of it is limited, so we did not deep into these factors or incorporate them into our design. As the country is undertaking the reconstruction process, these factors can be developed and considered in landscape design in the future, which may help recover cultural memory of spaces and brings people with different backgrounds together. Effort can be taken to find patterns from Liberia's history, culture and religion, the use of these elements will provide people with a sense of belong and increase the meaning of the site. Common objects of Liberia's life can be collected and exhibited using forms of sculpture and space, the act of making accessible the cultural and religious factors will also make the site more related to community.

By completing the project, we have gained valuable knowledge about the landscape architecture field and sustainable design. We learned what a least developed country looks like, how would the coastal climate affect the materials selection. It was our first time to touch on building design and we took effort to figure out the building shapes and size, as

well as their connections to outdoor spaces. We also enhanced a number of important skills by practicing the entire process, such as collaboration and project management.

We enjoyed engaging with our client, and got valuable information from them while having active interactions. It is pleasant to see our professional knowledge and skills have contribution to the sustainable Eco-retreat Center design project. We hope this attractive design could help raise funding for reconstruction in Liberia, and be a starting point for a more solid design in the next phase, and eventually be a model for sustainable redevelopment in other places in West Africa.

Appendix I Interview Questions

Interview with the client

- What is the height of the existing fence?
- How much is the average income of a Liberian?
- Who are the potential donors for the project?
- Who are the potential users of the site?
- What is the garbage collection method in Liberia?
- Are there any fire station, police station and hospital nearby? Will you have them on your site?
- What is the capacity for the Conference Hall?
- What is the capacity for the parking lot?
- Do you need handicap parking space?
- What is the topography of the site?
- What is the type of the soil on site?
- How many buildings do you need in total?
- Are there any existing examples you like in Liberia? Why do you like them?

Interview with local agriculture specialist

- What does your company do?
- Do you know the soil condition in Liberia?
- What is the soil type in Liberia?
- Do you know what kind of grass species here is good for using as lawn?
- How about the maintenance? Does it cost?
- Do you have a list of native plants of Liberia? Such as decorative grass, flowers, shrubs and trees.
- Do the plants grow fast here?

Interview with potential builders

- What projects have you done in West Africa?
- What materials do you use for buildings?
- Who is the designer for China Embassy?
- What are the local materials for roofs?
- Is that possible to build green roof here?
- What pavement materials do you use for the construction site?
- What plant materials do you use for the site?
- What lawn materials do you use for the site?
- How do you solve the problems of water shortage and electricity production?

Appendix II Picture Preference Survey

DATE: _____

NAME (PRINT): _____ OCCUPATION: _____

Please select the images you would like to add comments to. Have a look at the images and write down what you like about the landscape, what you do not like and any ideas to create a better space. (think about aesthetics, function, and applicability)

** use the back of the paper if you need more space*

IMAGE NO. _____

Like:

Don't like:

Your ideas to make it better:

Cavalli Wine Estate
Somerset West South Africa

1



2



Biomimicry Discovery Park - Conceptual Design

3



El Monte Sagrado, Taos, New Mexico

4



The Lodge at Chaa Creek

Chaa Creek, Belize

5



6



Indaba-hotel

Johannesburg, South Africa

7

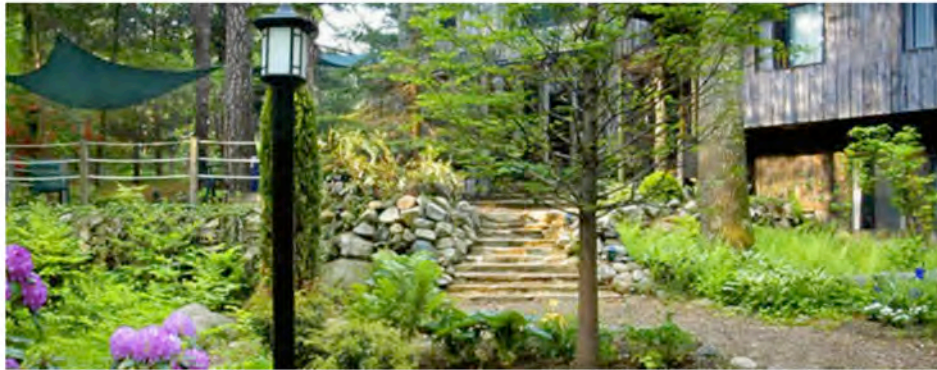


8



The Essex Conference Center & Retreat, MA

9



Mary and Joseph Retreat Center

Rancho Palos Verdes, CA

10



Appendix III Stakeholder Questionnaire

STAKEHOLDER QUESTIONNAIRE

The purpose of this questionnaire is to obtain information that will be helpful in preparing a design for the Eco-retreat Center. All information you provide will be held in strict confidence and will aid in creating a design that fits the special needs of community and conditions of the site. Please feel free to make additional comments or notes wherever you think it would be helpful. Thank you in advance for your cooperation.

I. Users' Characteristics. Please list all the users for the Eco-retreat Center such as age and occupation.

II. Existing Site Conditions.

A. Problems. Please list the current problems in the site that you think should be minimized or overcome in the design.

1. Visual.

2. Functional.

B. Potentials. Please list all the positive elements and qualities of the site that should be retained or enhanced in the design.

1. Visual.

2. Functional.

III. Desired Outdoor Activities. Place a check mark next to those activities in which you want to participate on your site. After each activity, please identify the season(s), average number of days per week, and time of day you would enjoy this activity.

	Season		Days per Week	Time of Day
	Rain	Dry		
Barbecuing				
Eating				
Sitting/Relaxing/Reading				
Entertaining				
Watching birds				
Gardening				
Annuals				
Perennials				
Vegetables				
Fruit trees				
Woody shrubs				
Recreation				
Badminton				
Volleyball				
Croquet				
Swimming				
Basketball				
Throwing baseball				

Throwing football				
Throwing Frisbee				
Other				

III. Desired Site Character. Please describe how you think your site should look (formal/informal, open/wooded, etc.)

IV. Materials.

A. Please list the types of materials you like most for pavements, fences, walls, building, etc.

B. Please list your favorite plant materials.

C. Please list the plant materials you do *not* want used on your site.

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