

DESIGN AND CONSTRUCTION PROPOSAL

ESPACE COMMUNITY CENTER
BUKHUBALO, UGANDA





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Special thanks to: Sandy Stannard, for being a wonderful studio professor and mentor; Daniel Wiens, for giving me this opportunity; Steph Fellows, for always drafting up emails for me when I was just too stressed; Andrew Goodwin, for helping me when I needed it; Joan Pinder, for being my proof reader; Stefano Mahande, for being an amazing client; and Serhino Espinosa, for trekking to Uganda with me.

*"When you have strong common will, then projects go forward. There's nothing worse than selling or convincing, but if you're inspiring and including then it's a beautiful thing, and at the end of it you're part of the community."
-Cameron Sinclair*





Dear Potential Sponsors,

Uganda is ranked among the highest in the world for birth rates, HIV/AIDS prevalence, and has a low literacy rate, and 38% of the population lives on less than \$1.25 a day.¹ According to UNAIDS, 1.5 million adults and 190,000 children are living with HIV/AIDS, ranking Uganda eighth in the world.² Although the government now pays fees for the first four children per family to participate in primary school, only 16% of children attend secondary school because of the enrollment fees.³ Non profit organizations have stepped in to help provide the enrollment fees for this type of schooling.

Uganda has found a special place in my heart since working on this project. You can help the people of Bukhubalo, Uganda by providing time, services, or money to help bring about a project that will empower the members of the community as well as others in the region. This project will change the education level of thousands in the region and will give community members skills that are applicable to their future careers and employment.

ESPACE, the organization operating this facility, has obtained 16 acres in Bukhubalo, 160km east of Kampala. The following presents the master plan for a facility that brings the community together through many different facets. The different functions will include education (both secondary and tertiary), medical treatment and research, and cultural outreach. It is facilities like these that empower the people of Uganda. This will be the solution.

Thank You.



Notes from Designer

My name is Cameron Hempstead and I am a 5th year architecture student at Cal Poly San Luis Obispo in California, USA. I have done humanitarian work internationally in the past, constructing classrooms and a health center with Rustic Pathways in Tanzania and Global Brigades in Honduras, but this is my first opportunity to do design work for a humanitarian cause.

I am very excited to be working with a great organization, Journeyman International. It provides sustainable designs to communities by partnering student designers with humanitarian organizations. They have given me a wonderful opportunity to do my thesis project with a real client and site with hopes that the project will be built in the future. This project has allowed me to use the skills that I have acquired at university in a meaningful and relevant way.

The information put forth in this book represents the most important work that I have done thus far in my career as a designer and has been my whole focus for the last nine months. I hope that this project will offer you the same adventure that it has given me, and you will continue to be involved in the process.

Sincerely,

Cameron Hempstead
cameron@journeymaninternational.org

"If you can visualize it, if you can dream it, there's some way to do it."

—Walt Disney





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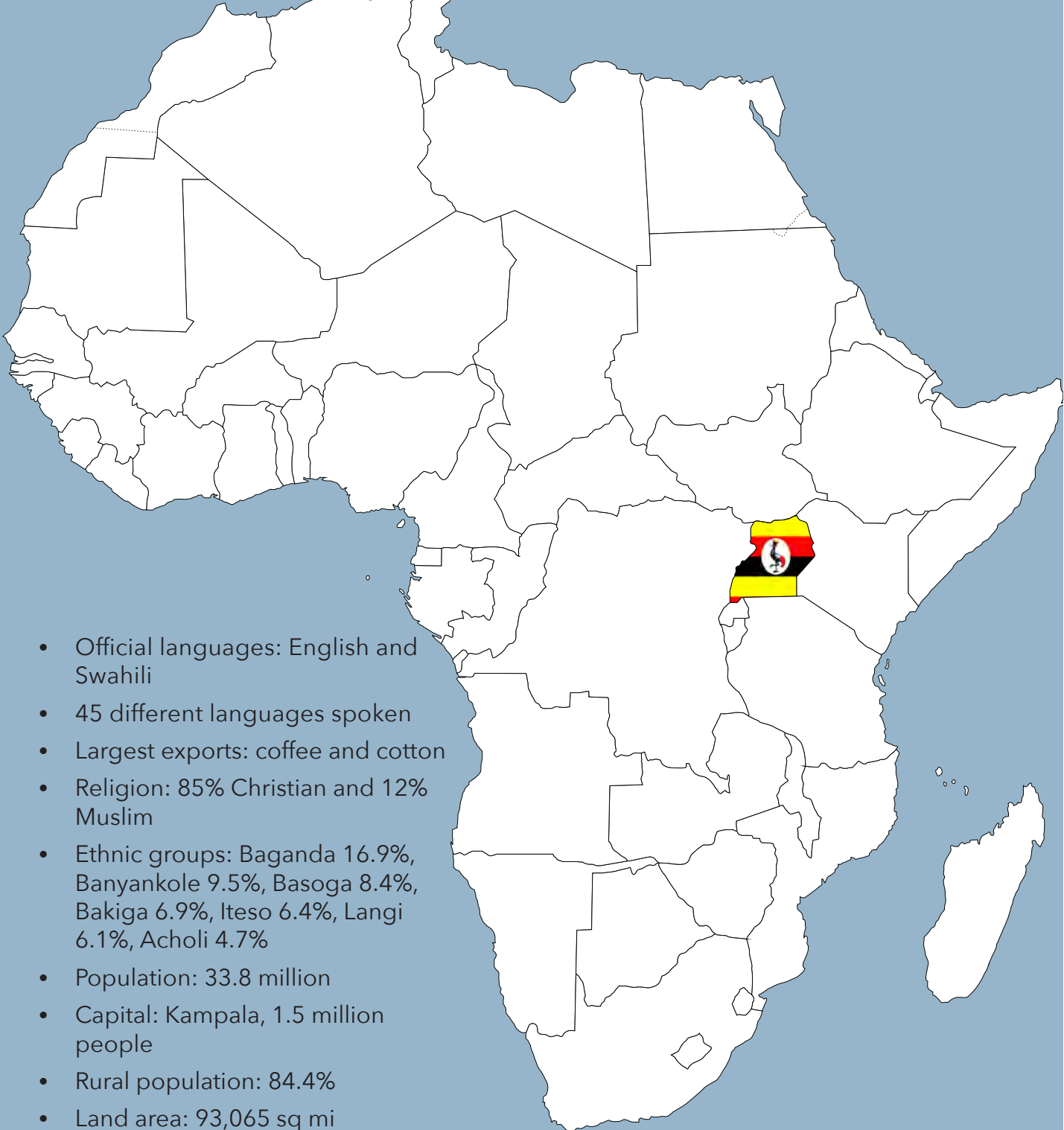
"Launching a turnaround takes courage. I cannot measure that ... but behind the moments of change there are always a few people within these societies who have decided to try to make a difference."

-Paul Collier, The Bottom Billion



Issue





- Official languages: English and Swahili
- 45 different languages spoken
- Largest exports: coffee and cotton
- Religion: 85% Christian and 12% Muslim
- Ethnic groups: Baganda 16.9%, Banyankole 9.5%, Basoga 8.4%, Bakiga 6.9%, Iteso 6.4%, Langi 6.1%, Acholi 4.7%
- Population: 33.8 million
- Capital: Kampala, 1.5 million people
- Rural population: 84.4%
- Land area: 93,065 sq mi
- Fertility Rate: 6 children/woman
- President: Yoweri Museveni
- Currency: Ugandan Shilling
- 1 USD = 2535 UGX

Uganda

Uganda, called the 'Pearl of Africa' by Winston Churchill, is located in Eastern Africa at the equator and is surrounded by the Democratic Republic of Congo, Rwanda, Tanzania, Kenya, and Southern Sudan. Uganda is a cultural melting pot that has over 45 different tribes.¹ Agriculture accounts for four-fifths of the jobs in Uganda, although most of the technology used is rudimentary. The two main cash crops for export are coffee and cotton, but many other crops, such as corn, millet, cassava, plantains, and peanuts, are grown as a part of their subsistence farming.⁶

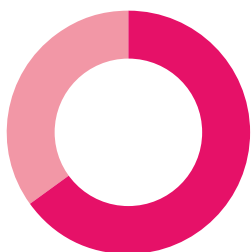


Kingdoms Under British Protectorate

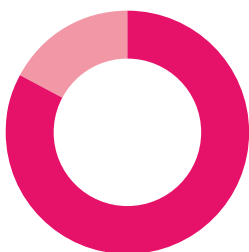


Language Families

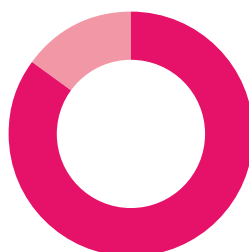
Education Status



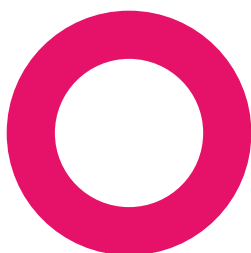
65% literary
rate for women



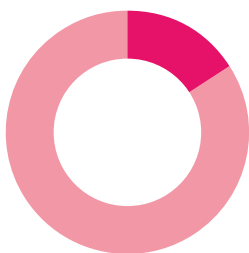
83% literary
rate for men



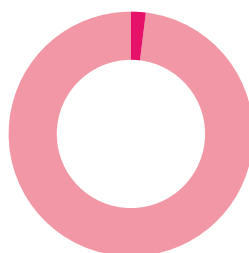
85% literary rate
for adolescence



154% primary
school enrollment**



16% secondary
school enrollment



2% university
enrollment



Government pays primary
school enrollment fees for
the first **four** children



Government pays secondary
school enrollment fees for
zero children



50% of communities
have a primary school

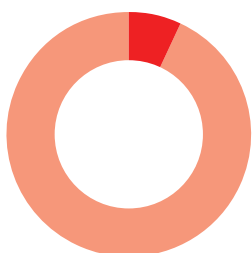


6% of communities have
a secondary school

*Citations: 1, 5

**Over 100% due to the inclusion of over-aged and under-aged students
because of early or late school entrance and grade repetition

Health Status



7.2% adults with HIV/AIDS



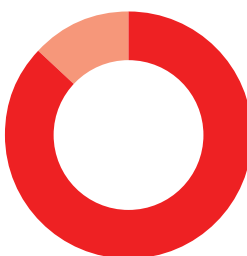
30% women deliver babies at home



25% women had first sexual experience against will



30% contraceptive prevalence use



85% live in rural countryside



14% children under five years underweight

| | UGANDA | USA |
|---|--------|-------|
| Life Expectancy (years) | 53.98 | 78.62 |
| Birth Rate (births/1,000 population) | 44.5 | 13.66 |
| Death Rate (deaths/1,000 population) | 11.26 | 8.39 |
| Maternal Mortality Rate (deaths/100,000 births) | 310 | 21 |
| Infant Mortality Rate (deaths/1,000 births) | 62.47 | 5.9 |
| Children Born Per Woman | 6.06 | 2.01 |
| Mother's Mean Age at First Birth | 18 | 25 |
| Contraceptive Prevalence Rate (%) | 30 | 76.4 |
| HIV/AIDS Adult Prevalence Rate (%) | 7.2 | 0.6 |
| Adults Living with HIV/AIDS (million) | 1.5 | 1.2 |
| Children Living with HIV/AIDS (million) | .19 | N/A |



Project Teams



Journeyman International

www.journeymaninternational.org

The Journeyman International vision was launched with the intent of filling the expertise void between international NGO's and the new facilities they construct. While developing a dental clinic in Belize as a senior project, a group of architecture and environmental design students from Cal Poly San Luis Obispo began recognizing the potential to fill this need with a construction focused non-profit endeavor. These projects were a catalyst- JI is just getting started.

This year, 6,350 students will graduate with architecture degrees from universities across the country. If these students dedicated university studio hours to humanitarian design projects, 6,858,000 hours would be dedicated to designing solutions to the greatest challenges facing our world.⁴

By partnering student designers with local and global humanitarian organizations, JI provides sustainable design and construction methods to communities who need it most. JI invests in the next generation of socially minded architects, engineers, and construction managers by addressing and anticipating the ecological, economic and social issues shaping the built environment today and tomorrow.

ESPACE

Client: Stefano Mahande - ESPACE Founder

mahande@espul.org

Stefano Mahande is an electrical engineer in Kampala and volunteers as a Program Manager. He has managed youth centres, canteens and worked in slums and prisons. He has also extensively worked in counselling and community welfare.

"If man is to survive, he will have learned to take a delight in the essential differences between men and between cultures. He will learn that differences in ideas and attitudes are a delight, part of life's exciting variety, not something to fear."

-Gene Roddenberry



Culture

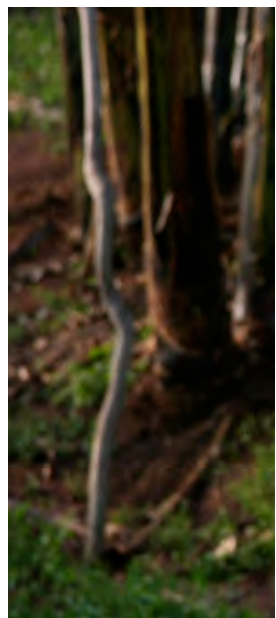
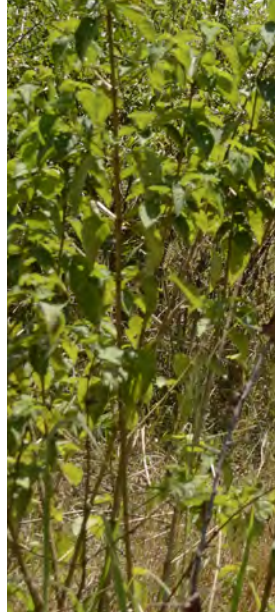


Etiquette

Uganda is still a very conservative country even though there have been changes in recent years. The gender roles are evolving, but it is still a male-dominated society. Dress is more formal, pants for men and nothing tight or revealing for women; the legs should also be covered. Men and women both shake hands in greeting each other, but a man should wait for a woman to offer her hand before shaking hands with her. It is also acceptable to nod if a woman does not offer her hand to shake. Touching is acceptable and common between persons of the same sex, but hand shaking is the only touching that should be done between men and women. When addressing another person, it is important to use their title and last name; only use first names after having been invited to do so.⁷ Personal space is very limited and when talking, the other person may be very close. Eye contact can be seen as aggressive especially for women talking to men, and they should look down or away when speaking. When pointing at something it is okay to use the whole hand or arm, but avoid pointing a finger as this is reserved for animals. To motion for someone to come over, face the palm downwards and use a scratching motion with the fingers.¹⁰

The people of Uganda are very friendly, but this can make it more difficult to communicate as it can be hard to understand their true feelings behind the smiles.⁸ They use stories and proverbs to get a point across and also appreciate humor, but sarcasm does not translate well. Expect small talk to occur before any business discussions can begin, and keep the conversation going as silence can be interpreted as rude. Gifts and meals will often be shared as a part of their friendliness. Always wash your hands before eating as utensils are not often used. There will also likely be a prayer before the meal. While eating, do not lean on your left hand, stretch your legs out, or leave the room while the meal is still going on. Leaving some food on your plate shows that you are full; if your plate is empty, you will be given more food without asking. Always thank your host and the woman who has cooked the meal when you have finished.⁹

Time has a different meaning in Uganda and the higher status a person has, the later they will be. Also, the more prestigious an event is the later the guests will arrive. Hierarchy is very important, and those in authority should be shown respect.





Socioeconomic Factors

There are no castes in Uganda, yet there is still a high degree of social inequality; wealth distribution is governed by class position. More than one third of the wealth is held by the top 10% of the population and the bottom 10% owns less than 3%.¹¹ 65% of the population lives on less than US\$1.25/per day which is considered poverty level by UNESCO.¹² Eighty four percent of the population still lives in rural communities, with the richest people living mostly in Kampala, the capital of Uganda. Education is one of the key determinants in the lifestyle and status that can be achieved and although the literacy rate is improving in Uganda, the level of education especially in secondary and tertiary schooling remains low. The higher the level of education that is attained, the more knowledgeable they are about the need and use of facilities in their community.¹³ Out of the total child population of Uganda, 65% are vulnerable due to multiple factors including poverty, insecurity, diseases and conflicts.¹⁴

Dance

Dance is a large part of the Ugandan culture. Many of the dances reflect traditional activities such as the harvest, sex, marriage, and reproduction.¹⁵ In Ugandan dances, the body is split into seemingly independent body areas, as opposed to unified movements in Western culture dances.⁶

The Mwanga dance is a ceremonial initiation dance of the Bagisu people. They believe that for a boy to become a man, he must be circumcised in a ceremony that is reflected in this dance. Before this initiation, the boy must dance for 21 days.⁴⁶

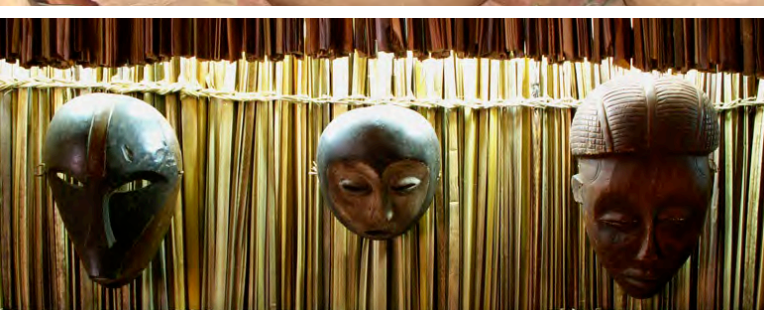


Music

Music is also very important in Ugandan culture and plays a role in social life. There are a variety of blown and stringed instruments in Uganda, as well as drums, xylophones, and idiophones.¹⁷ While musicians play instruments, they move parts of their bodies, such as the hands, shoulder, or legs, in harmonization with the music.⁶

The likembe is a series of flexible metal pieces of varying lengths fixed to a wooden plate. The musician holds it in both hands and uses his thumbs to pluck the free ends of the metal. It is usually played solo.¹⁸



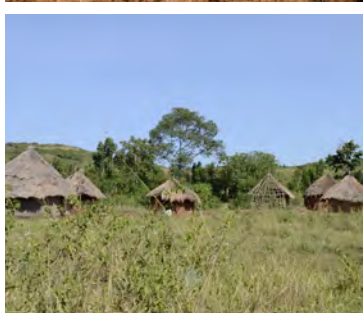


Traditional Artwork

Traditional art was a unifying force within a community in Uganda and it was a part of their community identity. Traditional art was produced to satisfy the needs of a community by someone who was closely integrated within the community. Even though art was not produced solely for its appearance, the artists were then free to evolve their personal adaptations within the framework accepted by the community.⁶

Ugandans produce woven textiles, such as basketry, and mats, pottery, sculpture, beads, hand textiles, and carved wood products. Creating the musical instruments used in Uganda is also a highly skilled craft.¹⁹

It has been a tradition to hand down the craftsmanship and skills from one generation to the next, but this has declined in the past. It has recently seen an increase as it can be a way for a family to attain more income on the side. A market outside of Uganda for this artwork has come about, making exporting a viable option.¹⁹





Building Traditions

Traditional homes are usually made of mud with either a thatched or tin roof, and the walls are framed with either wood or bricks. The bricks are made by hand from local clay and sand. The forms of the houses are shaped like beehives, cupolas or squares.¹⁵ The kitchen is usually a separate building and there is a toilet located somewhere in the compound. Wood is still the most common fuel material and most dwellings have dirt floors. Seventy-five percent of the households have access to drinking water, but it is on average a kilometer away.²⁰ Typical fences around the rural compound are made from live cacti or plants.²¹



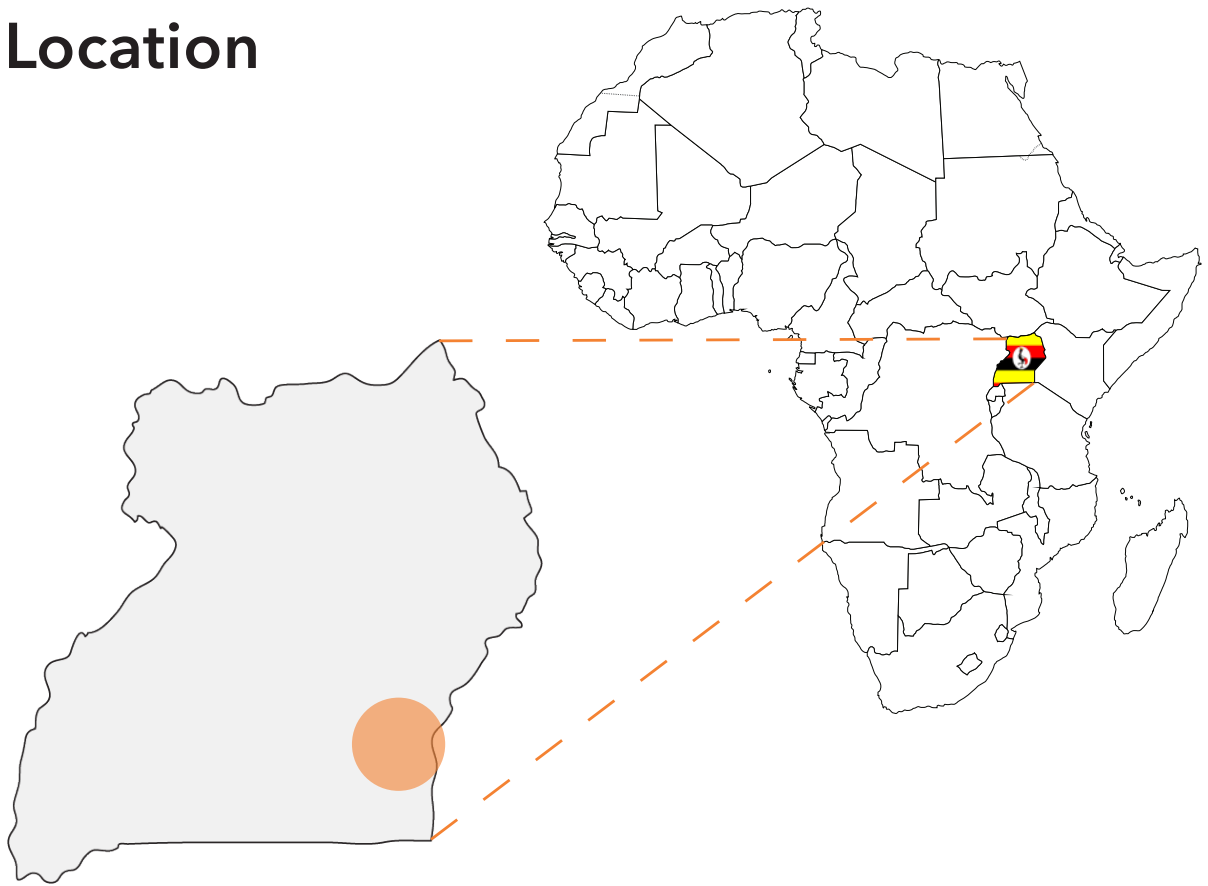
*"I'm not telling you it's going to be easy - I'm
telling you it's going to be worth it"*
-Art Williams



Site Study



Location



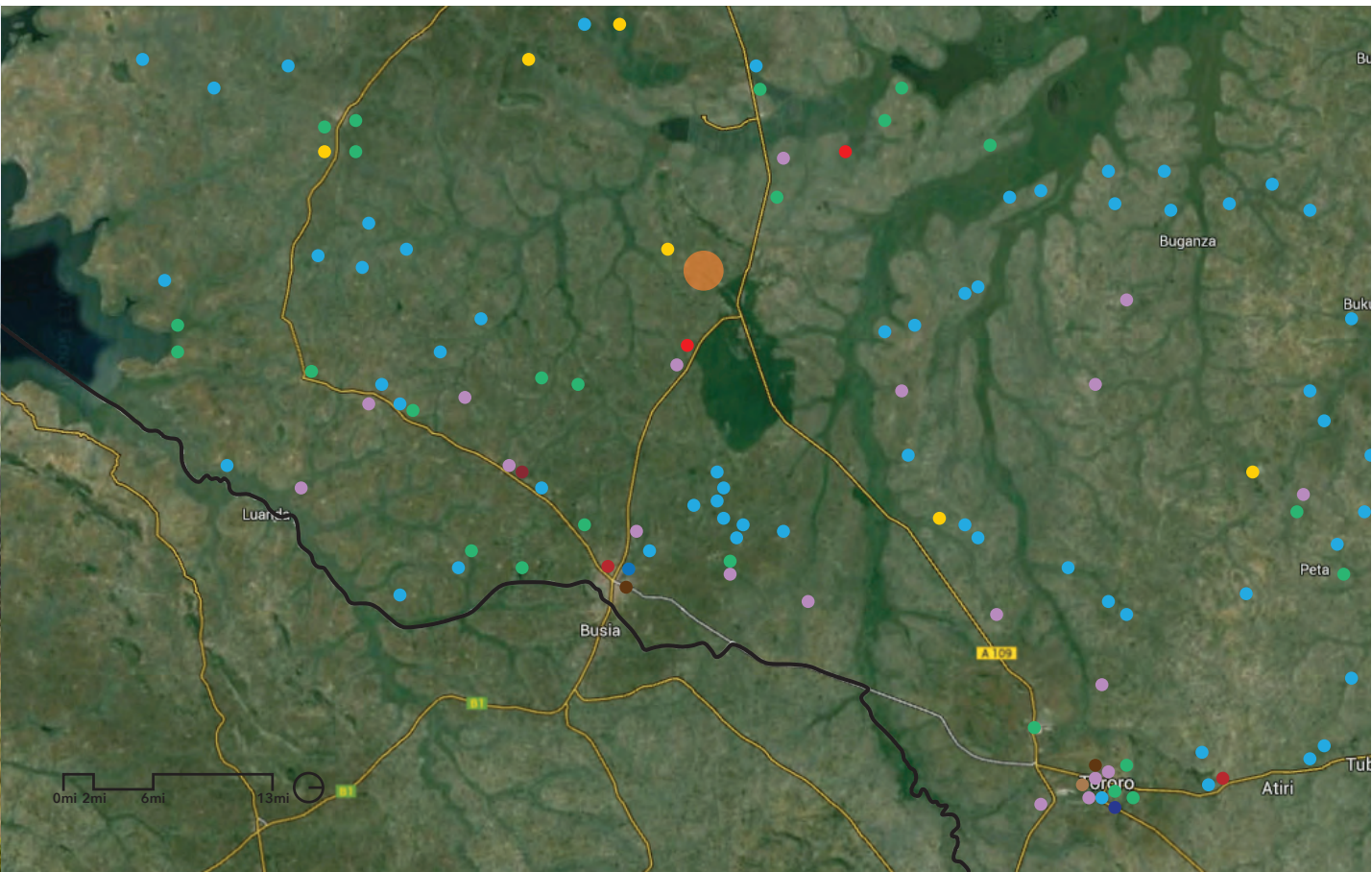
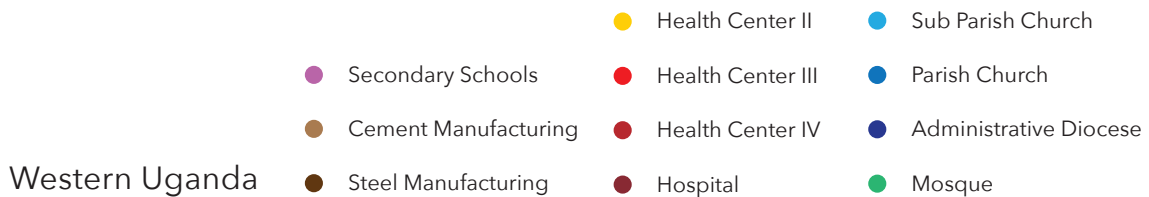
Common Phrases

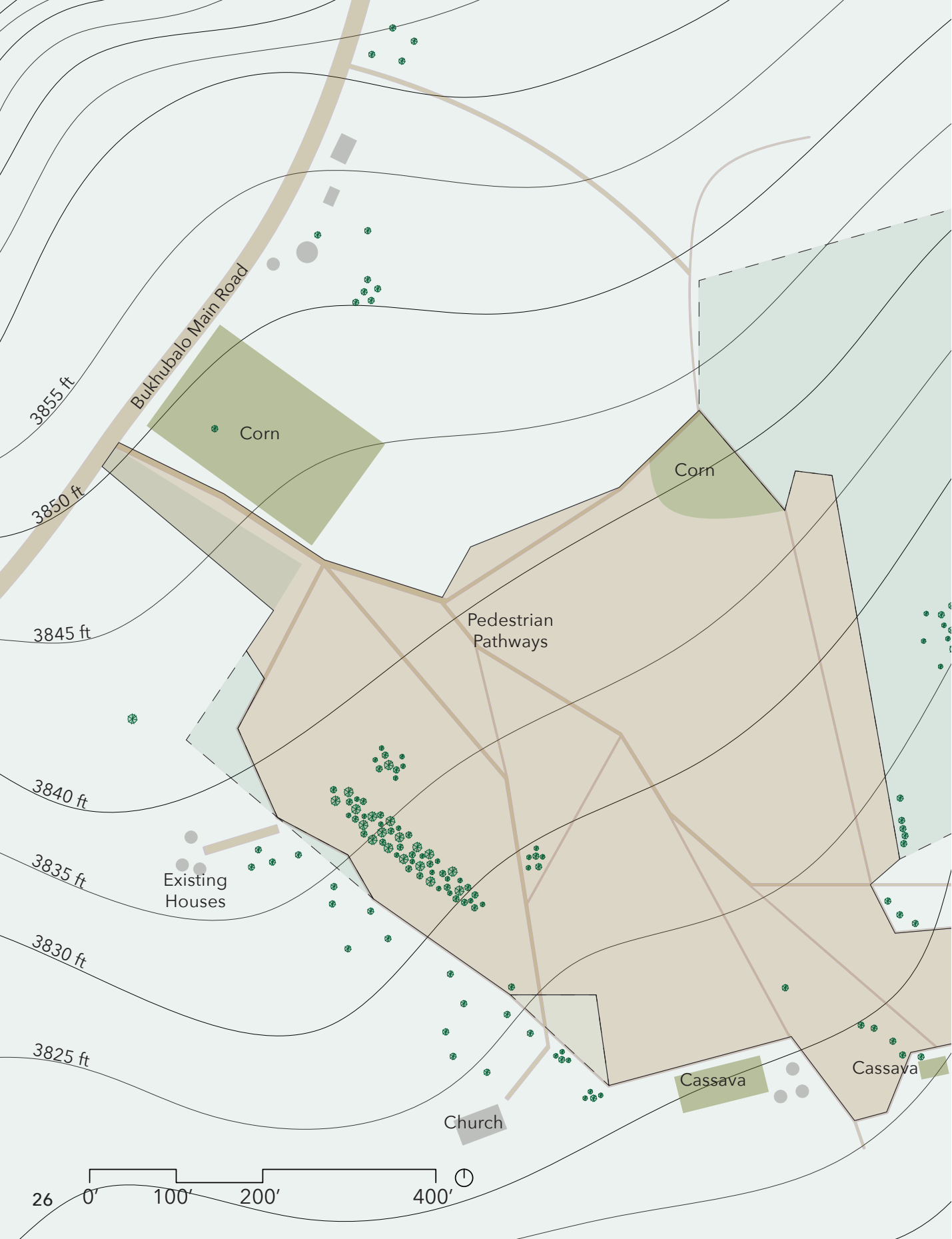
| | |
|---------------|---------------------|
| Jambo* | Hello |
| Karibu* | Welcome |
| Abari?* | What is the news? |
| Muzuri* | The news is good. |
| Wevale ** | Thank you |
| Obeyo** | Good bye (singular) |
| Mubeyo** | Good bye (plural) |
| Kale Mubeyo** | Ok bye |

* Swahili

** Lugwe

The site is located in Bukhubalo, Uganda and is 160km east of Kampala, the capital of Uganda. The main ethnic group surrounding the site is the Bagwe, part of the Bantu Family. Some of the other groups near the site are the Samias, Banyala, and Basoga who are also Bantu; the Jopadhola and Luya who are Luo, and the Itesots who are Nile Hamites. The project will focus on the Bagwe as they are the closest, but it will also serve the surrounding communities. The most common language is a combination of Lugwe and Swahili. There is electricity along the major roadways, but it stops approximately 5km away from the site.





Site

The site is 16 acres; 10 acres is open for development and 6 acres will be kept as it is. It consists mainly of dry grass and shrubs, and the soil is 0" to 1'-10" deep before it hits rock. Most of the shrubs are located on top of ant hills where the dirt has been dug up. The surrounding area and partitioned area both have trees. There is a slight downward slope from North West to South East. This slope comes from the Nahoma hill to the North West of the site.

The main road through Bukhubalo is located to the North West of the site. From this road, there are two paths onto the site: one main path and one secondary path. The main path is currently wide enough for one car to pass through and the secondary path is wide enough for foot traffic. The paths through the site are currently used by community members to get from the main road to their houses. There are secondary paths along the edge of the site that can access the houses as well. There is currently corn growing on the north part of the site, and the site is also being used for cattle grazing by the community.

The site is 16 acres and is in a rural setting with agriculture fields and scattered houses surrounding it.





South View



South West View



North West View





Testimonies



Robert is studying many different subjects in secondary school level S4. His favorite subject is chemistry and he would like to become a lecturer. He wishes that his dorm room had a table and some chairs that he could study at. He thinks that his school is lacking professional teachers and that this is the most important thing.

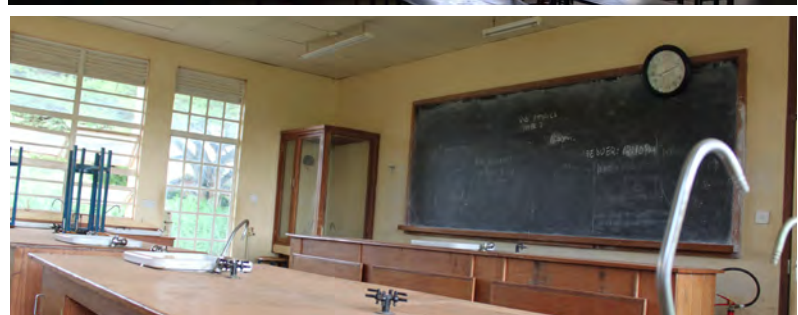
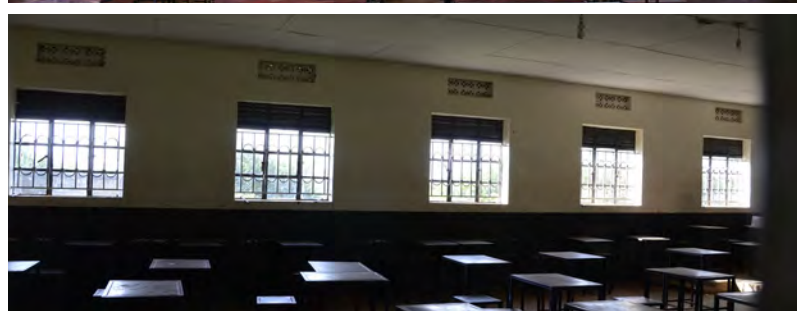


Francis is majoring in Business Administration and Management at University. He is currently in this 3rd semester there. He wishes that the library facility in his school had more computers and books. He would like to be able to look up a book on the computer and then find it in the library. He also wishes that there was better internet access as it is very limited and can only be accessed at certain times by the students.



Dennis is studying Geography in secondary school level S6, equivalent to our 12th grade. His school only has two trees, and he wishes there were more trees on the compound. He also wishes that the compound was bigger and there was more ventilation. He thinks that the library is too small, and that there is no place that he can eat his meals. He also wishes that he could have a job while going to school.

The existing school facilities near Bukhubalo are brick with wood trusses and corrugated metal roofs. One of the bigger schools has dropped ceilings in the classrooms, but the smaller ones only have corrugated metal. The bigger secondary school also have three lab facilities that are set up with running water and gas with which experiments could be done. All of the schools have overhangs of at least five feet. These are only used to shade the windows and walls and the spaces were not commonly used as a social space.



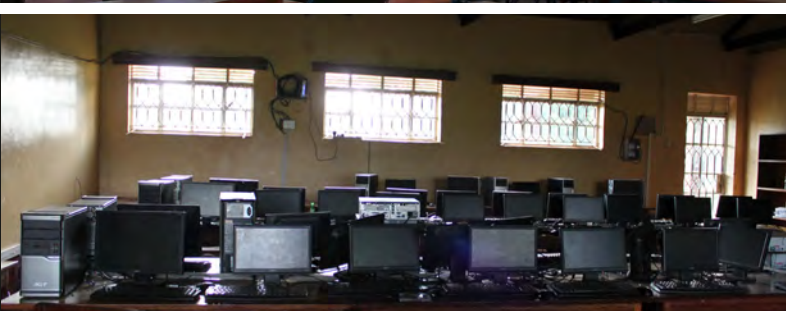
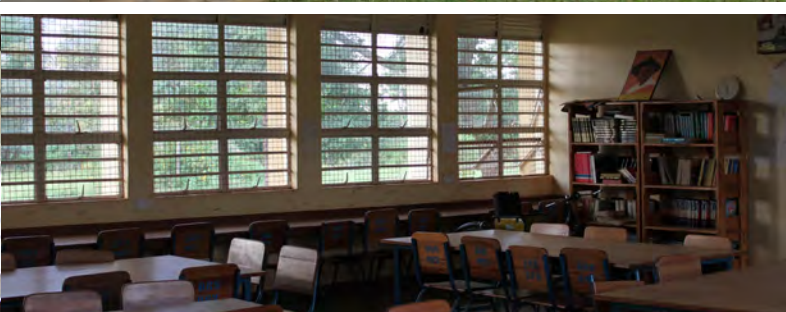
Existing Facilities in Region



The top photo is of the area where food is served to the children. There is no place for them to sit to eat their food, so they have to bring their food back to their dorm rooms (photo below). The existing dorms rooms are triple bunks extremely close together with about 30 students all in one room. The shower facilities are below this. It is an all girls school, but the showers have no curtains or privacy.

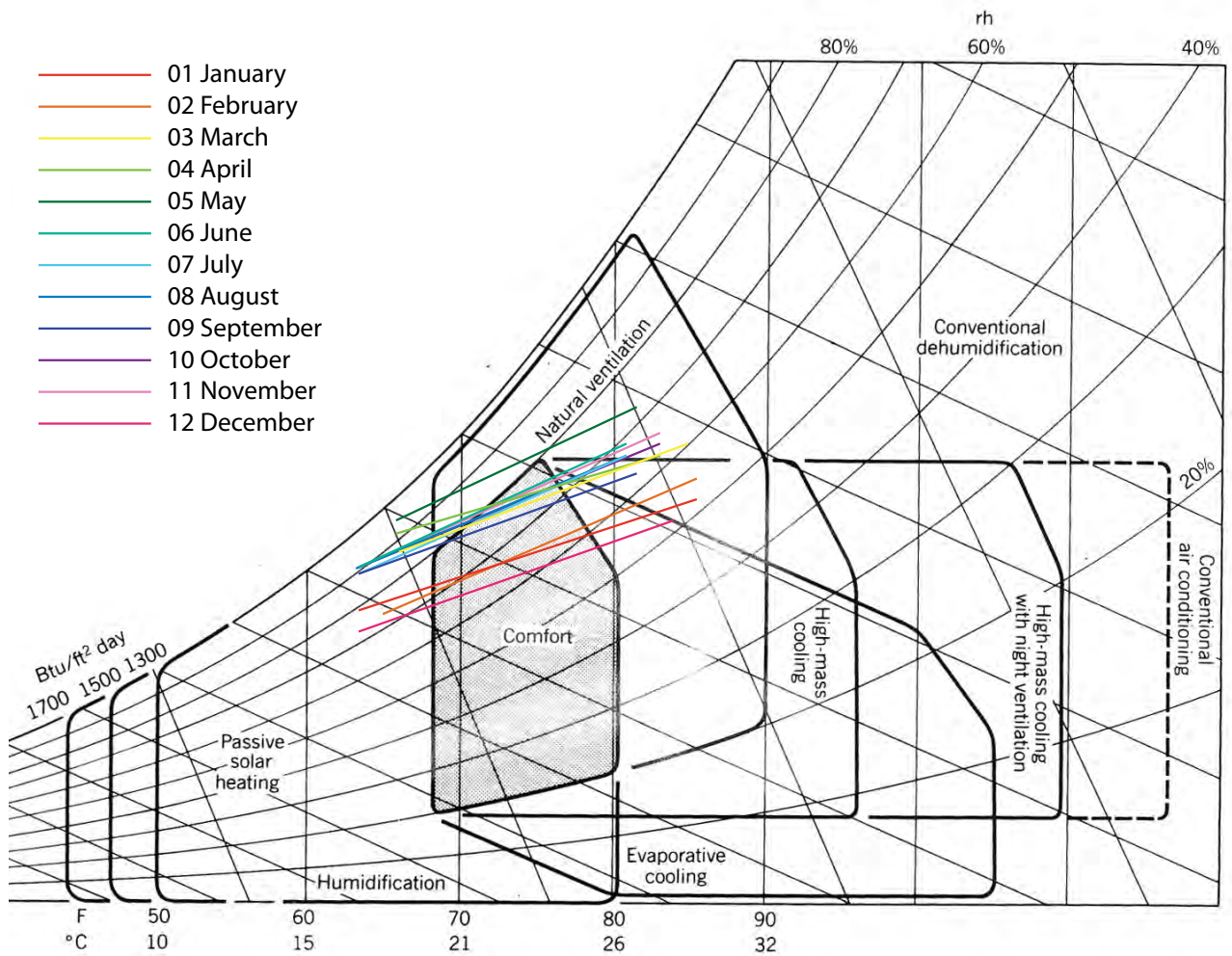


The library has only two shelves of books and some tables. The books are mainly encyclopedia type books and old textbooks. Even the teachers do not have access to the books that they need to teach their classes. The computer labs are equipped with computers, but the internet is not very good and downloading a large file can shut it down for days.

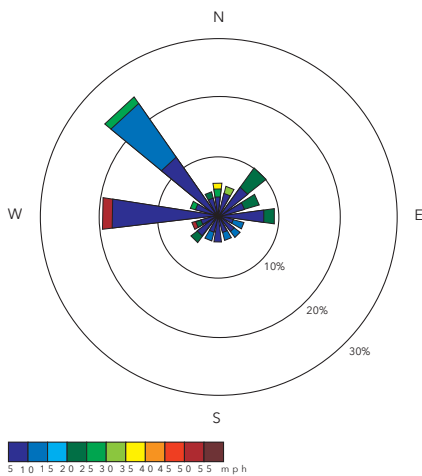


The soccer fields are only signified by the goal posts. Some of the fields are lucky to have grass, but others are just dirt.

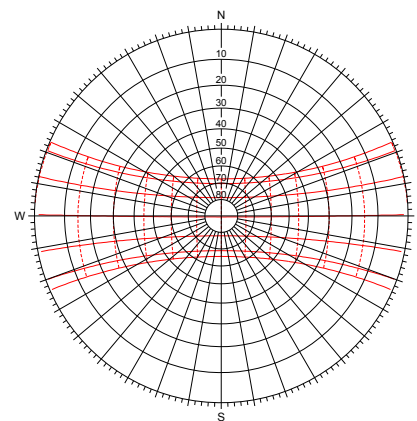




Psychrometric Chart



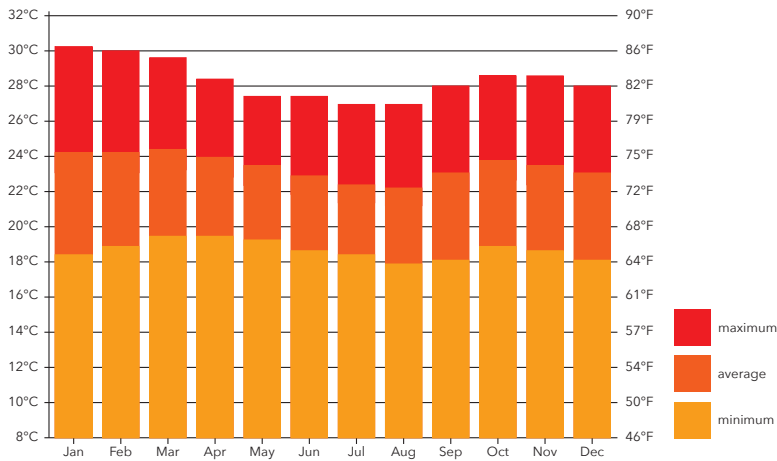
5 10 15 20 25 30 35 40 45 50 55 mph



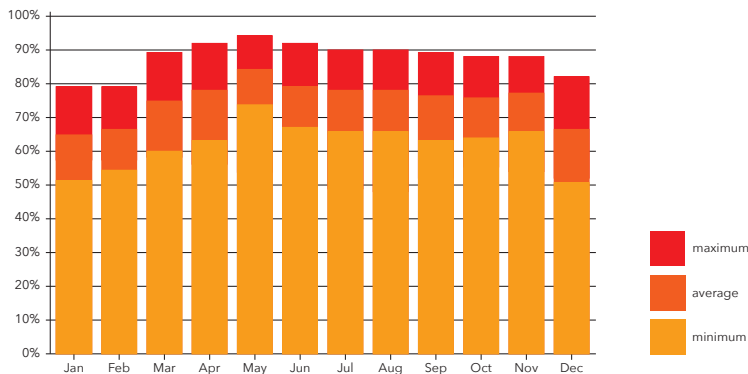
Sun Path

Site Climate

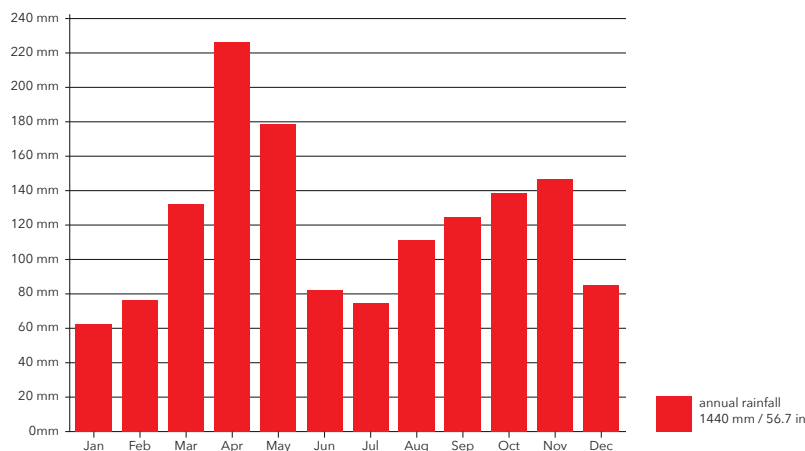
Bukhubalo, Uganda is near the equator, so there is little temperature fluctuation throughout the year. The hottest months are January and February. There are two wet seasons: from mid-September to November and March to May.



Temperature



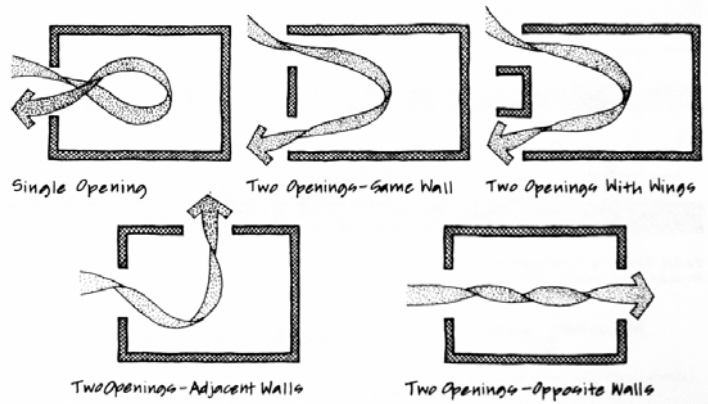
Relative Humidity



Precipitation

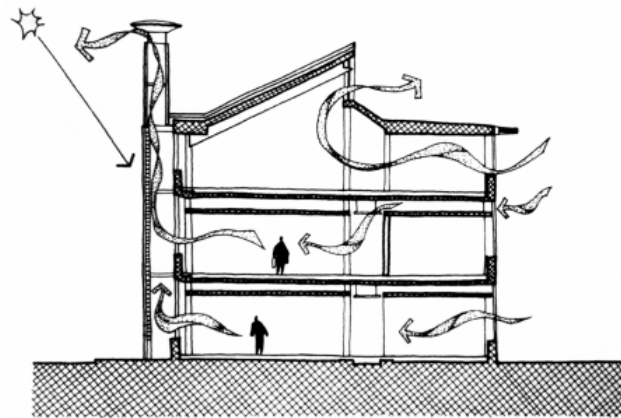
Cross Ventilation

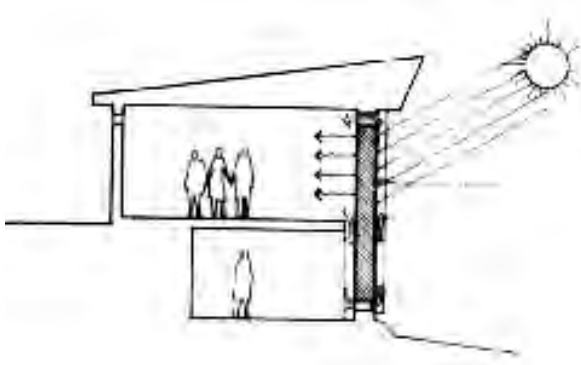
- Locate opening perpendicular to the prevailing wind direction
- Create low inlets to concentrate air flow at occupant level
- Maximize exposure to prevailing wind
- Avoid internal and external obstructions to wind flow
- Outdoor air must be at least 1.7°C (3°F) cooler than indoor air



Stack Ventilation

- Warmer air rises and is let out at the high point while cooler air is pulled in at the bottom and rises as it heats up
- Outlets cannot face the prevalent wind direction
- Outdoor air must be at least 1.7°C (3°F) cooler than indoor air
- Greater temperature differences can be created by increasing the height of the stack

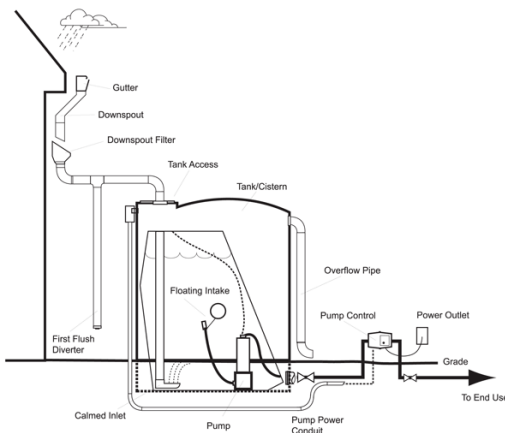




Climate Analysis

Thermal Storage Wall

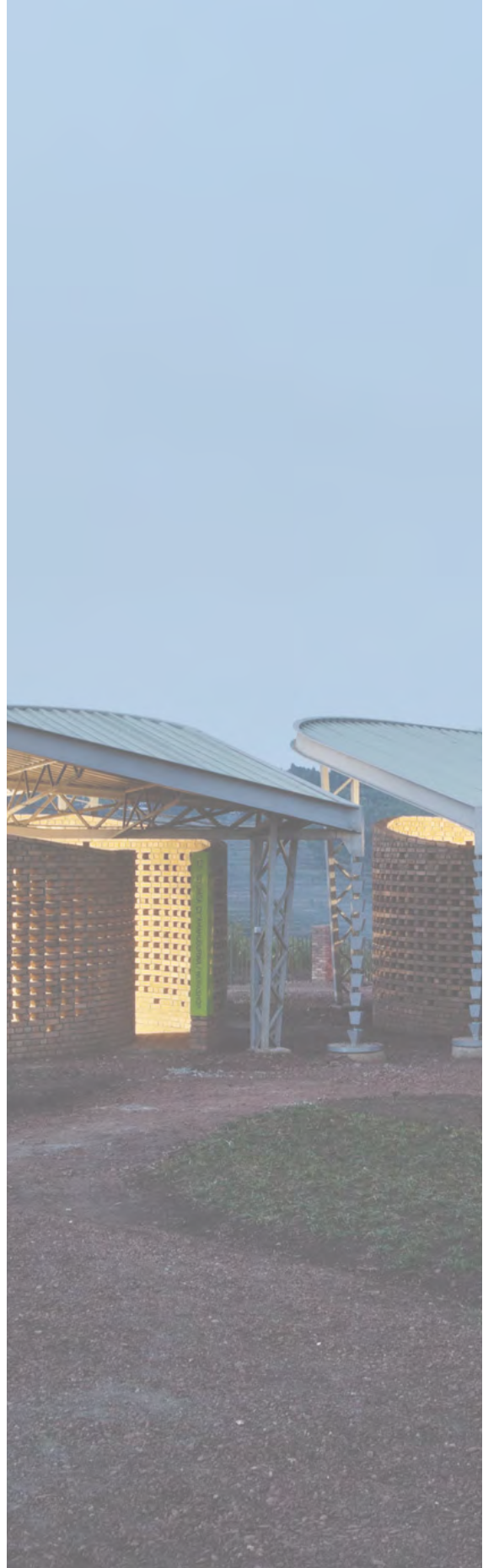
- Mass wall behind solar glazing facing equator
- Make exterior wall dark color
- 30 - 46 cm (12-18 in) for concrete
- 25 - 36 cm (10-14 in) for brick
- 20 - 30 cm (8-12 in) for adobe



Water Catchment

- Reduces stormwater runoff
- Reduces water demand
- Storage tank capacity (liters) = water catchment area (m²) x rainfall (cm) x 7.38
- $3,600\text{m}^2 \times 144\text{cm} \times 7.38 = 3,800,000 \text{ liters} = 1,000,000 \text{ gallons}$
- Small scale catchment systems use roof runoff
- Large scale systems use the landscape as the catchment area





"Study the past if you would define the future."
-Confucius

Precedents





Mapungubwe National Park Center

| | |
|----------------------------|-----------------------|
| Architect: | Peter Rich Architects |
| Structural Engineer: | Structural Design Lab |
| General Contractor: | Ousnqa Builders |
| Materials Engineer: | Matthew Hodge |
| Poverty Relief Consultant: | Lineo Lerotholi |

The Mapungubwe National Park Center in South Africa was designed by Peter Rich Architects and Structural Design Lab using the Guastavino Vaulting Method. It was made using unfired clay bricks that were constructed on site using a standard brick press. The structure was made using local labor that was trained in this building method prior to the start of construction. This method is more labor intensive, so the cost of labor is more expensive, but there is minimal formwork, and no steel is required as the structure is always in compression. The site was far from Johannesburg and it was expensive to get materials to the site. Steel prices also increased by 200% due to the 2010 World Cup structures building built at the same time. This made the it cost effective to use this system. The project also had funding to provide poverty relief. This made a more labor intensive system a better option. Local stone was placed on top of the vaults to create a uniform load over the whole structure.²⁴







Butaro Hospital

| | |
|--------------------------|--|
| Architect: | MASS Design Group |
| Landscape Design: | Sierra Bainbridge Maura Rockcastle |
| Structural Engineer: | ICON |
| Construction Supervisor: | PIH/IMB Bruce Nizeye Felix Ndagijimana |
| Sewage Plant Engineer: | EcoProtection |
| Signage Design: | Vignelli Associates |

The Butaro Hospital in Rwanda, Africa was designed to mitigate and reduce the transmission of airborne disease through various innovative systems, including overall layout, patient and staff flow, and natural cross-ventilation.

Patient beds are arranged so they are in the center of the room facing out towards the Rwandan landscape, and color is used to create a sense of place for patients. Each ward was assigned a different color and it creates an alternative wayfinding system for patients instead of solely relying on signs.

Open air waiting areas are used as a strategy to help control the spread of infection as well as create a therapeutic space for patients. These outdoor spaces are also used as social areas for patients and their family members.

The hospital uses volcanic rock from the nearby Virunga Mountains. The construction of this project was used as an opportunity to train and give jobs to the local community members who could help build the project.²⁵

| | |
|-------------------------|----------------------------|
| Burera District Before: | Butaro Hospital Amenities: |
| 340,000 population | 140 new ward beds |
| 0 physicians | 2 operating rooms |
| Burera District After: | 1 emergency procedure room |
| 12 physicians | Neonatology unit |
| 300 nurses | Post-maternity ward |
| Built Area: 6,040 sq m | Delivery ward with 4 beds |
| Cost: \$4.4M | ER with 4 trauma bays |



Kutamba Primary School

Architect:

Project H Design

Partner:

Architecture for Humanity

The Kutamba Primary School is for the education of children orphaned by the HIV/AIDS epidemic in the Rukungiri district of Southern Uganda. The project takes advantage of renewable energy systems, local materials and building methods, and context-sensitive systems solutions. There are four classrooms at the school which provide schooling for 120 students in grades 1-4. The school employs three teachers, a headmaster, a nurse, and cooks to prepare breakfast and lunch. The playground is a learning landscape, which is a playground that teaches the children elementary math concepts. The grid of tires are used for games that teach addition, subtraction, multiplication, and division.²⁶



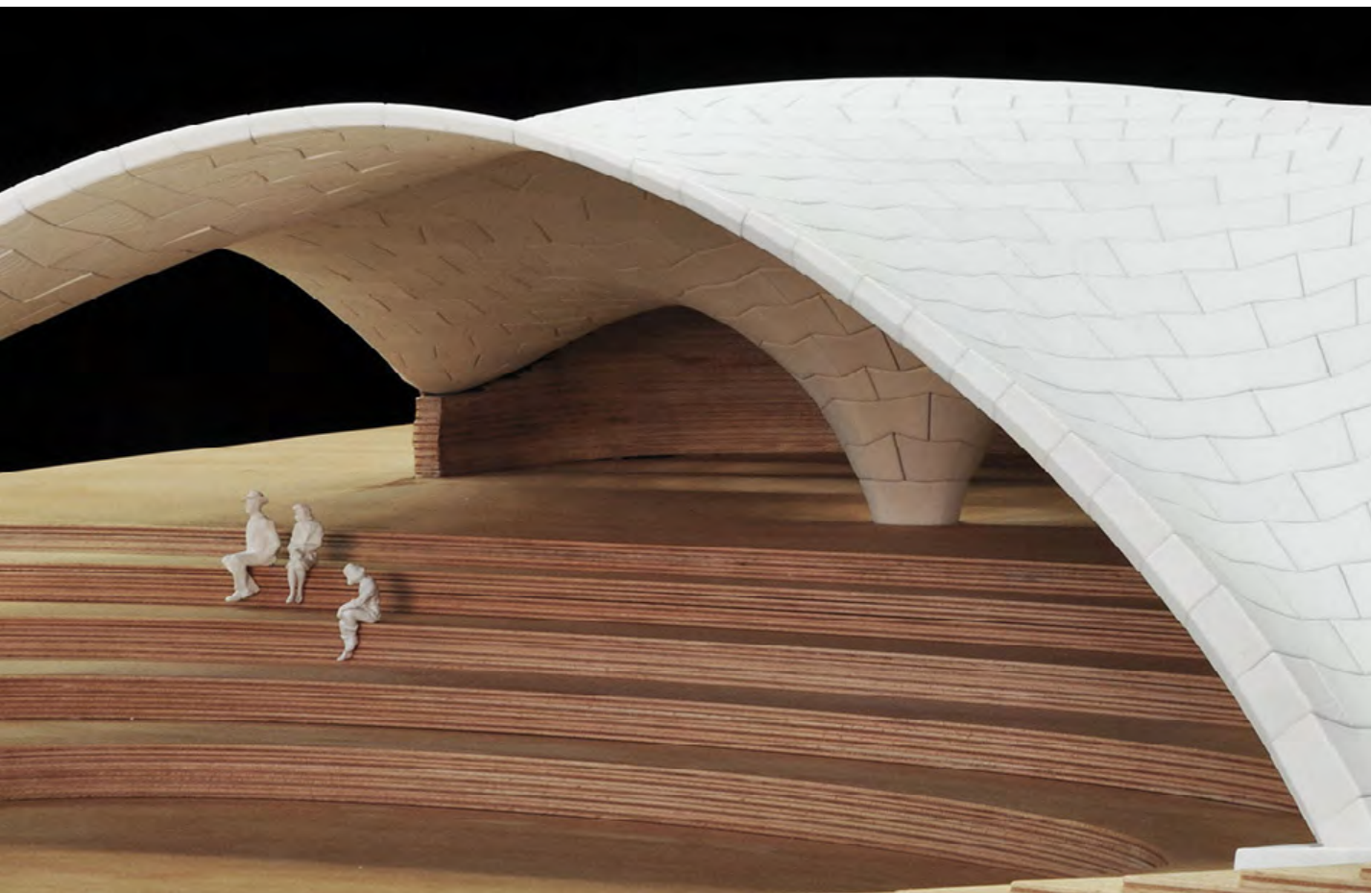
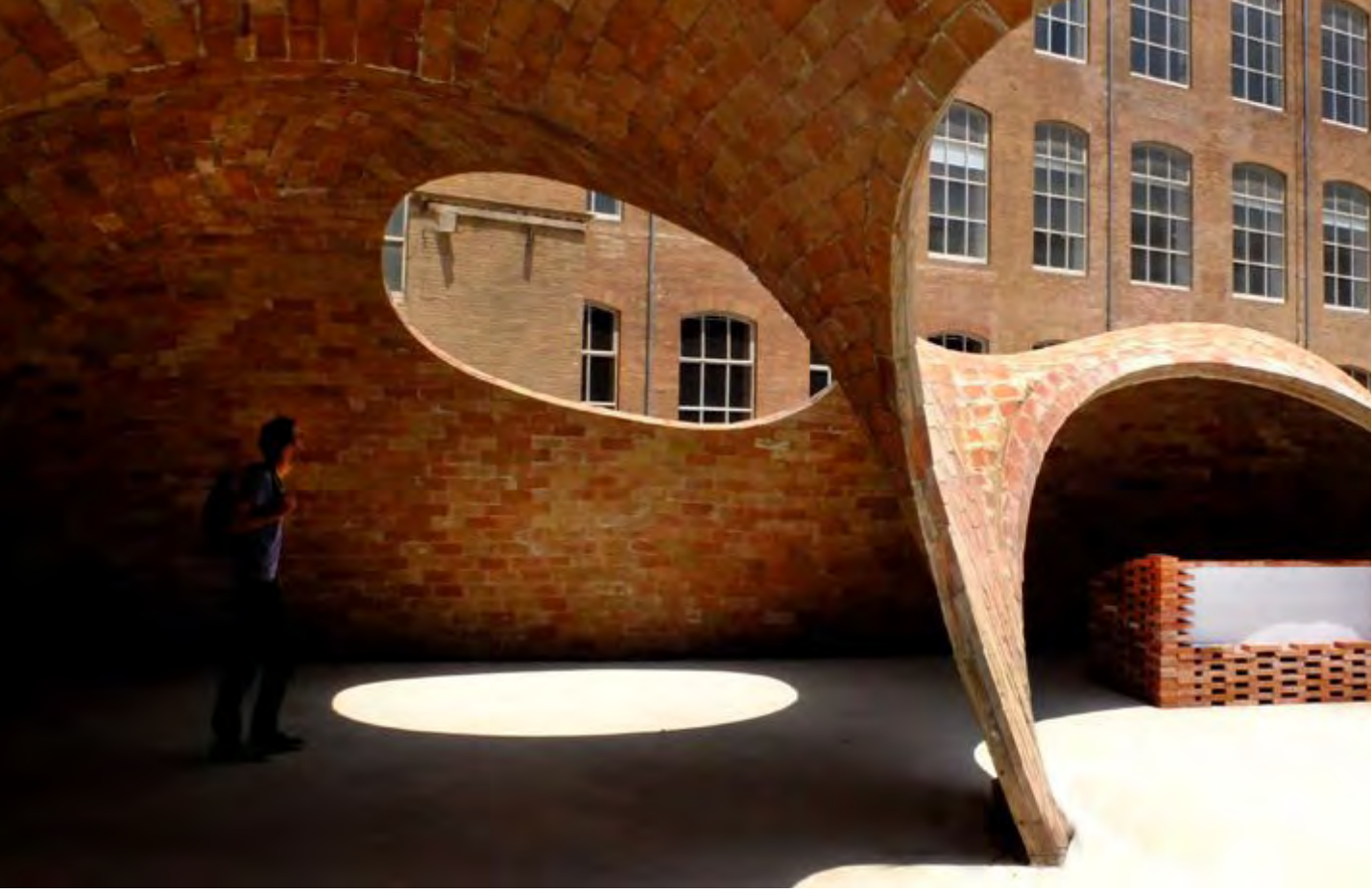
*"Education is the most powerful weapon which
you can use to change the world."*

-Nelson Mandela



Systems





Guastavino Tile Vaulting

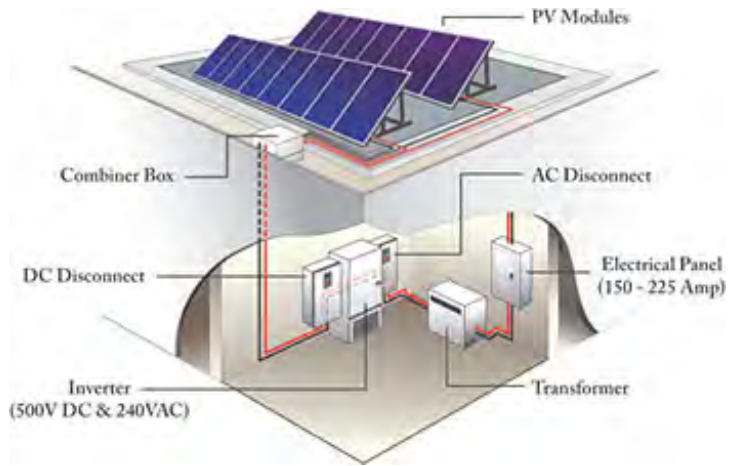
Guastavino tile is a thin shell structural tile that is used in arches that are in compression. A method called graphical statics is used to create an arch that is always in compression where the uniform loads go directly through the material without having to change the direction of the forces as they go to the ground. This allows for very thin bricks to be used without any steel reinforcement as a structural material. It was patented in the United States by Rafael Guastavino in 1885 and was used in various buildings around the country. The method is being studied and built today by the Structural Design Lab at MIT.²⁷



Energy Systems

Photovoltaic (PV) panels convert energy from solar radiation directly into electricity using semiconductor materials. It has no mechanical moving parts, so it lasts for decades and requires only minimal maintenance. It is modular and can be installed in any size necessary, with the only limitation being the availability of a sunny roof or ground space.²⁸

When there is no power access in rural sites, photovoltaic panels can generate electricity that could not otherwise be received.



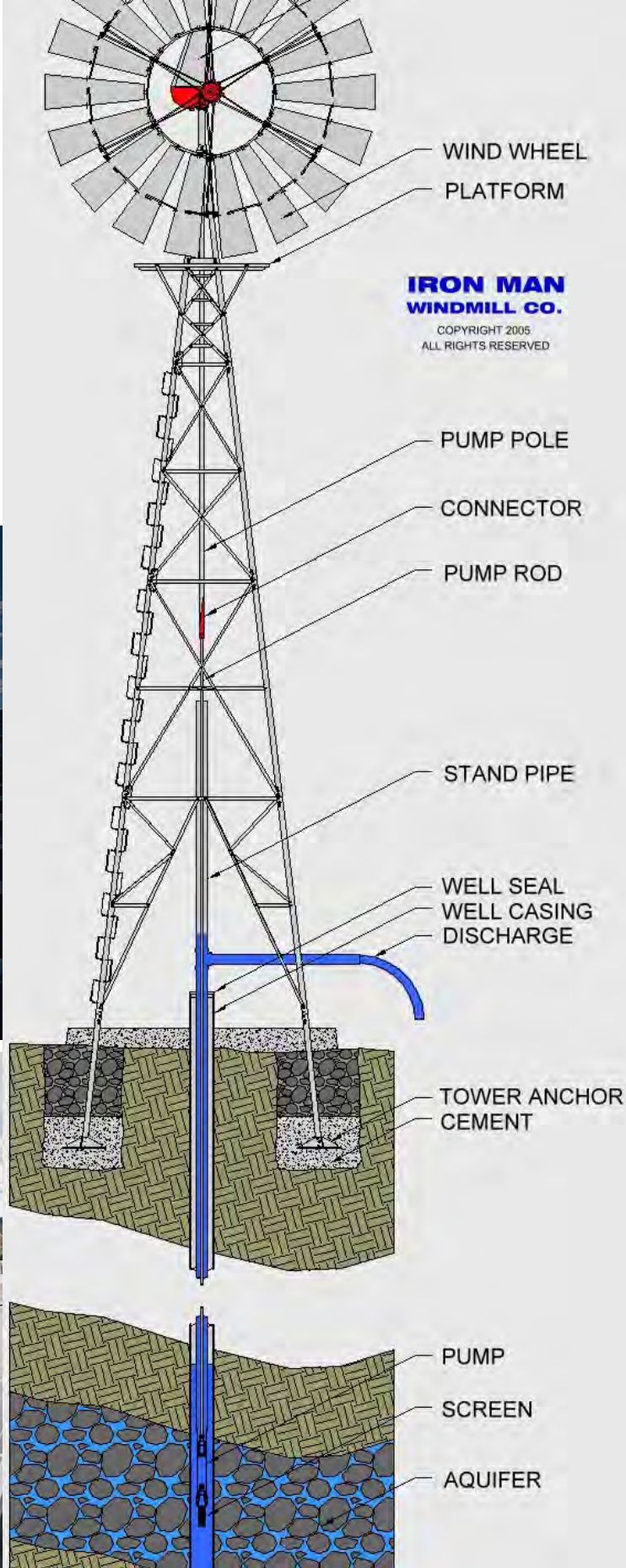
Water Systems

Uganda's government has spent millions of dollars over several years to provide clean water as a way of preventing cholera, bilharzia and other water borne diseases. Still, 40% of the population lacks access to safe drinking water.²⁹ There are several methods of water collection that can be used in the area.

Rainwater harvesting is an inexpensive way to collect water, as the materials are cheap and the construction methods are straightforward. The disadvantage is that the collection surface must be kept clean of animal and plant droppings and the collection vessels can be invaded by insects, rodents and bacteria if not kept clean and properly maintained.³⁰

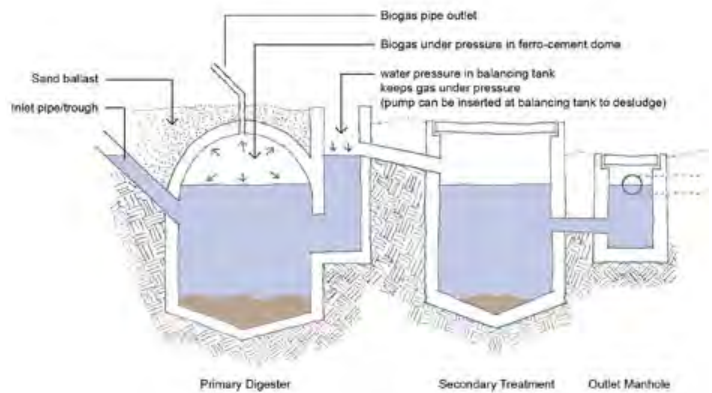
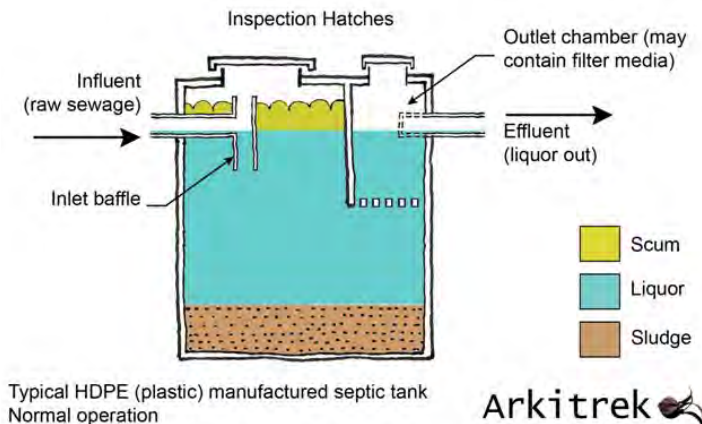
Another water collection system uses a supply of water from a spring or stream that is upland of the site to create a gravity-fed water system. The initial capital costs are higher, but the use of gravity negates the need for an expensive pump, which helps keep maintenance and running costs low. The distance from the water source to the site can be a disadvantage if it is too far away.³¹

Windpumps can also be used to continuously pump water from a well. It is also possible to combine these with an electric generator during peak times.³²



Leach Fields

Architects wishing to have a low impact on the land need to consider the impact of the development on local waterways. This makes treatment of sewage one of the most important factors of environmentally responsible design.³³ Leach fields are a low cost technology that provides a secondary treatment of water that has already been partially treated in a septic tank.³⁴ The liquid from the septic tank flows by gravity or pumping into perforated pipes built into trenches. The waste water slowly diffuses through the soil and into a groundwater aquifer. An additional method is to treat sewage in a small biogas digester which captures the methane gas to be used for fuel in cooking or lighting.



Compost Toilets

The Skyloo is a type of ecological toilet used extensively in southern Africa. It is particularly useful in areas where water is not readily available for flushing. The toilets work by separating urine and solid waste. Urine is either infiltrated into the ground or diluted and used for fertilizing crops, while solid waste drops into a vault, which is sealed when full while a second pit is used. After several months, the waste in the first pit will have turned into natural compost, which is safe to handle and use on crops. After the second pit becomes full, the process is repeated. Skyloos produce valuable compost, which can improve food production. Unlike traditional pit latrine systems, Skyloos do not pollute groundwater and they do not require additional pits to be dug once full.³⁵



"You have to do this marriage between what is appropriate, learning from the local nature, but also can we leapfrog technologies, so we're not burdening people with outdated technologies. If we can come up with that, then it truly is sustainable."

-Cameron Sinclair



Final Design

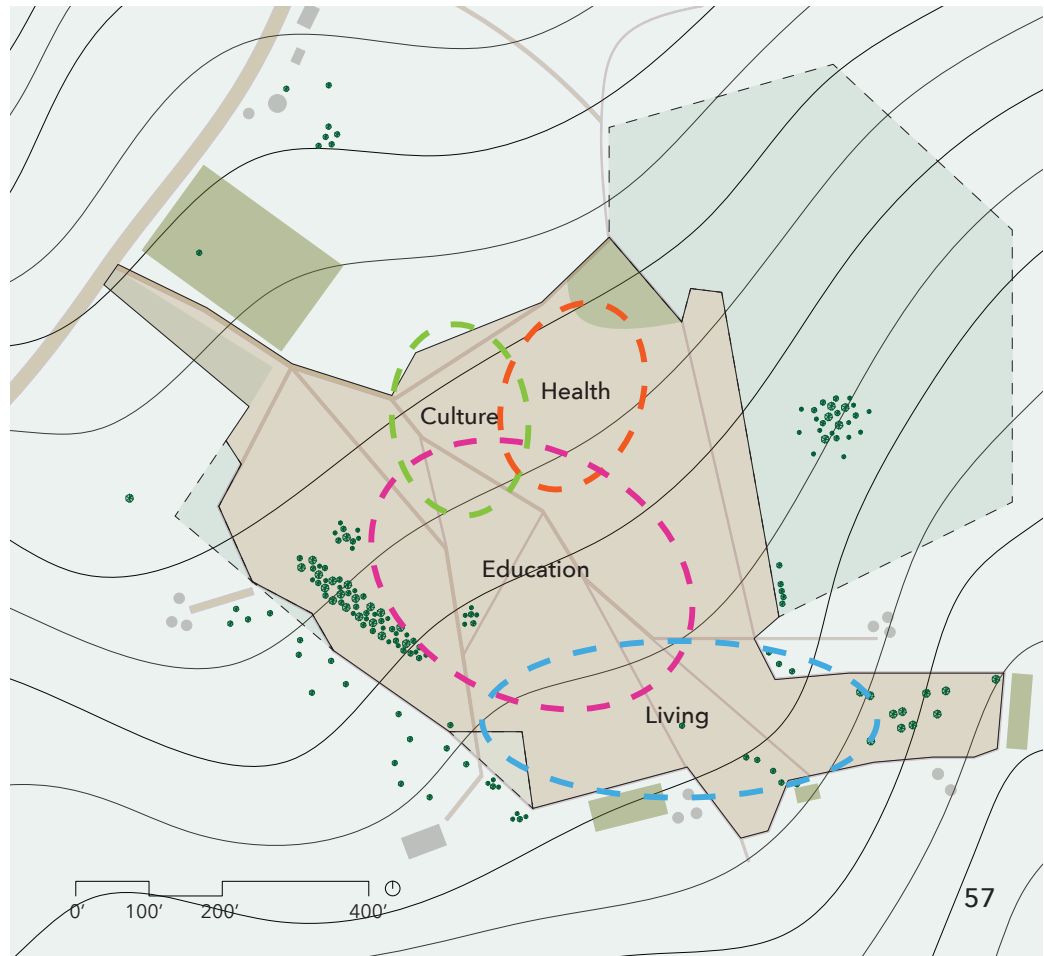
The people in Bukhubalo, Uganda do not have the **economic means** or **access** to education, health care, or cultural development. This thesis aims to bring the **community** of Bukhubalo together through a facility that provides these **opportunities**. It will include a secondary school, tertiary school, medical center, and cultural center.





Programmatic Diagram

The education portion is the heart of the complex and has easy access from the road for the children coming to school. The cultural center is also located near the entrance so it is the first building seen and visited by the community. The health care center is pushed slightly to the outside in case there is an infection outbreak and it needs to be quarantined. The focus of the secondary school will be to provide schooling for children who cannot afford the entrance fees of conventional schooling, especially girls, as their enrollment rate is lower than boys. The tertiary school will focus on training that the local community members can use to get jobs through this facility. The three main communal spaces, the cafeteria, cultural center, and library will use the Guastavino Vaulting method. They are the heart of the complex and will be the most active and commonly used spaces; they are also centrally located within the site for this reason. The other buildings will take on a simpler building typology with a rectilinear footprint.



Program Breakdown

Secondary School

| | | |
|----------------------|---------------------|-------------------|
| | 13,350 sq ft | 1,240 sq m |
| Classrooms (16) | 11,200 sq ft | 1,040 sq m |
| Administration | 700 sq ft | 65 sq m |
| Offices (6) | 390 sq ft | 36 sq m |
| Conference Rooms (4) | 320 sq ft | 30 sq m |
| Bathrooms (10) | 740 sq ft ea | 68 sq m |



Tertiary School

| | | |
|-------------------------|--------------------|-----------------|
| | 6,500 sq ft | 600 sq m |
| (3) Tertiary classrooms | 2,170 sq ft | 200 sq m |
| Woodshop | 1,000 sq ft | 93 sq m |
| Metalshop | 1,000 sq ft | 93 sq m |
| Sewing Shop | 1,000 sq ft | 93 sq m |
| Workshop | 1,000 sq ft | 93 sq m |
| (4) Bathrooms | 330 sq ft | 30 sq m |



Library

| | | |
|--------------|--------------------|------------------|
| | 2,000 sq ft | 185 sq ft |
| Library | 700 sq ft | 65 sq m |
| Computer Lab | 1,300 sq ft | 120 sq m |



Laboratory

| | | |
|-----------|--------------------|-----------------|
| | 3,240 sq ft | 300 sq m |
| Physics | 1,000 sq ft | 93 sq m |
| Chemistry | 1,000 sq ft | 93 sq m |
| Biology | 1,000 sq ft | 93 sq m |
| Storage | 240 sq ft | 22 sq m |



Housing

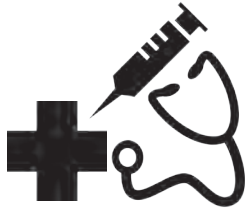
| | | |
|-------------|---------------------|-------------------|
| | 11,200 sq ft | 1,040 sq m |
| Dormitories | 12,880 sq ft | 1,195 sq m |
| Staff | 2,140 sq ft | 198 sq m |
| Executive | 1,450 sq ft ea | 135 sq m |



Cafeteria

| | | |
|---------|--------------------|-----------------|
| | 4,100 sq ft | 380 sq m |
| Kitchen | 400 sq ft | 40 sq m |
| Dining | 3,700 sq ft | 340 sq m |





Medical Facility

Women's Recovery
Men's Recovery
HIV/AIDS Ward
Cancer Ward
Post-maternity Ward
Delivery Rooms (2)
Neonatology Unit
Operating Rooms (2)
Isolation Rooms (4)
Clinic Rooms (4)
Doctor's Office (4)
Pharmacy

4,460 sq ft

430 sq m

500 sq ft

46 sq m

500 sq ft

46 sq m

400 sq ft

40 sq m

400 sq ft

40 sq m

400 sq ft

40 sq m

160 sq ft

15 sq m

240 sq ft

22 sq m

300 sq ft

15 sq m

300 sq ft

28 sq m

300 sq ft

28 sq m

250 sq ft

22 sq m

150 sq ft

15 sq m



Research Facility

Researcher Labs (3)
Researcher Offices (4)

1,215 sq ft

113 sq m

1000 sq ft

93 sq m

215 sq ft

20 sq m



Cultural Center

Assembly Space
Rehearsal Space
Art Studio

5,400 sq ft

500 sq m

4,000 sq ft

370 sq m

700 sq ft

65 sq m

700 sq ft

65 sq m

Agriculture Warehouse

1,500 sq ft

140 sq m

Amenities

3,950 sq ft

365 sq m

TOTAL

61,680 sq ft

5,730 sq m

Systems

Photovoltaic Panels
Leach Field

40,000 sq ft

3,720 sq m

20,000 sq ft

1,860 sq m

20,000 sq ft

1,860 sq m



Concept Models



Exploring interweaving and blurred lines between floor, walls, and roof



Exploring performance space and differences between stage and viewer entrance



Exploring shelter and shading



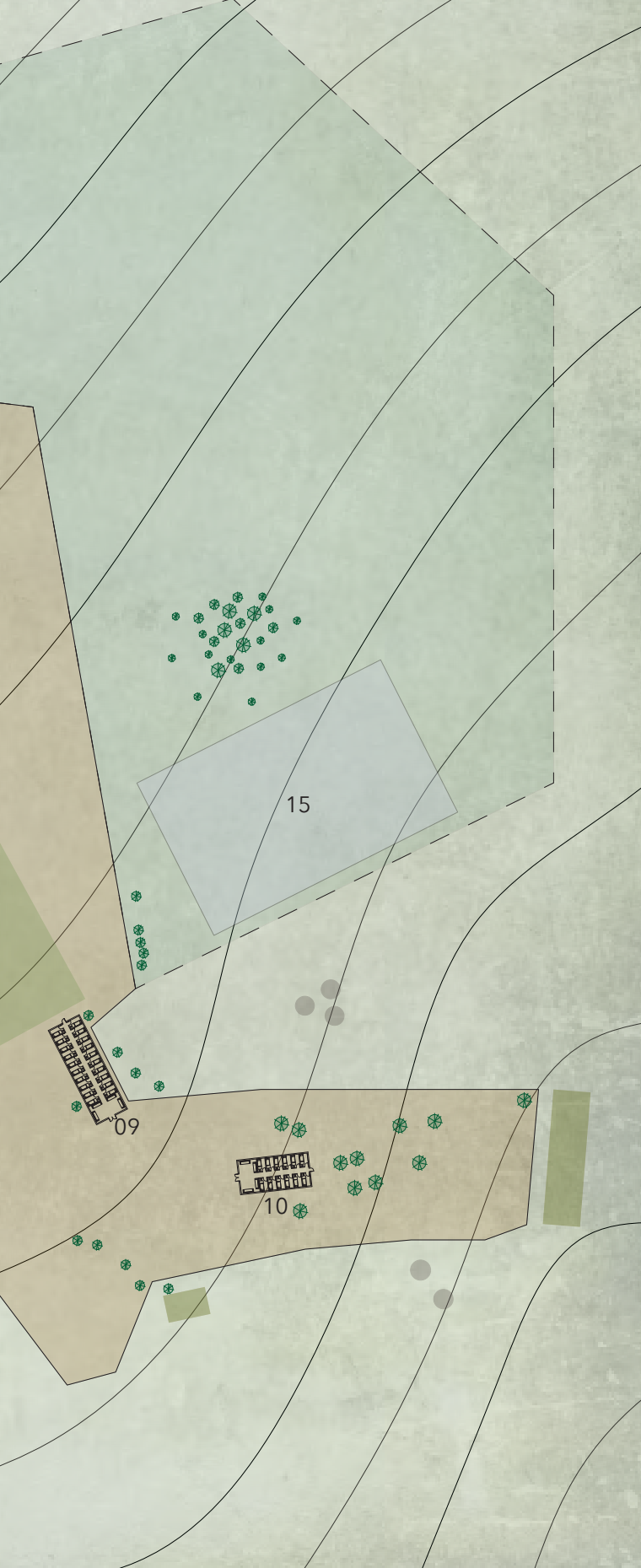
Exploring central stage in center versus stage on one end of building

Bukhubalo Main Road

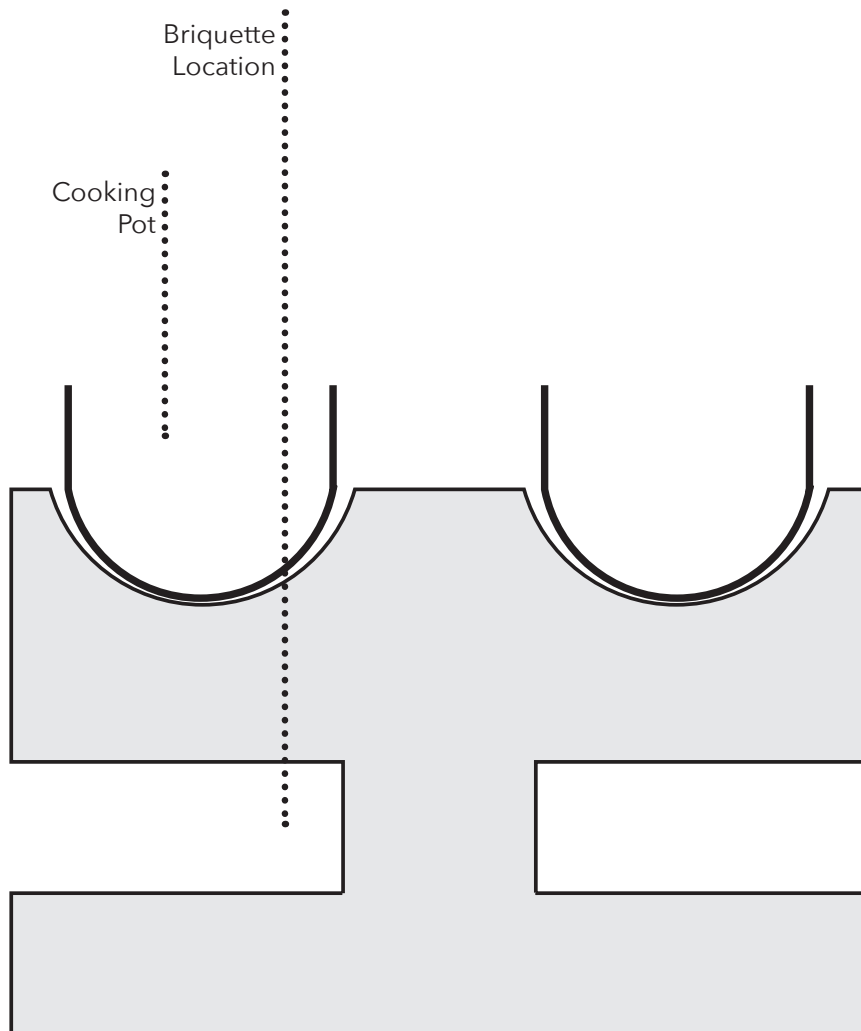


Master Plan

The master plan includes secondary school, tertiary school, medical center, cultural center, and the amenities needed for running the facility. The cultural center, cafeteria, and library will be built using the Guastavino Vaulting method as they are the main public spaces in the facility.



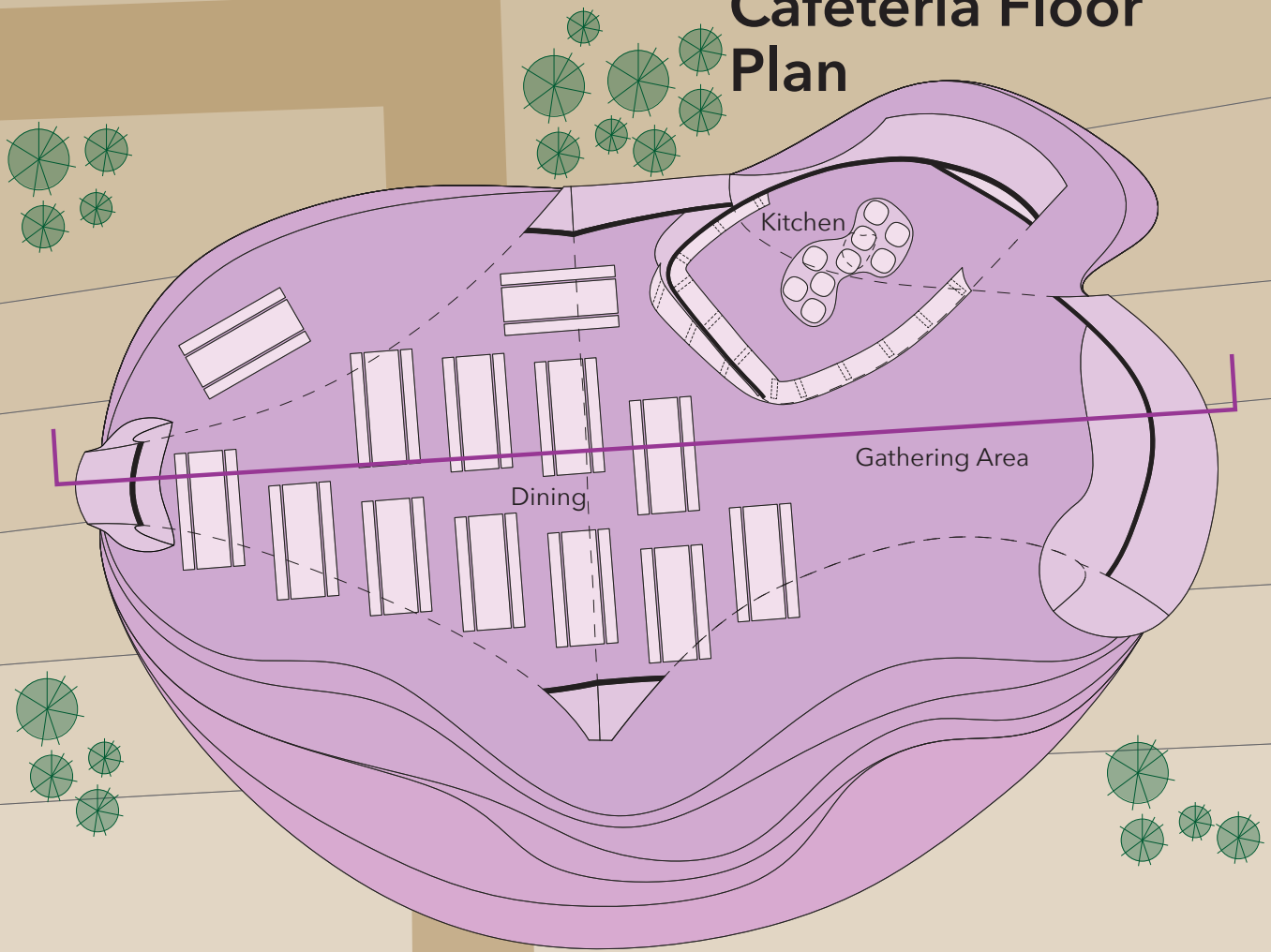
- 01 Cultural Center
- 02 Medical Center
- 03 Cafeteria
- 04 Secondary School
- 05 Tertiary School
- 06 Library
- 07 Laboratories
- 08 Dormitories
- 09 Faculty Housing
- 10 Executive Housing
- 11 Sports Fields
- 12 Parking
- 13 Warehouse
- 14 Windpump
- 15 Leach Field
- 16 Water Catchment



Kitchen Stove Section

The stove is made of bricks and has an opening in the side where briquettes made from waste can be burned to cook the food located above it. There is a chimney in the arched structure where the smoke can exit.

Cafeteria Floor Plan

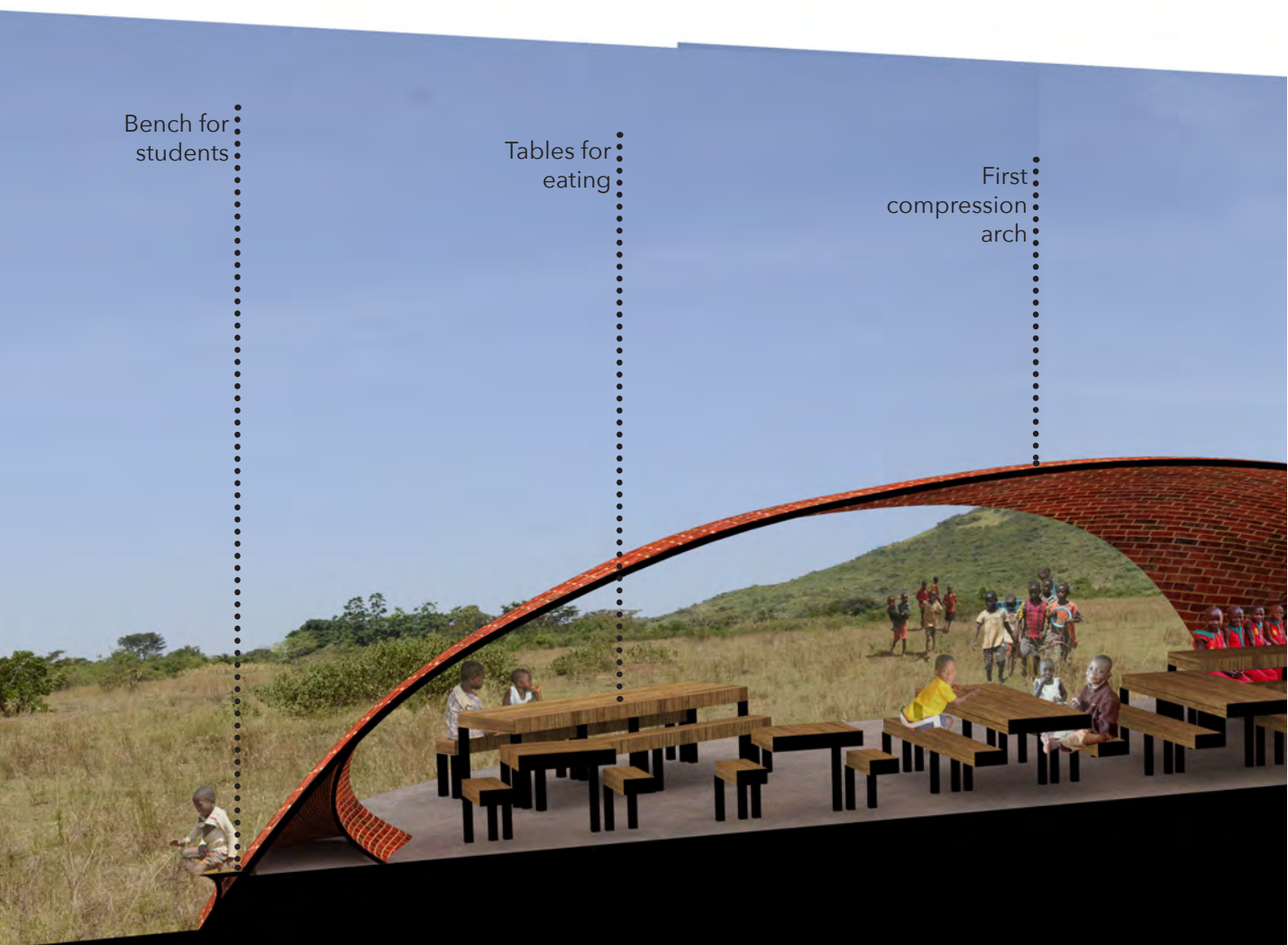


The cafeteria and kitchen building is the focus of this thesis because it is a place where children can come in and out throughout the day, and it does not need to be a place where only food is eaten. It can also be a place that is used to study, hang out, or stay in the shade. The cafeteria is designed to seat 150 students at one time with space for other students to wait in line for their food under the shade of the structure.

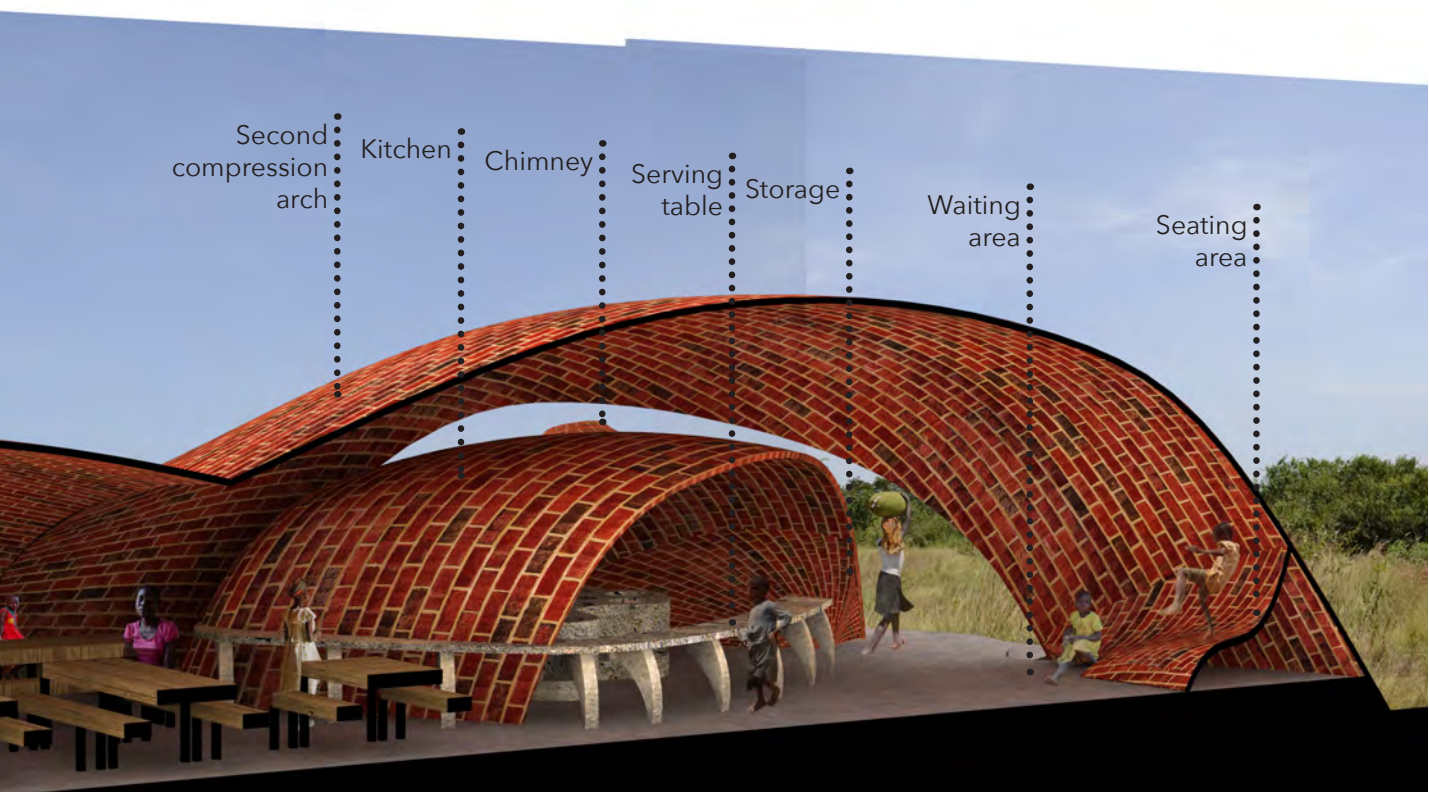
Bench for
students

Tables for
eating

First
compression
arch



Cafeteria Section





Kitchen





Cafeteria





Final Cafeteria Model



Bukhubalo Main Road

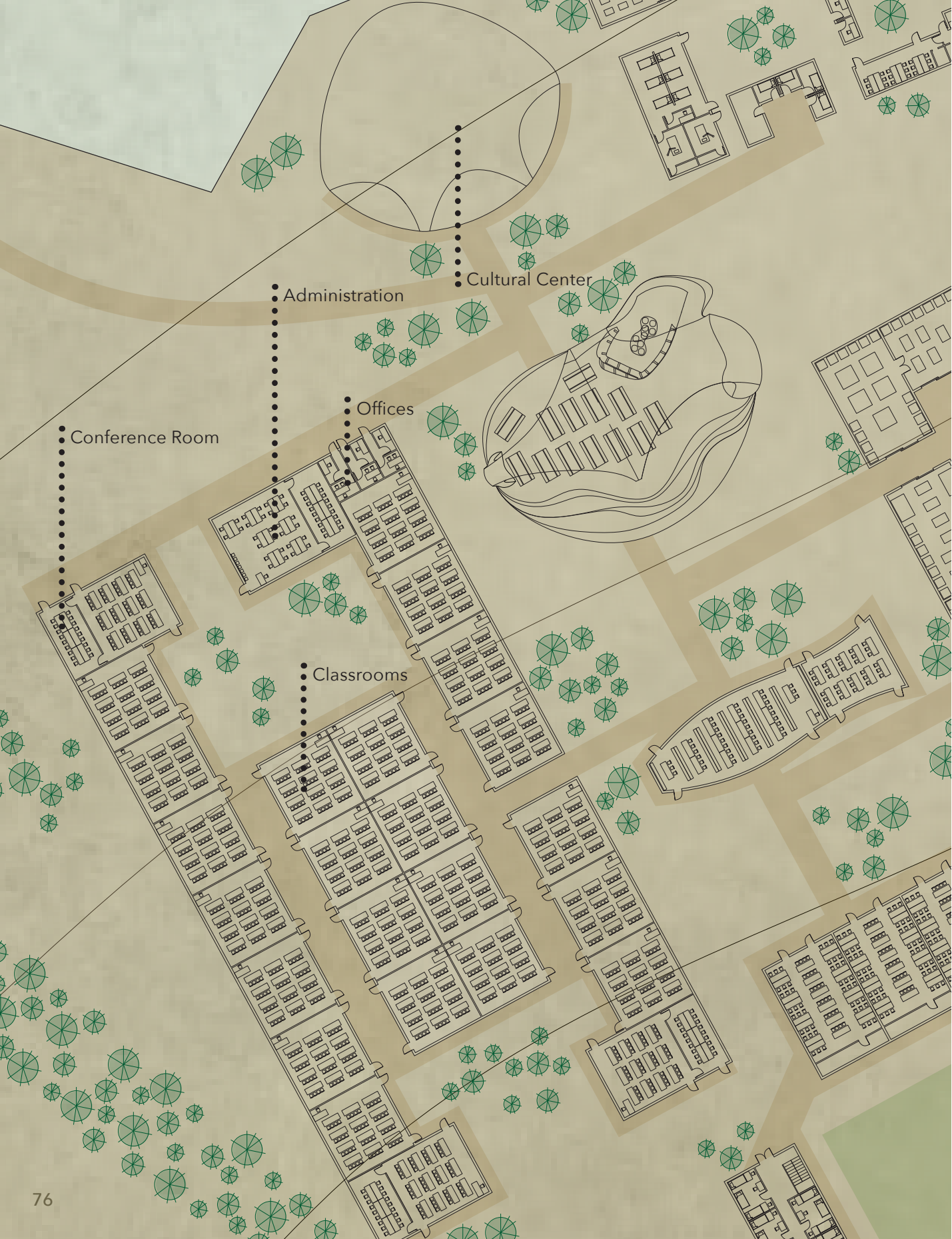


Expansion Plan

The possible expansion will increase the secondary school capacity to 1000 students and the tertiary school to 120 students. It will also allow 40% of the student population to be housed on campus.



- 01 | Secondary School
- 02 | Tertiary School
- 03 | Dormitories





Secondary School

The secondary school will include 25 classrooms, four conference rooms, six private offices, and one administration room. It is centrally located because secondary students are the highest percentage of users on the site.

Cultural Center

The cultural center will be built using the Guastavino Vaulting method. It will be used for community gatherings, school gatherings, performances, and daily church services. It is located near the entrance to the site so it is easily accessible to large groups of community members entering the site.

Dormitories

The dormitories will have six person rooms for S1-S4 students and the bottom floors and two person rooms for S5-S6 and tertiary students on the top floors. There are also rooms on each floor for both studying and hanging out.



Work Room

Metalshop

Woodshop

Bike Shop

Computer Lab

Sewing Room

Library

Woodshop

Classrooms

Chemistry Lab

Physics Lab

Biology Lab

The background of the page features a large, abstract architectural drawing. It consists of several overlapping geometric shapes in muted colors: a large light beige area at the top, a large olive green area at the bottom, and a smaller light green area in the middle. A thin black line runs diagonally across the composition. In the bottom left corner, there is a small, detailed line drawing of a building's floor plan, showing various rooms and corridors. A small green circular icon with radiating lines is also visible near the top left.

Tertiary School

The tertiary school will include three classrooms, two woodshops, one metalshop, one sewing room, one bike repair shop, and one general work room.

Library

The library will be built using the Guastavino Vaulting method. It will house the computer lab as well. It is centrally located between the tertiary and secondary schools as they will be used by both groups of students.

Laboratory Wing

The laboratory wing will have a physics, biology, and chemistry classroom that will be used by both the secondary and tertiary students.



Neonatology Unit

Delivery Rooms

Post-maternity Ward

Women's Recovery

Cancer Ward

HIV/AIDS Ward

Isolation Rooms

Warehouse

Research Offices

Research Labs

Doctor's Offices

Clinic

Pharmacy

Operating Rooms

Nurses Station

Men's Recovery



Medical Facility

The medical center will include a women's recovery center, men's recovery center, HIV/AIDS ward, cancer ward, post-maternity ward, delivery ward, neonatology unit, operating room, isolation rooms, clinic rooms, doctor's offices, and a pharmacy. The patient beds are oriented so that they face outwards towards either the landscape surrounding the site or the interior courtyards. In the case of an emergency disease outbreak, the isolation rooms, HIV/AIDS ward and cancer ward can be locked down and accessed via the secondary path into the site.

There will also be a research facility where herbal and agricultural medications will be tested. It is located near the HIV/AIDS and cancer wards as some of the patients here will be a part of these experimental trials.

Warehouse

The warehouse will be used to store crops sold to the facility from local farmers and families. It will also be used to store crops grown on the property. The main food crops are plantains, cassava, sweet potatoes, millet, sorghum, corn, beans, bananas and peanuts.



*"The best thing we can create is a classroom
that is rich with exploration and discovery."*

-Emily Pilloton

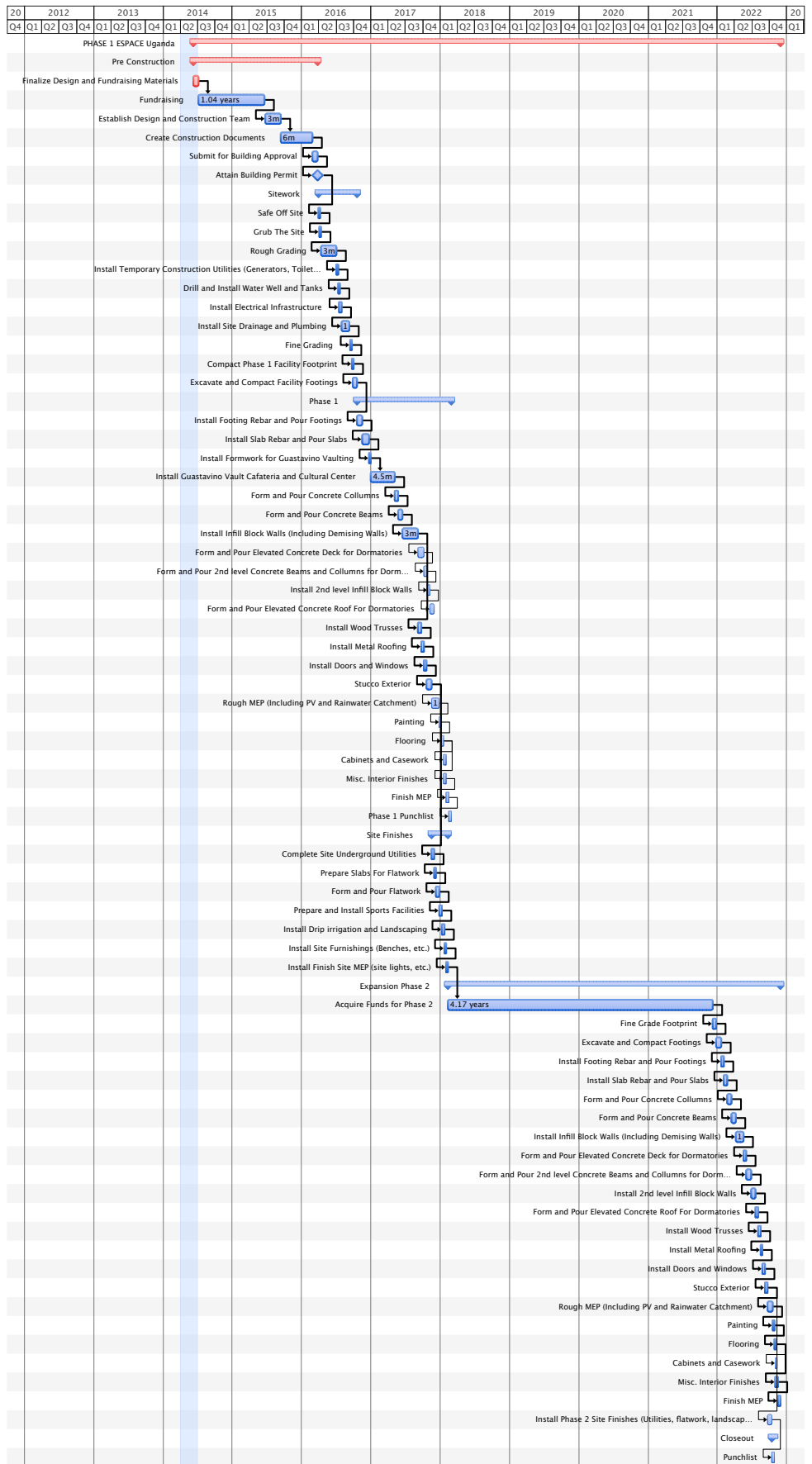
Construction



| itle | Given Plan ned Work | Flag Status | # Prede cessors | Expected Start |
|---|------------------------|----------------|--------------------|----------------|
| ☐ PHASE 1 ESPACE Uganda | | 🔴 | | 6/9/14 |
| Pre Construction | | 🔴 | | 6/9/14 |
| Finalize Design and Fundraising Materials | 20 days | 🔴 | | 6/9/14 |
| Fundraising | 250 days | | 2 | 7/7/14 |
| Establish Design and Construction Team | 60 days | | 3 | 6/22/15 |
| Create Construction Documents | 120 days | | 4 | 9/14/15 |
| Submit for Building Approval | 20 days | | 5 | 2/29/16 |
| Attain Building Permit | | | 6 | 3/25/16 |
| Sitework | | | | 3/28/16 |
| Safe Off Site | 5 days | | 7 | 3/28/16 |
| Grub The Site | 5 days | | 9 | 4/4/16 |
| Rough Grading | 60 days | | 10 | 4/11/16 |
| Install Temporary Construction Utilities (Generators, Toilets, Water Tanks, Etc.) | 5 days | | 11 | 7/4/16 |
| Drill and Install Water Well and Tanks | 5 days | | 12 | 7/11/16 |
| Install Electrical Infrastructure | 10 days | | 13 | 7/18/16 |
| Install Site Drainage and Plumbing | 30 days | | 14 | 8/1/16 |
| Fine Grading | 8 days | | 15 | 9/12/16 |
| Compact Phase 1 Facility Footprint | 5 days | | 16 | 9/22/16 |
| Excavate and Compact Facility Footings | 15 days | | 17 | 9/29/16 |
| Phase 1 | | | | 10/20/16 |
| Install Footing Rebar and Pour Footings | 20 days | | 18 | 10/20/16 |
| Install Slab Rebar and Pour Slabs | 25 days | | 20 | 11/17/16 |
| Install Formwork for Guastavino Vaulting | 5 days | | 21 | 12/22/16 |
| Install Guastavino Vault Cafateria and Cultural Center | 90 days | | 22 | 12/29/16 |
| Form and Pour Concrete Collumns | 15 days | | 23 | 5/4/17 |
| Form and Pour Concrete Beams | 15 days | | 24 | 5/25/17 |
| Install Infill Block Walls (Including Demising Walls) | 60 days | | 25 | 6/15/17 |
| Form and Pour Elevated Concrete Deck for Dormitories | 20 days | | 26 | 9/7/17 |
| Form and Pour 2nd level Concrete Beams and Collumns for Dormitories | 15 days | | 27 | 10/5/17 |
| Install 2nd level Infill Block Walls | 10 days | | 28 | 10/26/17 |
| Form and Pour Elevated Concrete Roof For Dormitories | 15 days | | 29 | 11/9/17 |
| Install Wood Trusses | 10 days | | 26 | 9/7/17 |
| Install Metal Roofing | 10 days | | 31 | 9/21/17 |
| Install Doors and Windows | 10 days | | 32 | 10/5/17 |
| Stucco Exterior | 20 days | | 33 | 10/19/17 |
| Rough MEP (Including PV and Rainwater Catchment) | 30 days | | 34 | 11/16/17 |
| Painting | 5 days | | 35 | 12/28/17 |
| Flooring | 10 days | | 36 | 1/4/18 |
| Cabinets and Casework | 10 days | | 37 | 1/18/18 |
| Misc. Interior Finishes | 10 days | | 37 | 1/18/18 |
| Finish MEP | 10 days | | 39 | 2/1/18 |
| Phase 1 Punchlist | 10 days | | 40 | 2/15/18 |

Construction Schedule

| | | | | |
|--|-----------|----|--|-----------------|
| Site Finishes | | | | 11/16/17 |
| Complete Site Underground Utilities | 10 days | 34 | | 11/16/17 |
| Prepare Slabs For Flatwork | 5 days | 43 | | 11/30/17 |
| Form and Pour Flatwork | 15 days | 44 | | 12/7/17 |
| Prepare and Install Sports Facilities | 10 days | 45 | | 12/28/17 |
| Install Drip irrigation and Landscaping | 10 days | 46 | | 1/11/18 |
| Install Site Furnishings (Benches, etc.) | 5 days | 47 | | 1/25/18 |
| Install Finish Site MEP (site lights, etc.) | 5 days | 48 | | 2/1/18 |
| Expansion Phase 2 | | | | 2/8/18 |
| Acquire Funds for Phase 2 | 1000 days | 49 | | 2/8/18 |
| Fine Grade Footprint | 10 days | 51 | | 12/9/21 |
| Excavate and Compact Footings | 20 days | 52 | | 12/23/21 |
| Install Footing Rebar and Pour Footings | 10 days | 53 | | 1/20/22 |
| Install Slab Rebar and Pour Slabs | 15 days | 54 | | 2/3/22 |
| Form and Pour Concrete Collumns | 15 days | 55 | | 2/24/22 |
| Form and Pour Concrete Beams | 15 days | 56 | | 3/17/22 |
| Install Infill Block Walls (Including Demising Walls) | 30 days | 57 | | 4/7/22 |
| Form and Pour Elevated Concrete Deck for Dormitories | 10 days | 58 | | 5/19/22 |
| Form and Pour 2nd level Concrete Beams and Collumns for Dormitories | 20 days | 59 | | 6/2/22 |
| Install 2nd level Infill Block Walls | 15 days | 60 | | 6/30/22 |
| Form and Pour Elevated Concrete Roof For Dormitories | 10 days | 61 | | 7/21/22 |
| Install Wood Trusses | 10 days | 62 | | 8/4/22 |
| Install Metal Roofing | 5 days | 63 | | 8/18/22 |
| Install Doors and Windows | 10 days | 64 | | 8/25/22 |
| Stucco Exterior | 10 days | 65 | | 9/8/22 |
| Rough MEP (Including PV and Rainwater Catchment) | 20 days | 66 | | 9/22/22 |
| Painting | 5 days | 67 | | 10/20/22 |
| Flooring | 5 days | 68 | | 10/27/22 |
| Cabinets and Casework | 5 days | 69 | | 11/3/22 |
| Misc. Interior Finishes | 10 days | 69 | | 11/3/22 |
| Finish MEP | 10 days | 71 | | 11/17/22 |
| Install Phase 2 Site Finishes (Utilities, flatwork, landscaping, etc.) | 15 days | 66 | | 9/22/22 |
| Closeout | | | | 10/13/22 |
| Punchlist | 10 days | 73 | | 10/13/22 |



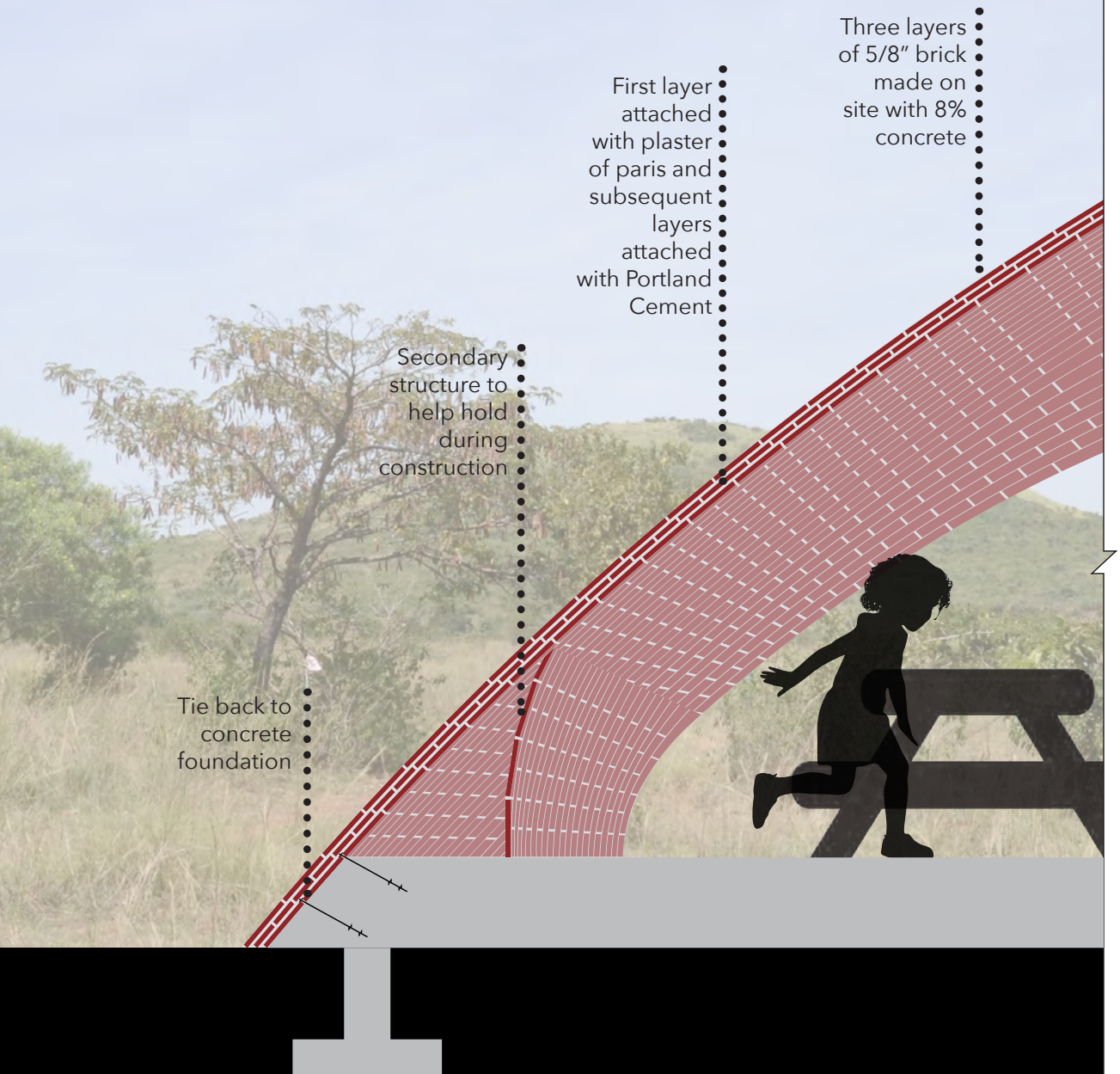
| COST CODE | DESCRIPTION OF WORK | ESTIMATE USD | ESTIMATE Shilling | SubTotal USD | TOTAL SHILLINGS |
|-------------------|---|---------------|---------------------|----------------------|----------------------------|
| DIVISION 1 | GENERAL CONDITIONS | | | \$ 180,000.00 | \$ 462,600,000.00 |
| | Permit | \$ 15,000.00 | \$ 38,550,000.00 | | |
| | Cost Estimating | included | | | |
| | Equipment Fuel | included | | | |
| | Plan Reproduction | included | | | |
| | Travel | NIC | | | |
| | Subsistence | included | | | |
| | Inspection/Testing | Included | | | |
| | Clean-Up | included | | | |
| | Final Clean-Up | included | | | |
| | Small Tools | included | | | |
| | Misc Gen Condition | \$ 150,000.00 | \$ 385,500,000.00 | | |
| | Traylor/Storage | included | | | |
| | Temporary Utilities | \$ 15,000.00 | \$ 38,550,000.00 | | |
| | Bonds | included | | | |
| | All Risk Insurance | included | | | |
| | Safety/OSHA Permit | Included | | | |
| | Temporary Fencing | Included | | | |
| | Project Closeout | included | | | |
| DIVISION 2 | SITE WORK | | | \$ 342,500.00 | \$ 880,225,000.00 |
| | General Sitework | \$ 180,000.00 | \$ 462,600,000.00 | | |
| | Traffic Control | included | | | |
| | Demolition | \$ 2,500.00 | \$ 6,425,000.00 | | |
| | Driven Piles | NIC | | | |
| | Surveying | \$ 2,500.00 | \$ 6,425,000.00 | | |
| | Construction Water (dust control) | included | | | |
| | Dewatering (flood control) | included | | | |
| | Shoring | NIC | | | |
| | Rough Grading | included | | | |
| | Fine Grading | included | | | |
| | Excavate road | NIC | | | |
| | Trench/Backfill | included | | | |
| | Soil Treatment | NIC | | | |
| | Underground Utilities/Water System | \$ 50,000.00 | \$ 128,500,000.00 | | |
| | Erosion Control (SWPPP) | \$ 2,500.00 | \$ 6,425,000.00 | | |
| | Undrground Elect connection | included | | | |
| | Rainwater catchment system | \$ 45,000.00 | \$ 115,650,000.00 | | |
| | Base Rock | included | | | |
| | Asphalt Concrete Paving (road entry) | included | | | |
| | Site Concrete | NIC | | | |
| | Retaining Walls | \$ 5,000.00 | \$ 12,850,000.00 | | |
| | Perimeter fencing | \$ 50,000.00 | \$ 128,500,000.00 | | |
| | Green Roof | NIC | | | |
| | Landscape/Irrigation | \$ 5,000.00 | \$ 12,850,000.00 | | |
| DIVISION 3 | CONCRETE | | | \$ 650,000.00 | \$ 1,670,500,000.00 |
| | Sub Base | included | | | |
| | Forms & Accessories | included | | | |
| | Form Liners (for asthetics) | included | | | |
| | Reinforcement (rebar) | included | | | |
| | Cast-In-Place Conc | \$ 650,000.00 | \$ 1,670,500,000.00 | | |
| | Tree Grates | NIC | | | |
| | Caissons | NIC | | | |
| | Curing & Sealers | NIC | | | |
| | Precast Concrete | NIC | | | |
| | Floor Toppings (apoxy over concrete floors) | NIC | | | |
| | Rammed Earth | NIC | | | |
| | CMU Grout | included | | | |
| DIVISION 4 | MASONRY | | | \$ 300,000.00 | \$ 771,000,000.00 |
| | Concrete masonry units (CMU's) | NIC | | | |
| | Brick | \$ 300,000.00 | \$ 771,000,000.00 | | |
| | Stone/Gabion | NIC | | | |
| DIVISION 5 | METALS | | | \$ 143,000.00 | \$ 367,510,000.00 |
| | Structural Steel | NIC | | | |
| | Metal roof | \$ 100,000.00 | \$ 257,000,000.00 | | |
| | Crane & Hoisting | Included | | | |
| | Misc Metal Fab | \$ 15,000.00 | \$ 38,550,000.00 | | |
| | Concrete Stairs | included | | | |
| | Handrails & Railings | \$ 25,000.00 | \$ 64,250,000.00 | | |
| | Gratings | \$ 3,000.00 | \$ 7,710,000.00 | | |
| DIVISION 6 | CARPENTRY | | | \$ 245,000.00 | \$ 629,650,000.00 |
| | Rough Carpentry | \$ 125,000.00 | \$ 321,250,000.00 | | |
| | Glu Lams/Trusses | included | | | |
| | Finish Carpentry | NIC | | | |
| | Cabinets | \$ 120,000.00 | \$ 308,400,000.00 | | |
| | Counter Tops | included | | | |
| | Architectural Mill Work | NIC | | | |
| DIVISION 7 | THERM.&MOIST.PROTECT | | | \$ 80,000.00 | \$ 205,600,000.00 |
| | Waterproofing | \$ 35,000.00 | \$ 89,950,000.00 | | |
| | Water Repellent | NIC | | | |
| | Insulation | NIC | | | |
| | Roofing | included | | | |
| | Roof Accessories | NIC | | | |
| | Metal Siding | NIC | | | |
| | Deck Coatings | NIC | | | |
| | Flashing & Sheet Metal | \$ 35,000.00 | \$ 89,950,000.00 | | |
| | Downspouts/Gutters | \$ 10,000.00 | \$ 25,700,000.00 | | |
| | Joint Sealants/Caulk | NIC | | | |
| DIVISION 8 | DOORS & WINDOWS | | | \$ 255,000.00 | \$ 655,350,000.00 |
| | Doors/Windows/Frames | \$ 250,000.00 | \$ 642,500,000.00 | | |
| | Access Covers/Panels | \$ 5,000.00 | \$ 12,850,000.00 | | |
| | Overhead Door Systems (garage doors) | NIC | | | |
| | Skylights | NIC | | | |
| DIVISION 9 | FINISHES | | | \$ 170,000.00 | \$ 436,900,000.00 |
| | Demising Wall | included | | | |
| | Lath & Plaster (stucco) | \$ 150,000.00 | \$ 385,500,000.00 | | |
| | Drywall (green board, x-board, gypsum) | NIC | | | |
| | Tile | NIC | | | |
| | Carpet/ hardwood | NIC | | | |
| | Wall Coverings | NIC | | | |
| | Painting | \$ 20,000.00 | \$ 51,400,000.00 | | |

Cost Estimate

| | | | | | |
|--------------------|-----------------------------------|---------------|---------------------|-----------------|---------------------|
| DIVISION 10 | SPECIALTIES | | | \$ 4,000.00 | \$ 10,280,000.00 |
| | Blackboards (classrooms) | By Owner | | | |
| | Bulletin/Tack Boards (classrooms) | By Owner | | | |
| | School desks and chairs | By Owner | | | |
| | Toilet partitions | By Owner | | | |
| | Bumper/Corner Guards | By Owner | | | |
| | Flagpoles | By Owner | | | |
| | Exterior Signage | By Owner | | | |
| | Interior Signage | By Owner | | | |
| | Fire Extinguishers | \$ 1,500.00 | \$ 3,855,000.00 | | |
| | Fire Extinguisher Cabinets | NIC | | | |
| | Prefab Awnings | Included | | | |
| | Mail Boxes | By Owner | | | |
| | FRP Screen (bathroom walls) | By Owner | | | |
| | Metal Shelving | By Owner | | | |
| | Wood Shelving | By Owner | | | |
| | Toilet Accessories | \$ 2,500.00 | \$ 6,425,000.00 | | |
| DIVISION 11 | EQUIPMENT | | | \$ - | \$ - |
| | Audio Video Screens/TV's | By Owner | | | |
| | Coax/Antenna/BTS | By Owner | | | |
| | Food/Kitchen Service | By Owner | | | |
| | Appliances | By Owner | | | |
| | Sports Equipment | By Owner | | | |
| | Hood/Vent Systems | By Owner | | | |
| | Office Furnishings | By Owner | | | |
| DIVISION 12 | FURNISHINGS | | | \$ - | \$ - |
| | Window Coverings | By Owner | | | |
| | Bunk beds | By Owner | | | |
| | Art work | By Owner | | | |
| | Office Furniture | By Owner | | | |
| DIVISION 13 | SPECIAL CONSTRUCTION | | | \$ - | \$ - |
| | Fire/Security System | NIC | | | |
| DIVISION 14 | CONVEYING SYSTEMS | | | \$ - | \$ - |
| | Scaffolding | Included | | | |
| | Elevator | NIC | | | |
| DIVISION 15 | MECHANICAL WORK | | | \$ 140,000.00 | \$ 359,800,000.00 |
| | Fire Protection sprinklers | NIC | | | |
| | Plumbing | \$ 140,000.00 | \$ 359,800,000.00 | | |
| | Cable/Coax Cover | NIC | | | |
| | HVAC (each house) | NIC | | | |
| | Air Test & Balance | NIC | | | |
| DIVISION 16 | ELECTRICAL | | | \$ 400,000.00 | \$ 1,028,000,000.00 |
| | Electrical | \$ 400,000.00 | \$ 1,028,000,000.00 | | |
| | Fiberoptic Internet System | NIC | | | |
| | Generators | NIC | | | |
| | Lighting | Included | | | |
| | Data & Communication | NIC | | | |
| | Audio/Video/CCTV | NIC | | | |
| | Fire Alarm | NIC | | | |
| SUBTOTAL | | | | | |
| | General Contractor | \$ 116,380.00 | | | |
| | Engineering | \$ 29,095.00 | | | |
| | Architecture | \$ 87,285.00 | | | |
| | Misc. Subconsultants | \$ 58,190.00 | | | |
| | Subtotal | \$ 290,950.00 | | | |
| SUBTOTAL | | | | \$ 2,909,500.00 | \$ 7,477,415,000.00 |
| Grand Total | | | | \$ 3,200,450.00 | |
| SF | | 80,000 | | | |
| \$/SF | | \$ 40.01 | | | |
| TOTAL | | | | | |



Cafeteria Detail

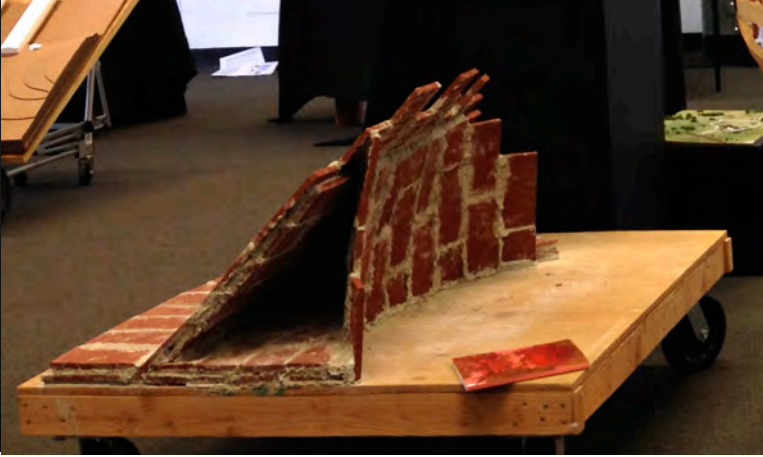


I created a hanging chain model of the structure to create the perfect curve and used this to model the detail curve.



Full Scale Detail Mock Up

The southwest corner of the cafeteria was mocked up at full scale to understand and personally explore the Guastavino Vaulting method.



I used bricks that were $3 \frac{5}{8}'' \times 7 \frac{5}{8}'' \times 5 \frac{5}{8}''$ with Rapid Set Mortar Mix that hardens to structural strength within an hour.



The bricks are able to support themselves until the form is completed, but when only a part of it is being built, it is harder for it to support itself at such an angle. More vertical support was added to make sure that the one point of connection did not snap.

*"Tug on anything and you will find it connected
to everything else"*

-John Muir



Appendix



-Appendix-

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