pre - diploma report

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pre-diploma research

The main idea for the diploma project is to collect information for a book which examinins the architectural typology of existing buildings and proposes guide lines for future projects at the Eco Moyo Education Centre, in Kilifi, Kenya. By exploring the local climate and the current architectural situation, I intend to gather information that helps me understand how materials are adopted locally.

With the collected information I wish to explore the relationship between material application, time and defect - by first reflectiong on how the matrial is adopted, I will be able to conclude if the material performance its basic function. If it does not fulfill its function I will explore how it can be replaced and repurposed.

The pre-diploma research helps me to learn about theoretical basis of vernacular architecture and circular societies - understanding these terms is a key for a future projects.

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I. Vernacular architecture

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Background

The term 'vernacular architecture' was introduced by Bernard Rudofsky at his 1964 exhibition Architecture Without Architects at the Museum of Modern Art, New York by Bernard Rudofsky. The show was accompanied by a book of the same title, including black-and-white photography of vernacular buildings around the world. It was Rudofsky who first made use of the term vernacular in an architectural context, and brought the concept into the eye of the public and of mainstream architecture: "For want of a generic label we shall call it vernacular, anonymous, spontaneous, indigenous, rural, as the case may be." Rudofsky presented vernacular architecture as a parallel to natural medicine and its harmony with nature.

"There is much to learn from architecture before it became an expert's art. The untutored builders in space and time – the protagonists of this show – demonstrate an admirable talent for fitting their buildings into the natural surroundings. Instead of trying to 'conquer' nature, as we do, they welcome the vagaries of climate and the challenge of topography."[1]

Vernacular architecture is typically characterised by the use of local materials and knowledge, usually without the supervision of professional architects. Vernacular architecture represents the majority of buildings and settlements created in pre-industrial societies and includes a very wide range of buildings, building traditions, and methods of construction. Vernacular buildings are typically simple and practical, whether residential houses or built for other purposes.

[1]Rudofsky, Bernard. 1964. *Architecture Without Architects. An Introduction to Non-Pedigreed Architecture.* The Museum of Modern Art, New York. p.4.

The word “vernacular” means “domestic, native, indigenous”. Paul Oliver in ‘Built to Meet Needs. Cultural Issues in Vernacular Architecture’ tries to define this term “vernacular architecture”: ‘The etymological roots of the word “architect”, from Greek arkhi- and tekton, mean “chief builder”, while “architecture” is defined as the “science of building”. The word “vernacular” derives from the Latin vernaculus, meaning “native”, so the definition “native science of building” is really quite appropriate.’

A milestone in a research and documentation of vernacular architecture was “The Encyclopedia of Vernacular Architecture of the World” released in 1997 under editorship of Paul Oliver – the information has been collected by around 250 scientists from more than 80 countries. It describes the vernacular as:

“(...) comprising the dwellings and all other buildings of the people. Related to their environmental contexts and available resources they are customarily owner- or community-built, utilizing traditional technologies. All forms of vernacular architecture are built to meet specific needs, accommodating the values, economies and ways of life of the cultures that produce them.”[2]

[2]Oliver, Paul. 2006. *Built to Meet Needs. Cultural Issues in Vernacular Architecture.* Elsevier. p.4.

Modern Interpretations

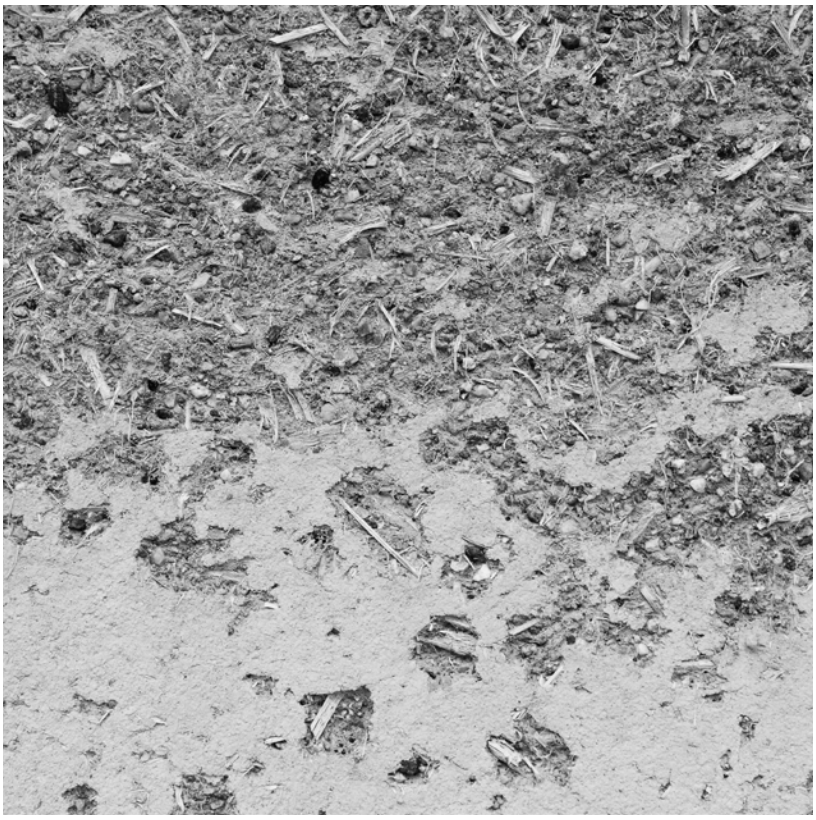
The first modern interpretations of "vernacular styles" can be observed in countries which regained independence in the mid-20th century, among others in Egypt, India, Arab countries, South America. Young artists educated in the capitals of colonial countries (London, Paris) after returning to their native countries began to look for local roots. The precursor of this direction is the Egyptian architect and poet Hasan Fathy.

Fathy designed the town of New Gourna near Luxor. After studying traditional Nubian settlements and technologies, he incorporated the traditional mud brick vaults in his designs. He did not build a replica of an Egyptian town, he combined traditions with modern requirements and functions.

"When en engineer designs a machine, a bridge, or a regulator, each line in his drawings is the result of a great accumulation of laws and principles from dozen different mechanical sciences. (...) Similarly, when an architect designs a town or a building, every line is determined by the application of the same complex set of mechanical laws, with the addition of a whole collection of other sciences whose provinces are less well defined: the sciences that concern man in his environment and society. These sciences – sociology, economics, climatology, theory of architecture, aesthetics, and the study of culture in general – are no less important to the architect than are the mechanical sciences, for they are directly concerned with man, and it is for man that architecture exists. (...) A machine is independent of its environment. It is a little affected by climate and not at all by society. A person, however, is a member of a living organism that constantly reacts to its environment, changing it and being changed by it."[3]

[3]Fathy, Hassan, Walter Shearer, and Abd-el-rahman Sultan. 1986. *Natural Energy and Vernacular Architecture: principles and examples with reference to hot arid climates.* Chicago: Published for The United Nations University by University of Chicago Press. p. 3.

II. Sustainability: circular society in the modern world.



Background

The term ‘circular society’ has its origins in a definition of economy definition and is an opposite to a linear economy. A circular economy is an economic system focusing on waste elimination and continual use of resources. It is a closed-loop system which consists of reuse, repair, refurbishment, remanufacturing, recycling and sharing. It entails the cyclical and cascading use of products and materials following the principle of circularity of ecosystems. Hence, the guiding principle of economic thinking and action should aim to keep extracted natural resources in use as long as possible and to preserve the maximum value of products through reuse and recovery strategies.

The fundamental nature of a circular society is interconnection between all of the actors –systems thinking and mutual responsibility.

Circular design focuses on upcycling industry, waste management, designing for deconstruction, local distribution, reuse of materials and reusability.

To follow these guidelines we should minimalize the number of different types of components and materials, design mono-material components, design durable components for generations of buildings, provide adequate tolerances for repeated disassembly and reassembly, aim for standard dimensions and modular design and for small-scaled and lightweight components. It is also important to reduce the complexity of components and plan for using common tools and equipment.

The vernacular and circular society

Vernacular architecture has interesting lessons for the concept of circular society. Vernacular architecture represents accrued wisdom about local traditions in construction, and how the climate and the natural environment affect the shape of buildings. Designing for a circular societies focuses on sustainability and reuse – which has always been the main principle of locally built environment.

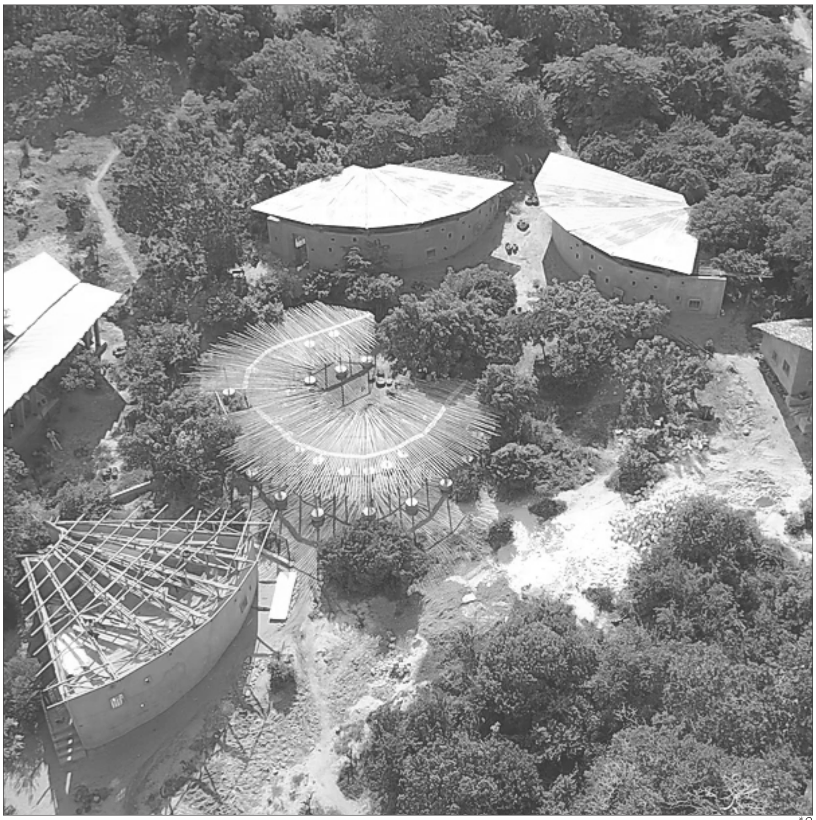
Both of these terms state the same approach to architecture and design – the only difference is that vernacular architecture talks about local traditions and natural environment when circularity tries to redefine and adjust them to our modern culture.

"Climate change is the biggest challenge facing our planet. There has never been a more important time to understand how to make the best use of local natural resources and to produce buildings that do not rely on stripping the environment or transporting materials across the globe."[4]

Additionally, working with vernacular architecture in times when big part of buildings industry is unified can have an important impact on local identity - as a reaction to the globalization of cultural values, uniform architectural styles, and stereotype patterns through discussing sustainability as a motivation for identity in culture and architecture.

[4] Piesik, Sandra. 2017. *Habitat. Vernacular Architecture for a Changing Planet.* Thames&Hudson. intro.

III. Eco Moyo Educational Centre: free education for children in rural Kenya.



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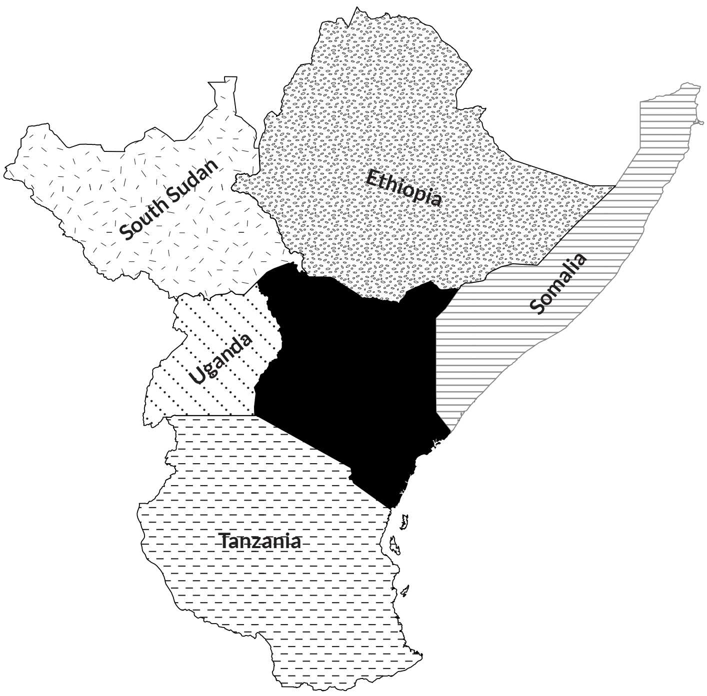
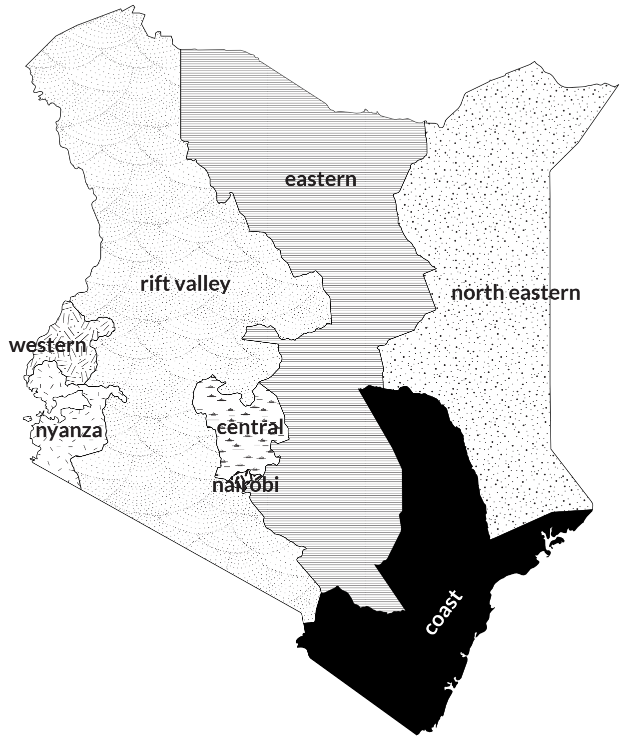
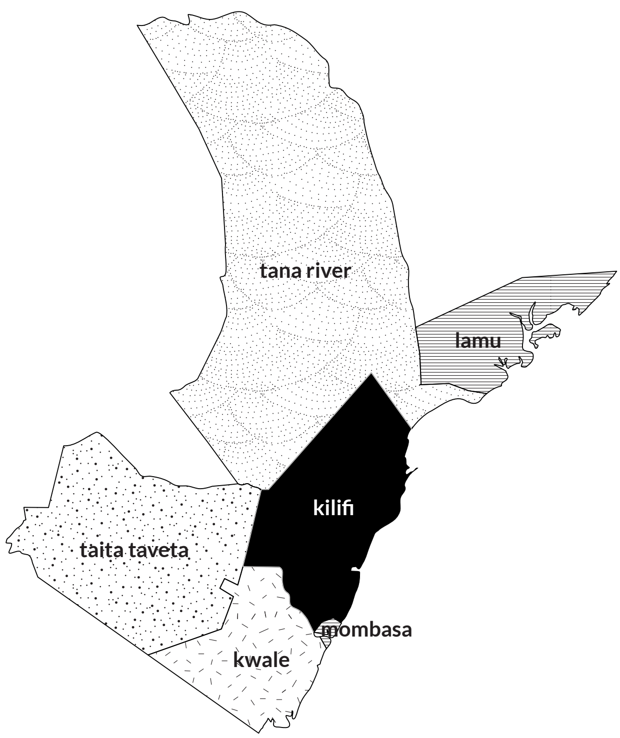
location of Kenya



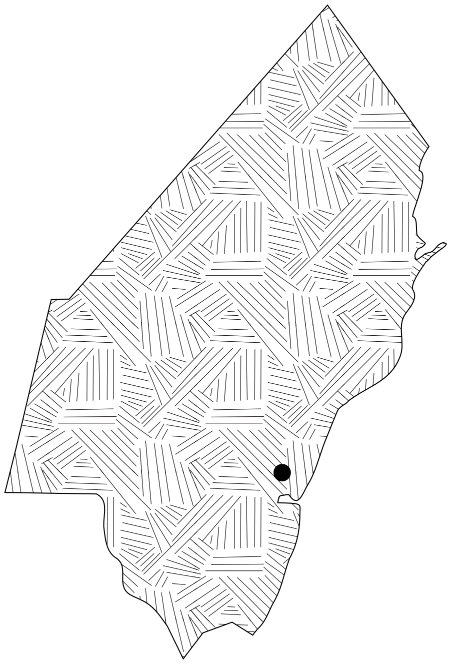
borders of Kenya



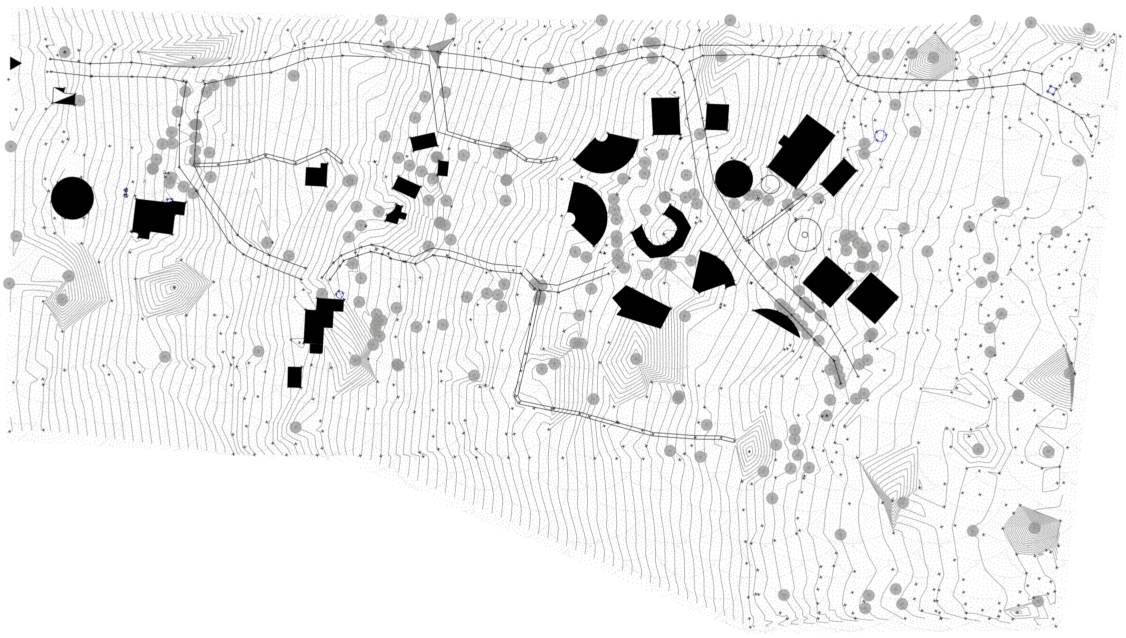
regions of Kenya



counties of Costal Kenya



Eco Moyo location



Eco Moyo

Eco Moyo Education Center is a private elementary school on the east coast of Kenya, a country at the equator in East Africa. Kenya borders Tanzania in the south, Uganda in the west, southern Sudan in the northwest, Ethiopia in the north, Somalia in the northeast and the Indian Ocean in the southeast. Kenya has an increasing population of 50 million people.

The school is located in Kilifi, one of the poorest counties in the country with a population of slightly over a million. Unemployment is high, and employment is largely linked to tourism and fishing. 70% of people live below the poverty line. Kenya has a young population and in Kilifi county, 47% are under 14 years. Only 51% have completed primary school and 13% have completed secondary school.

Eco Moyo Education Center was founded as a Norwegian association in Norway in 2013 and a CBO (Community based organization) in Kenya in 2014. Lindsay Sanner worked as a volunteer at an orphanage in Mombasa the year before. The meeting with children without family made a strong impression on her and the desire to help grew. After several attempts to collaborate with both the orphanage and individuals it became obvious that corruption was demanding to avoid unless she could managing the economy itself. Shocked at the standard of public school and the price of the private schools, she finally decided to start her own school. At the same time, she took courses in permaculture and natural building techniques. The dream to build a quality school with a green profile for children from poor people families began to take shape.

Eco is short for Ecology (the scientific study of interactions among organisms and their environment). Moyo means heart in Swahili. The name Eco Moyo therefore, refers to showing love for our environment.

The vision for Eco Moyo gives room for people, with different backgrounds and with
wide variety of skills and knowledge, can work together towards a greater goal.

Eco Moyo has developed a strategic plan, initiated by Lindsay Sanner in collaboration with Architects Without Borders (AUG) in the Spring of 2019. AUG has been the project group leader and organized the work. The project has been divided into two phases. The first part was about creating an overview of the school's needs and challenges as well as defining the project framework. The second part treats more specifically on land use and assessments related to the school's infrastructure where Engineers Without Borders (IUG) contributed with professional expertise. Lindsay Sanner has worked closely with AUG and IUG in the development of the plan. The plan gives the status of today's situation and points to future development opportunities.

"Pretty much every visitor is shocked by how secluded we are in the bush. All of a sudden, these incredible buildings appear, with bright colours and modern design. Kids playing, surrounded by lush trees and the sound of birds. No traffic or noise. People are just blown away. And with reason. It´s a magical place."[5]

[5] Lindsay Sander, grunnlegger. https://www.ecomoyo.com/

The Eco Moyo campus consists of a number of existing buildings on the site, the most recent of which are as follows:

2016 – The student dorm

This was the first building to be constructed on site. Two different workshops and the help from many volunteers as well as local workers was needed before finalising in 2016.

This natural building includes walls made from cob (mud and hay) filled with glass bottles and the roof is made from palm leaves.

The room is devided into two sections, one for the boys and one for girls. Per 2019, 16 students are living in the dormitory.

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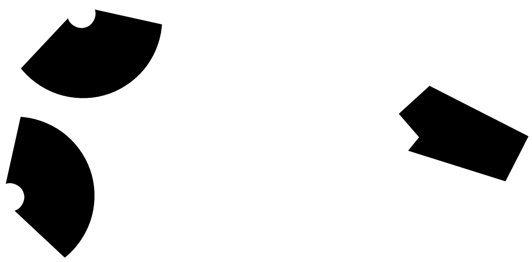
*4

2017 + 2018 – Classrooms / Scarcity and Creativity Studio

To the back of each classroom the ‘light wall’, which is built of planed softwood, allows for ventilation and the controlled penetration of natural light. The roof trusses are built with softwood and covered with corrugated metal sheets. The roofs drain all rain water into two large water tanks to the back. Materials used were coral stone blocks rendered with cement and local earth.

Materials used were coral stone blocks rendered with cement and local earth.

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*6

2019 - Visitors hut / Rintala Eggertsson Architects + NTNU

Placed at one of the highest points of the site. This small and simple building creates two distinct experiences. The entrance to the building is accentuated by the two large and bright cedar doors contrasting the dark green nero finish. These doors unfold onto two complementary walls that further enchance the patio of the building.

Furthermore, the ground level can be precived as a dark chamber constantly framing the surrounding vegetation with it's 3 long and narrow openings.

Moving through this space you go up a steep and narrow staircase that leads to the upper floor. Here you are embraceed by the makuti roof structure which is sent onto rectangular frames of cedar and supported by causarina poles that find support on the petruding floor beams. This structure and the two large and sloping surfaces of coconut leaves frame the underlying tropical forest and the Kenyan coastline, this also allows the breeze to sweep through and cool the inhabitants of the building.

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2019 - Kindergarden / Arkitekter Uten Grenser + Architectopia + Jan Kazimierz Godzimirski

During the design process it was important to use local knowledge and resources available in the vicinity of the school – local masons were hired in the construction of the foundation, and traditional carpenters were hired for the timber structure. The timber was sourced from a nearby casuarina forest, and the coral stones used in the foundation was also quarried nearby.

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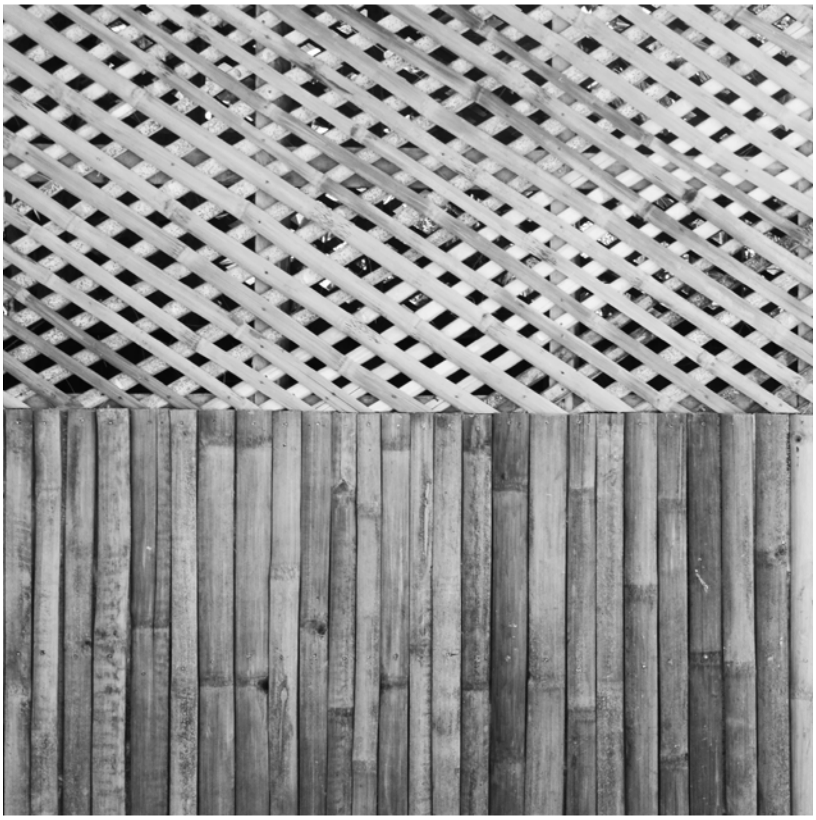
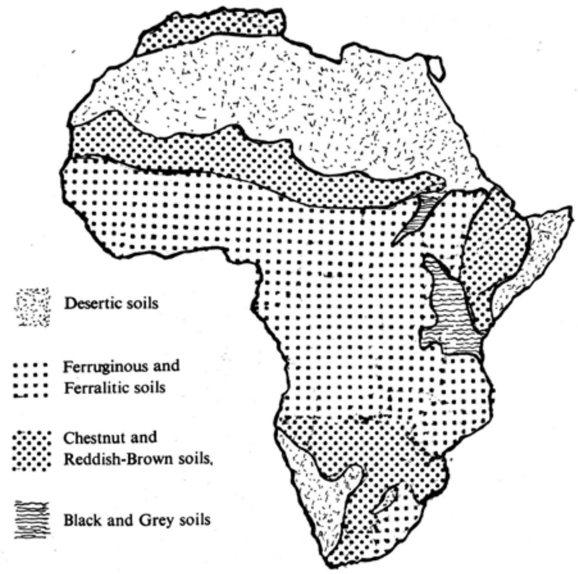
The Eco Moyo project provides an opportunity to study the notion of circular society at a small scale. By implementing and testing these steps in a small setting like Eco Moyo Education Centre, it will improve our understanding on how a sustainable and circular society can function at a larger scale and positively contribute to a built environment where materials and components get repurposed at the end of their life.

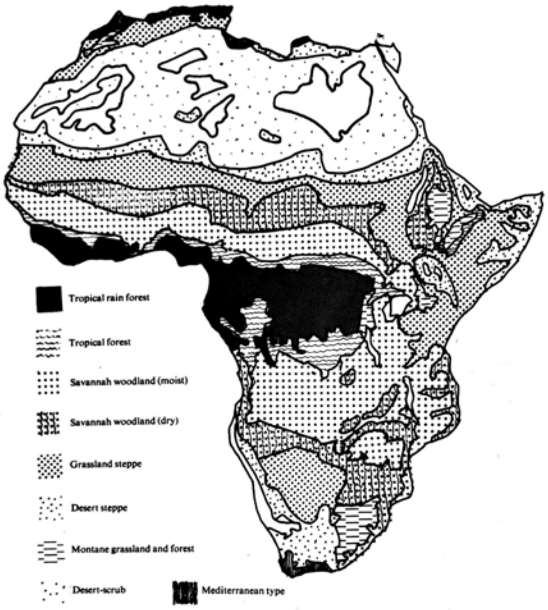
Eco Moyo aims to promote connections between schools, communities and the environments that sustain them. The aspiration of creating 'green schools' include characteristics such as growing chemical-free and ecological food, utilizing water in a sustainable manner, executing waste management and recycling, conserving energy and natural resources and constructing buildings with natural materials to name but a few.

IV. Local architecture: existing buildings and material used.

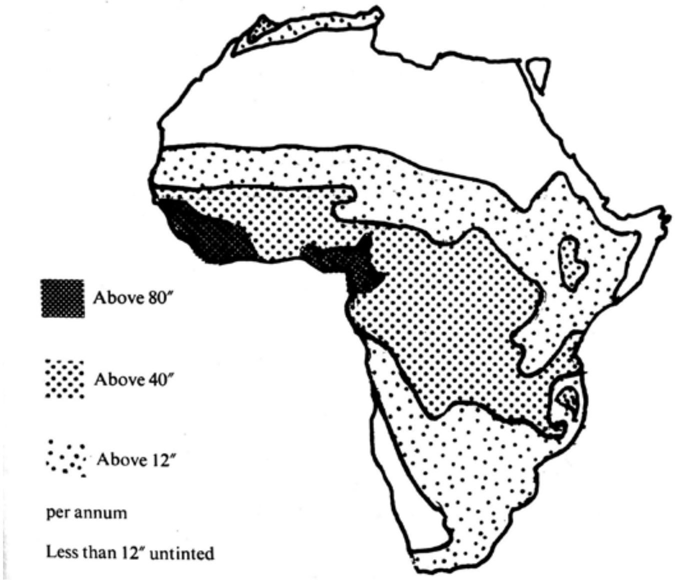




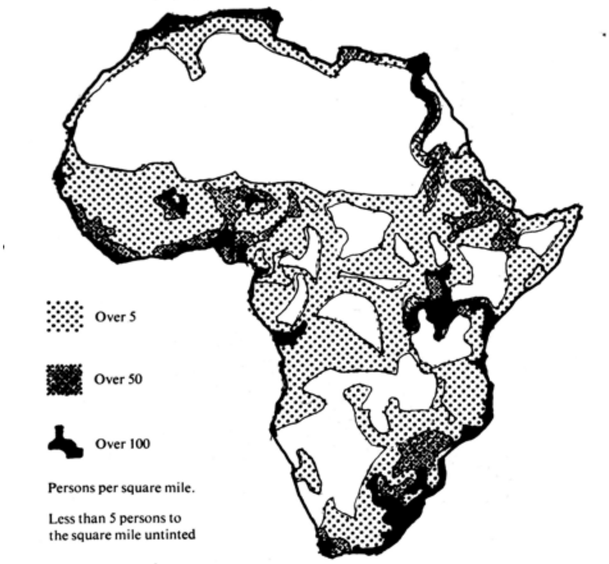
soils of Africa. [*11]



vegetation map of Africa. [*12]



rainfall map of Africa. [*13]



population map of Africa. [*14]

Kilifi County, Kenya, Africa 3°38’S 39°51’E

As/Aw (Köppen-Geiger system): tropical savanna climate

The weather is generally warm throughout the year - above 25°C. March is the warmest month of the year. The temperature in March averages 27.9 °C | 82.2 °F. The lowest average temperatures in the year occur in July, when it is around 24.1 °C | 75.4 °F. The annual temperatures in the county range between 21°C and 30°C in the coastal belt and between 30°C and 34°C in the hinterland.

The county experiences relatively low wind speeds ranging between 4.8 km/hr and 12 Km/hr. On average, the most wind is seen in May and the least wind is seen in November.

The winters are rainier than the summers in Kilifi. In a year, the rainfall is 1063 mm | 41.9 inch. The driest month is February, with 14 mm | 0.6 inch of rain. The greatest amount of precipitation occurs in May, with an average of 260 mm | 10.2 inch. Long periods of rain start around March and last into July, while the short periods start around October and last until December.

Local architecture elements.

foundation.

There are two primary methods for excavating foundations:

Digging by hand and marking with chalk, soil expands by 1.2 in volume when excavated, and can be compacted to about 0.9 its volume. Trench foundations dug by hand, minimum 3 courses deep, bottom up - 100 mm crushed hardcore (discarded coral stone), 50 mm kifusi (pulverized construction rubble), coral stone.

screens.

makuti: panels of sun-dried cocnut leaves
waddle and daub: sticks and mud

roof.

makuti (stacked panels of sun-dried cocnut leaves): insulates, inexpensive, ease of transportation, aesthetically pleasing, inclination cannot be less than 42°
mabati (corrugated metal sheets): thin metal sheets, allow for small inclination (5°) and water-catchment, high thermal radiation and reduced comfort in tight spaces

finishes.
nero: cement with pigment
mortar base for leveling the surface - 1 part cement, 5 part sand

Local materials present limitations as well as advantages for their use. To understand the local situation I spoke with Jan K. Godzimirski who was involved in many of the Eco Moyo projects.

"The materials used in rural Kilifi, Kenya range from highly processed materials like cement, corrugated metal sheets and river sand, to less processed materials such as four types of limestones – hardcore and grade 1-3 coral stones (masonry blocks) and various types of wood. Lastly are the unprocessed materials such as coconut-leaves, sisal, casuarina, local earth and beach sand.

Understanding these three stages of processing gives us a good overview of what is locally sustainable and what might present itself as an anomaly to the local structure. Unprocessed materials tend to be the cheapest and the easiest to get a hold of. While more processed materials tend to come from hardware shops and larger towns – thus transportation becomes a substantial factor in getting a hold of these materials.

Local materials have the common disadvantage that they are biodegradable, meaning that if they are used in a wrong way they will rot, and degrade with time – which for a structure could be catastrophic."

wood structures.

Common problems for woody materials is exposure to high levels of humidity over time, without room or time for sufficient drying, various bugs eat the softer types of woods, which causes the structures to fail locally.

casuarina.
Hardwood sourced locally and commonly cut and used immediately.
Irregular – tapering and not straight pieces.
Hard – tough to cut and nail.
Heavy – high density.
Skilled work – requires skilled labor for more intricate structures.

sisal.
Grass-like wood battens
Porous – weak tensile strength.
Irregular – varying dimension.
Biodegradable

pine.
Softwood used in some structures – seen as a invasive species.
Soft – eaten by bugs easily

masonry structures.

coral stones (hardcore).
Hardcore is used as a stabilizing material under various structures, walls, floor slabs and, and can be used in walls consisting.
Pebble - 4 - 64 millimeters
Cobble – 64 - 256 millimeters

coral stones (grade 1).
Limestone fine cut at 6 sides
Block – 200 – 200 – 400 millimeters
Skilled work – requires skilled labor for more intricate structures.

coral stones (grade 2).
Limestone fine cut at 4 sides
Block – 200 – 200 – 400 millimeters
Skilled work – requires skilled labor for more intricate structures.

coral stones (grade 3).
Limestone fine cut at 2 sides
Block – 200 - 200 (±10) - 400 (±20) millimeters
Rough surface
Control – hard to control courses

roof structures.

mabati (corrugated metal sheets).

Corrugated metal roofs are very resistant but have the disadvantage th at they can start leaking. Nails can get loose with time and make unwanted holes that start to leak during heavy rains over the very space they are trying to protect, sheets are generally very thin, and can start buckling during maintenance.

Noise – when it rains, and the roof is at low angles.
Heat radiation – when the space is not properly ventilated.
Leakage – where holes have been.
Corrosion – if not properly produced it can start to corrode.
Skilled craft – requires skilled workers to mount properly.

makuti (coconut leaves).

Makuti roofs are made of local coconut leaves – they are biodegradable and will with time need to be replaced. Depending on the "thickness" of these roofs the longevity of the roofs can vary from 10 to 30 years – leaks can happen in places where two different surfaces meet and produce a concave corner.

Biodegradable – relatively short lifespan if heavily exposed.
Skilled craft – requires skilled workers to mount properly.
Leakage – if placed improperly.

floors.

galana tiles.

Stone tiles from the Galana region
Irregular – thickness and size

concrete.

Labor intensive – mixed by hand, and large surfaces are difficult to make uniform
Weak formwork – weak formwork makes concrete imprecise
Adaptability – low repurposing of concrete elements with manual labor
Dusting – surfaces are generally weak if not sealed

nero.

Cement finish with pigment
Chips – with time small pieces can come of where the surface is heavily used or at corners.
Fades – pigment can fade over time, losing its intended color

V. Statement: The architect's role in an intuitive architecture.

What more can architecture do? As architects we should think about creating new job opportunities, looking for sources regionally and investing in dignity of the communities in which we serve. Architecture could become a transformative engine for a change.

Buildings should not be simply expressive sculptures. They make visible our personal and our collective aspirations as a society. Our job should be to make the teaching-learning process possible, sharing knowledge with non-professionals and creating interactions that connect communities.

Using our skills and knowledge we can improve the building process organization. Moreover by thinking about upcycling, waste management, designing for deconstruction and reuse of materials we can advance the way of thinking about architecture and buildings.

"Why was it that the best architects, the greatest architecture all beautiful and visionary and innovative is also so rare, and seems to serve so very few? And more to the point: With all of this creative talent, what more could we do?

And the beauty, to me, comes from the fact that I know that hands cut these stones, and they formed them into this thick wall, made only in this place with rocks from this soil.

When you go outside today and you look at your built world, ask not only: What is the environmental footprint? – an important question – but what if we also asked: What is the human handprint of those who made it?" [6]

[6]Murphy, Micheal. 2016. *Architecture that's built to heal.* TED Talks.

the eco moyo typology book.

architectural guide lines and
material reuse.

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content.

I. exploring eco moyo.

II. material reuse possibilities.

III. architectural guide lines.

the book.

The main idea for the diploma project is to write a book which examines the architectural typology of existing buildings and proposes guide lines for future projects at the Eco Moyo Education Centre, in Kilifi, Kenya. By exploring the local climate and the current architectural situation, I intend to collect information that helps me understand how materials are adopted locally.

With the collected information I wish to explore the relationship between material application, time and defect - by first reflecting on how the material is adopted, I will be able to conclude if the material performance its basic function. If it does not fulfil its function I will explore how it can be replaced and repurposed.

The architectural guidelines will be compiled to create a typology catalogue containing information about materials, structural solutions and adaptable sustainable solutions for recycling and repurposing local resources.

By implementing and testing these steps in a small society like Eco Moyo Education Centre, it will improve our understanding on how a sustainable and circular society can function at a larger scale and positively contribute to a built environment where materials and components get repurposed at the end of their life.

the project.

For the design of the diploma the idea is to propose a solution for a visitors area in Eco Moyo. The outcome of the book will serve as design-guidelines for a project - an experimental building that tests and implements the observations.

inspiration.

The inspiration that led me to this approach for my diploma project is the Japanese book "Design Part Collection In Japanese Traditional Style Architecture". A small-format textbook of traditional Japanese architecture and its terminology, this guide features clear drawings and diagrams, including isometric views and floor plans, that help users to understand every kind of architectural element.

„The things wabi-sabi are expressions of time frozen. They are made of materials that are visibly vulnerable to the effects of weathering and human treatment. They record the sun, wind, rain, heat, and cold in a language of discoloration, rust, tarnish, stain, warping, shrinking, shriveling, and cracking. (...) Though things wabi-sabi may be on the point of dematerialization (or materialization) – extremely faint, fragile, or desiccated – they still possess an undiminished poise and strength of character."[1]

„Things wabi-sabi can appear coarse and unrefined. They are usually made from materials not far removed from their original condition within, or upon, the earth and are rich in raw texture and rough tactile sensation. Their craftsmanship may be impossible to discern."[2]

1,2 - Leonard Koren „Wabi-Sabi for Artists, Designers, Poets & Philosophers"

Literature.

1. Fathy, Hassan, Walter Shearer, and Abd-el-rahman Sultan. 1986. *Natural Energy and Vernacular Architecture: principles and examples with reference to hot arid climates.* Chicago: Published for The United Nations University by University of Chicago Press.

2. Kozminska, Urszula. *2019. Circular design: reused materials and the future reuse of building elements in architecture. Process, challenges and case studies.* IOP Conference Series: Earth and Environmental Science.

3. Lammert, Laura, *Circular Economy in Architecture - sustainable principles for future design.* 2019. Master's Thesis, Oulu School of Architecture.

4. Murphy, Micheal. 2016. *Architecture that's built to heal.* TED Talks.

5. Nordby, Anne Sigrid. *2020. Linear vs Circular Society.*

6. Oliver, Paul. 2006. *Built to Meet Needs. Cultural Issues in Vernacular Architecture.* Elsevier.

7. Oliver, Paul. 2003. *Dwellings: The Vernacular House World Wide.* Phaidon Press Limited.

8. Oliver, Paul. 1971. *Shelter in Africa.* Barrie&Jenkins London.

9. Piesik, Sandra. 2017. *Habitat. Vernacular Architecture for a Changing Planet.* Thames&Hudson

10. Rudofsky, Bernard. 1964. *Architecture Without Architects. An Introduction to Non-Pedigreed Architecture.* The Museum of Modern Art, New York.

11. Röstlund, Ida. 2017. *Form Follows Material.* Master's Thesis, Chalmers University of Technology - Gothenburg.

Sources of illustration.

1. Oliver, Paul. 1971. *Shelter in Africa.* Barrie&Jenkins London. p. 27

2 - 10 . Eco Moyo, *https://www.ecomoyo.com/*

11-14. Oliver, Paul. 1971. *Shelter in Africa.* Barrie&Jenkins London. p. 15