AFRICAN CULTURE COMPLEX

AFRICAN CULTURE TOWER & HOTEL

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Co-Supervisors: Prof. Corrado Pecora
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POLITECNICO
DI MILANO

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School of Architecture Urban Planning Construction Engineering
2° level (Corso di Laurea Magistrale - Equivalent to Master of Science) - Architecture

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ABSTRACT

Africa has always been a continent of lost culture and traditions. So many inspiring stories that have been neglected, it's Art and Architecture unappreciated. Because of this there's is very little research in Medicine, Technology, Art. This leaves the whole world at a loss since this knowledge is a contribution to global knowledge. Some blame it on colonialism and slave trade and the perception of Africans and especially Negro's as an inferior race. That could have been a reason which gave room for Africans themselves neglecting their own rich culture and instead embracing foreign culture. While embracing foreign culture and methods is not a bad thing, the problem stems when culture is copied instead of being inspired from. The idea of inspiration is much stronger as it allows for stripping away unnecessary items from the source and only taking what is useful and combining it with the existing to create something beautiful. This aim of this intervention is to reawaken the passion for African Art and Architecture, using state of the Art technology and local content to pass a message that has both physical and mental value to those who belong to the culture and those wish to learn from it.

In context, the country which suits best this kind of intervention is Nigeria. A country with vast Natural resources in agricultural and mineral resources that even neighboring countries depend on, but also Human Resources with a population of 200 million people and over 360 languages and three times more dialects. It's evident that Nigeria has a lot of cultural history dating back to the early days of trans-Saharan routes. And with many Stories untold and many resources untapped, leaves room for a start of a New age.

The project, which is a Culture tower and Hotel located next to the airport of Abuja, the country's capital, will serve as an introduction to the many different resources of the country to transit passengers, visitors, residents. It would also include an educational facility where the visitors and the locals can learn native Art and crafts, a botanical garden with different fruits from all parts of the country and market place where all these crafts and products can be sold.

01 INTRODUCTION

1 - 1 COUNTRY: NIGERIA

Is a country in West Africa, bordering Niger in the north, Chad in the northeast, Cameroon in the east, and Benin in the west. Its coast in the south is located on the Gulf of Guinea in the Atlantic Ocean. The federation comprises 36 states and 1 Federal Capital Territory, where the capital, Abuja, is located Nigeria's population is projected to grow from more than 186 million people in 2016 to 392 million in 2050, becoming the world's fourth most populous country. Nigeria's sustained high population growth rate will continue for the foreseeable future because of population momentum and its high birth rat**e.**

Figure 1 : Map of Nigeria

Source : Google Map

NIGERIA : GEOGRAPHY

Nigeria is located in western Africa on the Gulf of Guinea and has a total area of 923,768 km2 (356,669 sq mi),[95] making it the world's 32nd-largest country. It is comparable in size to Venezuela, and is about twice the size of the US state of California. Its borders span 4,047 kilometres (2,515 mi), and it shares borders with Benin (773 km or 480 mi), Niger (1,497 km or 930 mi), Chad (87 km or 54 mi), and Cameroon (1,690 km or 1,050 mi). It's coastline is least 853 km (530 mi).[96] Nigeria lies between latitudes 4° and 14°N, and longitudes 2° and 15°E.

The Zuma Rock near Suleja

The highest point in Nigeria is Chappal Waddi at 2,419 m (7,936 ft). The main rivers are the Niger and the Benue, which converge and empty into the Niger Delta. This is one of the world's largest river deltas, and the location of a large area of Central African mangroves.

Figure 2 : Map of Nigeria showing state boundaries,waters and highway

Source : Google Map

NIGERIA : CLIMATE

Nigeria has a tropical climate with variable rainy and dry seasons, depending on location. It is hot and wet most of the year in the southeast but dry in the southwest and farther inland. A savanna climate, with marked wet and dry seasons, prevails in the north and west, while a steppe climate with little precipitation is found in the far north.

In general, the length of the rainy season decreases from south to north. In the south the rainy season lasts from March to November, whereas in the far north it lasts only from mid-May to September. A marked interruption in the rains occurs during August in the south, resulting in a short dry season often referred to as the "August break." Precipitation is heavier in the south, especially in the southeast, which receives more than 120 inches (3,000 mm) of rain a year, compared with about 70 inches (1,800 mm) in the southwest. Rainfall decreases progressively away from the coast; the far north receives no more than 20 inches (500 mm) a year. Temperature and humidity remain relatively constant throughout the year in the south, while the seasons vary considerably in the north. The humidity generally is high in the north, but it falls during the harmattan (the hot, dry northeast trade wind), which blows for more than three months in the north but rarely for more than two weeks along the coast.

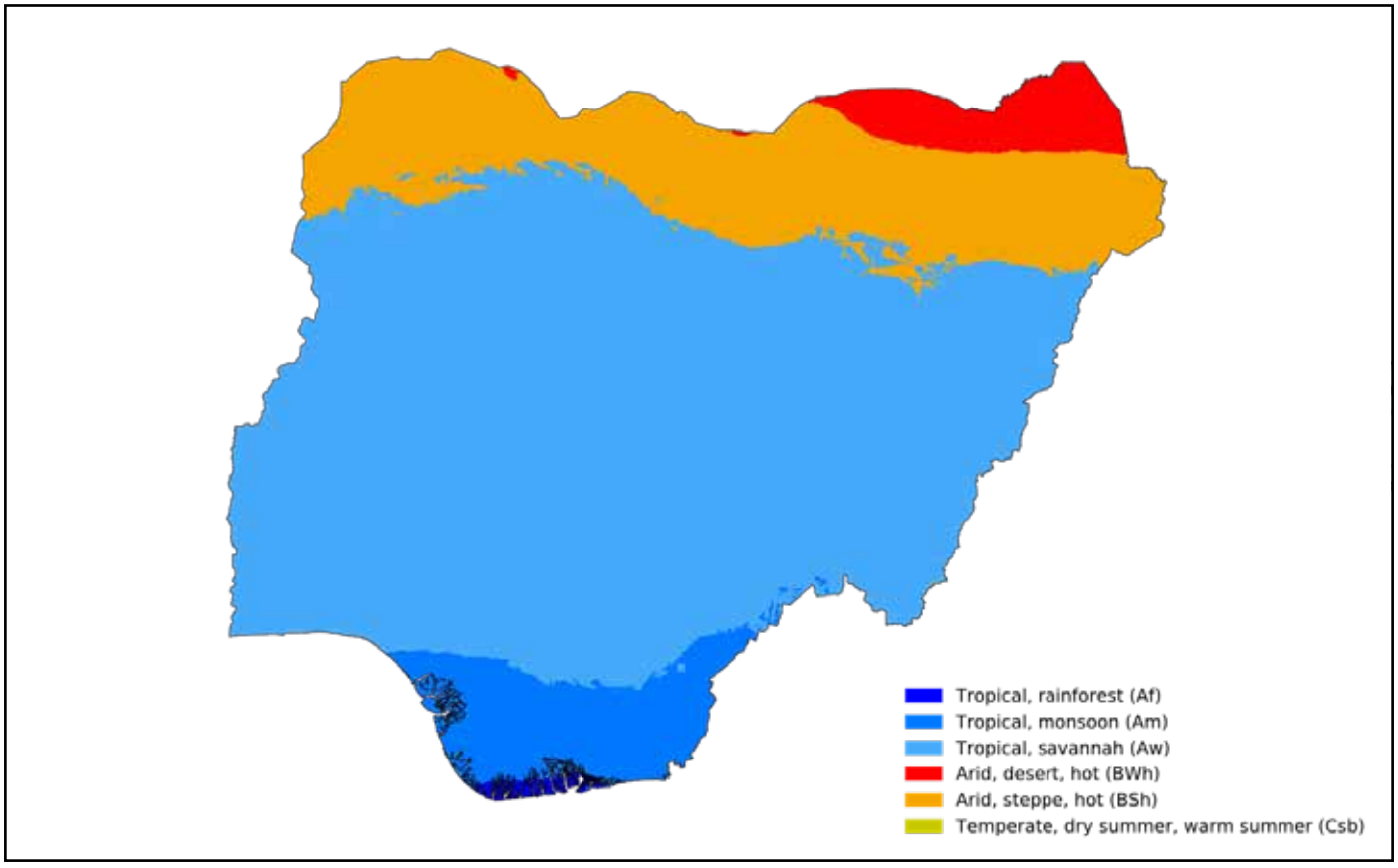


Figure 3: Köppen-Geiger Climate Classification Map of Nigeria (1980-2016)

Source :

NIGERIA : ETHNIC DIVERSITY (STRUCTURE)

Nigeria is Africa's most populous country, is composed of more than 250 ethnic groups. The country is a mosaic of many ethno-linguistic groups, some large, many very small indeed, altogether numbering about 250 to 400,The architecture of Nigeria at amalgamation comprised two entities: the Northern and Southern Protectorates. Each of these Protectorates contained large numbers of ethnic and linguistic groups, some large, some small, some not aware of their neighbours; some were organized prior to colonization into kingdoms, states, provinces or outposts of other power systems, while some were entirely clan based with little awareness of far-flung parts of the same ethnic and linguistic group so that amalgamation was in some cases a first step in bringing together the different clans of the same ethnic and linguistic group to a sense of a shared identity. The common myth is that Nigeria has 250 ethnic groups. Some estimates put the number at over 400 [cf. Bangura, nd]. The sociologist, Onigu Otite, has provided a list of 374 ethnic groups [Otite, 1990]. There is common agreement, however, that these ethnic groups are broadly divided into ethnic 'majorities' and ethnic 'minorities'. The numerically – and politically - major ethnic groups are the composite Hausa-Fulani of the north, the Yoruba of the southwest, and the Igbo of the southeast. These three 'hegemonic' ethnic groups are popularly referred to by the generic term 'wazobia'. Centres of large population concentrations coincide with the homelands of these three majority ethnic groups who constituted 57.8% of the national population in the 1963 census [Afolayan, 1978; 147 & 155]. That census has the Hausa at 11,653,000 (20.9%), the Yoruba at 11,321,000 (20.3%), and the Igbo at 9,246,000 (16.6%) [Jibril, 1991, 111]. All the other ethnicities constitute different degrees of 'minority' status. There are 'large minorities' like the Ijaw, Kanuri, Edo, Ibibio, Nupe, and the Tiv. Eleven of such largeminorities constituted 27.9% of the population in the 1963 census [Afolayan, 1978;

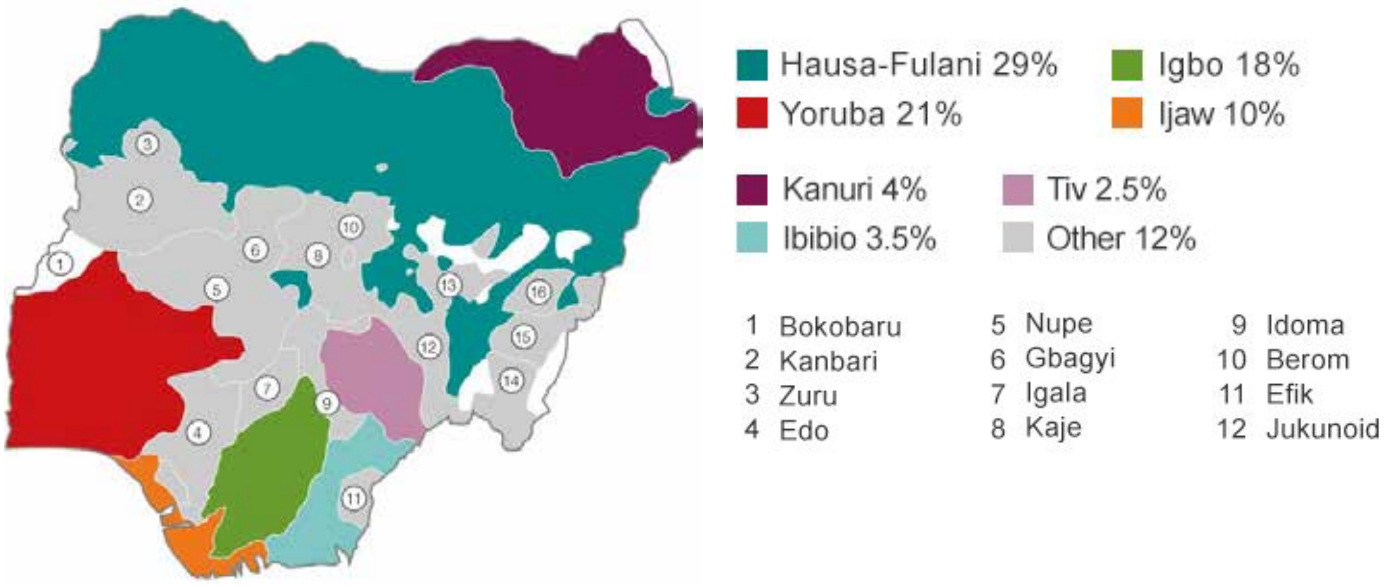


Figure 4: Major Etnic Groups (% of population)

Source :

NIGERIA : ETHNIC DIASPORA (CULTURE)

Nigeria hs vast population and concentrated ethic groups with different culture and belief system. However there are major, minor and much smaller ethic groups.That census has the Hausa,the Yoruba, and the Igbo. All the other ethnicities constitute different degrees of 'minority' status. There are 'large minorities' like the Ijaw, Kanuri, Edo, Ibibio, Nupe, and the Tiv. These groups have their unique arts and tradition

HAUSA AREWA

YORUBA TWINS

IGBO ADAMMA

IBIBIO MASK

BENIN BRONZE MASK

BENIN BRONZE MASK

FULANI CALABASH

URHOBO IPHRI

KANURI CALABASH

CITY: ABUJA

Abuja is the capital of Nigeria. It replaced the former capital, Lagos, as the capital city in 1991, although Lagos remains the most populous city.
Once Nigeria declared its independence, it was decided that a capital would be created that would unite the ethnicities and religions of the country. The location was selected during the 1970s.
The master plan for Abuja and the Federal Capital Territory (FCT) was developed by International Planning Associates (IPA), a consortium of three American firms: Planning Research Corporation; Wallace, McHarg, Roberts and Todd; and Archisystems, a division of the Hughes Organization. The master plan for Abuja defined the general structure and major design elements of the city that are visible in its current form. More detailed design of the central areas of the capital, particularly its monumental core, was accomplished by Kenzo Tange, a renowned Japanese architect.

Figure 14: Location of Federal Capital Territory in Abuja

Source :

ABUJA: MAP & MASTERPLAN

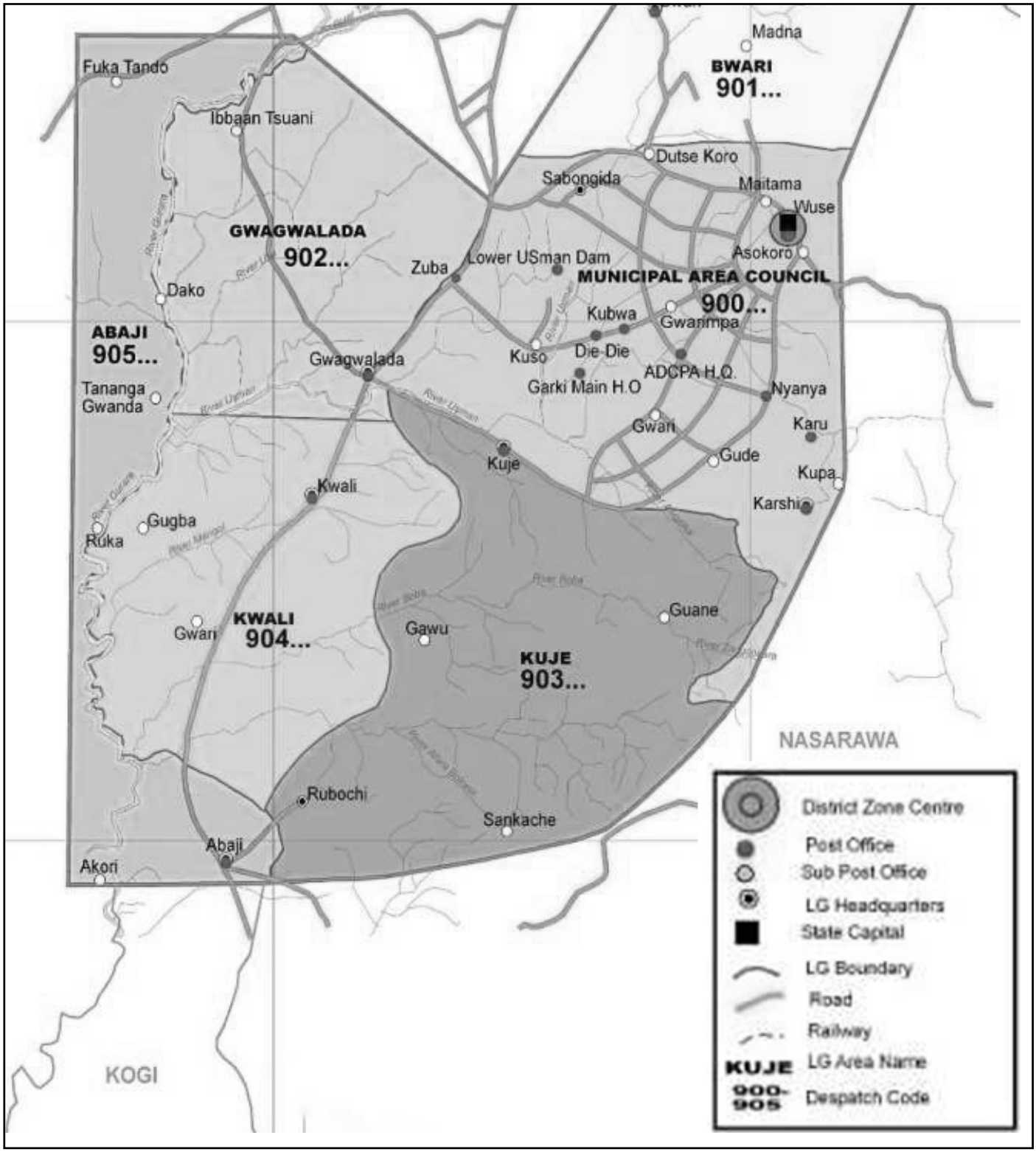


Figure 15: Maps of Federal Capital Territory

Source :

ABUJA: GROWTH DEMOGRAPHY

The city of Abaja is one of the only planned cities in Africa, and judging by its massive population growth, it is one of the most successful. The city is home to multiple religious sites and centers, including the Nigerian National Mosque.Abuja is one of the wealthiest cities in Africa.The city's population is extremely diverse, and groups that reside here include Afo, Gwari, Hausa, Koro and Bassa, just to name a few. The official language of the city is Enlish, although other languages are spoken, including Ibo, Fulani and Yoruba. Approximately-half of the city's residents are Muslim, 40% are Christian, and the remainder have follow other religions.

Abuja Population Growth

Abuja is one of the fastest growing cities in the world, with a population that already is climbing to 2.5 million since its development in the 1980s. During theearly 2000s, the city's population grew by almost 140%. Today, most areas of the city still see annual growth of 35%, making it one of the fastest-growing cities in the world. Because of the city's reputation for being welcoming to all groups, no matter their ethnicity or religion, the population is only expected to continue to grow for Nigeria's capital city. The last census taken in 2006 put the population at 776,298. However, between 2000 and 2010, the population grew by almost 140%, with more recent estimates showing that the population now exceeds 2.4 million.

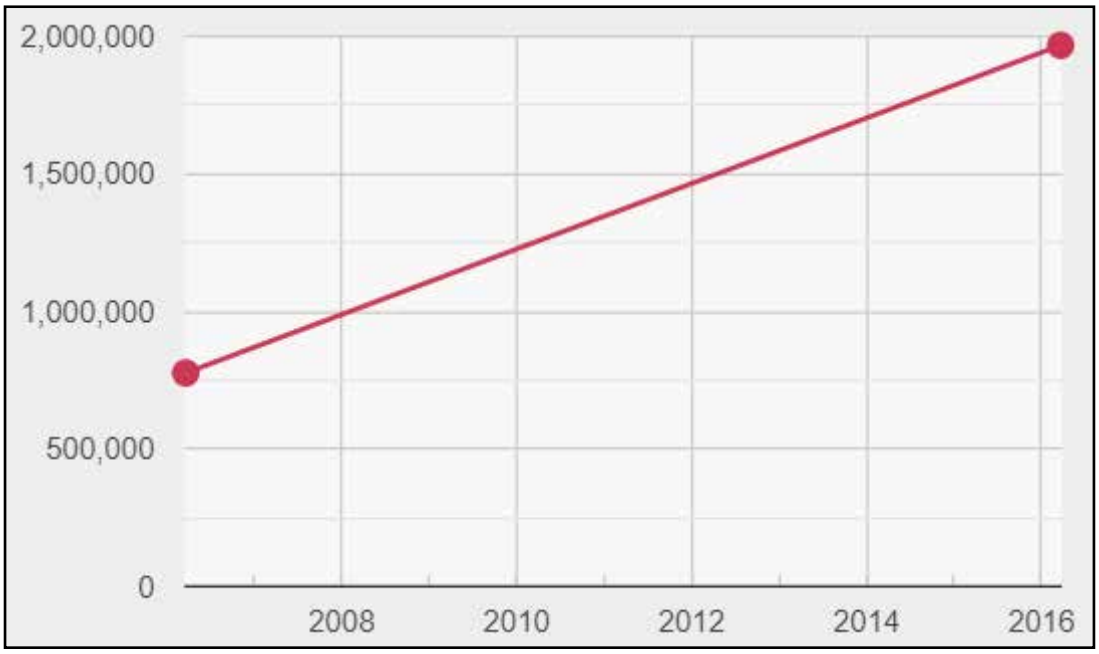


Figure 16: Growth Demographic Chart

Source :

ABUJA: URBAN SUITUATION

The questions are, who are the people mostly affected by the poor implementation of the Abuja Master Plan, Abuja demolitions and, the high cost of securing housing accommodation in Abuja and its territory? According to Bamidele (2010), most of the workers who cannot afford to live within the city, find their way to the squatter settlements and uncompleted or abandoned buildings within the city which punctuated all high-brow areas of the city and many The people, according to Uji and Okonkwo (2007), frustrated by the inadequacies and failure of the conventional approaches to provide urban shelter and services to a significantly large enough proportion of the poor in the urban areas of the developing nations, these ever-increasing class of urban populations have to resort to squatting on public or private land, either by invading and forcefully occupying or leasing such land (illegally sub-divided) on which they hurriedly construct (through self-help) their shelter from any available materials using any readily affordable and available technology.

The government's approaches have not necessarily, extensively reviewed and investigated the ancestral concerns of most of the residents of the Abuja urban poor communities. A lot of government's solutions are centered on quick-fix urban renewal programmes that have not in anyway, helped the course of the urban poor communities and settlements in Abuja metropolis. The demolition exercises (several), resettlements and land swaps programmes adopted by the governments have added more frustrations to the Abuja urban poor problems instead of solving them.
Almost all the government housing programmes have failed to address the housing needs of the urban poor, especially, the Abuja urban poor housing demands. Keeping and maintaining the government's failed, orthodox housing delivering schemes to the expanding poor Nigerian populations, how can the government, sustainably, provide where the urban poor can live without disturbing the urban equilibrium, knowing that they (the urban poor) have no lands, that they squat anywhere they see and provide services needed to maintain the rich communities. Lack of accommodation has become the bane of most Abuja residents. During the Mallam Nasir el-Rufai administration of the Federal Capital Territory (FCT), many residents of Abuja lost their houses to the demolition exercise. That incident, however, contributed to the high cost of securing accommodation in the city center and even in the satellite towns. The influx of people into Abuja to look for greener pastures has helped to worsen the situation. To the average civil servant, securing a befitting accommodation in the FCT, irrespective of its location, is not only a challenge, but also an uphill task. Decent accommodation has continued to constitute a big problem to Abuja residents. Houses located at Garki, Maitama, Asokoro, Wuse, Jabi and Utako districts are practically beyond what the middle and low income earners can afford. That resulted to concentration of squatter settlements in the Federal Capital Territory.

ABUJA: URBAN INBALANCE

Squatter settlements and urban imbalance

ABUJA: URBAN CASE STUDY

Kuruduma community in Asokoro

The Story of Koroduma, the Slum near Asokoro in Abuja, Nigeria, where Opulence meets Squalor, Odinaka (2017), indicated that, it is a tale of striking ironies. Opulence on one side, squalor and debilitating poverty on the other side. That is the story of Koroduma, a slum near the highbrow Asokoro in the Federal Capital City of Abuja, Nigeria Undoubtedly, there are scores of slums in Abuja, but Koroduma stands out for its heart-rending narrative. The United Nations Human Settlements Programme (UN Habitat) in Nigeria has stated that about 80 million Nigerians, representing 79 per cent of the population, are living in slums. Growth of informal settlements are on the increase in the FCT. This is largely as a result of inadequate, unaffordable housing for all classes of the citizenry. The challenges of securing land tenure for the teeming populace, the high cost of building materials, inaccessible mortgage mechanisms for the poor as well as the high rents of urban accommodation have been responsible for the mushrooming of many of the city's suburban slums. To get to Koroduma village, one needs to get to the "Asokoro AYA," where tricycle-lists line up for their turns to the bus stop called Kasangari. There, one would be greeted by hundreds of makeshift shacks, most of them made of mud, roofed with rusty zinc sheets.The settlement, like every other village, despite the obvious chaos in the structures, has leaders and a system of law and order. One feature of the village that stands out is its landscape. Roads are dusty and narrow.

The image above clearly shows the extent of urban and Architectural disconnect in one area due to negligence of professionally established policies and bad governmance .

Figure 23-24: Amenities/Environmental Urban constrast between Asokoro and Kuruduma village (In Asokoro) .

Source :

ABUJA: URBAN CASE STUDY

Kuruduma vs Asokoro in light of Housing suituation and Economic performance

An apartment built either with mud or cement costs between N100,000 and N150,000 in rent compered to millions of Naira paid in properly surveyed areas in AsokoZro and other parts of the Abuja city. The residents seem to have come to terms with their community and see nothing wrong with their garbage-infested environment. It is a place that would always command attention and elicit questions such as what are the possible solutions to revitalise the unhealthly condition of this community.

Adiukwu (2014), in his Prospects and Challenges of Informal Settlements and Urban Upgrading in Abuja, indicated that, poverty has a social dimension (poor quality of housing and the living environment, i.e. lack of access to basic services like clean water, health care, education etc.). Abuja is one of the most rapidly urbanizing cities in Africa, faced with challenges of squatter settlers. The shelters are, built by the efforts of the squatters who cannot afford to secure legal or formal land or a safe site on which a house can be, built. Informal land developments provide shelter for over 85% of the population of urban residents in most developing Nations (UNCHS, 1996 and 2000; Durand-Lasserve, 1997). Urban Poverty,citing Copenhagen resolution (2000), is strongly associated with high levels of environmental risk. This is largely due to poor quality and overcrowded housing conditions and the inadequacies in provision of water, sanitation, drainage, health care, garbage/ waste collection, poor percolation resulting into flood, building on waterways and pollution of land, air, and water. Daramola and Ibem (2010) affirmed that the concentration of more people in urban areas has brought more pressure on the land space for the production of food, infrastructure, housing, and industrialization. The movement affects the capacity of the environment to cope, as each additional person increases the demand on the infrastructure and the natural system and as result creating ecological imbalance with adverse environmental penalty in hazards and disaster.

Figure 25-26: Housing Urban constrast between Asokoro and Kuruduma village (In Asokoro) . The image above clearly shows the extent of urban and Architectural disconnect

Source :

ABUJA: LAND USE

Abuja was declared the new capital city of Nigeria in 1976, due to overpopulation, shortage of land for urban expansion, distortion of the master plan, and traffic congestion, in the formal capital Lagos. By contrast, Abuja featured availability of space for urban development, a central location to provide almost equal access to the different ethnic groups across Nigeria, and an ethnically neutral territory . The FCT Abuja was carved out from four states. The seat of government was officially relocated to FCT Abuja in 1991 and since then the region has witnessed a high rate of urban growth . The population of FCT Abuja was 1,406.239 million in 2006 . Based on the 2006 population, we estimate the population of FCT Abuja to be 3,770,376 million in 2017. This population expl sion and the accompanying sprawl has led to pressure on the surrounding natural resources causing loss of other land uses in the region.

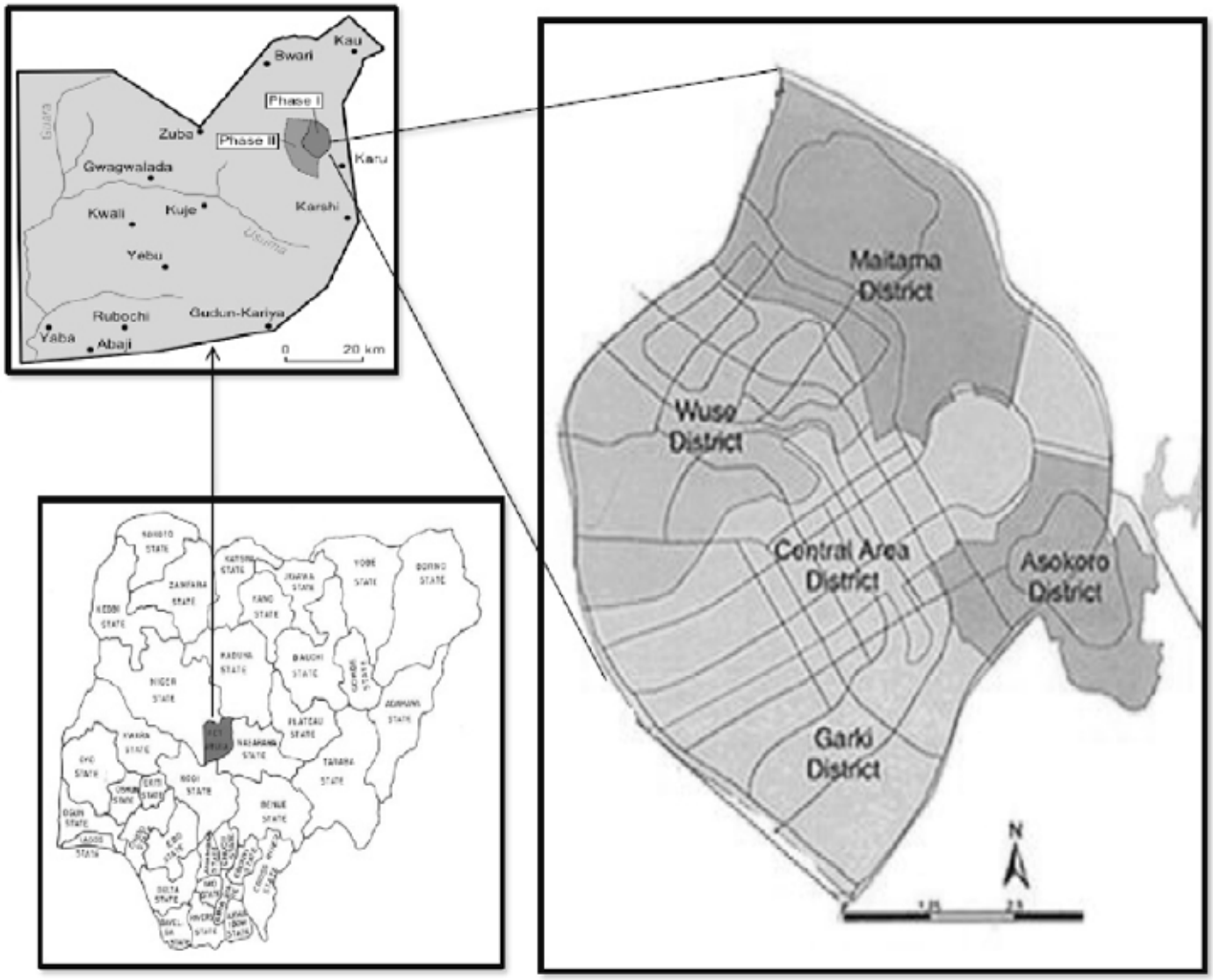


Figure 27: Most developed areas of Abuja city

Source :

ABUJA: LAND USE

In 1979, the Abuja master plan was prepared to comprise regional and urban land use plans The regional land use plan covers the FCT Abuja, while that of the urban land use plan was limited to the city, Abuja, and was divided into four phases. The four development phases included 5, 15, 19, and 29 districts, respectively . Phase 1 included the central district (planned for the governmental seat of power and the Central Business District), and four other residential districts ,Additional urban land use plans for the satellite settlements were separately designed . However,through field surveys, we observed that the urban land use plans for the satellite settlements have not been implemented in most areas. These areas are currently characterized by informal settlements. The purpose of the Abuja land use plans included the designation of areas for urban land uses, the preservation of the natural environment, improved accessibility of all areas , coordination of land use, etc. Monitoring of urban expansion and updating of land use plans are challenged by rapid urban growth and especially by the development and expansion of informal settlements in peri-urban/satellite settlements in the city-region. In Abuja city, urban land uses expanded from a few development districts to create some urban extensions. Vegetation, which is another important land cover in the Abuja city-region, is similar to that of other parts of FCT Abuja. The vegetation is categorized under the West African ecoregion of Guinean Forest-Savannah mosaic. Due to the location of the Abuja city-region in the northern part of FCT Abuja, the area is dominated by the savannah vegetation, which is characterized by deciduous trees that are scattered among grasses .

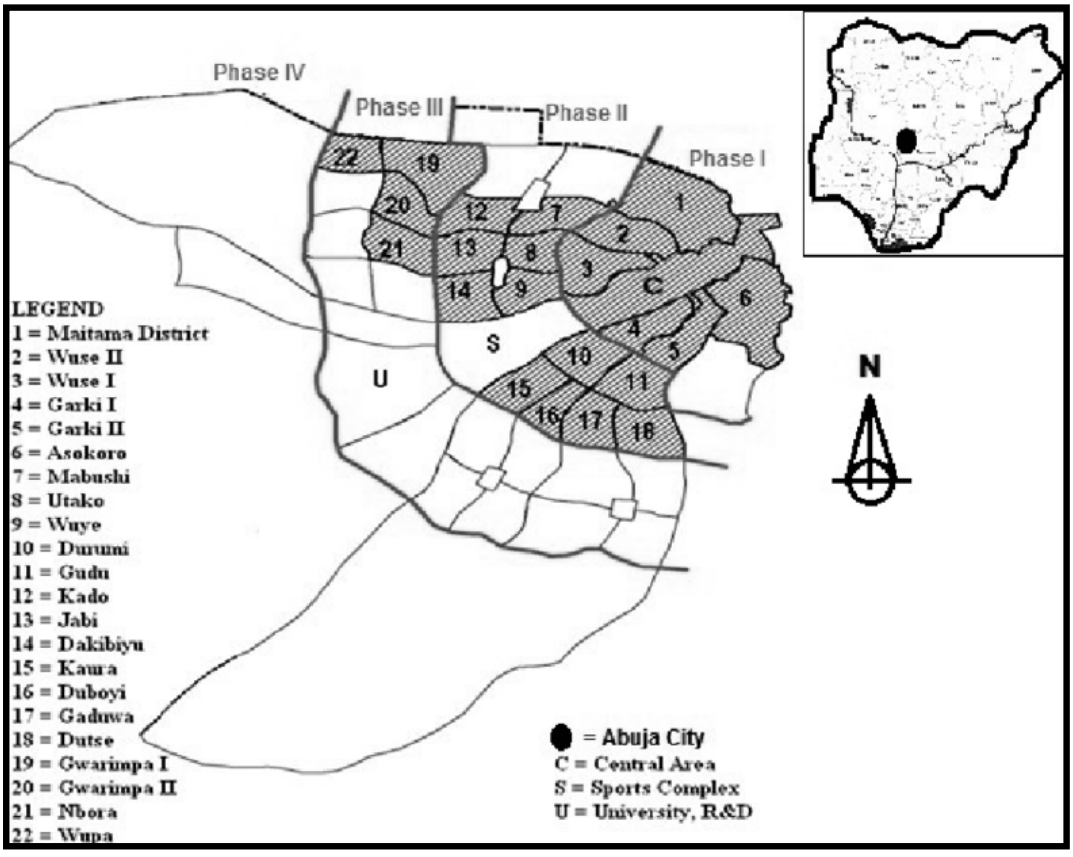


Figure 28: Proposed four phases of Abuja city and areas

Source :

ABUJA: LAND USE

Calculated area of land cover of Abuja in 1987, 2002, and 2017.

Land Cover classes	1987	2002	2017
Urban/built-up	36.8 (1.8%)	198.8 (10.0%)	385.4 (19.3%)
Vegetation	1455.6 (73.0%)	1262.5 (63.3%)	1011.9 (50.8%)
Bare land	491.9 (24.7%)	522.1 (26.2%)	588.6 (29.5%)
Water	9.3 (0.5%)	9.6 (0.5%)	7.7 (0.4%)
Total	1993.6 (100.0%)	1993.0 (100.0%)	1993.6 (100.0%)

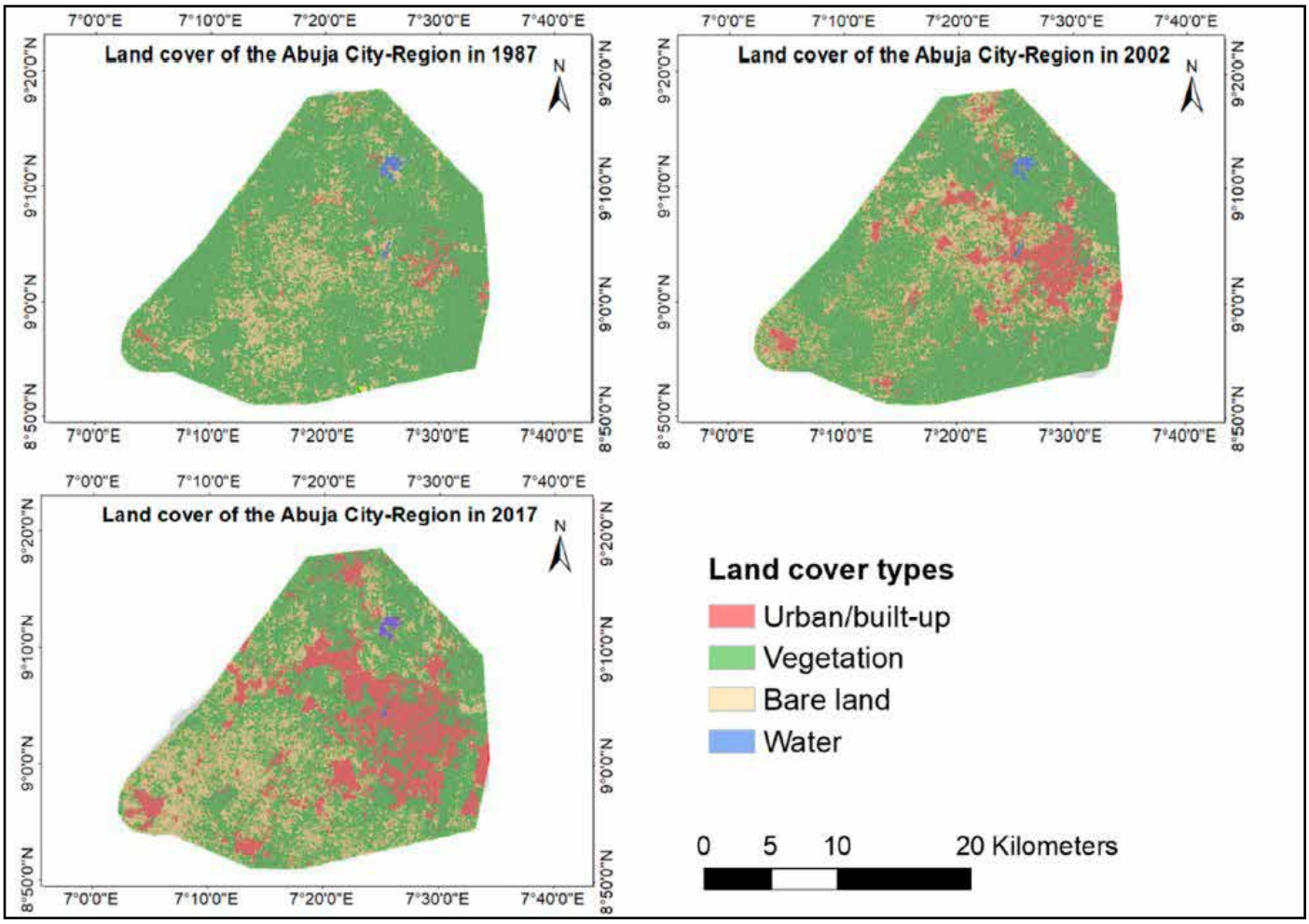


Figure 28: Land cover of Abuja city-region in 1987, 2002, and 2017

Source :

ABUJA: LAND USE

The regional land use plan indicated that the area designated for urban development are primarily within Abuja city, with urban extensions in the peri-urban/satellite settlements. In the southern part of the city-region, the area designated for urban development for Abuja city extends beyond the boundary of the city-region.

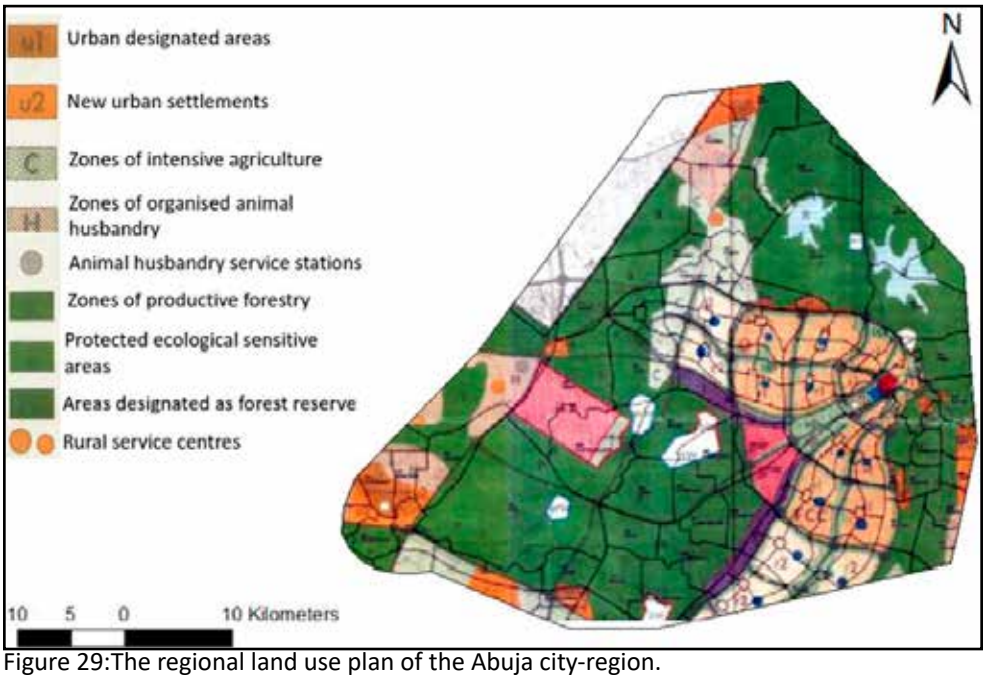


Figure 29:The regional land use plan of the Abuja city-region.

Source :

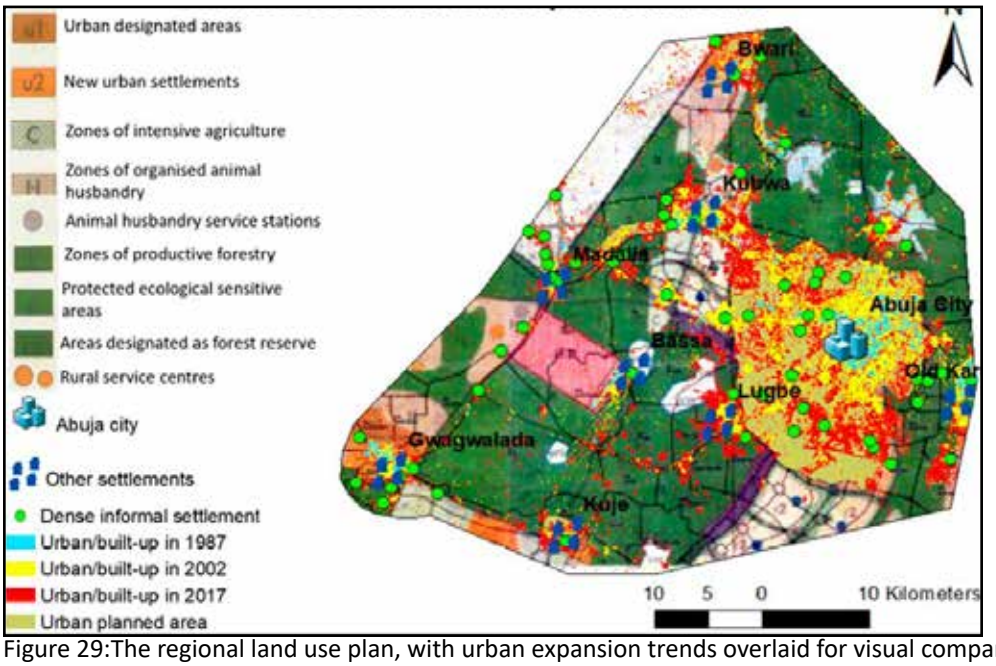


Figure 29:The regional land use plan, with urban expansion trends overlaid for visual comparison.

Source :

ABUJA: LAND USE

The past and current urban expansion encroached into the proposed land use for intensive agriculture, animal husbandry and protected areas. The protected area lost to urban/built-up in 1987, 2002, and 2017 are 0.92 km2, 6.84 km2, and 16.65 km2, respectively. In 1987, 2002, and 2017, the proposed land use for intensive agriculture lost 3.73 km2, 18.98 km2, and 34.91 km2, respectively, while that of animal husbandry lost 0.16 km2, 1.16 km2, and 3.59 km2 to urban/built-up. From 1987 to 2002 and from 2002 to 2017, the ACR of the protected areas lost to urban/built-up is 0.39 km2 and 0.65 km2 per year. The ACR of the proposedland use for intensive agriculture lost to urban/built-up is 1.02 km2 from 1987 to 2002 and 1.06 km2 from 2002 to 2017 per year, while that of animal husbandry is 0.07 km2 and 0.16 km2 from 1987 to 2002 and from 2002 to 2017.

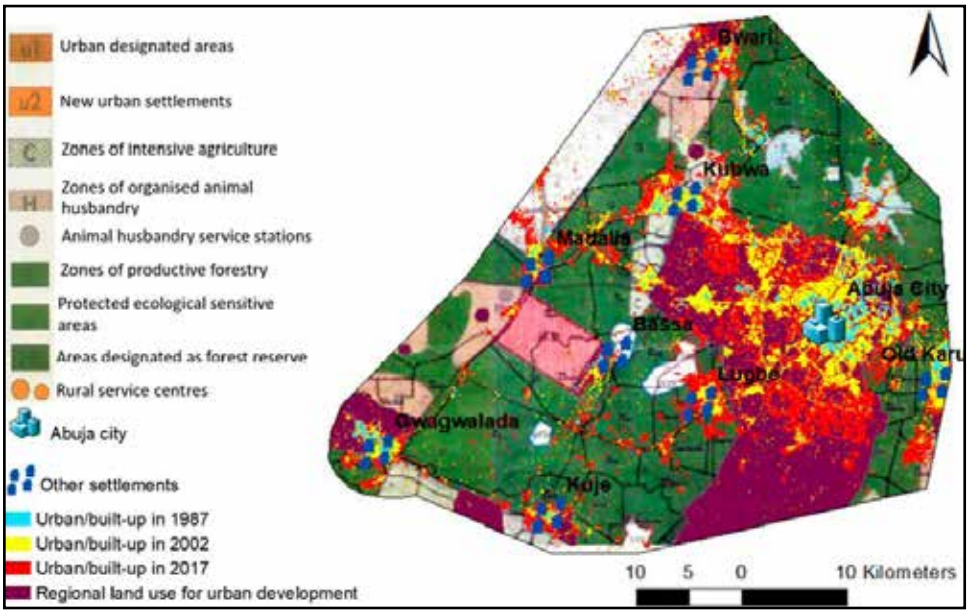


Figure 31:The regional land use for urban development and urban expansion into other land uses.

Source :

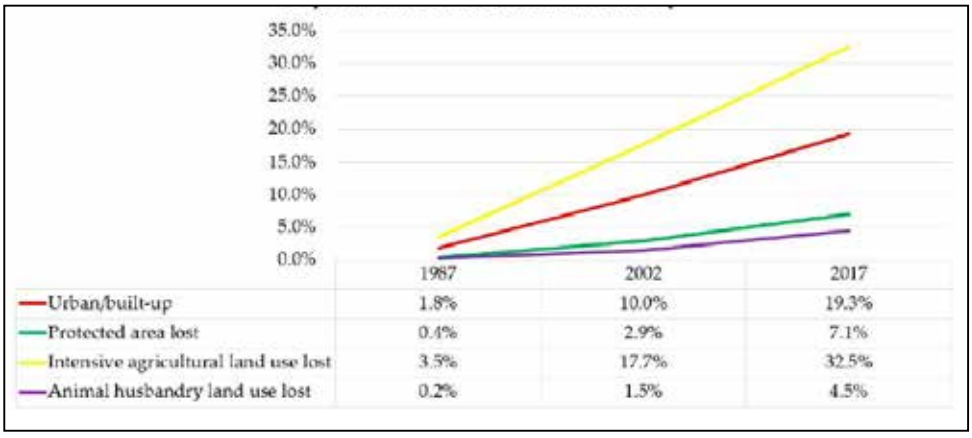


Figure 32: Percentage of proposed land uses lost to urban/built up and urban expansion trends

Source :

ABUJA: SUSTAINABILITY

The Three Pillars of Sustainability

In 2005, the World Summit on Social Development identified three core areas that contribute to the philosophy and social science of sustainable development. These “pillars” in many national standards and certification schemes, form the backbone of tackling the core areas that the world now faces. We must consider the future then, in making our decisions about the present.

Economic Development
Economic development is about giving people what they want without compromising quality of life, especially in the developing world, and reducing the financial burden and “red tape” of doing the right thing. Also, to encourage and foster incentives for the average person to do their bit where and when they can; one person can rarely achieve much, but taken as a group, effects in some areas are cumulative. The supply and demand market is consumerist in nature and modern life requires a lot of resources every single day; for the sake of the environment, getting what we consume under control is the paramount issue.

Social Development
It is also about maintaining access to basic resources without compromising the quality of life. The biggest hot topic for many people right now is sustainable housing and how we can better build the homes we live in from sustainable material. The final element is education - encouraging people to participate in environmental sustainability and teaching them about the effects of environmental protection as well as warning of the dangers if we cannot achieve our goals.

Environmental Protection
We all know what we need to do to protect the environment, whether that is recycling, reducing our power consumption by switching electronic devices off rather than using standby, by walking short journeys instead of taking the bus. Businesses are regulated to prevent pollution and to keep their own carbon emissions low. There are incentives to installing renewable power sources in our homes and businesses. Environmental protection is the third pillar and to many, the primary concern of the future of humanity. It defines how we should study and protect ecosystems, air quality, integrity and sustainability of our resources and focusing on the elements that place stress on the environment. It also concerns how technology will drive our greener future; developing technology and biotechnology is key to this sustainability, and protecting the environment of the future from potential damage that technological advances could potentially bring.

02 URBAN CONTEXT

SITE: DISTANCE ANALYSIS

The project site is located 8kms away from the city international airport,15kms away from rail line and 35kms away from the city .Also around the project site are smaller rural communities,farm lands and military base.

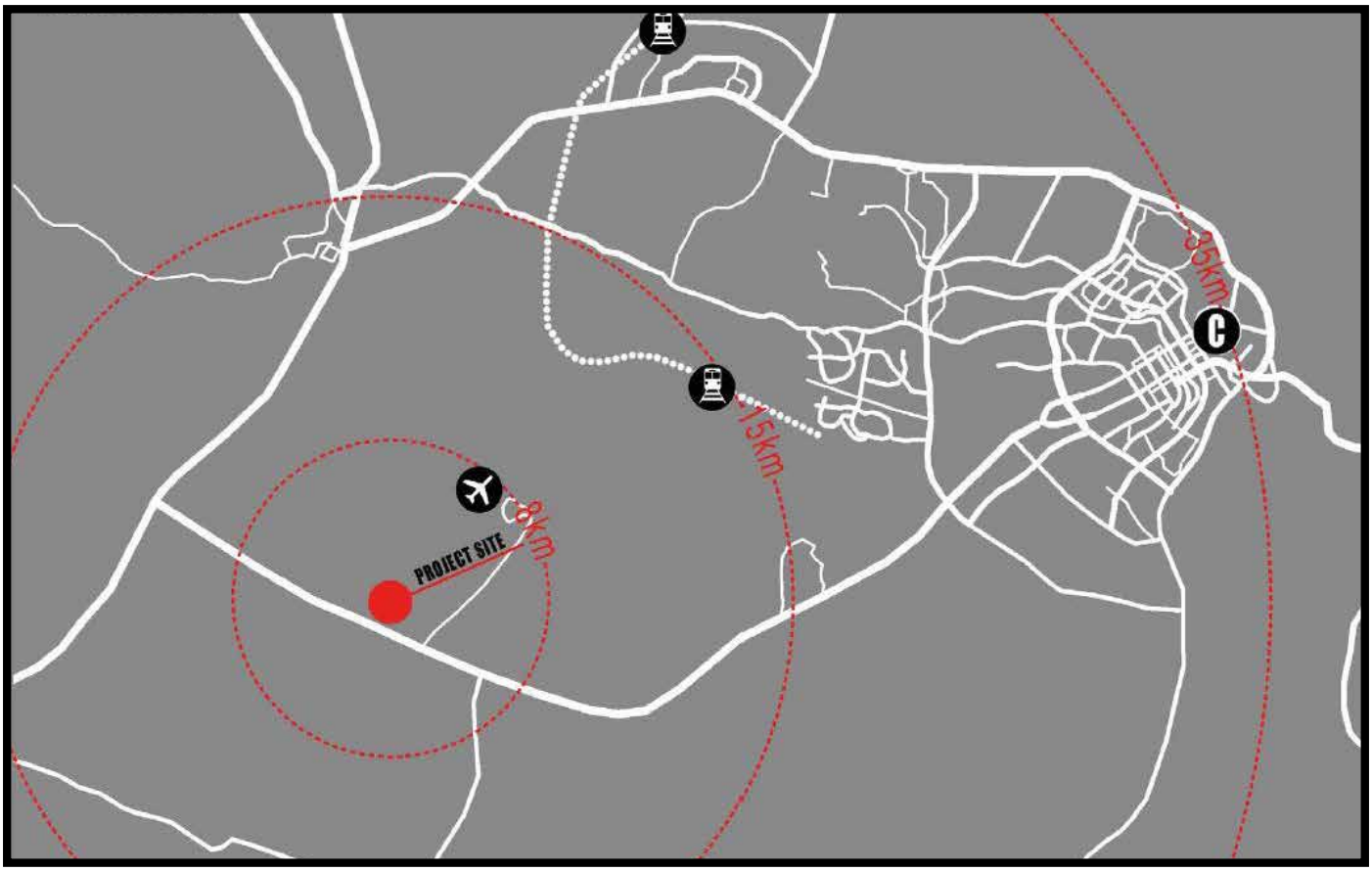


Figure 33: Distance Analysis from project site into the main city of Abuja

Source :

SITE: CURRENT SUBURBAN SUITUATION

The airport/military district is a sub urban region which through our project and proposal will regenerate and improve the current livelihood of dwellers of this region.however the inhabitants of this region is considered low income earners and lacks proper infrastructure to aid quality living, hence the language Urban regeneration. The settlers of these various communities in this region expresses and practices a certain lifestyle as regards to business, ethnic belives,arts and security.Their major means of livelihood boarders of Agricultural produce mud art and wood crafts. However,in recent times these communities have experienced some level of economic burst following the establishment of an airport and major raod route linking the airport to other more developed cities hence providing opportunity to sell their agricultural produce and home made crafts to travellers.

As shown in the images,These smaller communities display and sell their agricultural produce and wood crafts on a major highway with the aim of selling to travellers . Our proposal will however bring a positive and sustaintable turnaround in terms of social development, Economic development and environmental protection.

SITE: COMMUNITIES

SITE: PURPOSE, AIM, APPROACH

Having understood the sub urban way of life,needs and their social class in the econocomic and urban context at diffferent scales, it is paramount to underlay in details the foreseen improvement the proposed project will drastically induced in this region,also approach and scientific methods adopted to ensure the realization of goal as regards to the project.

AIM
- To revive a highly potiential but static environment
- To improve quality of life
- To equalize the urban imbalance between this region and the main city
- To drive innovation on both local and international scale

REVIVAL CONSIDERATIONS
- Infrastructure
- Financial Empowerment and Awareness
- Access to quality healthcare,education and services
- Affordable housing

APPROACH
- Inclusive urban redesign (consideration of all social classes)
- Integrated architectural design to achieve better building behaviour
- Use of traditional materials which are cost effective and readily avaliable

Improve Economic Situation

Attraction Point

Agricultural Products

African Culture

Safety Environment

Comfortable Accomodation

URBAN CONTEXT: PROJECT PROPOSAL

African Culture Complex

we would like to provide people with the experience of African culture during their visit. There has also been the argument of stolen artifacts by Colonialists (British, etc) on whether they should be returned or not. Recently, proposals have been made as to whether they should be returned unconditionally or loaned back to Nigeria. So we would like to design an African Culture tower (a tall building) that will have a museum that these artifacts can be returned and an African themed spa hotel which services the traditional experiences about Africa. This tower will contain different activites including museum,conference rooms,restraunt, interesting architectural elements such as high windows, ramps and so on which will aid in giving interestin views and utmost intimate experience.

Most importantly this project will be executed using readily available and traditional building materials which are Red clay and bamboo.The project aim to meet across the globe creating the awe sense of feel of originality and geniuenity of a dwindling culture and tradition through the maginfying lens of architecture, we intend to create through this project a deep level of intimacy between these buildings and the guests
The desired construction technique for this project is the use of the 3d clay printing machine and wiil will done on site.


HOTEL


SPA CENTER


MUSEUM


BAMBOO


CLAY

SITE: CONTEXT

Following the instensive study of Abuja and the site location of the project, It is imperative go gradually and logically develope a masterplan that best suites the project, the users and the environment.
Stage 1, Acknowleging the presence of the water body and planning activities to flow in linar manner

Stage 2 creation of master plan in 3 linar directions Market place, Hotel/botanical Garden and Arts/crafts district

SITE: CONTEXT

stage 3, Defining the urban pattern ınto zones

stage 4, Introduction and planning of the Arts/craft district and Marketplace district following the historic and traditional settlement pattern

SITE: CONTEXT

stage 5, Introduction and planning of the botanical garden in a very fluid and organic pattern

stage 6, Introduction and planning of hotel settlement and tower into green zone.

URBAN PLAN


Art & Craft District
Culture Hotel
Green Wall
Culture Tower
Botanic Garden
Marketplace

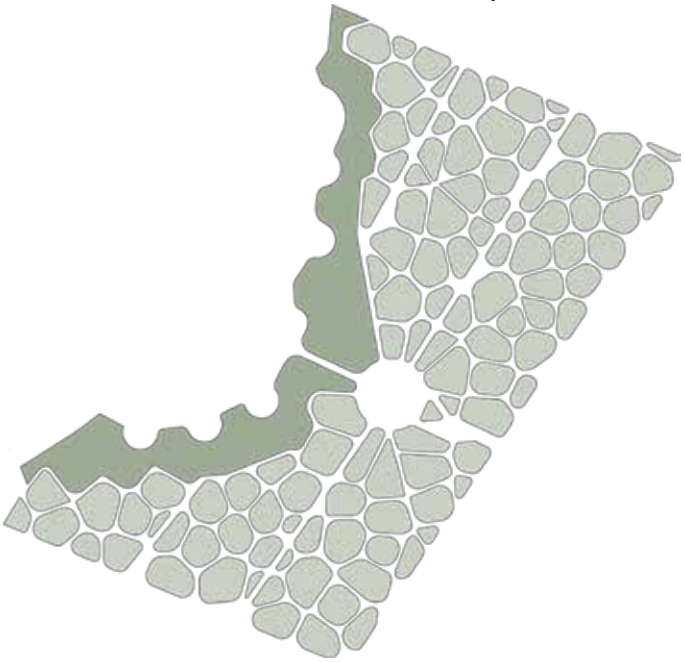
ENVIRONMENTAL CONSIDERATION

Vegetation

Given the gblobal issue of carbon print/Global warming which threatens the eco systems and environment at large, we are compelled by ethics of research to think in a more sustainable dimension as how we can through our project mitigate or reduced the existance these threat .This very much influenced the choice of materials to be used both on the building and landscape. In Nigeria the CO2 emissions per capita for was 0.44 metric tons as a result of burning fossils and manufacture of cement.They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. And so to reduce the carbon footprint in and around the project area, we propose to have a BOTANICAL GARDEN and GREEN WALL which includes varieties of trees,fruits and flowers also we choose to use more sustainable materials like clay and bamboo.

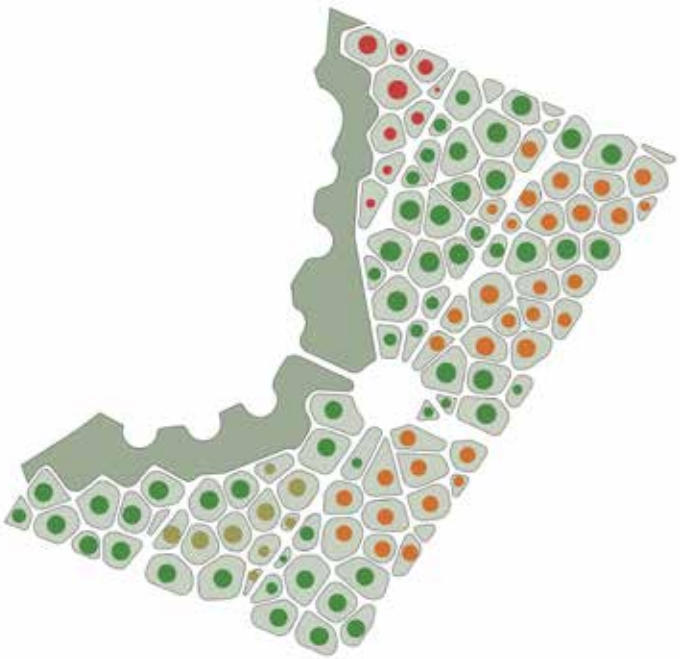
Clay as a building material provided by nature has numerous advantages for which energy efficency is one of many.
Bamboo as a natural composite material is energy efficient ,sustainable and self reliance.
Plants flowers absorbs Co2 for sugar and oxgygen production
through celluare respiration.

The Green wall serves as natural air-filtration system and Noise/wind barrier.



Botanical Garden

The Botanical Garden in our project serves various unique purposes all at once which includes restoring ecosystems,provide knowledge on biodiversity and promotes human to nature relationship on the greater scale which defines the one of the numberous research ethnics in our project from the enviromental point of view.



Varieties of Plants

The Botanical gardern contains varieties of fruits and flowers which is accessible to all guests .Here are some of the local fruits in the botanical gardern

03 ARCHITECTURE

CONCEPT : FULANI CALABASH INSPIRATION

These images of women signify the typical fulani woman carrying a calabash of cow's milk, which is a very popular drink in Nigeria. The way in which they carry the calabashes in stacks on their looking like a tower is what is inspiring. They carry them for long distances and have perfected the art of stability over time. In Some cases they use a system of ropes to bind them together. the ropes are made from palm leaves. They usually first place a support which in this case we can refer to as a "plinth" that is usually textile wrapped in the shape of a donut. which normalizes the curvature of carrier's head and the calabash base, then subsequent calabashes are stacked on each with a flat disc covering called "marufa" made from straw.

The Calabash itself is made from the fruit of the calabash tree which is popular in tropical regions around the world. When the fruit is harvested, its cut open in half and the juice and seeds are scraped off from the shell and used as drinks or for medicinal purposes. The shell however, is left to dry and then decorated with variety of designs. Some of them tell stories of the user's or their tribes. it is resistant to degradation from moisture and very stable. Because of this it can be used to store liquids and food.

The fulani people are nomadic people who have established routes for over 200 years and travel all across the equatorial region of africa from West- Central -and East. Fula are primarily known to be pastoralists, but are also traders in some areas. Most Fula in the countryside spend long times alone on foot, moving their herds; they were the only major migrating people of West Africa. Taking from the calabash inspiration we designed our tower in this form. With this we took inspiration for our tall building, by stacking calabashes on top of each other to get a tower with other stacks similar but lower to make them act as a cluster.

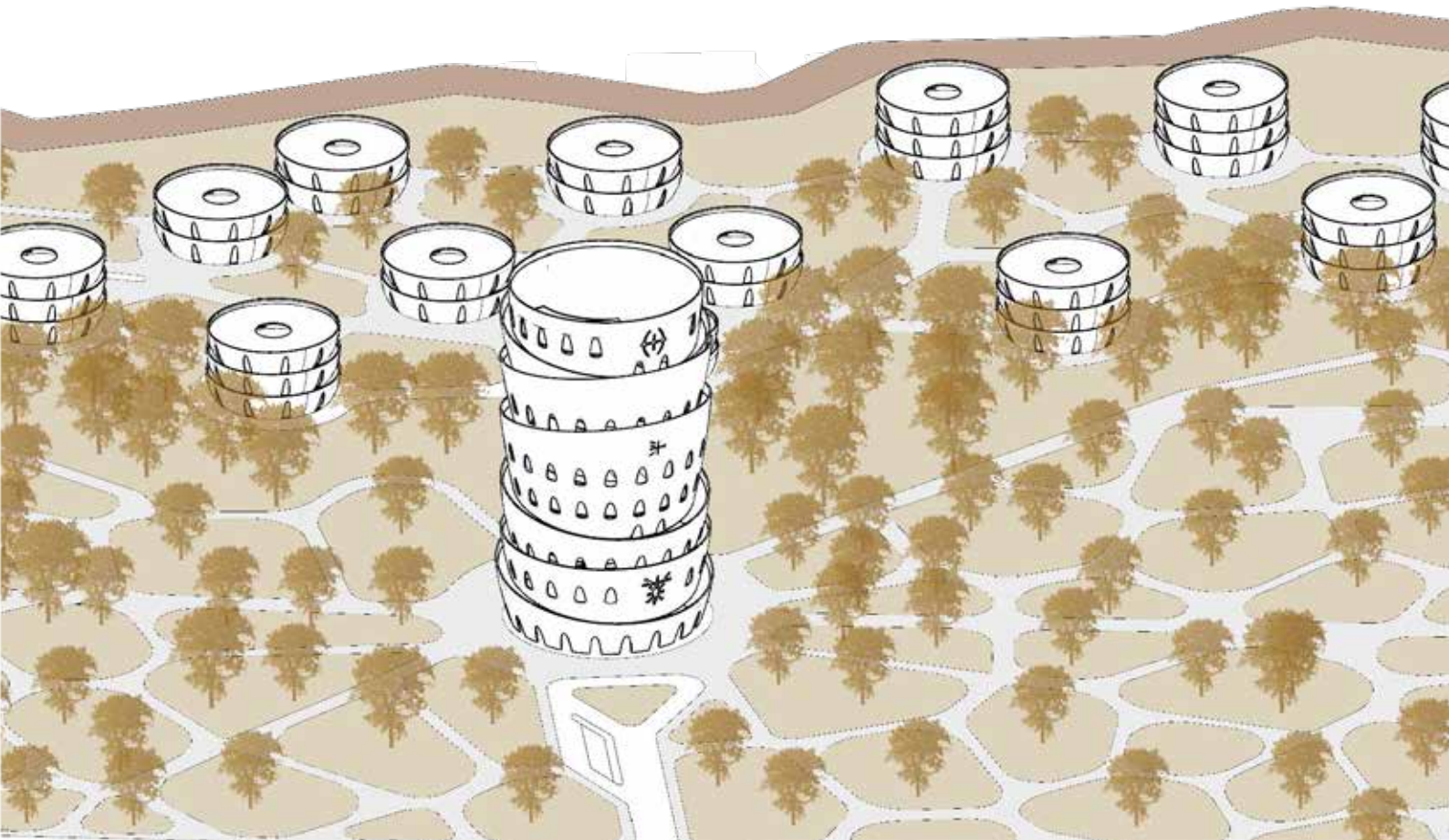
AFRICAN CULTURE COMPLEX

African Culture Tower

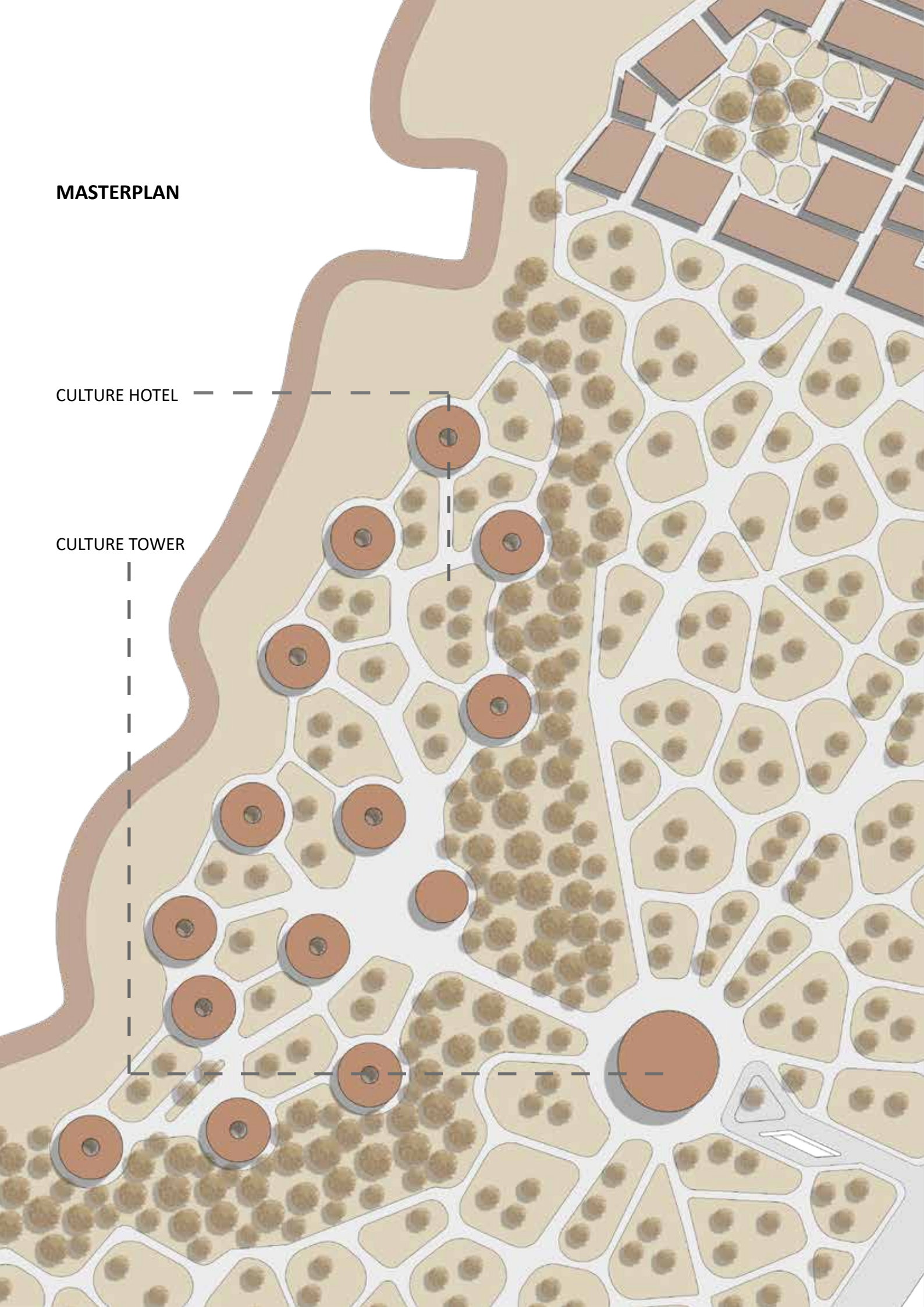
In the form of building, from the bottom to top, the circular visiting route orients people to follow it in interior spaces and exterior spaces by ramps. So, in this route, people see the African Culture by the exhitions inside and by the landscape outside. Route starts with museum, conference area and continue with library and exhition area. Then after the ramp walking in sense of form of building, it finishes with traditional african kitchen in restaurant and clear viewpoint in terrace floor at the top of the building.

African Culture Hotel

A part of to know the African Culture is a new way to host people. The Culture Hotel buildings are in different garden for privacy but close to Culture Tower for easy accesssible. They designed into low stories to feel close to garden and includes traditional African massage service to experience the African Culture in third, another different way.

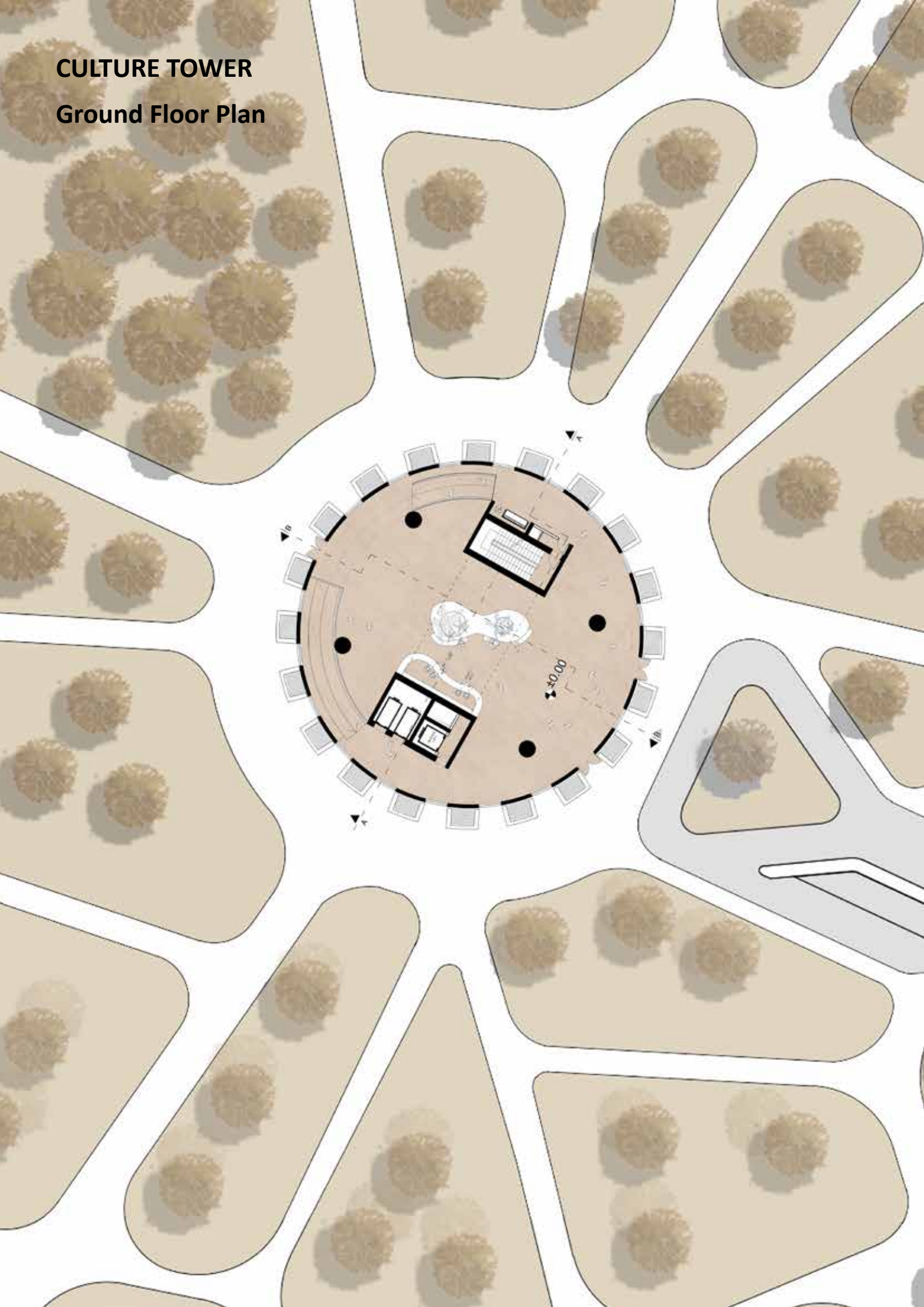


MASTERPLAN

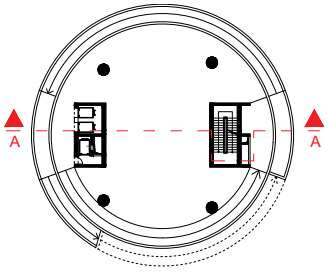


CULTURE TOWER

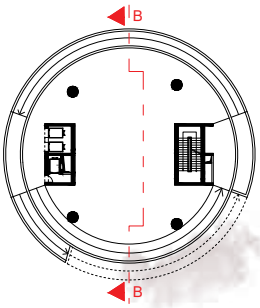
Ground Floor Plan

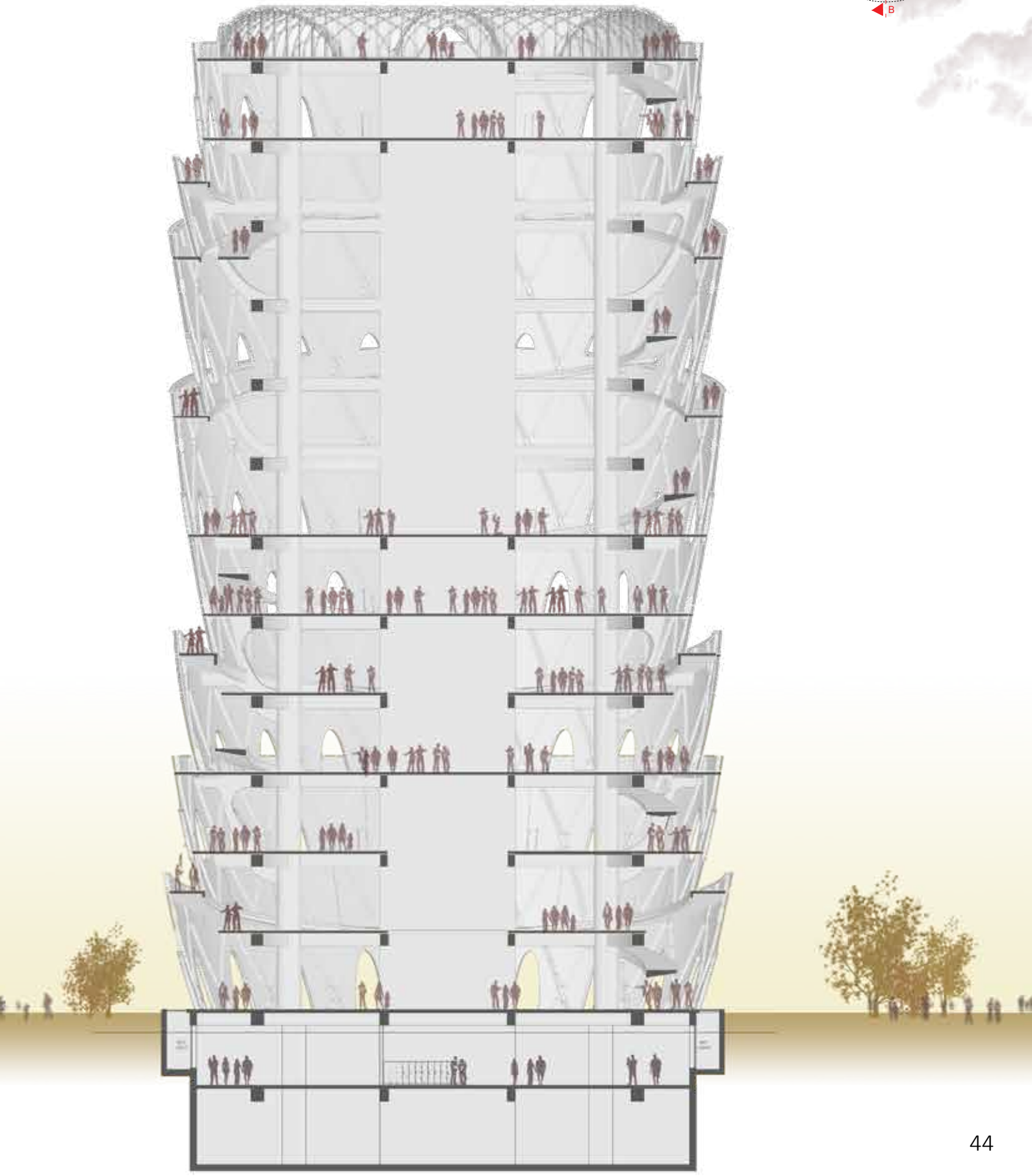


Section N-S



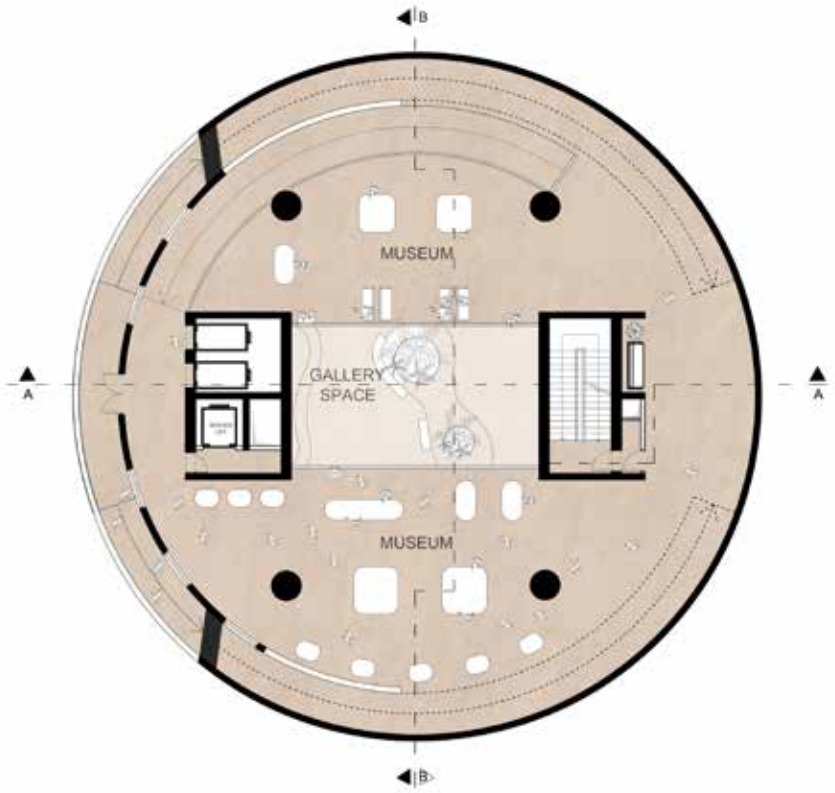
Section W-E



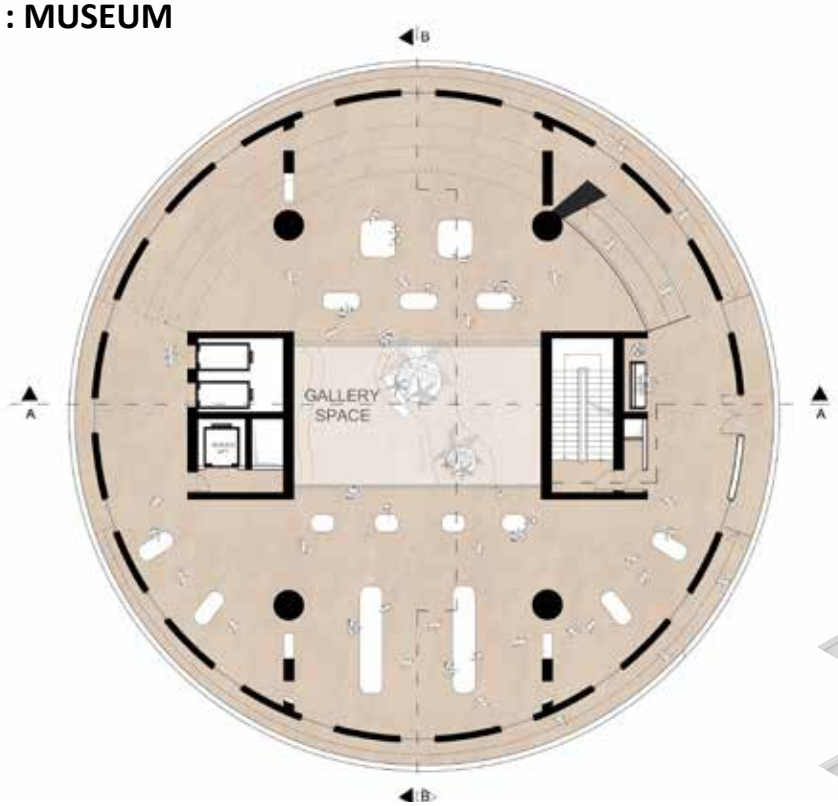


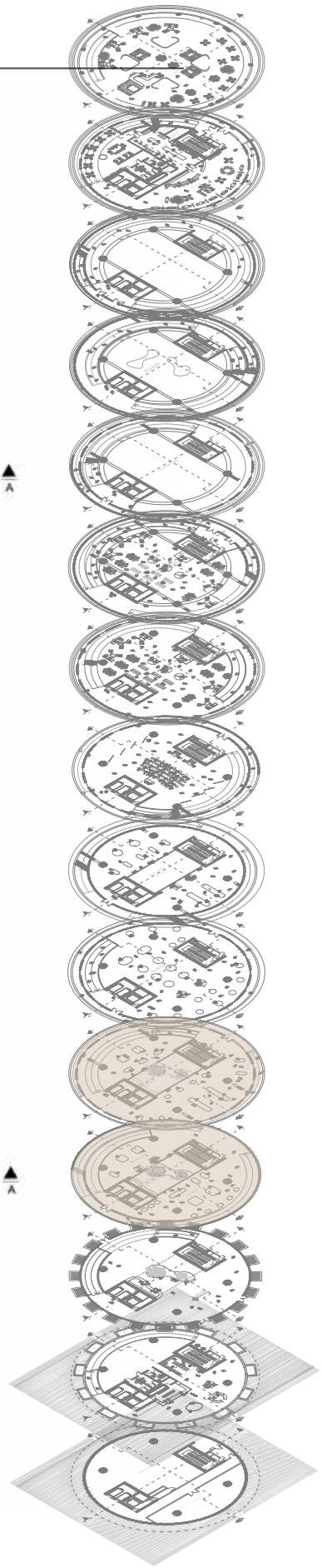
FLOOR PLANS

First Floor : MUSEUM

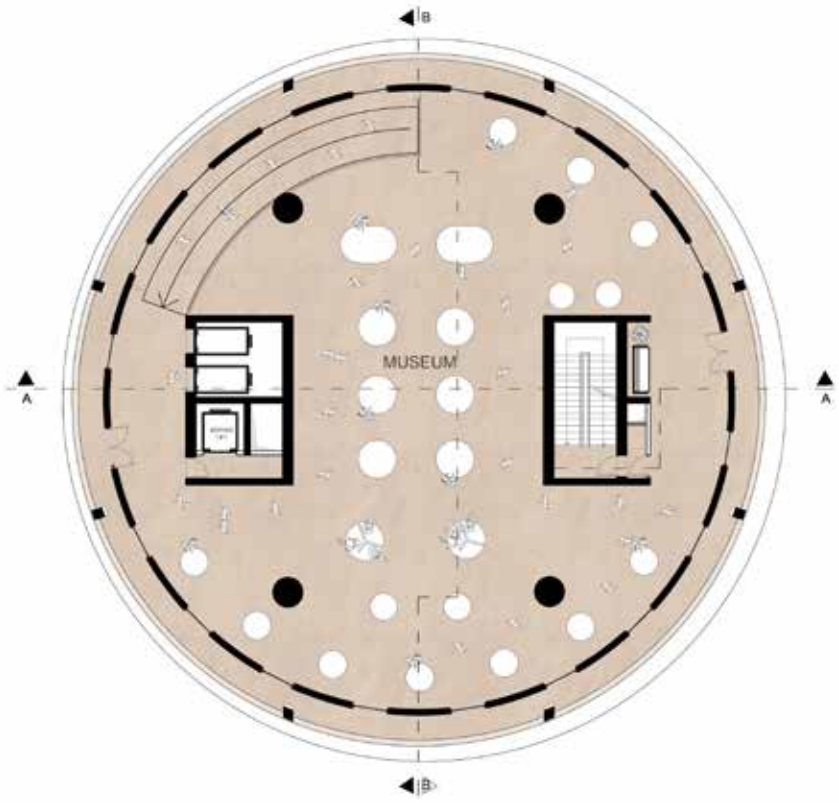


Second Floor : MUSEUM

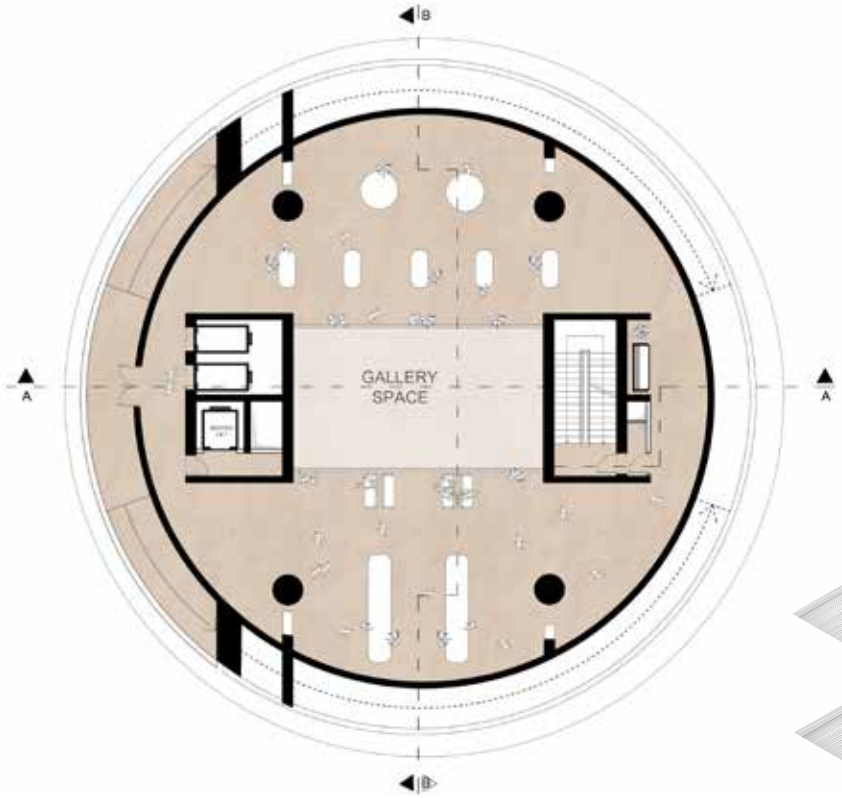


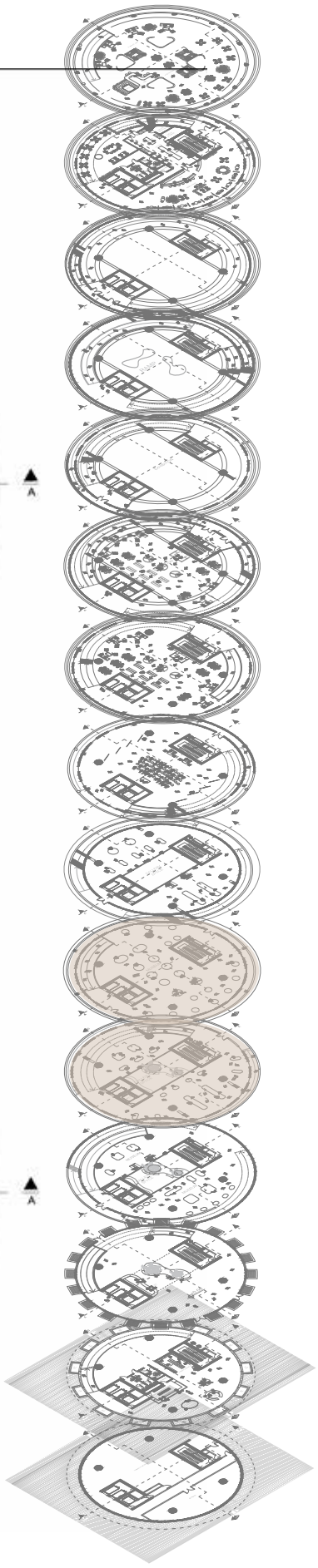


Thirth Floor : MUSEUM

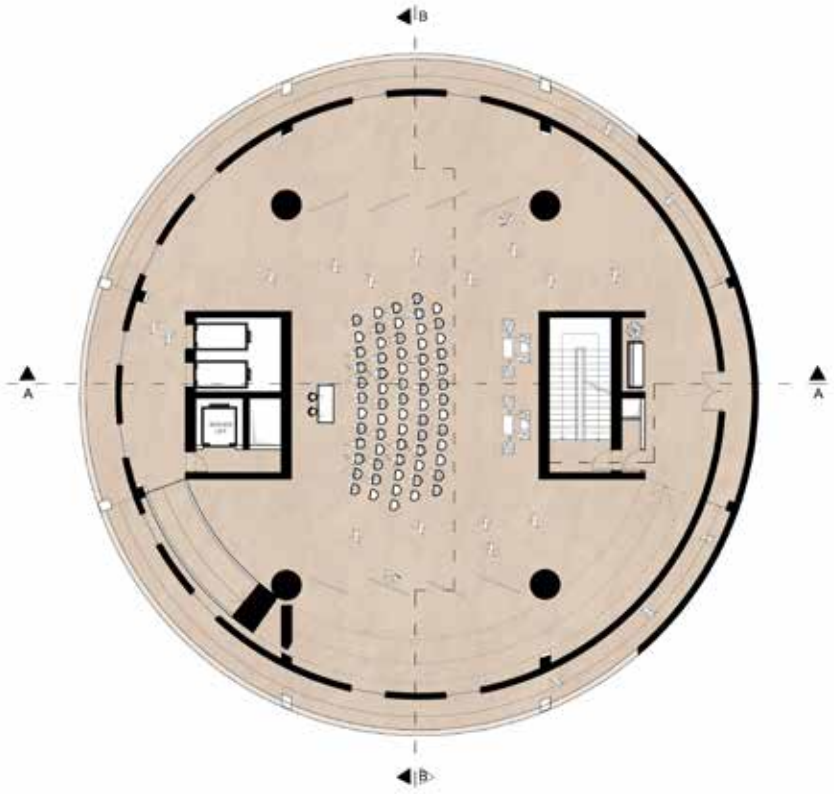


Fourth Floor : MUSEUM

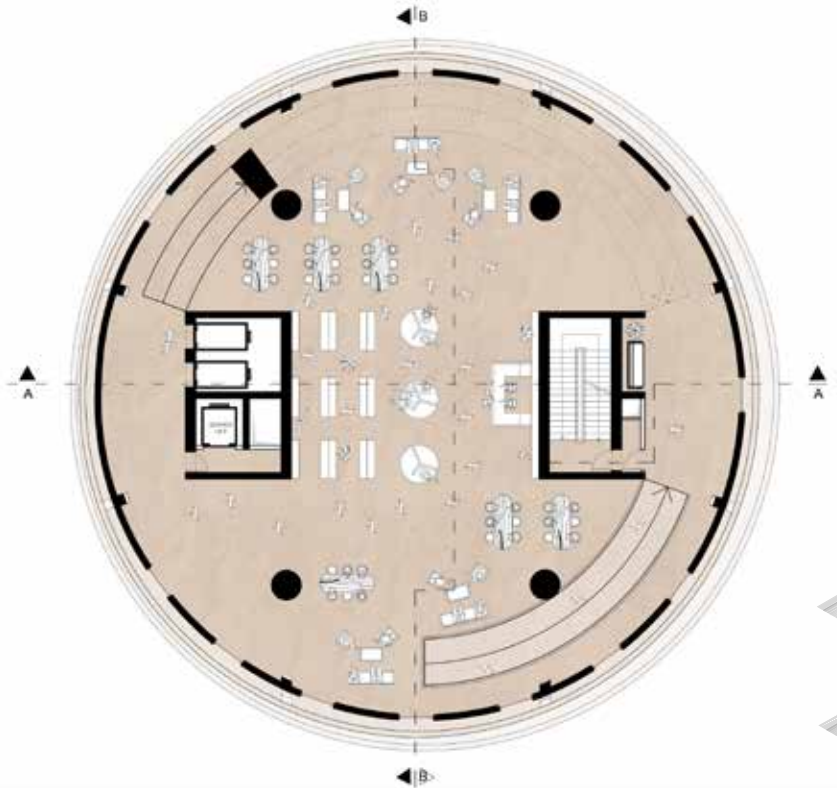


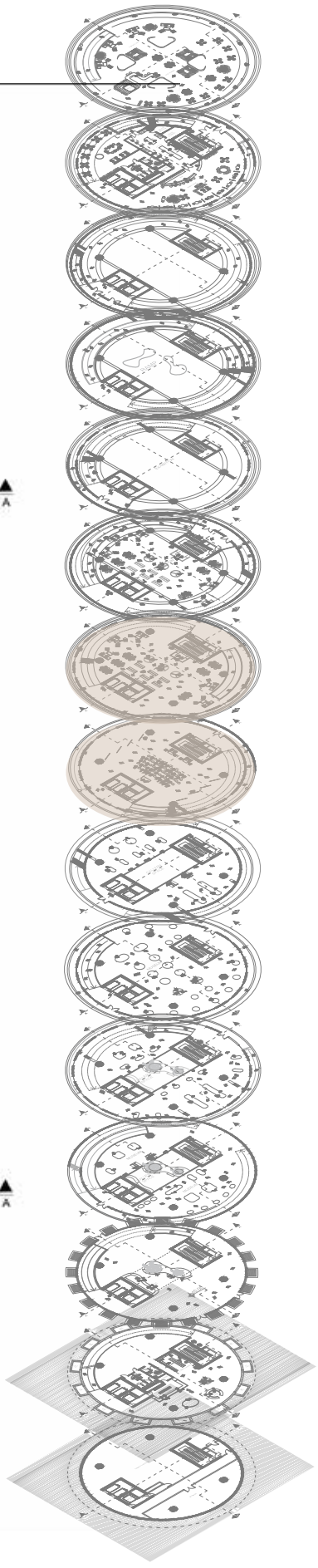


Fifth Floor Plan : CONFERENCE

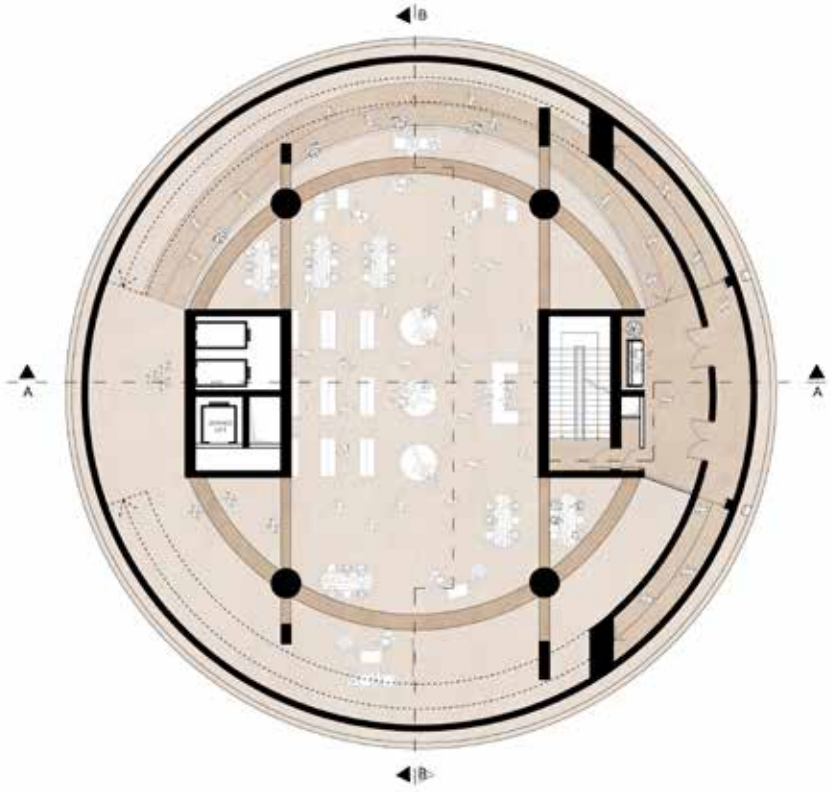


Sixth Floor : LIBRARY

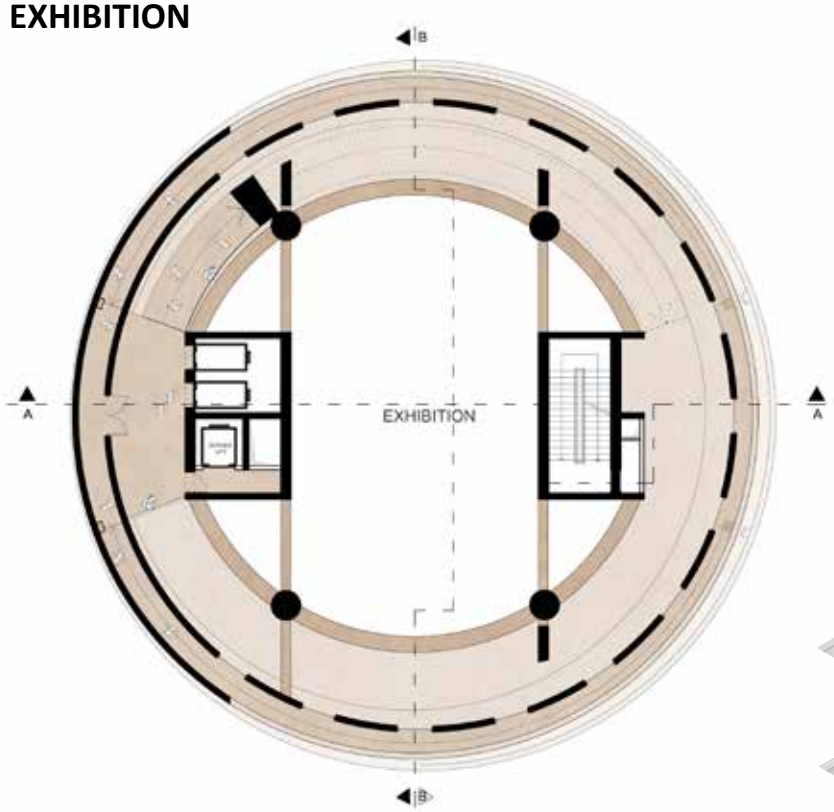


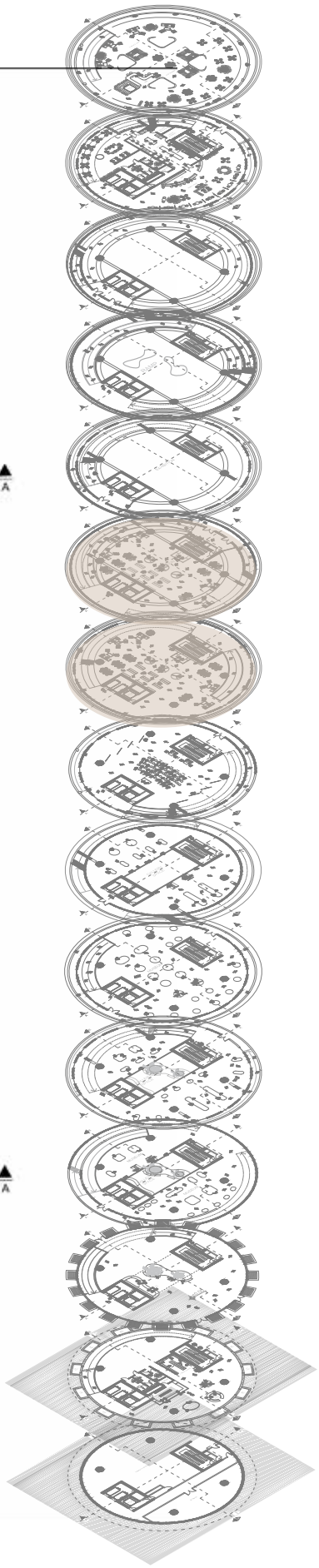


Seventh Floor : EXHIBITION

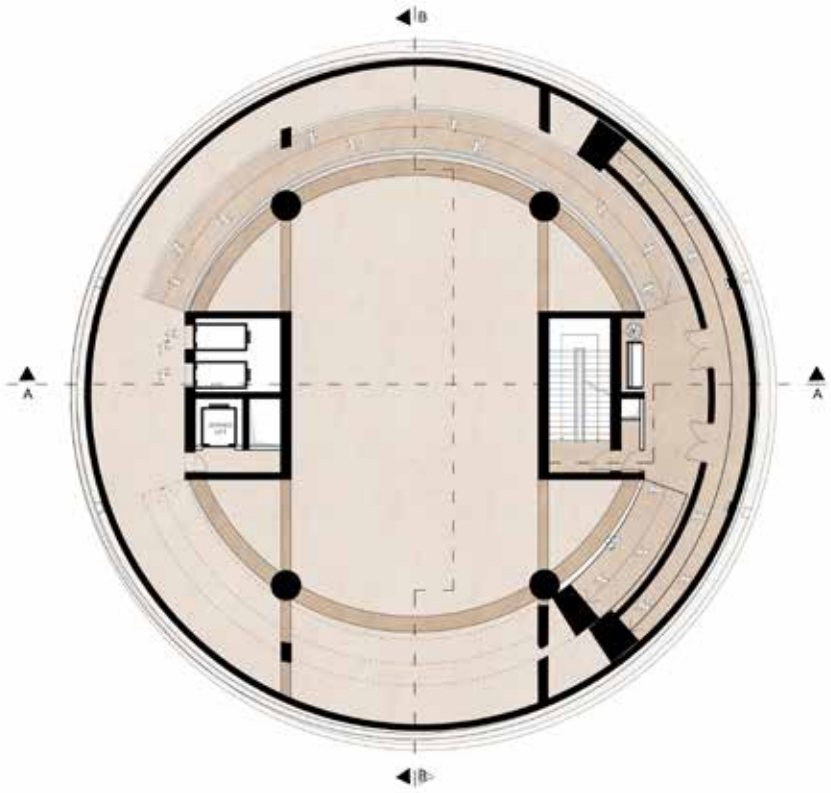


Eighth Floor : EXHIBITION

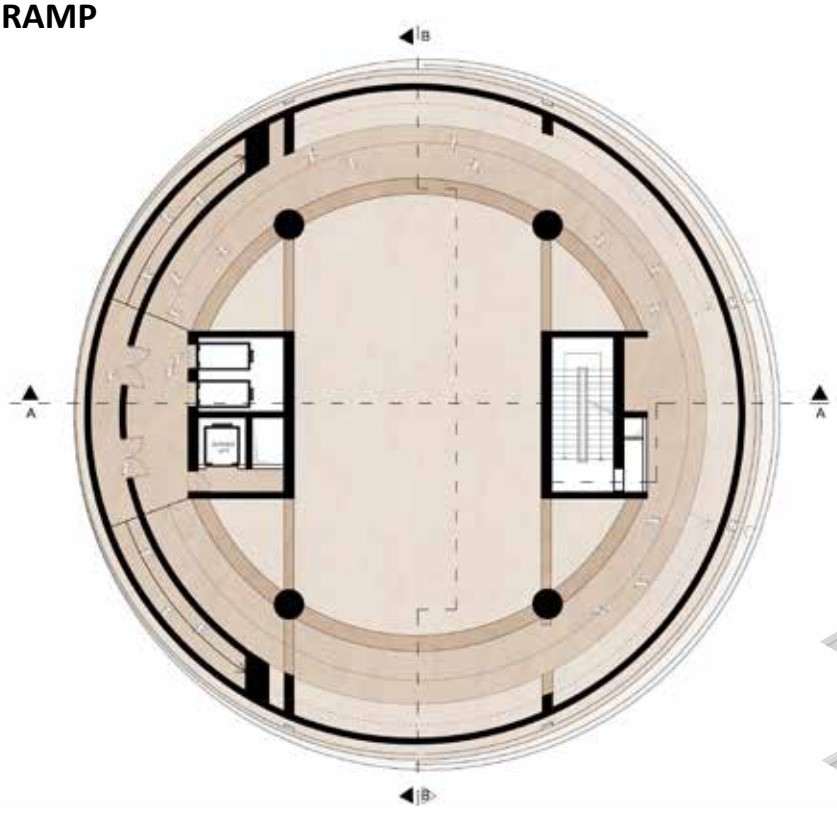


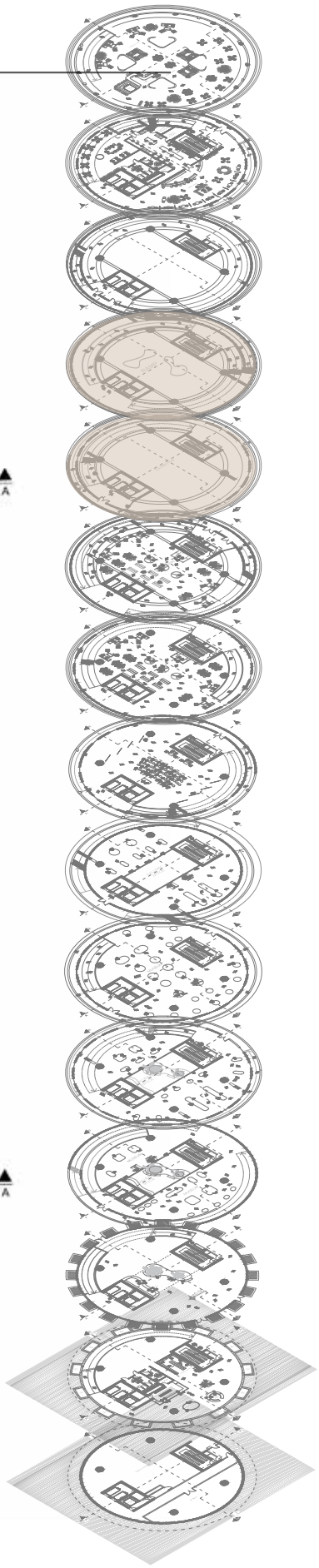


Ninth Floor : RAMP

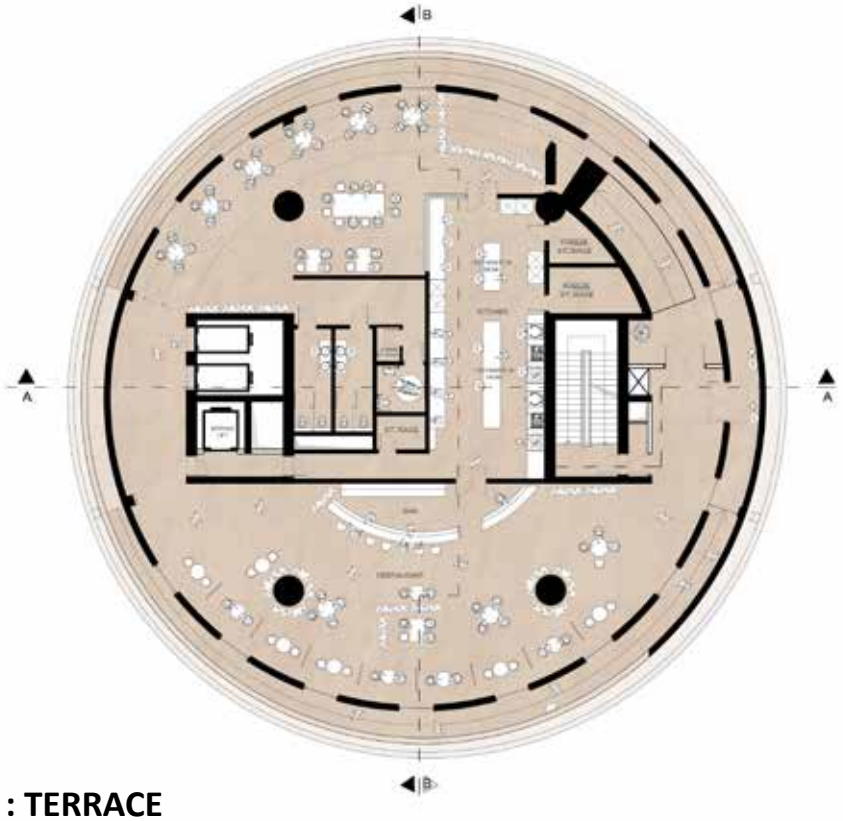


Tenth Floor : RAMP

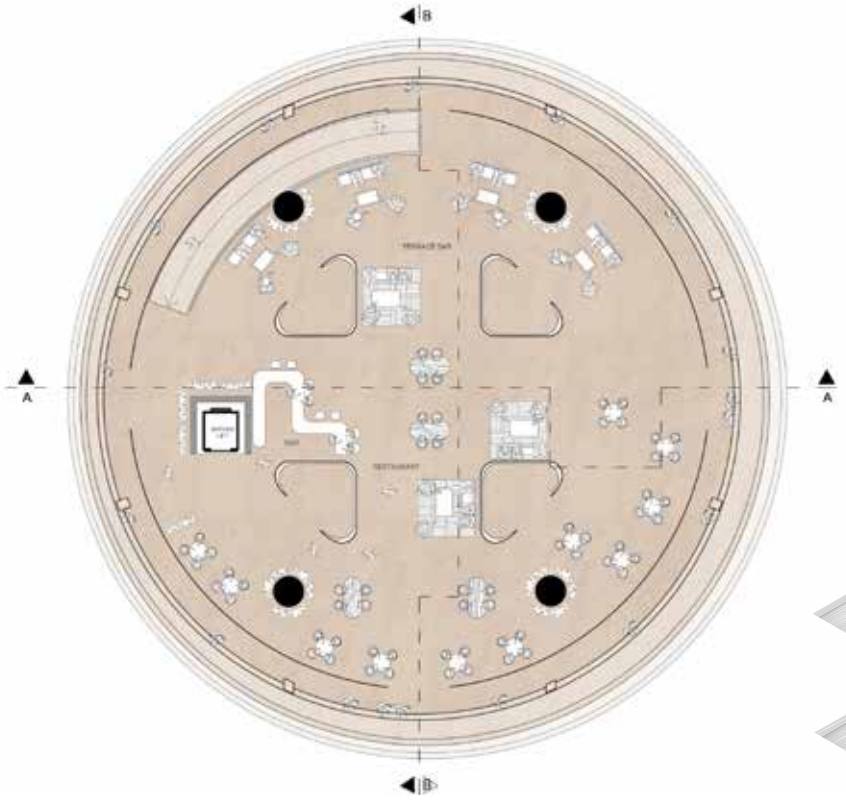


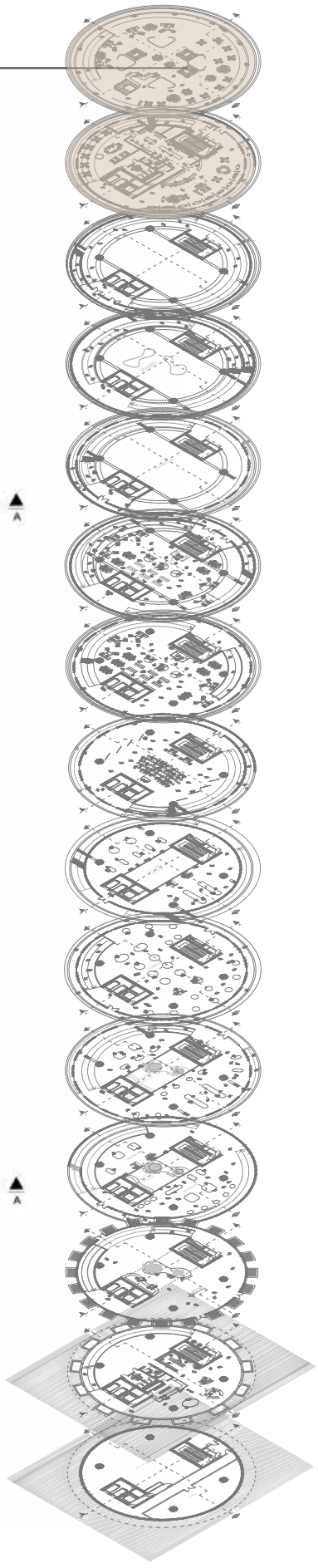


Eleventh Floor : RESTAURANT

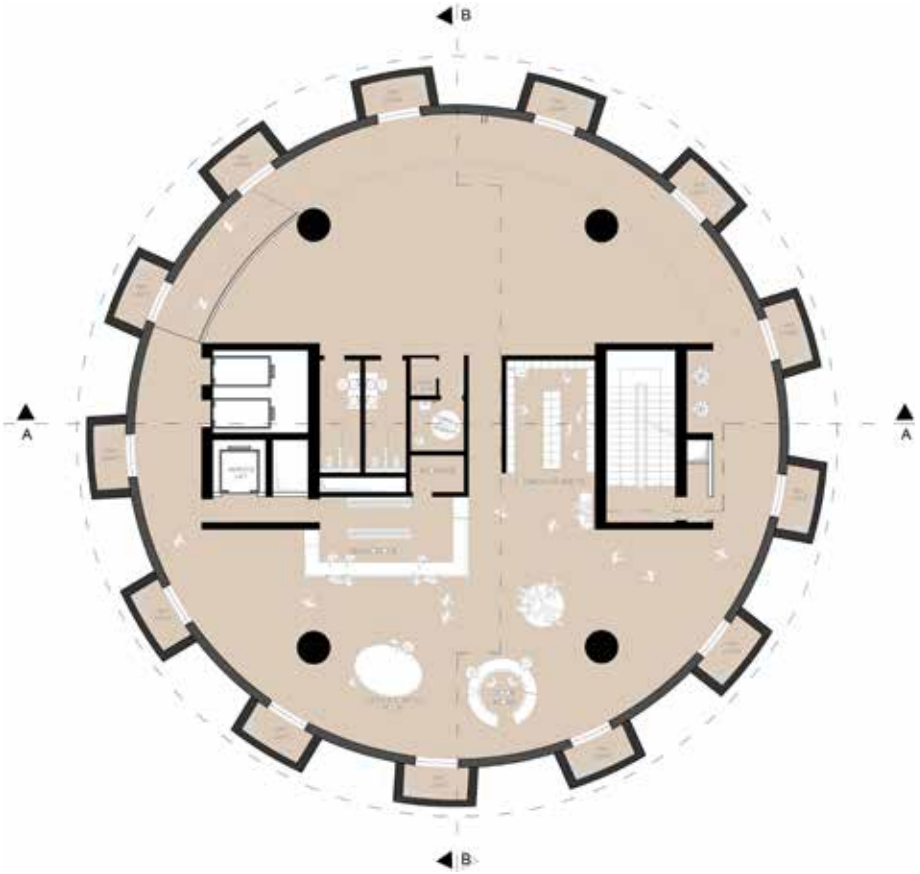


Twelfth Floor : TERRACE

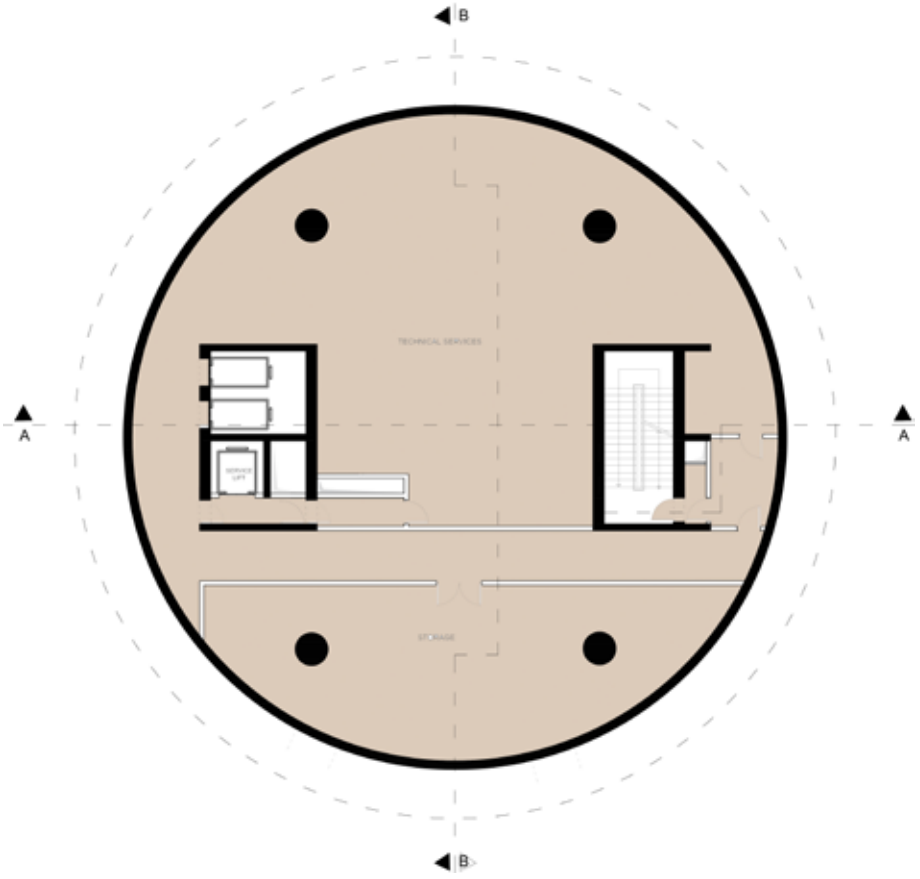


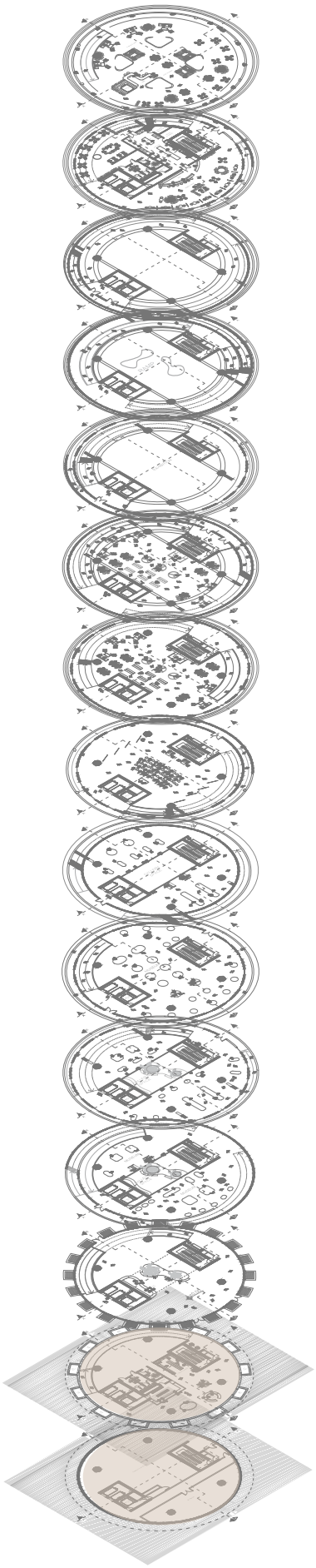


Basement Floor : SERVICES



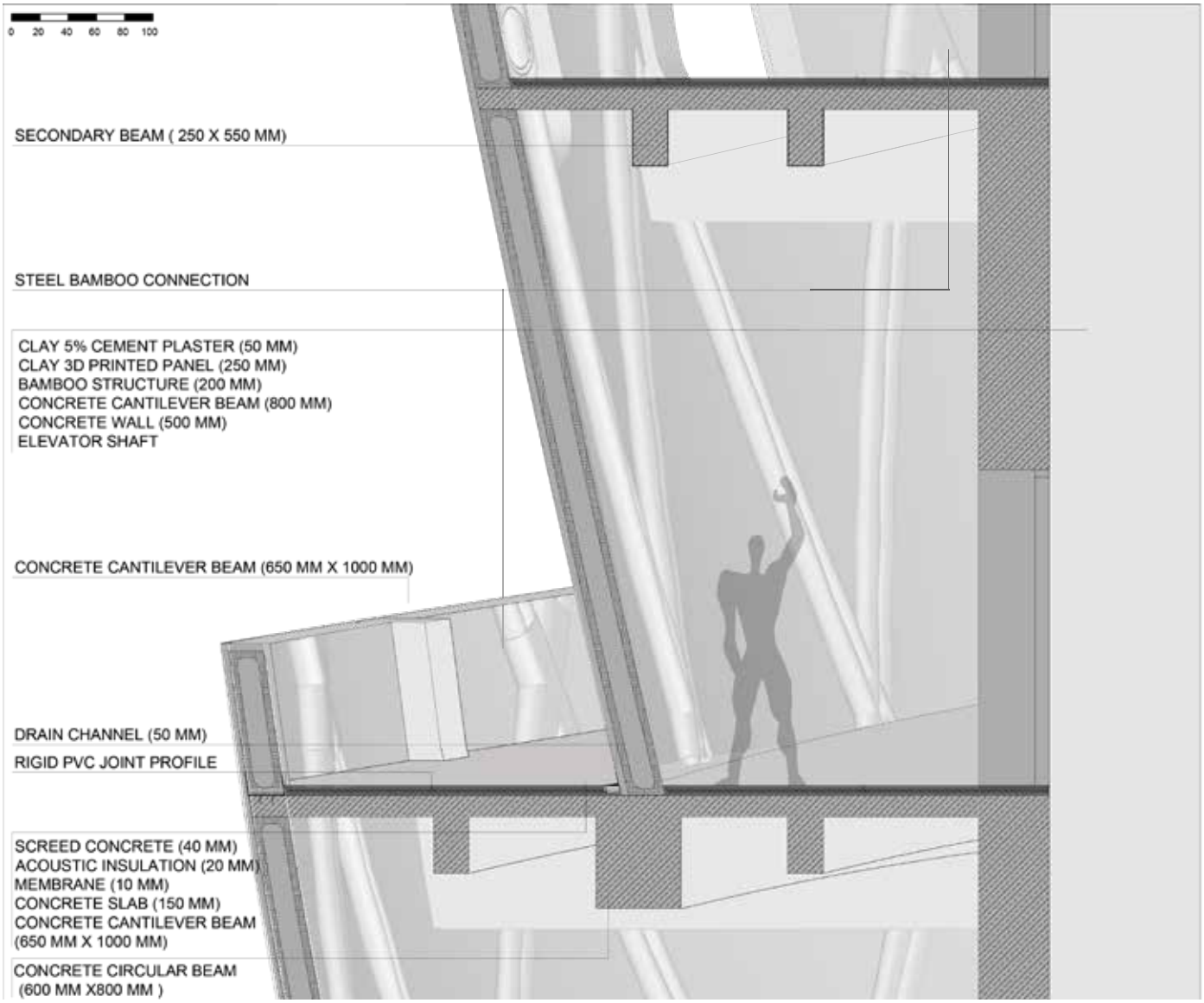
Basement Floor : TECHNICAL SERVICES



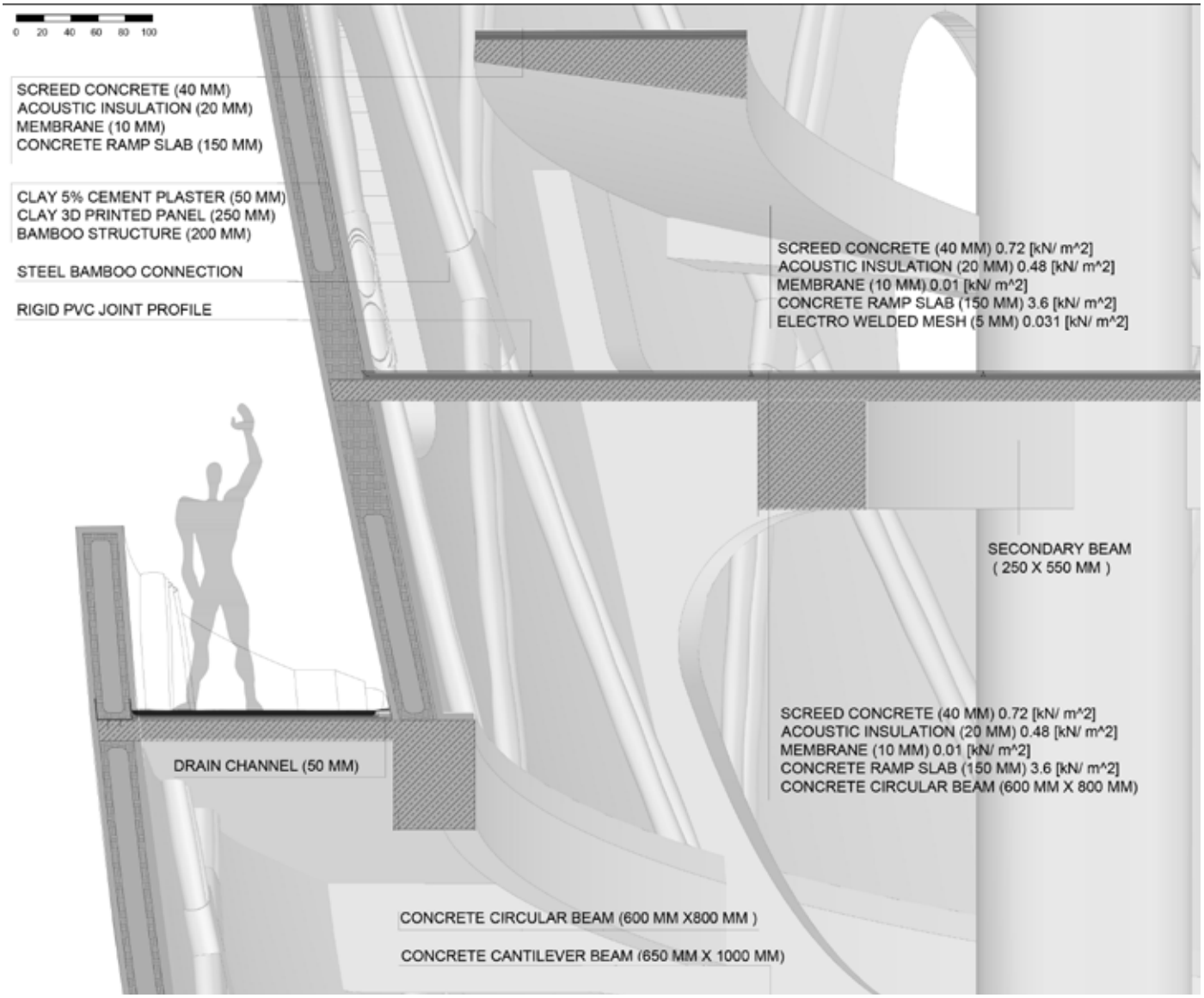


DETAILS

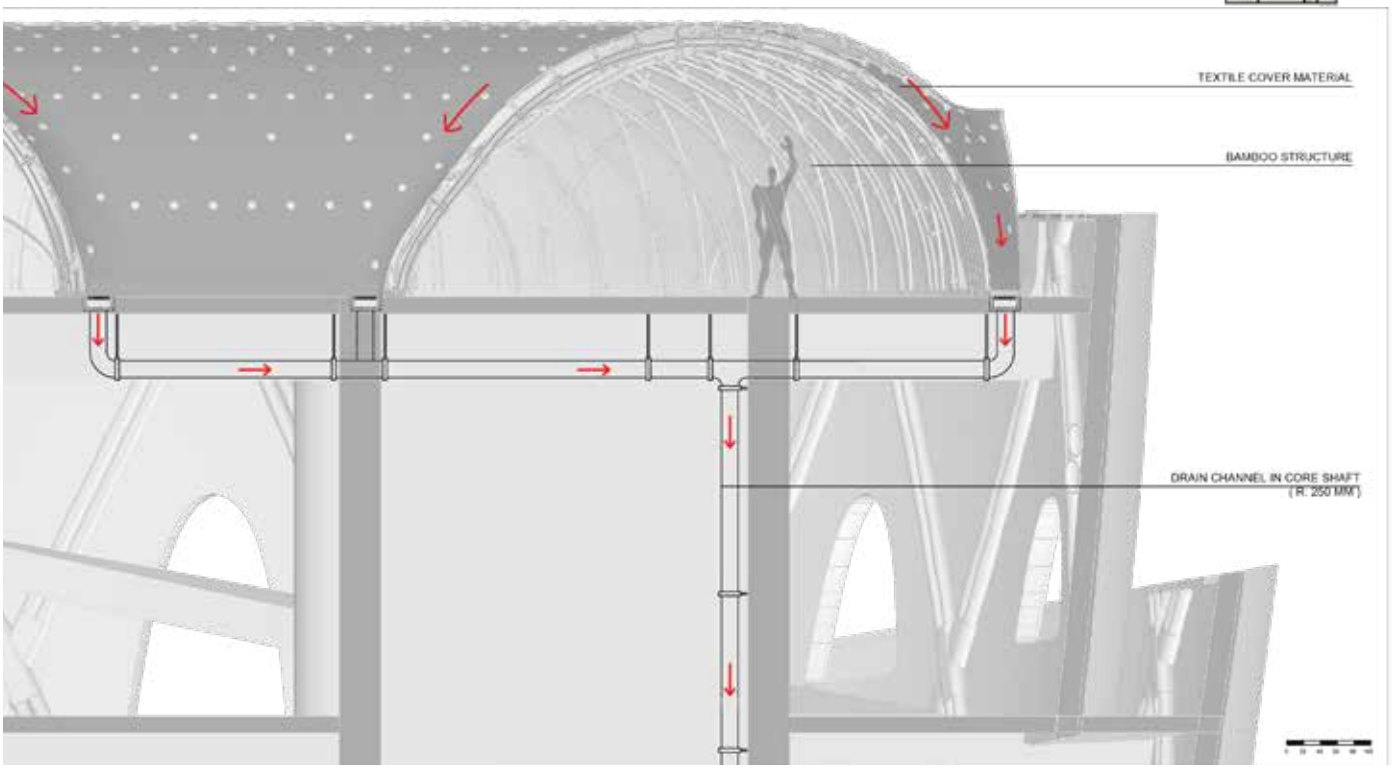
Detail 1 - Wall - Slab



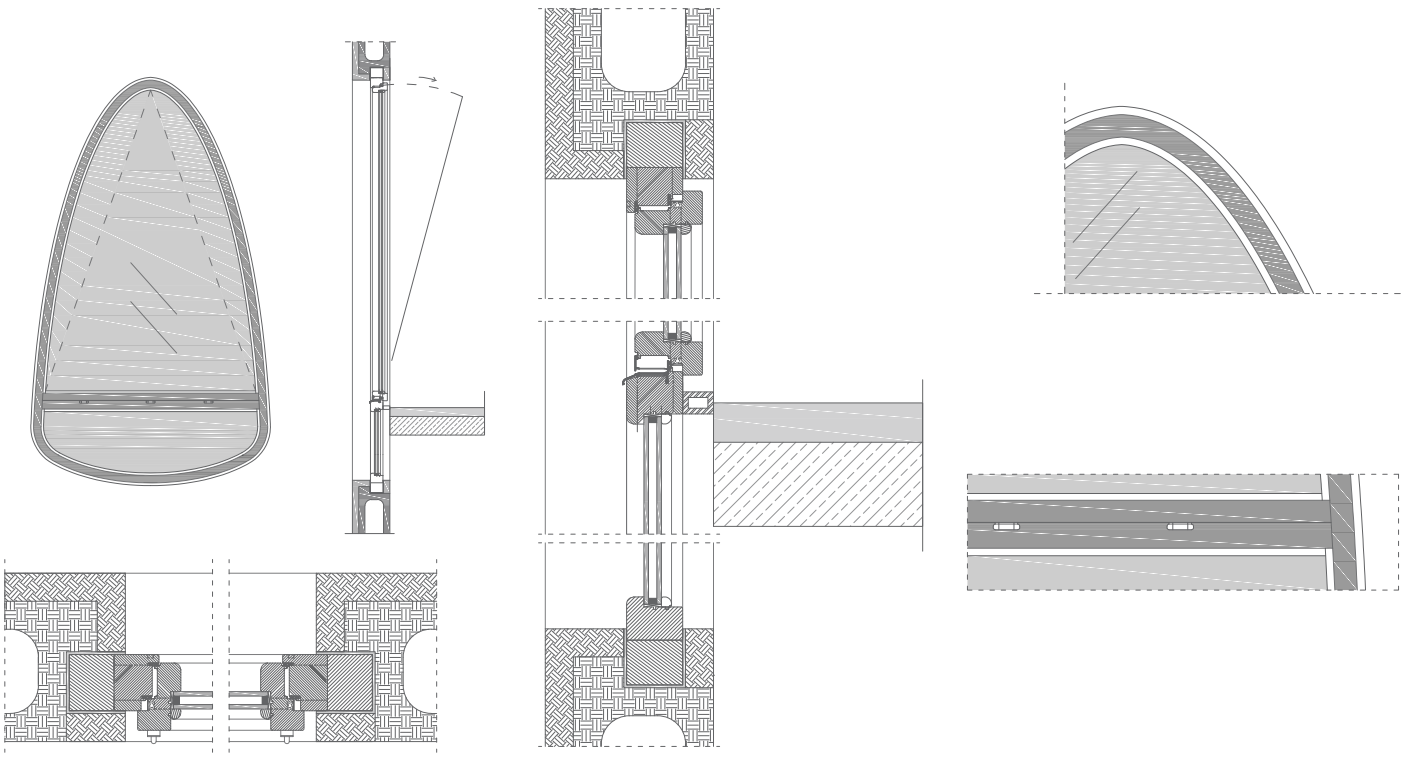
Detail 2 - Wall - Slab



Detail 3 - Roof



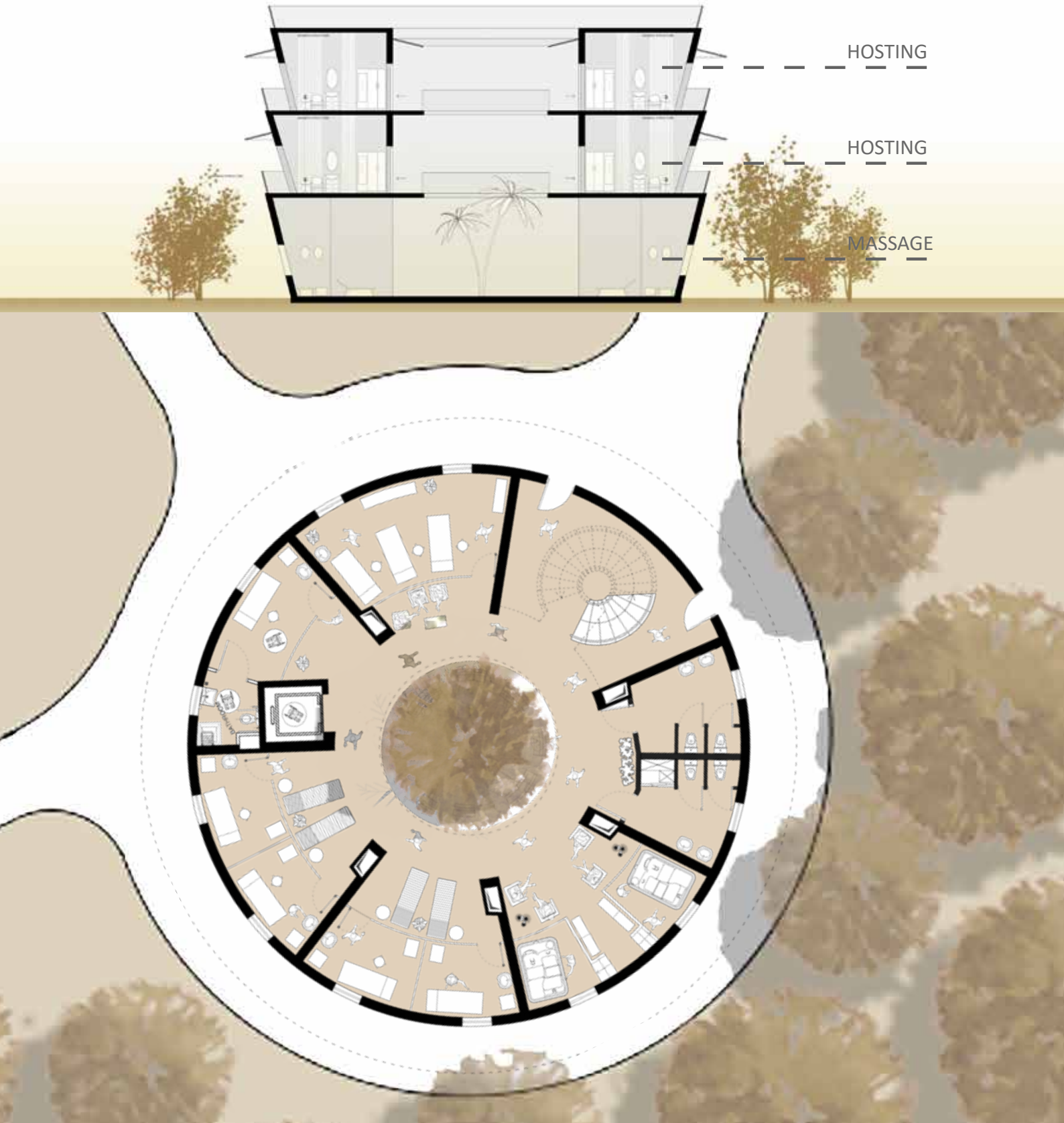
Detail 4 - Window



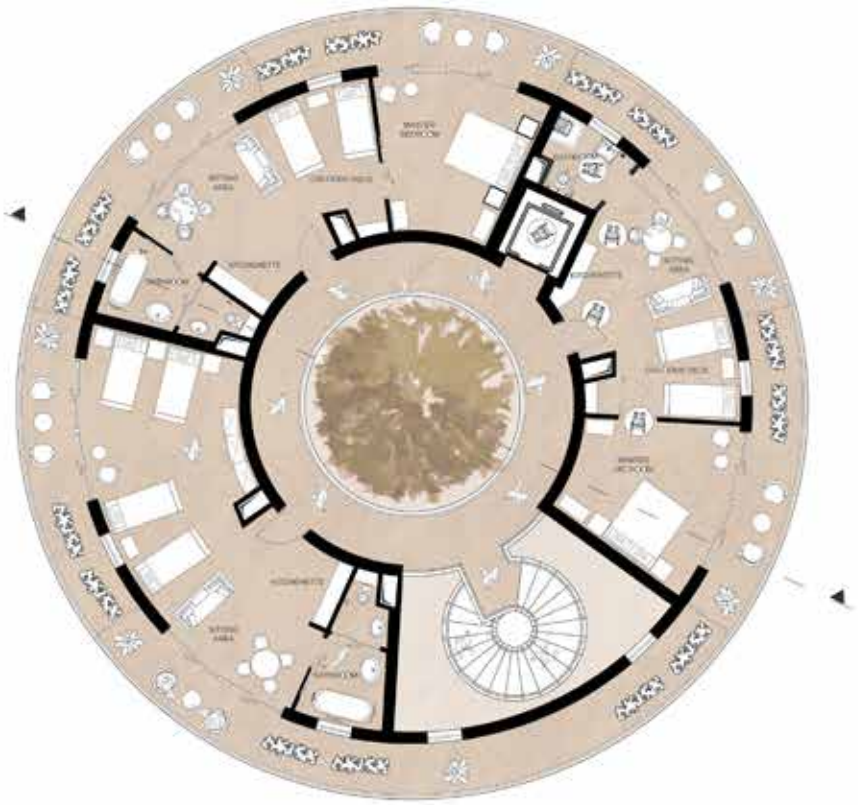
CULTURE HOTEL

Section & Ground Floor Plan

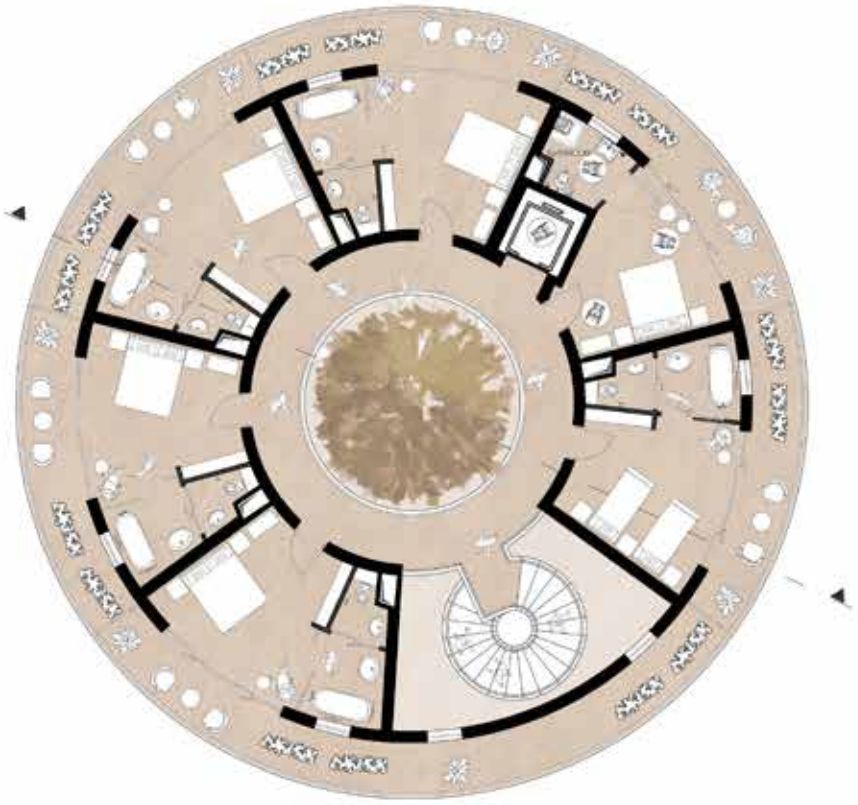
A part of to know the African Culture is a new way to host people. The Culture Hotel buildings are in different garden for privacy but close to Culture Tower for easy accesssible. They designed into low stories to feel close to garden and includes traditional African massage service to experience the African Culture in third, another different way.



Second Floor Plan



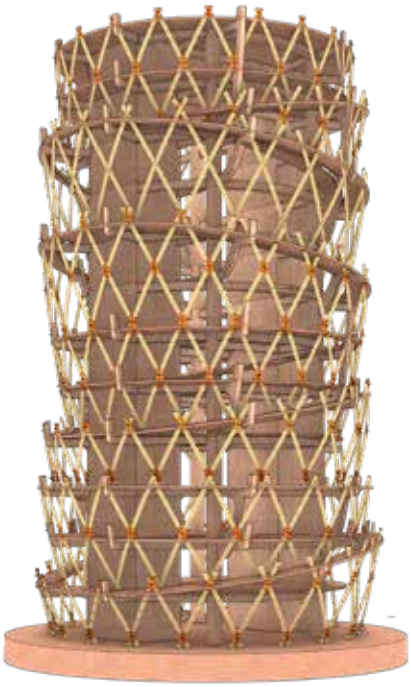
First Floor Plan



04 STRUCTURE

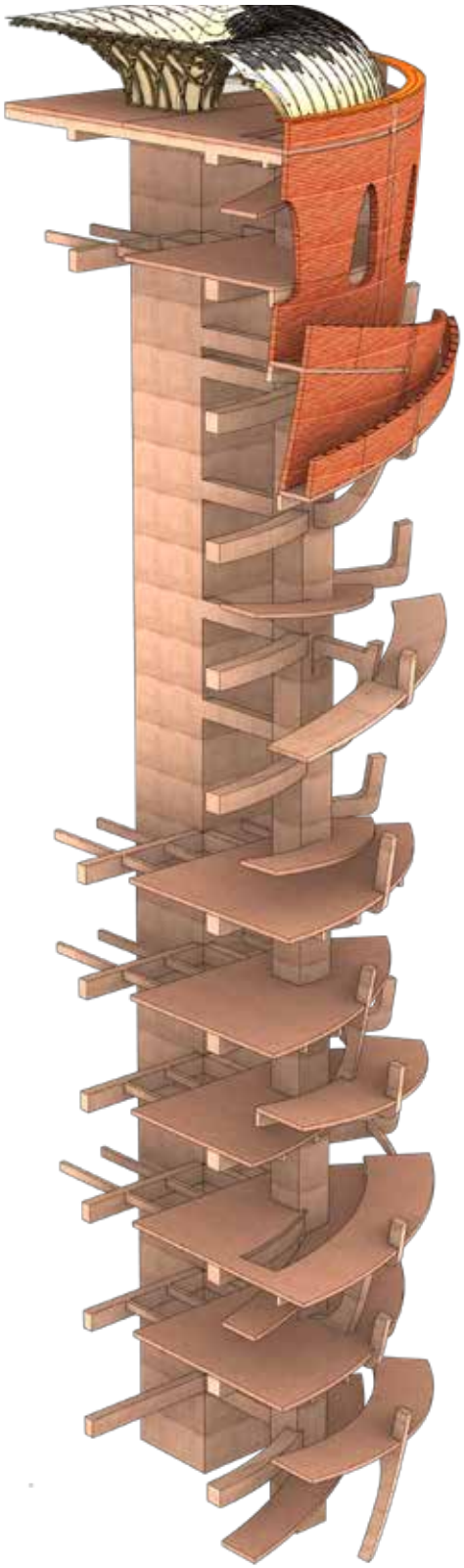
CONCRETE

BAMBOO

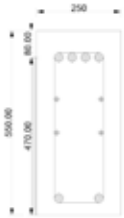


3D PRINTING CLAY

CONCRETE STRUCTURE



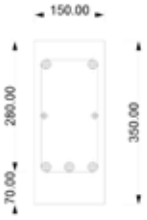
SECONDARY BEAM (cantilever) 1



We will have a secondary beam with the following characteristics:

Length:	6.00 [m]
Width:	25.00 [cm]
Height:	55.00 [cm]
Interaxis between secondary beam:	1.10 [m]
Section concrete area:	900.00 [cm^2]
Section steel area:	21.24 [cm^2]
Rebars in tension:	4 ø 26
Rebars in compression:	2 ø 26
Stirrups	ø 8/150 [mm]

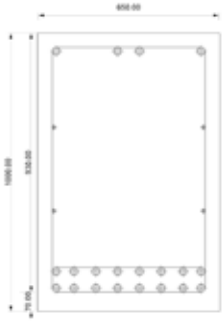
SECONDARY BEAM 2 (simply supported)



We will have a secondary beam 2 with the following characteristics:

Length:	6.00 [m]
Width:	15.00 [cm]
Height:	30.00 [cm]
Interaxis between secondary beam:	1.10 [m]
Section concrete area:	900.00 [cm^2]
Section steel area:	7.63 [mm^2]
Rebars in tension:	3 ø 20
Rebars in compression:	2 ø 20
Stirrups	ø 8/150 [mm]

PRIMARY BEAM (simply supported)



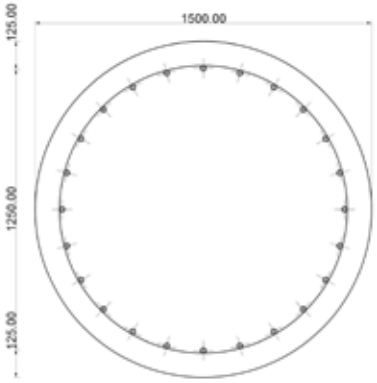
We will have a primary beam with the following characteristics:

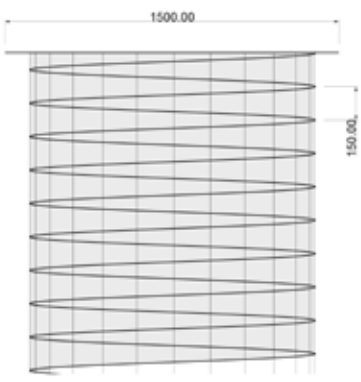
Length:	13.3 [m]
Width:	65.00 [cm]
Height:	100.00 [cm]
Interaxis between primary beam:	8.8 [m]
Section concrete area:	4'800.00 [cm^2]
Section steel area:	98.52 [cm^2]
Rebars in tension:	16 ø 28
Rebars in compression:	2 ø 28
Stirrups	ø 8/150 [mm]

COLUMN

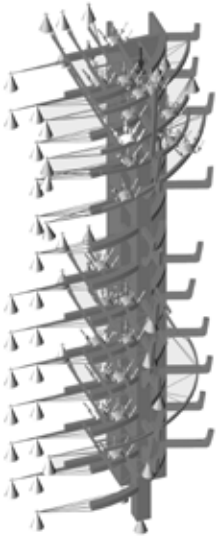
We will have a column with the following characteristics:

Length:	13.3 [m]
Width:	65.00 [cm]
Height:	100.00 [cm]
Interaxis between primary beam:	8.8 [m]
Section concrete area:	4'800.00 [cm^2]
Section steel area:	98.52 [cm^2]
Rebars in tension:	16 ø 28
Rebars in compression:	2 ø 28
Stirrups	ø 8/150 [mm]





OVERVIEW

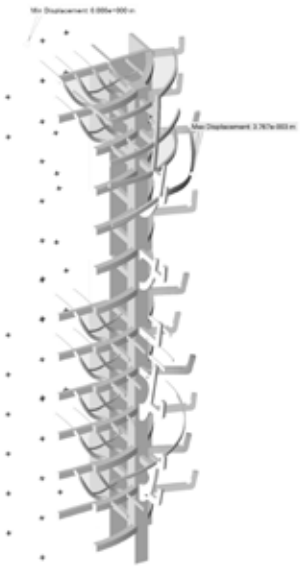


Load Cases

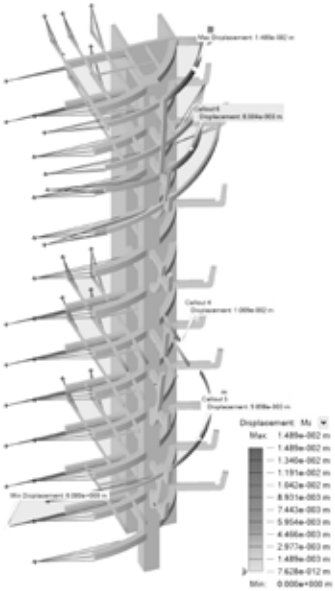
Summary Details

Load Name	Load Type	Magnitude	Position X	Position Y	Position Z	Applied To
Wall Load	Pressure	53507.20915 Pa	-3.09 m	15 m	54.8 m	Face
Wall Load	Pressure	53507.20915 Pa	-9.04 m	12.3 m	54.8 m	Face
Slab Load	Pressure	14719.33715 Pa	-4.34 m	11.2 m	59.8 m	Face
Variable Load	Pressure	13954.02053 Pa	-5.76 m	4 m	59.8 m	Face
Wall Load	Pressure	74048.05911 Pa	-4.91 m	14.1 m	59.8 m	Face
Slab Load	Pressure	14719.33715 Pa	-4.93 m	10.9 m	54.8 m	Face
Slab Load	Pressure	14036.1412 Pa	-3.96 m	3.96 m	54.8 m	Face
Wall Load	Pressure	9569.848423 Pa	-6.62 m	13.4 m	59.8 m	Face
Wall Load	Pressure	47668.04042 Pa	-3.53 m	14.8 m	51.5 m	Face
Wall Load	Pressure	44712.05844 Pa	-9.62 m	11.6 m	50.5 m	Face
Wall Load	Pressure	44401.71159 Pa	-2.58 m	15.7 m	47.7 m	Face
Wall Load	Pressure	15011.5124 Pa	-11.2 m	12 m	49.2 m	Face
Slab Load	Pressure	13434.15983 Pa	-4.83 m	11 m	29.8 m	Face
Variable Load	Pressure	13052.47497 Pa	-4.24 m	3.99 m	29.8 m	Face
Slab Load	Pressure	14719.33715 Pa	-4.57 m	11.2 m	24.8 m	Face
Slab Load	Pressure	14719.33715 Pa	-3.78 m	11.3 m	19.8 m	Face
Slab Load	Pressure	14719.33715 Pa	-3.51 m	11.4 m	14.8 m	Face
Slab Load	Pressure	14719.33715 Pa	-3.13 m	11.5 m	9.81 m	Face
Variable Load	Pressure	11709.34781 Pa	-4.24 m	4.08 m	14.8 m	Face
Variable Load	Pressure	15228.59644 Pa	-4.04 m	4 m	9.81 m	Face
Variable Load	Pressure	15501.13013 Pa	-3.68 m	4.06 m	19.8 m	Face
Variable Load	Pressure	13058.1148 Pa	-4.6 m	4.04 m	24.8 m	Face
RoofLoad	Force	472000 N	-9.61 m	9.96 m	60 m	Face

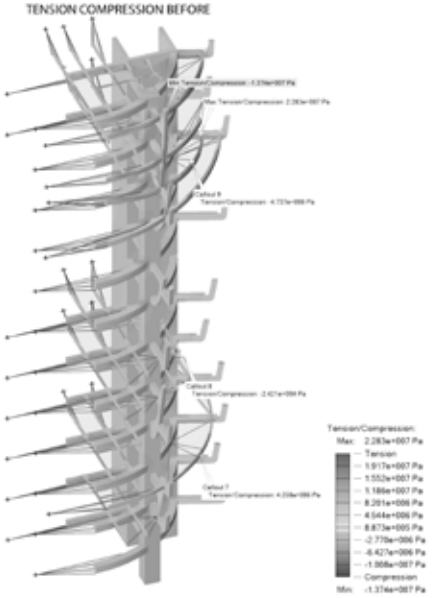
BEHAVIOR OF DEFORMATION



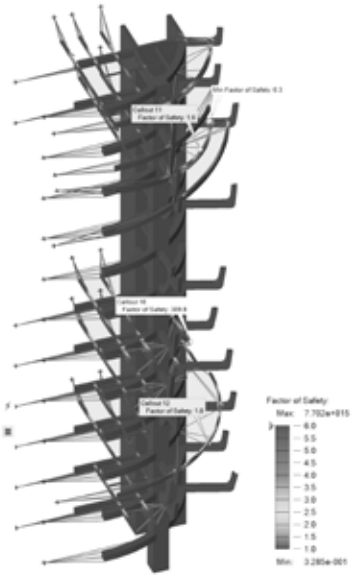
DISPLACEMENT BEFORE



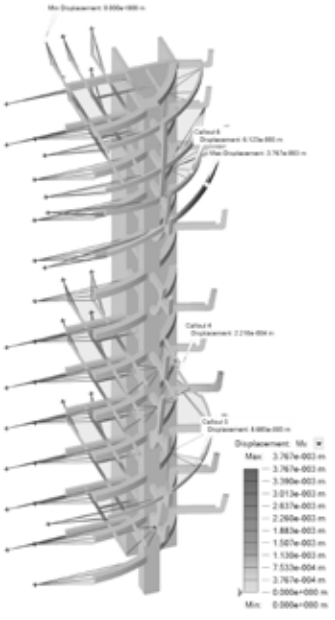
TENSION COMPRESSION BEFORE



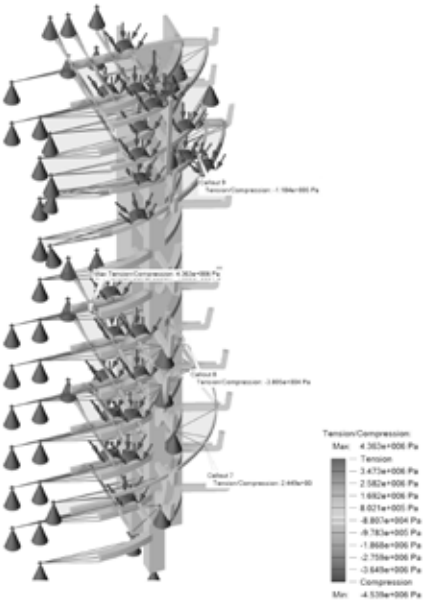
FOS BEFORE



DEFORMATION AFTER



TENSION COMPRESSION AFTER



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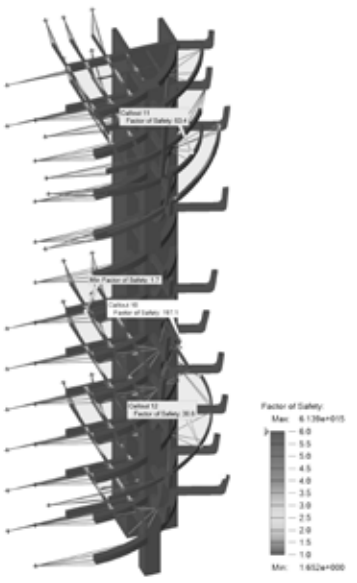
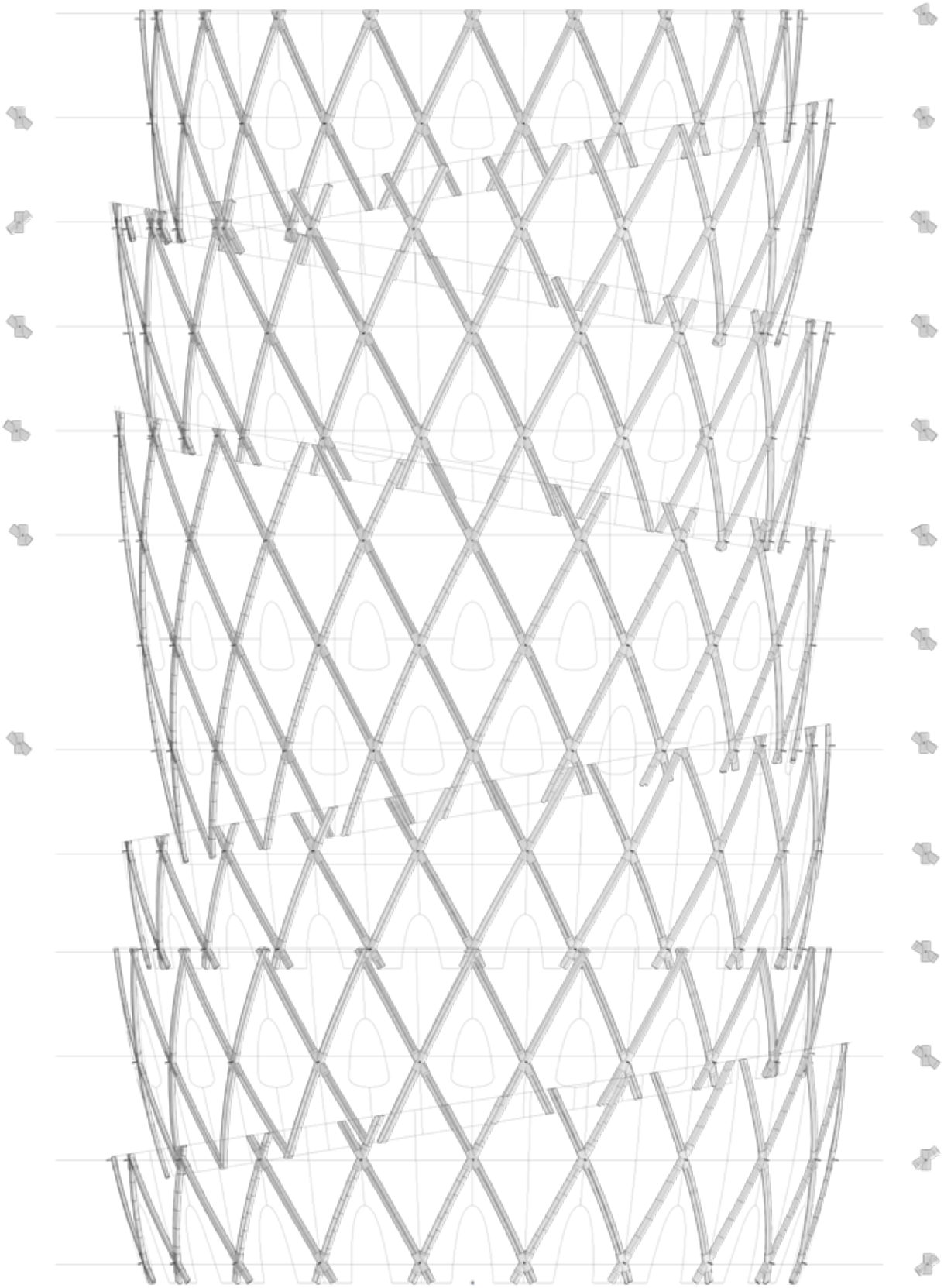
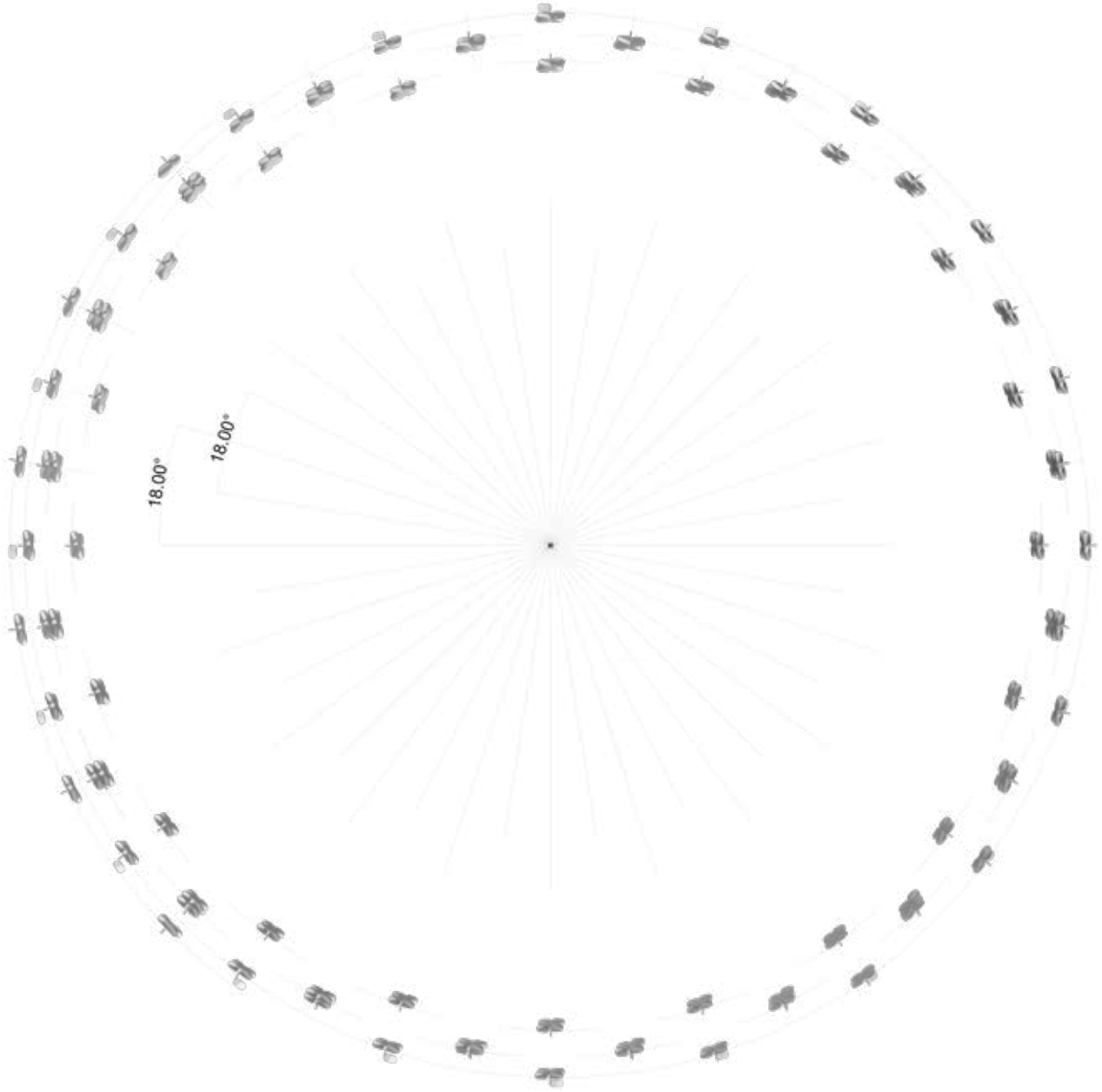


Calculations are made with Solid Thinking Inspire Software .

BAMBOO STRUCTURE



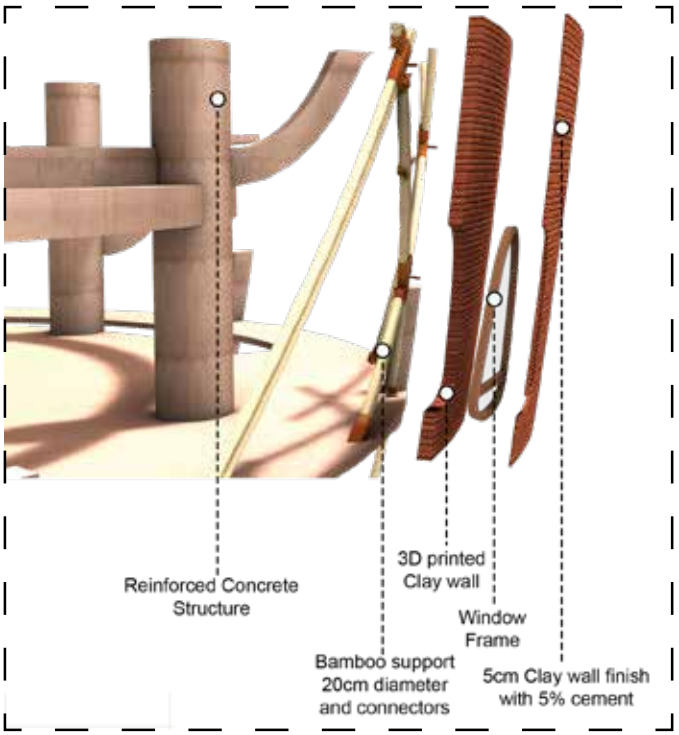
Bamooo Plan



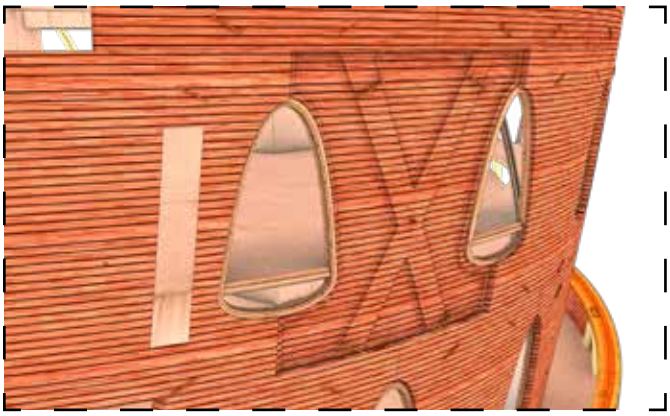
CLAY WALL PANEL DISTRIBUTION

CLAY STRUCTURE: 3D PRINTING CLAY PANEL

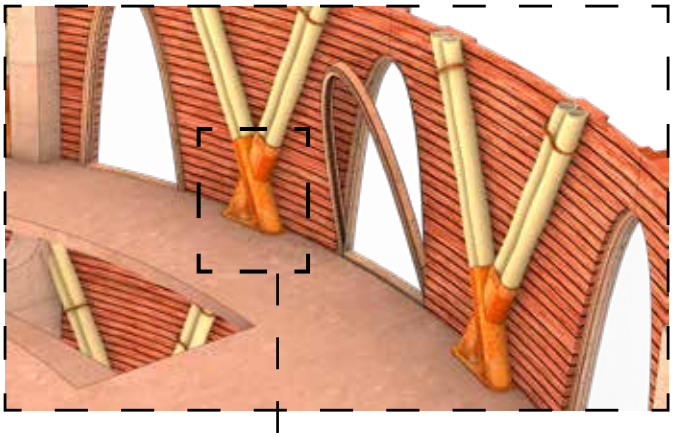
EXPLODED STRUCTURAL LAYERS



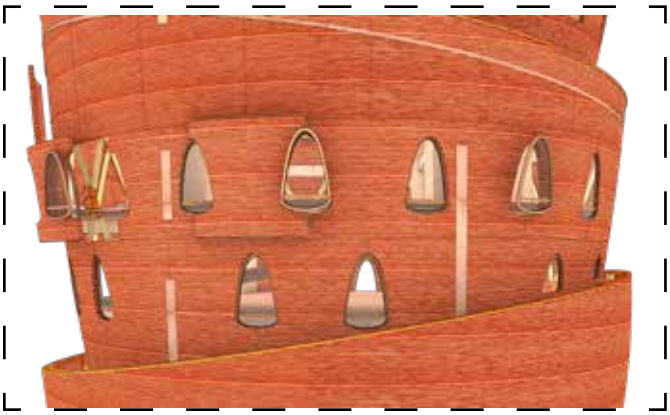
PANEL CROSS SECTION



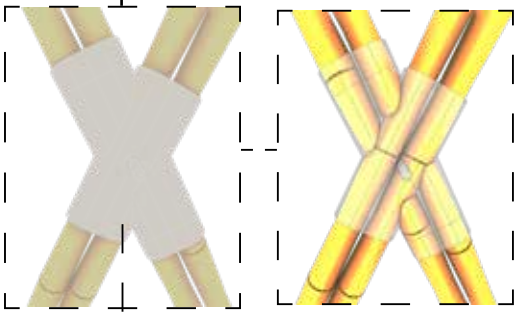
STEEL CONNECTION ELEMENT



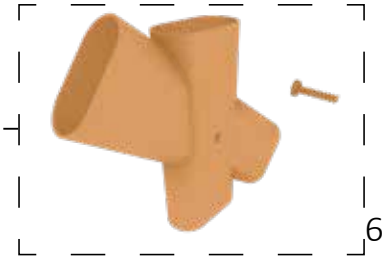
CLAY PANEL ASSEMBLY



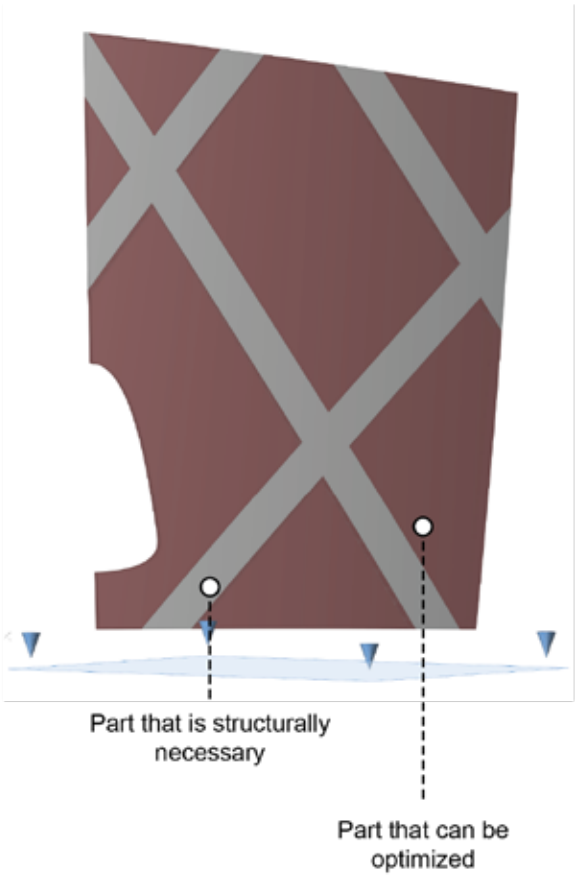
STEEL BAMBOO CONNECTION

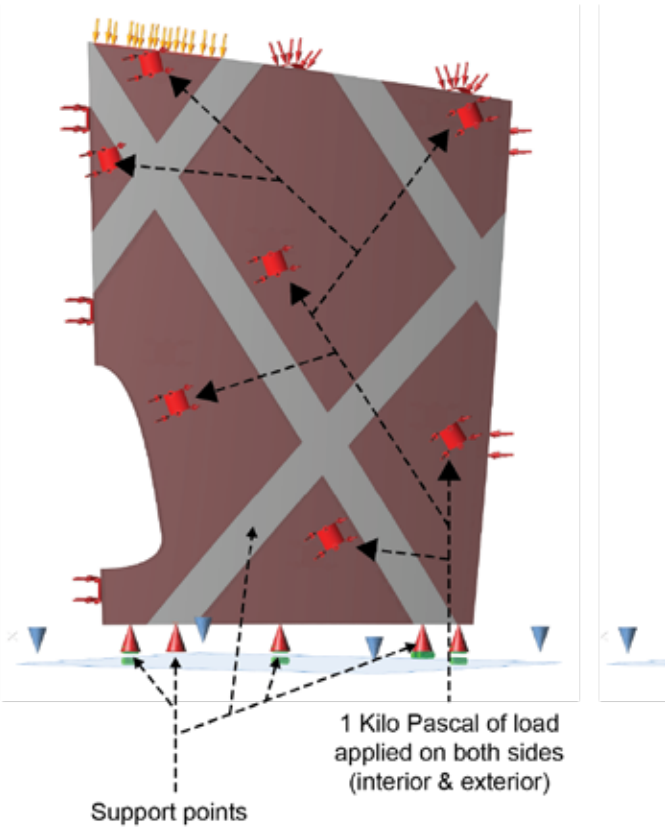


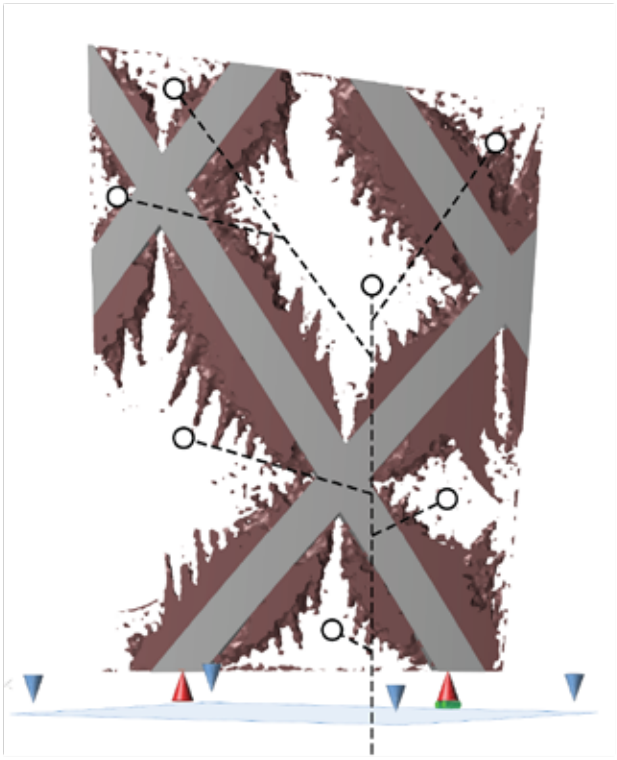
STEEL CONNECTION ELEMENT

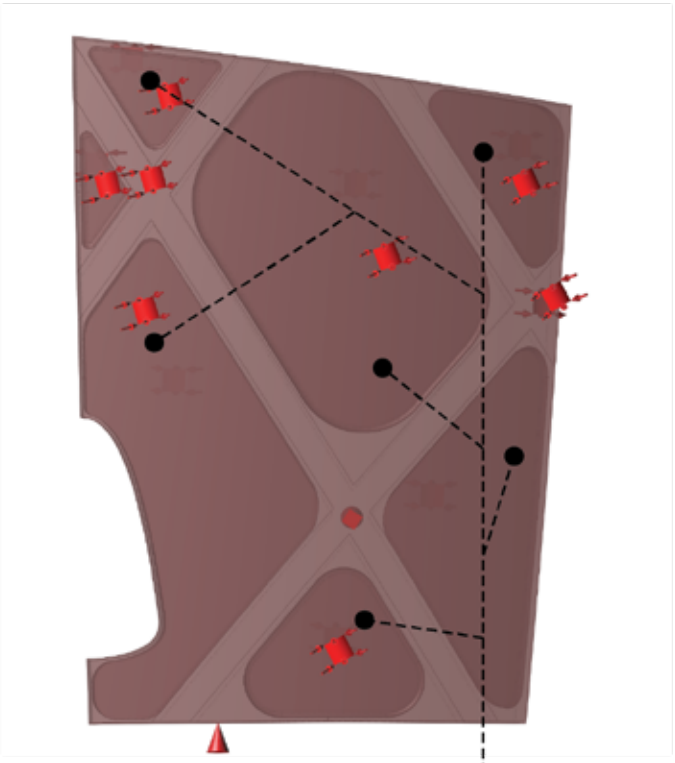


TOPOLOGY OPTIMIZATION OF CLAY WALL

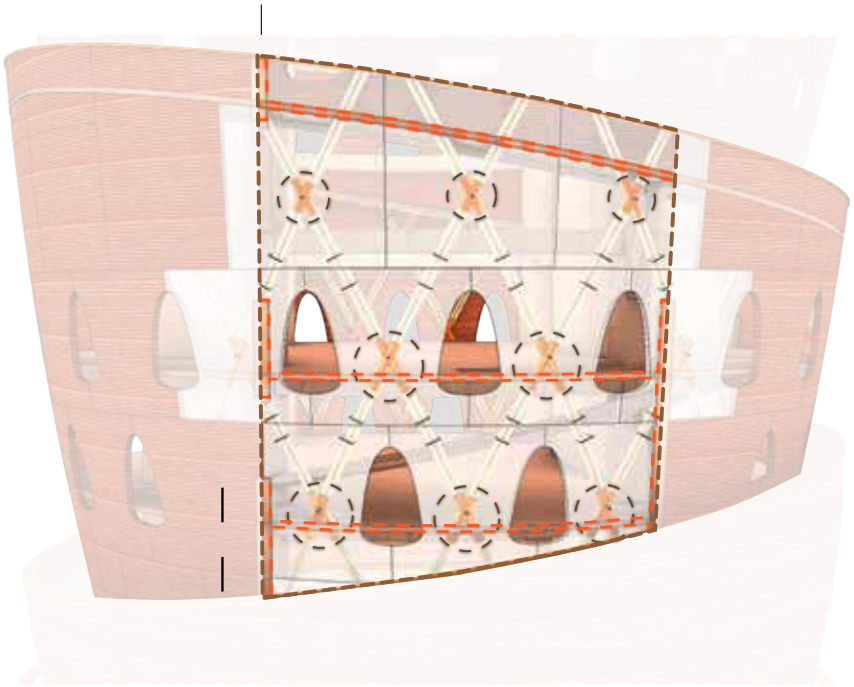




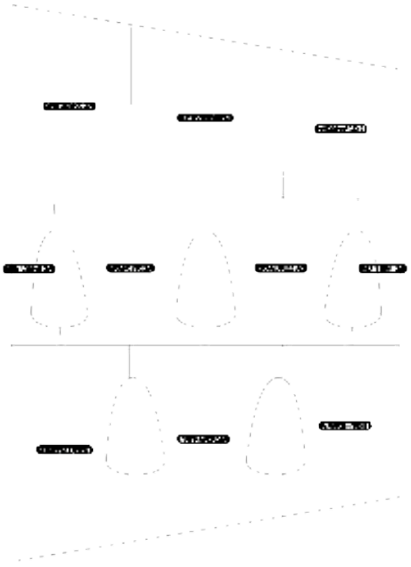

Result showing parts that can be eliminated with structural stability



FACADE STRUCTURAL ANALYSIS

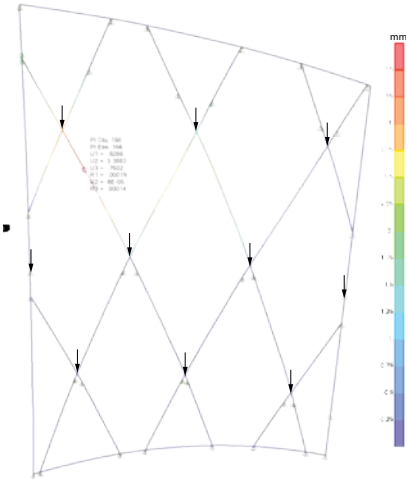


Bamboo - Clay Wall Connection

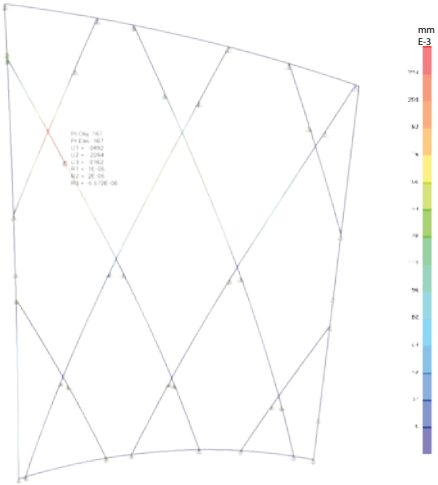


Clay Wall Panel Loads

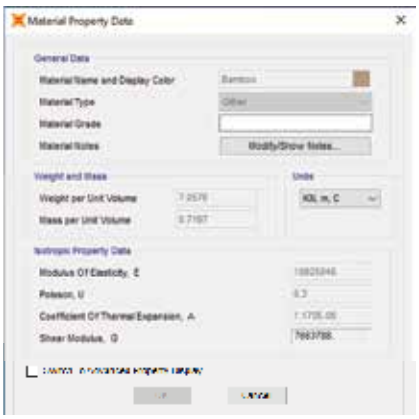
To Simplify the structural analysis, The bamboo shoots were considered as one (1) with diameter 350mm and thickness 15mm instead of two (2) with diameter 200mm and thickness 10mm

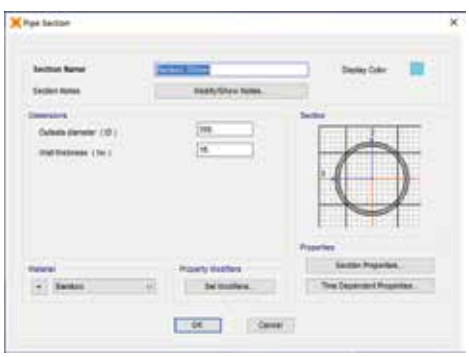


Displacement Values = Dead Loads (Bamboo) + Panels + Wind

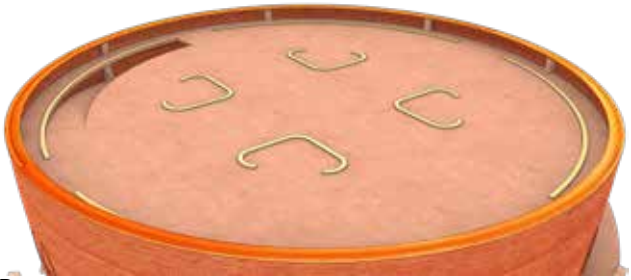


Wind Load (1 kN)



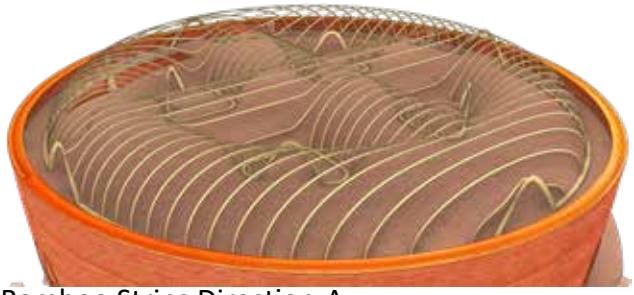


ROOF STRUCTURE ASSEMBLY

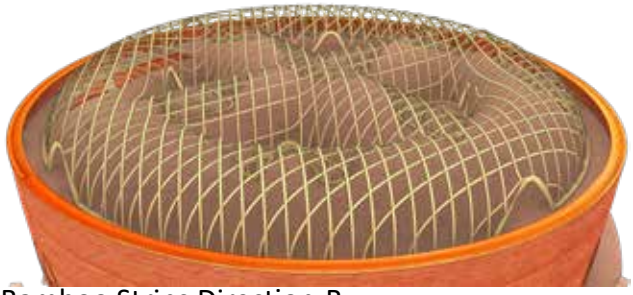


1. Base

2. Boundaries

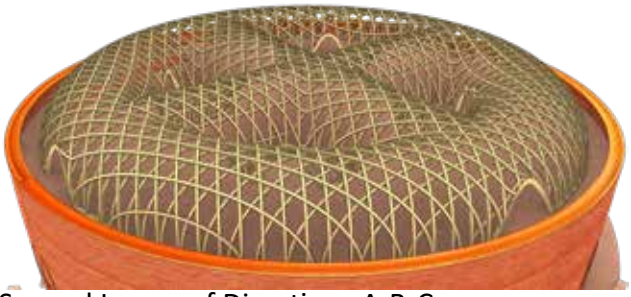


3. Bamboo Strips Direction-A

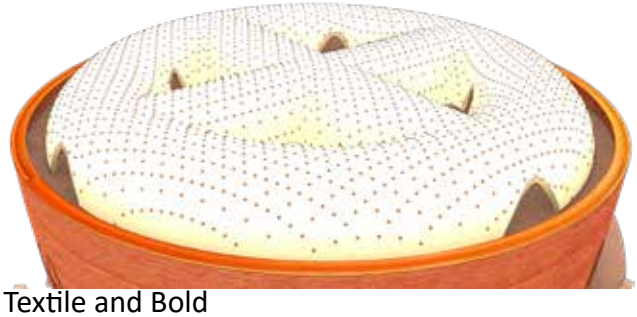


4. Bamboo Strips Direction-B

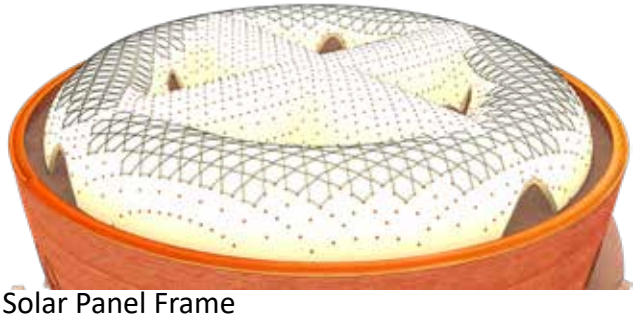
5. Bamboo Strips Direction-C



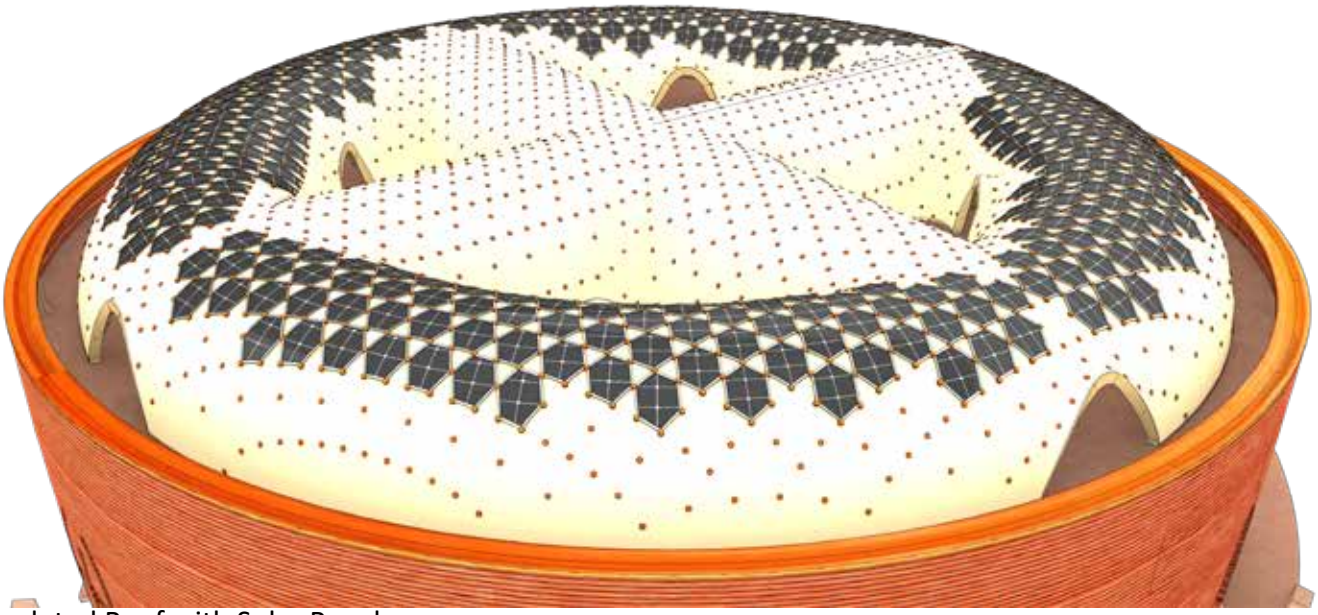
6. Second Layers of Directions A-B-C



7. Textile and Bold

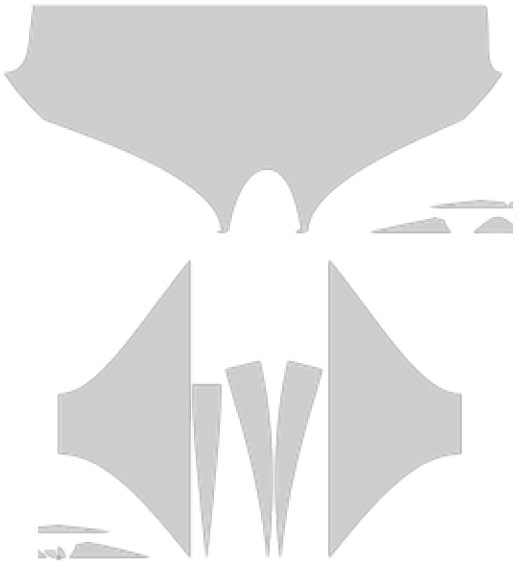


8. Solar Panel Frame



9. Completed Roof with Solar Panels

ROOF TEXTILE



05 MATERIALS

Introduction

The significance of solid mineral resources has been ofprofound value to man since time immemorial. Clay minerals appear not to be the most valuable among the minerals of the earth surface, yet they affect life on earth in far reaching ways. Nigeria in sub-Saharan Africa (surface area: 923,768 km2) is a country with considerable wealth in natural resources, with a record of over 30 minerals of proven reserves . As far back as 1903 and 1904, geological survey in Nigeria evolved when the Mineral Surveys of the Southern and Northern Protectorates of Nigeria were established under the British colony. The Mineral Surveys carried out broad reconnaissance of mineral resources of the two Protectorates with the prospect of using the raw materials for industries in Britain. In course of these activities, such deposits as Tinstone, Columbite Limestone, Bitumen, Lead-zinc Ores, Coal, Clays, Iron Ore, Gold, and Marble etc were discovered in various parts of the country.After the colonial era, government parastatals have been set up such as the Nigeria's Ministry of Solid Minerals Development, Raw Material Development Research Council (RMDRC) and the Federal Institute of Industrial Research Oshodi (FIIRO) which all tried to establish a comprehensive data list of basic mineral resources as they occur at various geological locations in appreciable millions of tonnage that supports experimental and industrial uses .In recent research purview, various studies on solid mineral resources using geo-scientific surveys and mineralogical charaterisation considered that the understanding of the nation'smineral potentials is critical for efficient exploration and exploitation towards promoting sustainable economic developmentas shown in . Results have shown that Nigeria's geosphereis enriched with a wide range of both metallic and non-metallic minerals deposited across the states of the nation which are and could still be beneficiated to provide the raw materials for industrial manufacturing among other productive purposes. Noteworthy, clay minerals constitute over 50% of the non-metallic, earthy and naturally-occurring resources abounding throughout Nigeria's sedimentary basins and on the basement it was observed that extensive investigation has been carried out on the liquid mineral endowment of the country, while little has been done to solid mineral endowment of which clay is prominent and as a result, adoption of solid mineral on industrial scale is scanty.

Mararaba-Rido and Kachia areas of Kaduna State are among the largest reserves of clay deposits in Nigeria with over 5.3 million tons. Despite the vast potentials, clay minerals are still grossly underutilized and the few pockets of existing clay-based industries have primarily harnessed the raw for the production of ceramic wares and structural products.A growing number of investigations carried on the solid industrial minerals in Nigeria have been broad based and genericwith consideration for geological survey and mineral characterization [see 1,4,6,8]. Besides, documented studies on clay minerals in selected areas of Nigeria tend to focus more on the mineral characterisation and with little emphasis on the economic potentials or usage of the minerals as such in . This study had considered the industrial potentialities in addition to the properties study of clay mineral using Kaduna State of Nigeria as a case study. The qualities of clay found determine its application and suitability for ceramic products such as in bricks, ceramic wares, and refractory. The findings of the study were gathered through field surveys with documentation of relevant information on clay reserves, mineral locations, and the economic significance of the minerals. This includes detailed evaluation of report findings from three clay-based industries at Mararaba-Rido, Jacaranda and Maraba areas in Kaduna State, Nigeria. The result shows a significant usage of clay mineral as a principal raw material for ceramic manufacturing such as structural, refractories, and whitewares products. Clay minerals hold high material value to industriesin Kaduna utilizing them for ceramic purposes towards socio-economic and industrial development. This supports the main policy thrust of the economic reform program of the Nigerian government which is targeted at mobilizing national capability in converting the country's endowments into utility products and services for the common man.

Documentation on clay minerals in Nigeria

The most abundant, ubiquitous, and accessible material on the earth crust is clay]. Reference observed that a great emphasis is placed on exploiting the abundant solid minerals endowments in Nigeria with a view to diversifying the economic base of the country, improving Gross Domestic Product (GDP) and industrial activity. One of these endowments with tremendous potential for economic utilization is clay. Clay deposit is spread across the six geo- political zones of the country .Clays have their origin in natural processes, mostly complex weathering, transport, and deposition by sedimentation within geological periods.

The abundance of the clay minerals in Nigeria supports its rich and historic traditional pottery industry that dates from the Stone Age. Archeological evidences from the ancient pottery areas of Nigeria such as Iwo-Eleru near Akure in Ondo State, Rop in Plateau state, Kagoro in Kaduna State and Afikpo in Ebonyi state proved that as far back as the late stone age, the occupants of these areas made productive used of clay for pottery. The composition of clayeyand organic materials such as straws made into adobe brick, served as a ubiquitous building material widely used for building weather-friendly housesin thevast rural domains. Modern industrial uses of clay for ceramics and bricks now obtained in notable parts of the country including Kaduna, Northern Nigeria.

Clay is simplydefined as earth or soil that is plastic and tenacious when moist and that becomes permanently hard when baked or fired. It consistsof a group of hydrous alumino-silicate minerals formed by the weathering of feldspathic rocks, such as granite. Individual mineral grains are microscopic in size and shaped like flakes. This makes their aggregate surface area much greater than their thickness and allows them to take up large amounts of water by adhesion, giving them plasticity and causing some varieties to swell (expandable clay). Common clay is a mixture of kaolin, or china clay (hydrated clay), and the fine powder of some feldspathic mineral that is anhydrous (without water) and not decomposed. Clays vary in plasticity, all being more or less malleable and capable of being molded into any form when moistened with water. The plastic clays are used for making pottery of all kinds, bricks and tiles, tobacco pipes, firebricks, and other products. The commoner varieties of clay and clay rocks are china clay, or kaolin; pipe clay, similar to kaolin, but containing a larger percentage of silica; potter's clay, not as pure as pipe clay; sculptor's clay, or modeling clay, a fine potter's clay, sometimes mixed with fine sand; brick clay, an admixture of clay and sand with some ferruginous (iron-containing) matter; fire clay, containing little or no lime, alkaline earth, or iron (which act as fluxes), and hence infusible or highly refractory; shale; loam; and marl

Listed industrial clay-based minerals in Nigeria

No	Mineral	Site Location	State	Estimated Reserve (tonnes)	Remark
1	Kaolin	Kankara	Katsina	20,000,000	Residual
		Major porter, Jos	Plateau	19,000,000	"
		Oshide	Ogun	.....	"
		Iseyin	Oyo	.....	"
		Ifon	Ondo	.....	"
		Ozubulu	Anambra	769,000	Sedimentary
		Illo	Sokoto	.....	Residual
		Darazo	Bauchi	10,000,000	.....
		Kpaki; Pategi	Niger	.....	.....
		Igbanke; Ozonnogogo	Edo	.....	Sedimentary
2	Ball clay	Abeokuta	Ogun	.....	Black
		Auchi; Ujogba	Edo	.....	Black; Cream
		Nsu	Imo	.....	Cream
		Giru	Kebbi	.....	.....
3	Common clay	Mararaban-Rido	Kaduna	5,500,000	grey
4	Feldspar	Okuta	Ogun	.....	Potash
		Lanlate	"	.....	"
		Egbe		.....	"
		Bari	Kwara	.....	"
		Okene	Niger	.....	"
		Gwoza	Kogi	.....	"
		Oshogbo	Borno	.....	"
		Ijero	Osun Ekiti	.....	Soda
5	Quartz/ Silica	Pankshin; Shabu	Plateau	27,962; 2,540,000	White; Sand
		Biu	Borno	.....	White
		Ijero	Ekiti	4,000,000	Sand
		Lokoja	Kogi	.....	"
		Ughelli	Delta	.....	"
		Badagry	Lagos	.....	"
		Epe	"	.....	"
		Igbokoda	Ondo	.....	"
		P/ Harcourt	Rivers	.....	"

6	Talc	Shagamu	Ogun	.....	.....
		Kumunu	Niger	40,000,000	.....
		Ilesha	Oyo	.....	.....
		Okolom	Kogi	.....	.....
		Zonkwa	Kaduna	.....	.....
6	Bentonite	Geshua	Yobe	.....	.....
		M/Belwa	Adamawa	.....	.....
		Esan/Isan	Edo	.....	.....
8	Limestone	Okpila	Edo	10,161,000	White
		Jakuru	Kogi	68,000,000	"
		Igumala	Benue	30,161,000	.....
		Mfamoging	C/river	26,000,000	Grey
		Nkalagu	Enugu	720,000,000	"
		Ewekoro	Ogun	7.1 Billion	Clayey
		Arochuku	Imo	101,000,000	.....
		Shagamu	Ogun	.....	Grey
		Isekulu	Delta	.....	.....
		Sokoto	Sokoto	.....	.....
9	Dolomite	Osara	Kogi	2,000,000	White
		Itobe	Benue	1,000,000	"
		Igara	Edo	.....	"
		Mura	Plateau	.....	"
		Elebu	Kogi	.....	"
		Igbeti	Oyo	.....	"
		Burum	FCT	8,000,000	"
		Kwakuti	Niger	2,540,000	"
		B/Gwari	Kaduna	.....	.....

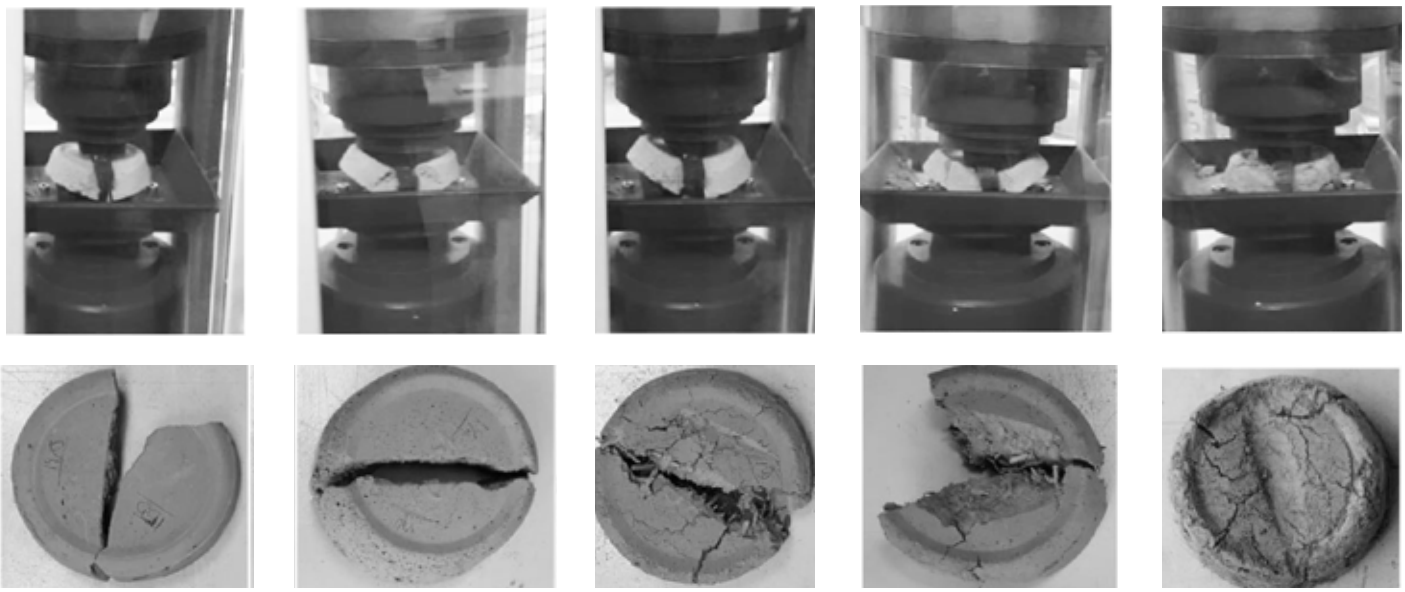
Proposed forms of clay composite adoptation to our project

Lightweight fiber-reinforced clay as a sustainable material for disaster resilient architecture of future buildings

The LRC material introduced in this section is basically consisted of clay, with a small percent of concrete foam to increase its porosity, resulting in decreased density, and also a small percent of either of the reinforcing materials, including gypsum, plant fibers, wood fibers, and also natural hair strands. The foam can be of synthesized or natural base. Natural foam can be made of horn and nail and some other abdominal leftover materials of the livestock, which can be provided form slaughter houses. The hair, which can be human hair or hair of any animal, can be provided from the waste of haircut shops, or the farms where the hair of animals, such as goat, are cut annually. first, the mechanical properties of LRC, which have been obtained through a set of laboratory bending tests, are presented. Then, the 'foamed hair-reinforced clay', which has superior advantages over other types of LRC is introduced, and the results of its shear and compression tests are presented, and finally its usage as a building material for achieving sustainable and resilient architecture of future buildings, or even upgrading the existing buildings for increasing their resilience.

Bending test

For bending tests, presents geometric specifications and average mechanical properties of the samples of the five materials used in the bending test for comparison. It can be seen in that the LRC sample with natural hair reinforcement, namely 'foamed hair-reinforced clay' (FHRC) has behaved much better than other samples in bending. In fact, all other samples have shown a brittle behavior in bending, while the FHRC has shown very high ductility and integrity. Also, it is seen in Table 1 that the FHRC has presented a bending strength the bending strength of the LRC with that special reinforcing material.



Plain Clay | Gypsum-reinforced LRC | Wood fiber-reinforced LRC | Plant fiber-reinforced LRC | Natural Hair-reinforced

Specifications of the five materials used and obtained from the bending test.

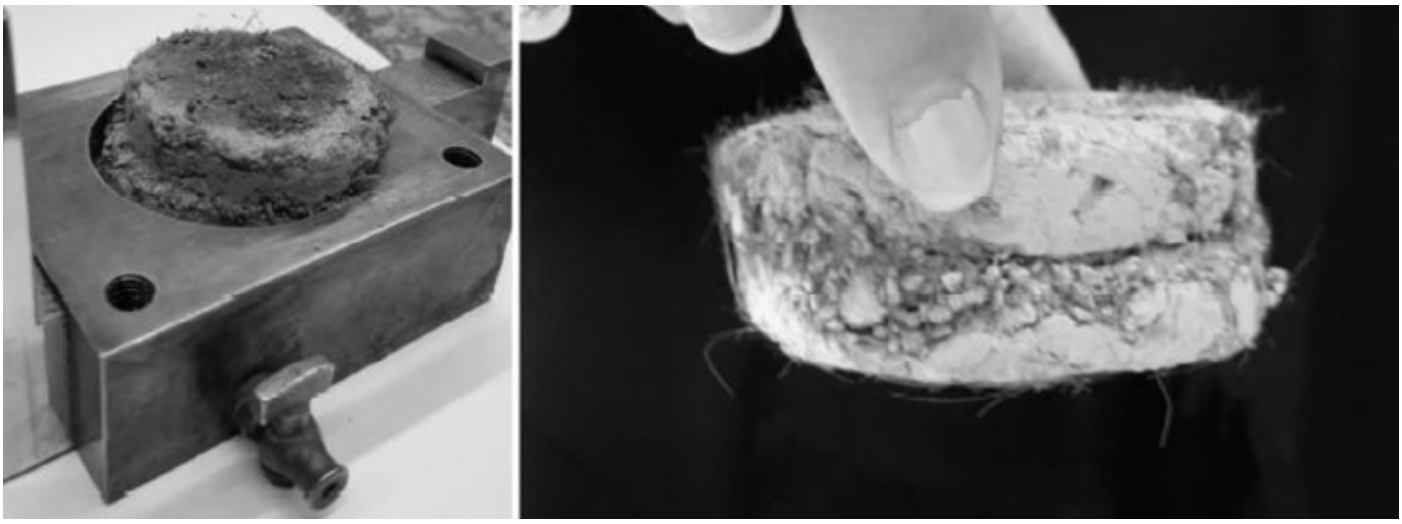
Specifications	Plain clay	Gypsum reinforcement	Wood straws reinforcement	Plant straws reinforcement	Natural hair reinforcement
D (mm)	83.0±0.1	84.0±0.1	84.0±0.1	84.0±0.1	85.0±0.1
H (mm)	16.0±0.1	19.5±0.1	21.5±0.1	22.0±0.1	20±0.1
Volume = $3.14D^2/4\times H$ (cm^3)	86.53±0.7	108.01±0.9	119.09±1.0	121.86±1.0	113.43±0.9
Weight (grf)	160±1	155±1	158±1	165±1	155±1
Density = weight/volume (grf/cm^3)	1.85±0.02	1.44±0.02	1.33±0.02	1.35±0.02	1.37±0.02
F (N)	750±10	810±10	750±10	610±10	5400±10
$M = F \times L/4$(N mm) ($L = 58$ mm)	10875±160	11745±170	10875±160	8845±130	78300±1150
$S = D \times H^2/6$ (mm^3)	3541±48	5324±72	6472±88	6776±92	5667±77
$\sigma_b = M/S$ (N/mm^2)	3.07±0.08	2.21±0.06	1.68±0.04	1.31±0.03	13.82±0.36
Strength to density ratio	1.66±0.06	1.53±0.05	1.26±0.04	0.97±0.03	10.09±0.36

FHRC as an innovative material

Past studies have shown that the human hair is very durable and can last for centuries (Lubec et al., 1987). Furthermore, it has been shown that adding a few percent of human hair to clay can remarkably increase the mechanical properties and decrease the thermal conductivity of clay (Jubran, Habali, Hamdan, & Zaid, 1988). In an experimental study by Ziegler, Leshchinsky, Ling, and Perry (1998), it has been shown that the inclusion of randomly distributed short fibers in the clayey soils can prevent effectively the development of desiccation cracks. Their test results have also shown that the fibers increase the tensile strength of the clay and provide a ductile behavior that was not present in the samples without fibers.

Direct shear test of FHRC and plain clay samples

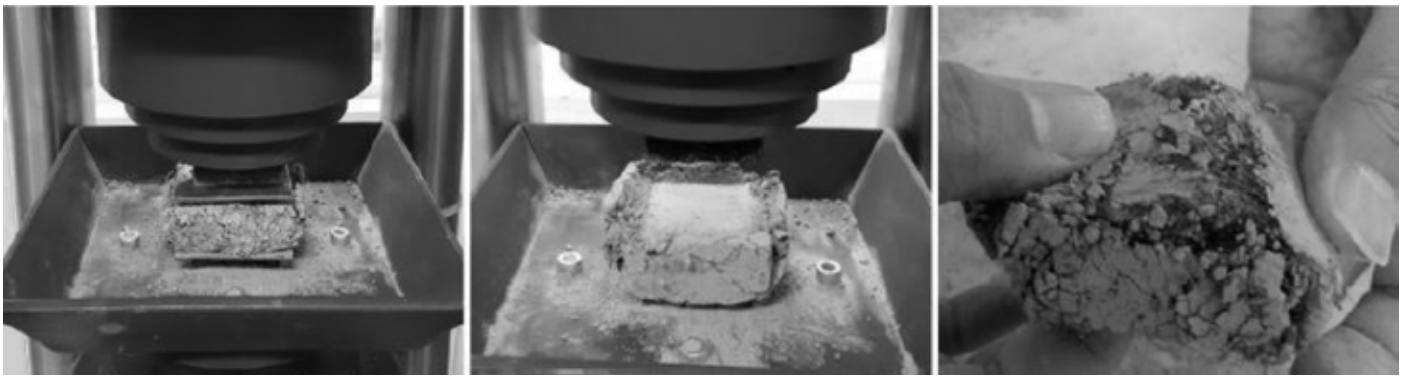
Since in bending test it was revealed that the FHRC has very high efficiency comparing to other samples, it was decided that for shear test only samples of FHRC are compared with samples of plain clay. The shear tests were of the direct shear type, and were conducted on two samples of each material.



The FHRC sample at the last stage of direct shear test (left) and its maintained integrity even after shear failure (right).

Compression test of FHRC samples

The last series of tests conducted on the FHRC samples were compression test. The samples for this test were of cube form with base dimensions of 4.9 cm and height of 3.0 cm. A sample of FHRC at the final stage of the compression test, and also after the test under the bending effect.



A sample of FHRC at final stage of the compression test (left), after unloading (middle), and after unloading under bending effect (right).

Advantages of FHRC

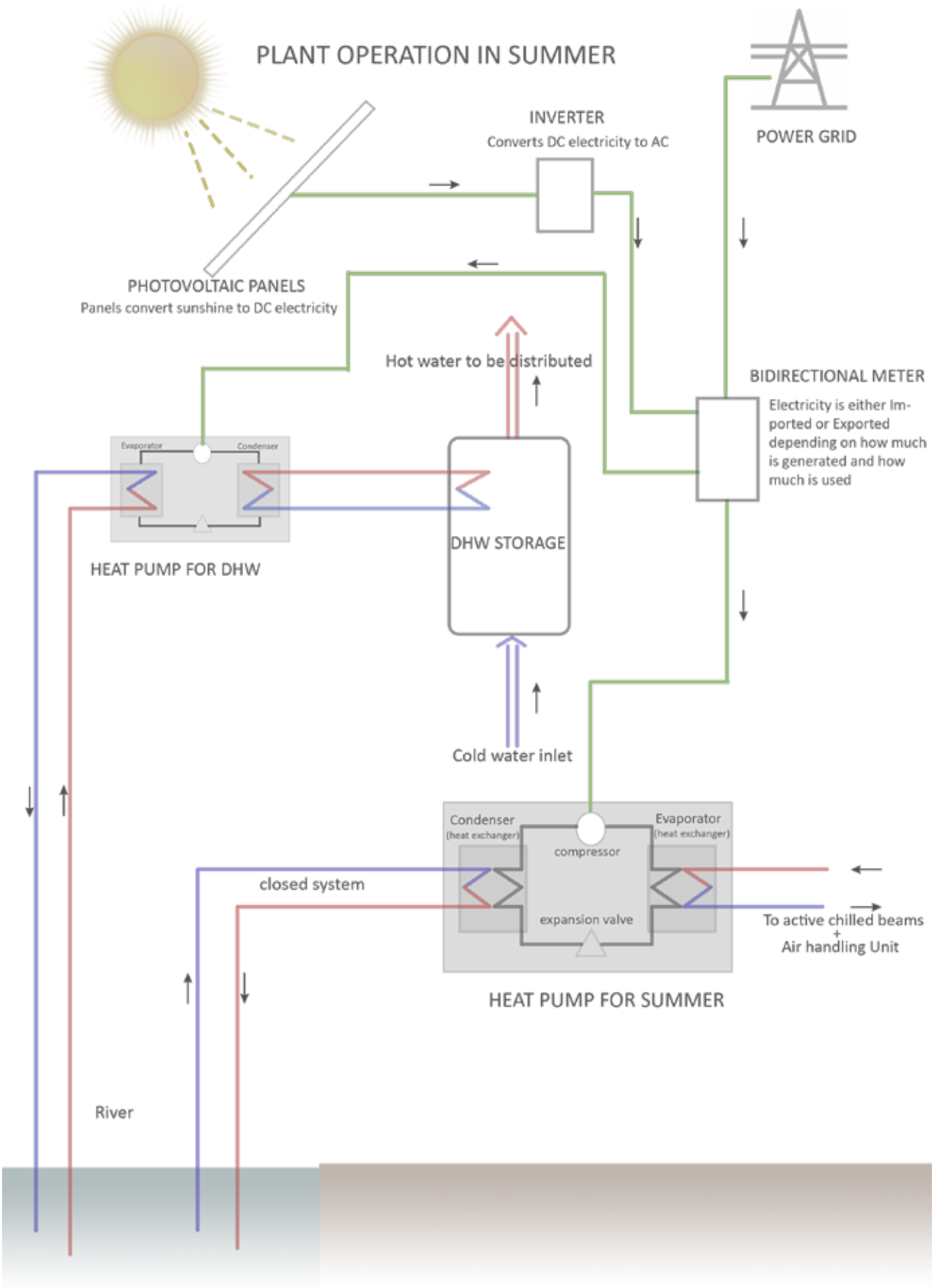
. Low cost
. High bending, shear and compressive strengths
. Sustainability and eco-friendliness
. Ease of accessibility
. High workability and mouldability
. Low density and high ductility/integrity
. High fire resistance
. High heat and sound insulation
. Higher moisture resistance comparing to plain clay

Using the FHRC material in building components

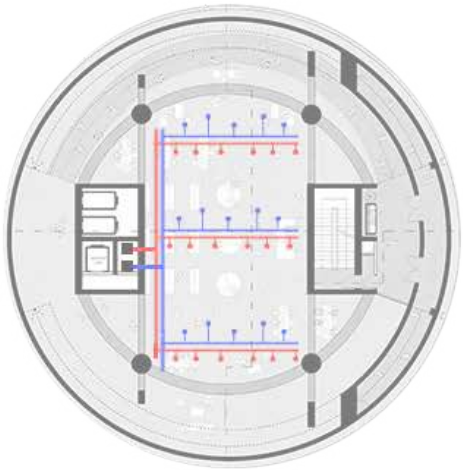
. Partitions
. Tiles of false ceiling
. Double-skin hollow external walls, and the building's façade
. Flooring material beneath finishing covers
. Load bearing masonry elements

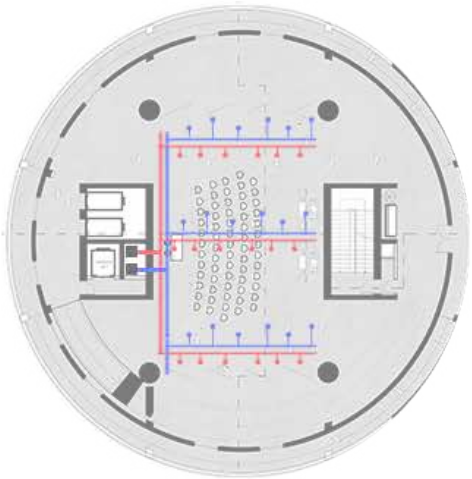
FHRC is very good heat and sound insulator, thanks to its high porosity on the one hand, and the inherent relatively high resistance of soil against heat. This heat insulation helps saving the hair strands in the body of FHRC in case of fire. The high heat insulation capability of FHRC helps the building in energy preservation as well, which is one of the important specifications of sustainable architecture. Finally, FHRC has high resistance to moisture and resistance against precipitations.

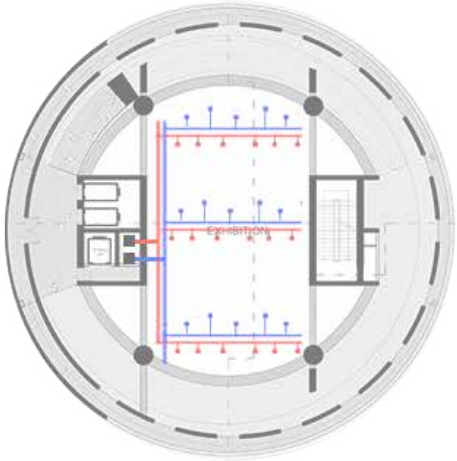
06 BUILDING SERVICE

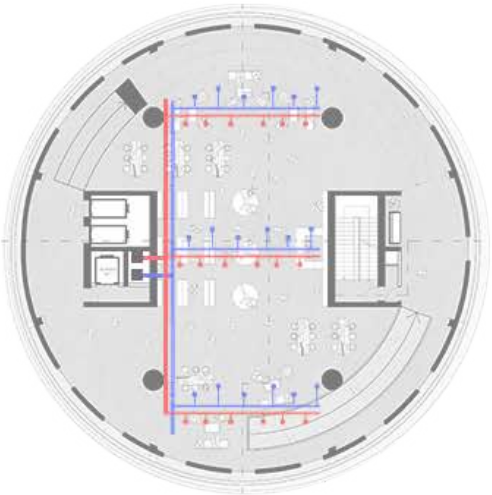


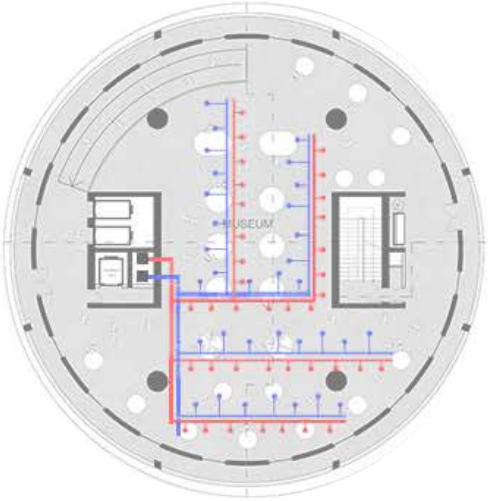

DOMESTIC HOT WATER
DOMESTIC COLD WATER
OUTELT
ELECTRICITY
INLET
Heat pump
DHW storage
Heat pump
RIVER

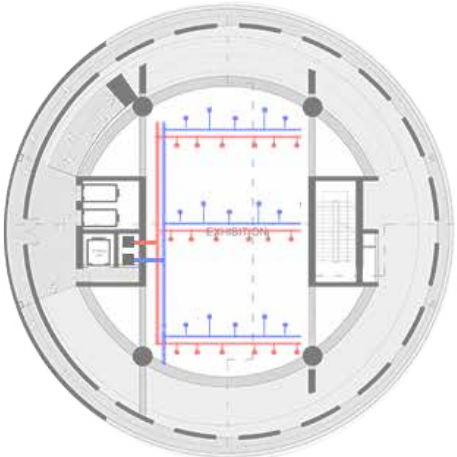





EXHIBITION

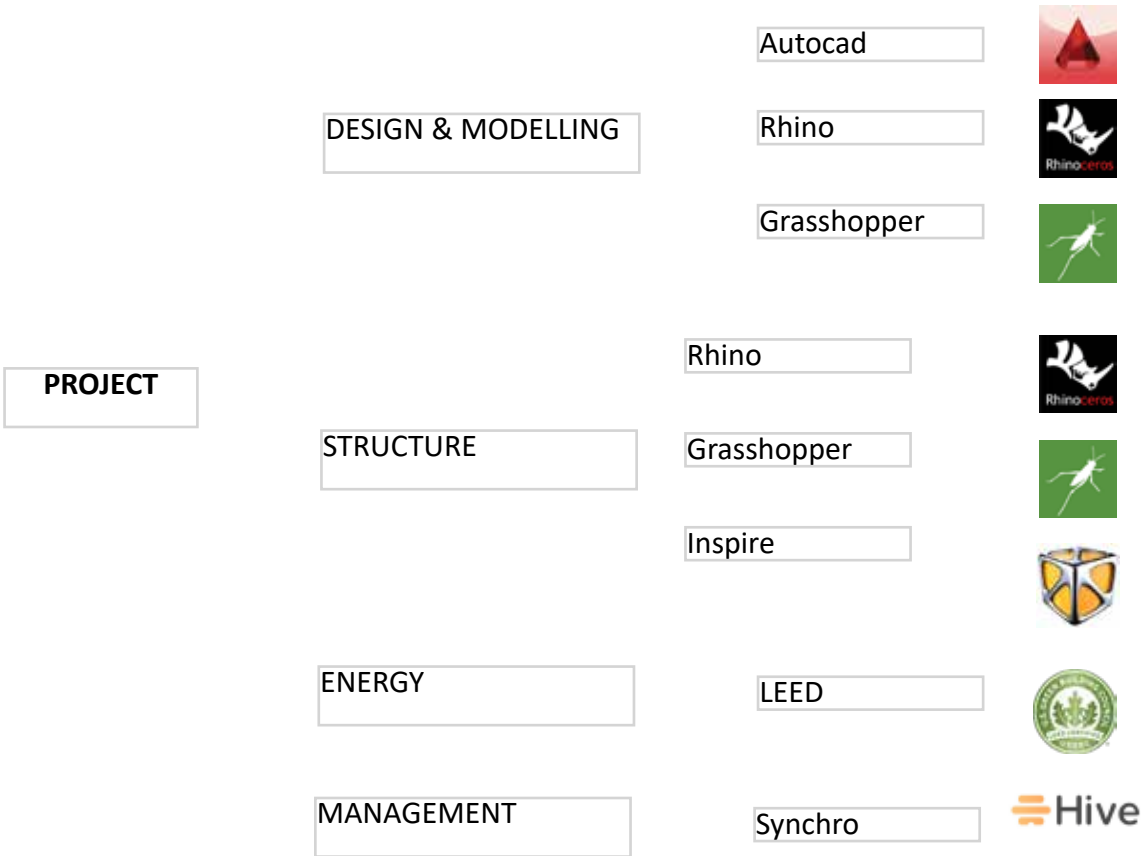



MUSEUM


EXHIBITION

07 BUILDING INFORMATION MODELLING

The emerging of building information modeling provides opportunities to break through the limitations of conventional building modeling such as tedious model preparation, model inconsistency and costly implementation, and promotes building modeling into the digital building design process. The method of using building information modeling for the building modeling process, named building information modeling-based-building energy modeling has become a prevalent and attractive topic in both the re- search and the industry society in recent years. energy simulation process, from the step 1 identifying the geometry, thermal properties of buildings to the information and components for HVAC systems. In gener-al, the current building information modeling methods are thoroughly evaluated and the trends for future developments are outlined. It is realized that the Building Information Modeling is particular appropriate for the early design stage, where the most suitable and cost effective approaches for efficient design can be integrated into the overall building design process. Starting with the Conceptual design & the whole integrated design processes and development, the form and geometry has been conceived by the use of Rhino and the dancing looking molecular botanical garden is achieved with the use of grasshopper. further more, we employed the used of Inspire for material optimization and structural analysis .other applications used are SAP2000 for facade structure analysis, Lad bug for weather analysis ,Honeybee for Luminance studies, Autocad for 2D Architectural drafting,Hive for construction project management. The link between each phases and processes shown below in the BIM flow diagram.



ENERGY

LEED

A sustainable building/city is considered as the urban systems and the infrastructure which are planned and designed for long-term requirements. It must be ensured that the project will survive over a long period of time maintaining its integrity, normal functioning, self-reliance and also ensure quality of life for its residents while ensuring its robustness and adaptive capacity simultaneously. sustainable buildings, which are environmentally friendly and have energy efficient structures, have been proposed to reduce the environmental impacts of buildings, save energy and water and make contributions to the occupant's health and comfort through practices such as temperature and humidity control, indoor air quality, nat- ural lighting, and waste management ,The design processes of sustainable buildings are arguably more complex than conventional design approaches due to the multidisciplinary design team works that are required to address the requirements of environmentally sustainable systems. Achieving an integrated design solution prior to construction means that the design team must manage reciprocal task interde- pendencies and address a complex of information sharing requirements surrounding data coordination and exchange across multiple disciplines. Therefore, because of the growing demand for the sustainable development and green buildings in the past few years, green building rating systems are established to estimate the life cycle performance of the buildings. These certification programs revolutionize the way cities and communities are planned, developed and operated in order to improve the quality of life of people around the world. The programs provide a framework to plan, design, measure and manage the performance of social, economic and environmental conditions on a city-wide or community level. Lead- ership in Energy and Environmental Design (LEED), which is one the most wellknown and commonly used green building rating systems, is developed by the U.S. Green Building Council (USGBC,2018) (Wu et al., 2017) and therefore its application in design, credit analysis, and documentation, that must be submitted in order to reach the required type of certification (Eastman, Teicholz, Sacks, & Liston, 2008), is significant in the research communit, LEED® uses an online rating system, which gives scores on choice of site, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, locations and linkages, innovation in design and regional priority. When the results are combined, successful projects are categorized as Certified, Silver, Gold or Platinum. Following the principles of sustainable integrated design we designed our project to meet LEED requirements and in so doing got a platinum rating.

Project Name: AFRICAN CULTURE COMPLEX
Date: 09/11/2019

LEED v4 for BD+C: New Construction and Major Renovation
Project Checklist

Y	?	N			
			Credit	Integrative Process	1

13	0	0	**Location and Transportation**		16
			Credit	LEED for Neighborhood Development Location	16
1			Credit	Sensitive Land Protection	1
2			Credit	High Priority Site	2
4			Credit	Surrounding Density and Diverse Uses	5
5			Credit	Access to Quality Transit	5
			Credit	Bicycle Facilities	1
1			Credit	Reduced Parking Footprint	1
			Credit	Green Vehicles	1

9	0	0	**Sustainable Sites**		10
Y			Prereq	Construction Activity Pollution Prevention	Required
1			Credit	Site Assessment	1
2			Credit	Site Development - Protect or Restore Habitat	2
1			Credit	Open Space	1
3			Credit	Rainwater Management	3
1			Credit	Heat Island Reduction	2
1			Credit	Light Pollution Reduction	1

8	0	0	**Water Efficiency**		11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
2			Credit	Outdoor Water Use Reduction	2
5			Credit	Indoor Water Use Reduction	6
			Credit	Cooling Tower Water Use	2
1			Credit	Water Metering	1

26	0	0	**Energy and Atmosphere**		33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
5			Credit	Enhanced Commissioning	6
15			Credit	Optimize Energy Performance	18
1			Credit	Advanced Energy Metering	1
1			Credit	Demand Response	2
2			Credit	Renewable Energy Production	3
			Credit	Enhanced Refrigerant Management	1
2			Credit	Green Power and Carbon Offsets	2

13	**0**	**0**	**Materials and Resources**		**13**
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
5			Credit	Building Life-Cycle Impact Reduction	5
2			Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
2			Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
2			Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2			Credit	Construction and Demolition Waste Management	2

13	**0**	**0**	**Indoor Environmental Quality**		**16**
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
1			Credit	Enhanced Indoor Air Quality Strategies	2
3			Credit	Low-Emitting Materials	3
			Credit	Construction Indoor Air Quality Management Plan	1
1			Credit	Indoor Air Quality Assessment	2
1			Credit	Thermal Comfort	1
2			Credit	Interior Lighting	2
3			Credit	Daylight	3
1			Credit	Quality Views	1
1			Credit	Acoustic Performance	1

6	**0**	**0**	**Innovation**		**6**
5			Credit	Innovation	5
1			Credit	LEED Accredited Professional	1

4	**0**	**0**	**Regional Priority**		**4**
1			Credit	Regional Priority: Specific Credit	1
1			Credit	Regional Priority: Specific Credit	1
1			Credit	Regional Priority: Specific Credit	1
1			Credit	Regional Priority: Specific Credit	1

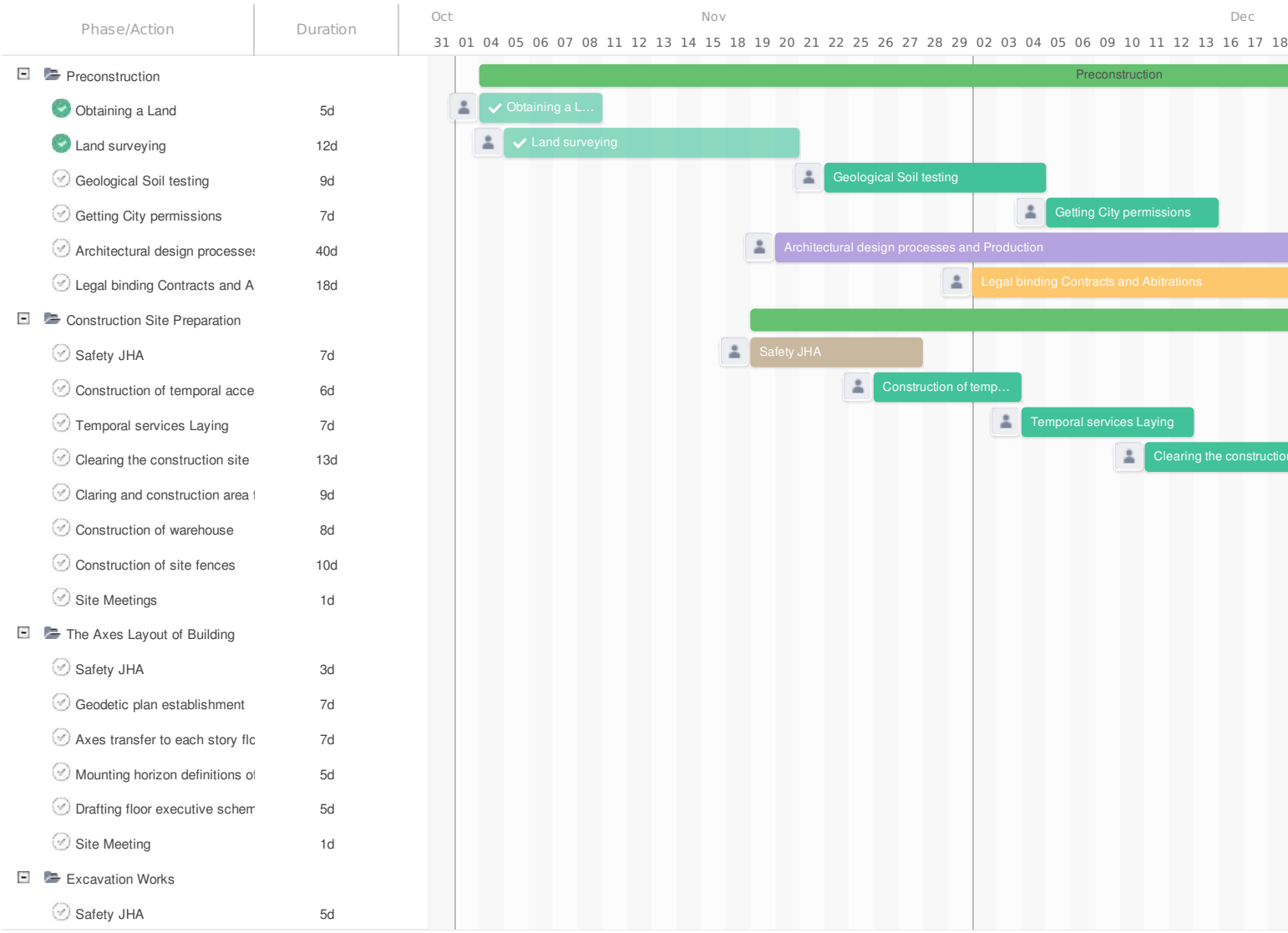
92	**0**	**0**	**TOTALS**	Possible Points:	**110**

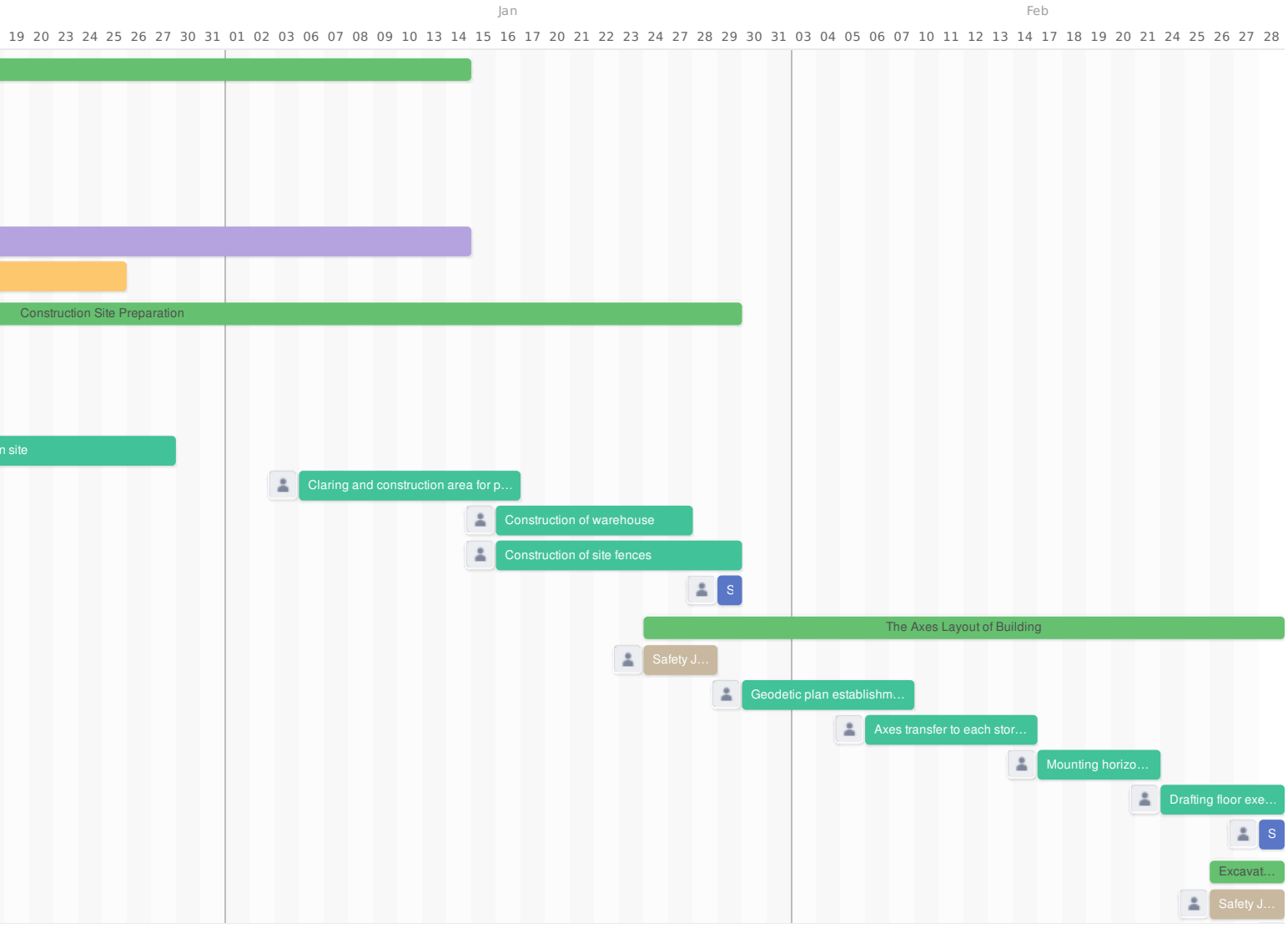
Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

PROJECT MANAGEMENT

HIVE

Hive is a modern productivity platform that centralizes teams, projects, conversations, and documents for complete collaboration, thereby promoting real-time visibility while improving work efficiency. It is flexible, and works well with other file formats , it has a robust suite of features that helps teams to plan, execute, communicate, and monitor projects, as well as predict events that may impact work.Hive im- proves quality, safety & productivity

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Construction Site Preparation
n site
Claring and construction area for p…
Construction of warehouse
Construction of site fences
S
The Axes Layout of Building
Safety J…
Geodetic plan establishm…
Axes transfer to each stor…
Mounting horizo…
Drafting floor exe…
S
Excavat…
Safety J…

AFRICAN CULTURE COMPLEX

BUILDING SERVICE

HVAC SYSTEM SOLUTION

Hvac solution adopted in our project is CENTRAL WATER WATER COOL SYSTEM,The idea is to take advantange of an existing water body(River) to supply energy and thermal comfort in our building with the use of sophisticated specific energy solutions machines like open water heat pumps, Heat recovery Air handling units and so on

SCREWED WATER HEAT PUMPS

An Open Water Heat Pump system works by recovering the solar energy stored naturally in river water or open water. The water then passes through heat pumps to yield its low grade heat before being returned to the river with a temperature change of 3°C

Specifications

Cooling capacity range: 98kw ~ 7931kw; heating range: 119kw ~ 9142kw
Applications: hotels, hospitals, sauna bath centers, factories and other areas
Energy efficiency ratio. 1KW of energy can be used for heating and cooling in the area of 6-10 square meters, which is 30%-80% more energy efficient than general central air condition

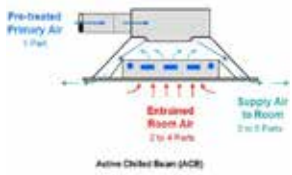
HEAT RECOVARY AIR HANDLING UNIT

Device used to regulate and circulate air as part of a heating, ventilating, and air-conditioning

Specifications
Cooling capacity: 25kW~888kW
Environment temperature:2-35C
Applications: hotels, hospitals, sauna bath centers, factories and other area
Size: 3900mm x 2200mm

ACTIVE CHILLED BEAM

The Active Chilled Beam is duct connected to the central air handling system which provides conditioned fresh air to rooms for ventilation purposes and is also supplied with hot and/or cold water to comfort condition the space.



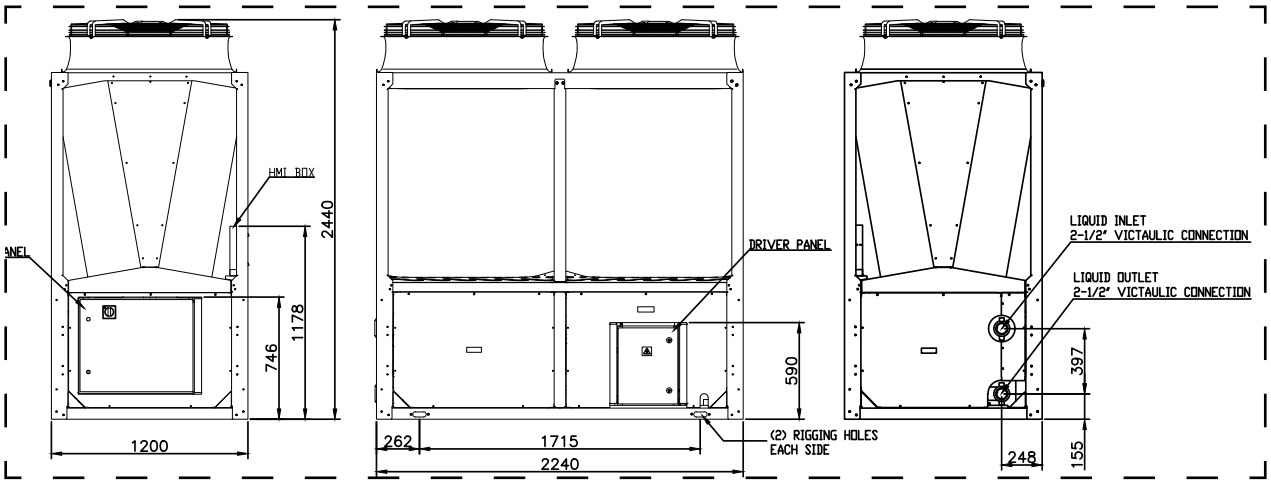
Specifications
System: 4 pipe system
Volumetric flow range: 20 170 m3/h/m
Size : 1200mm x 600mm
Applications: hotels, hospitals, sauna bath centers, factories and other area

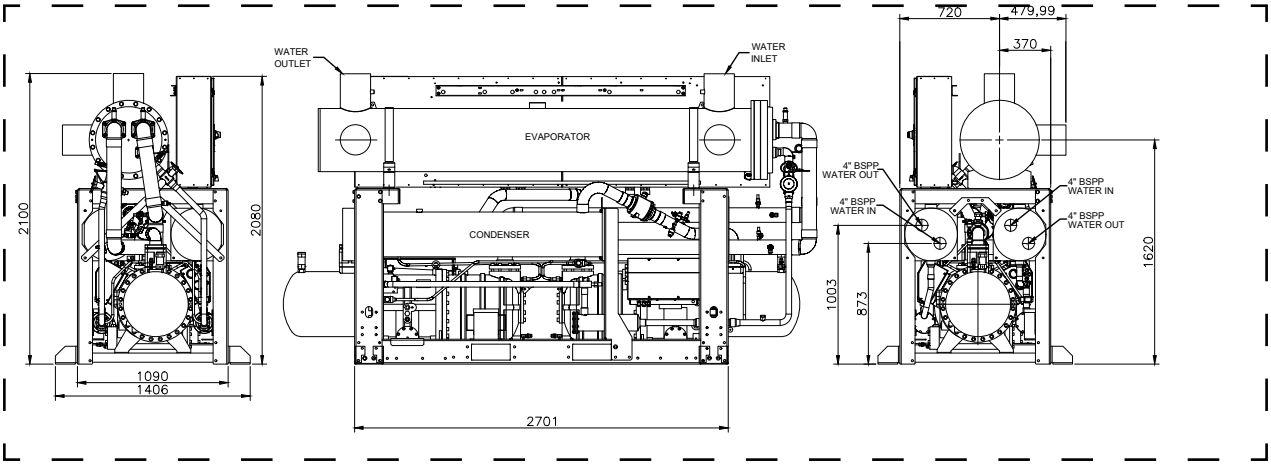
PHOTOVOLTAIC SOLAR PANELS

Photovoltaic panels absorb sunlight as a source of energy to generate electricity, It is used as a major source of energgy in our project

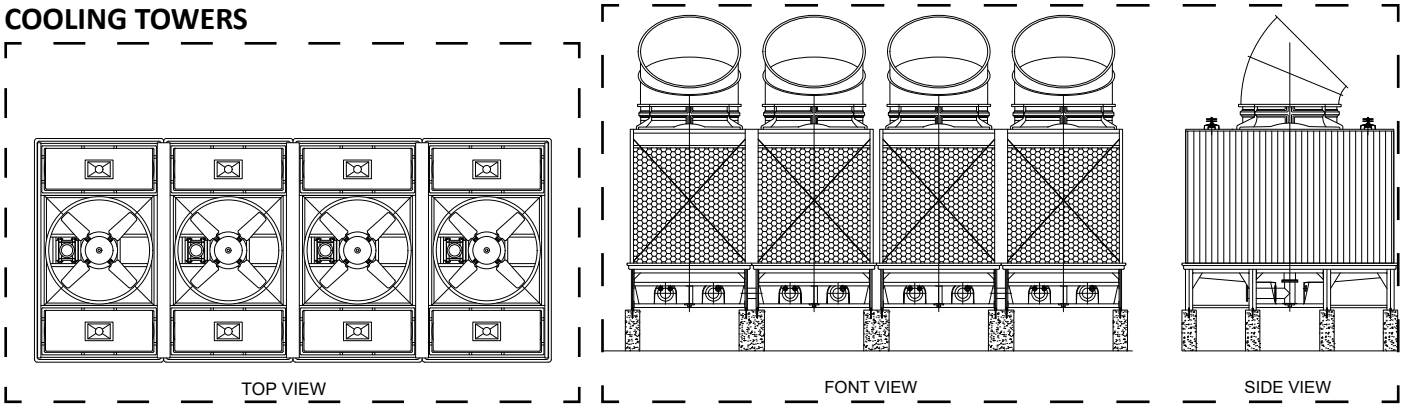
Specifications
Dimensions (LxWxH): 64.96 × 39.06 × 1.38 inches
Weight: 40.57 lbs
60-cell monocrystalline module
Silver anodized aluminum frame
White backsheet materialzz
0~+5W tolerance ratio
PID Resistant
UL and IEC listed
6000 Pa snow load / 3600 Pa wind load

CHILLERS AND HEAT PUMPS





COOLING TOWERS

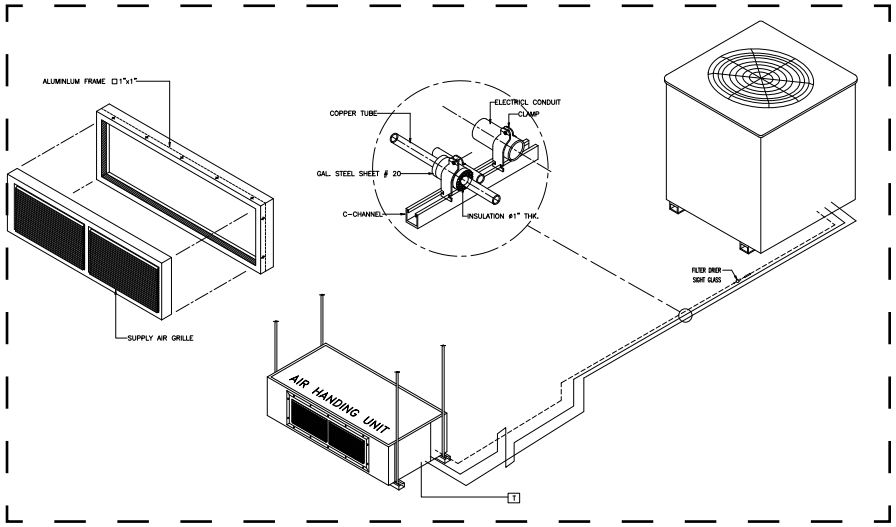


TOP VIEW

FONT VIEW

SIDE VIEW

AIR HANDLER



CONCLUSION

After intensive research,it is known that there is a very high urban,architectural and socio economic marginalisation in Abuja, the Federal Capital Territory of Nigeria, characterized by the invasion of the formal residential (housing) areas of the city by the informal settlements of the urban poor. As a result, it recommends, linking the urban poor settlements areas (urban elements) with the city urban economy and improving on their physical or built environment. It recommends retaining the urban poor settlement areas in their current locations and sustainably, spatially integrate with the central city infrastructure that would architecturally bridge the gap (spatial solution) between the urban poor settlements (place of abode) and place of work. It recommends adopting urban design principles, dealing with the density of the urban poor settlements, the aesthetics, urban amenities, well defined means of circulation, functional parks, how the urban poor settlement areas function and decongestion of the areas by building high rise (4 to 6 story apartments). The buildings would embrace facilities for factories and industries (commerce) on the lower floors, where the residents would be gainfully engaged in economic activities while they live on the upper floors.

Creation and enforcing policies drafted by professionsals ,the aim is to close or eradicate by huge margin the gap between all level of social classes in the city,as a rippling effect will increase conductive environmen for healthy living and better quality of life.This is greatly part of the projects ethics

REFERENCES