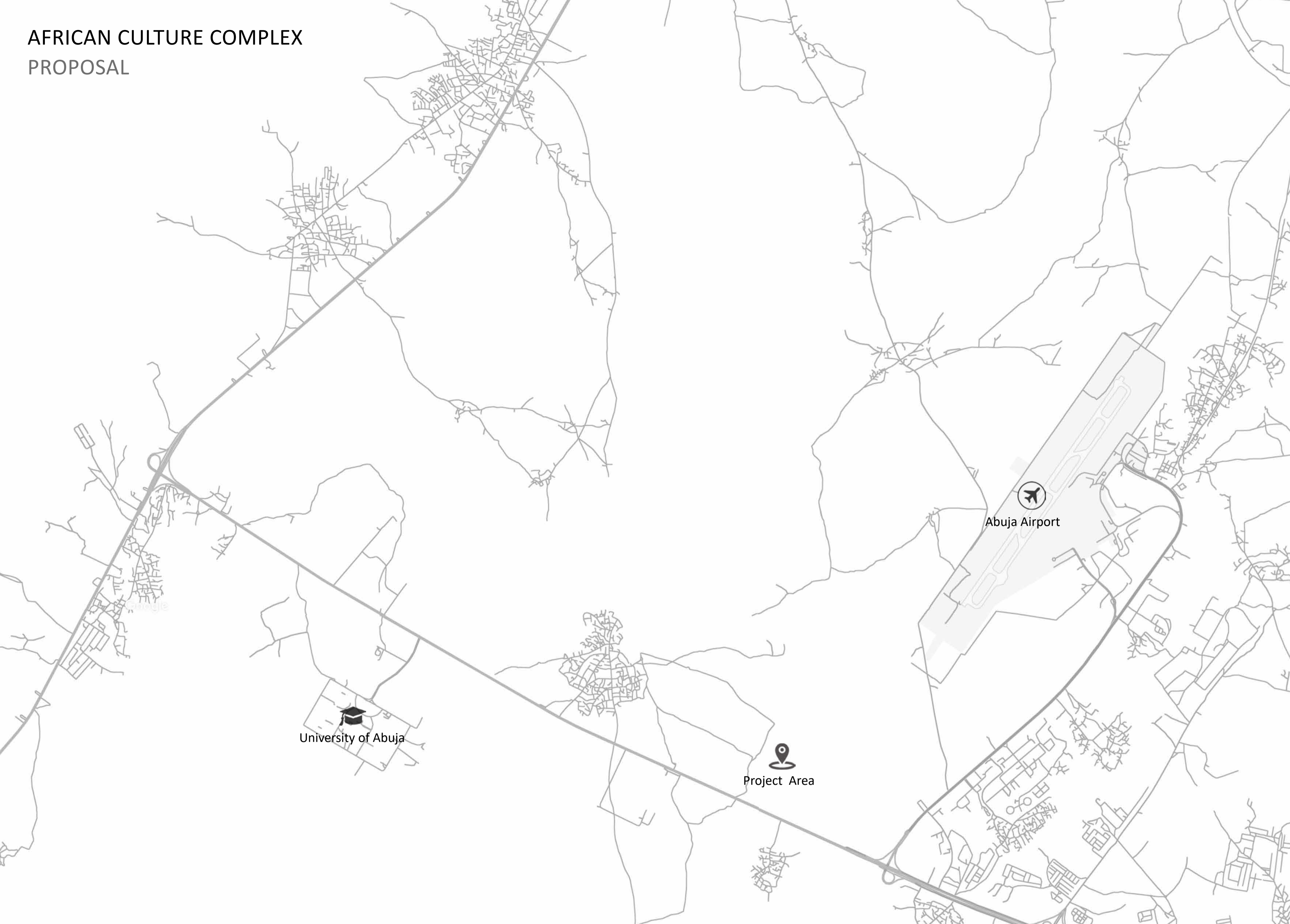


# AFRICAN CULTURE COMPLEX PROPOSAL



## CURRENT SUB-URBAN SITUATION

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 beliefs, arts and security. Their major means of livelihood boards 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 road route linking the airport to other more developed cities hence providing opportunity to sell their agricultural produce and home made crafts to travellers.

## SUB URBAN REGENERATION

Having understood the sub urban way of life, needs and their social class in the economic and urban context at different 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.

## 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 available

## AIMS

- Improve Economic Situation
- Attraction Point
- African Culture
- Safety Environment
- Comfortable Accommodation
- Agricultural Products

## PROPOSALS

- Culture Hotel & Tower
- Marketplace for Local Products

## PROJECT : AFRICA CULTURE COMPLEX

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 Complex (which will be 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.



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African Culture Complex - Hotel & Tower  
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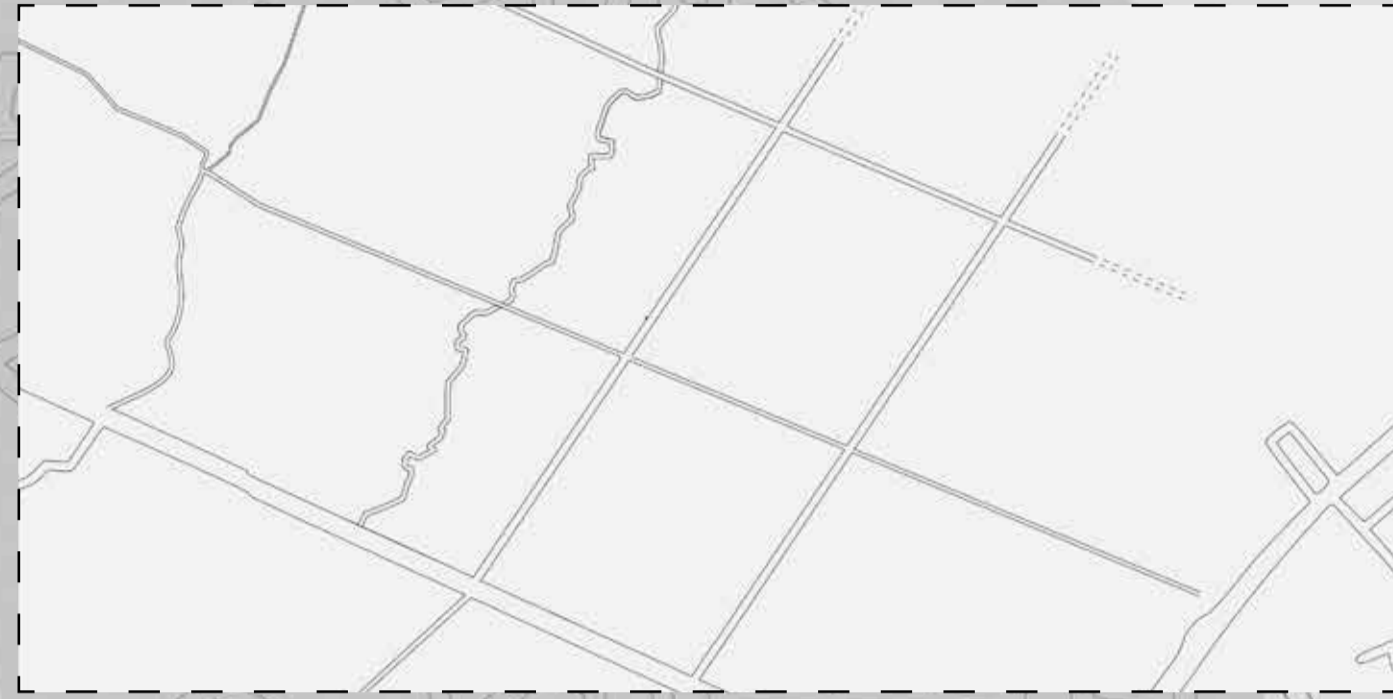


# AFRICAN CULTURE HOTEL & TOWER

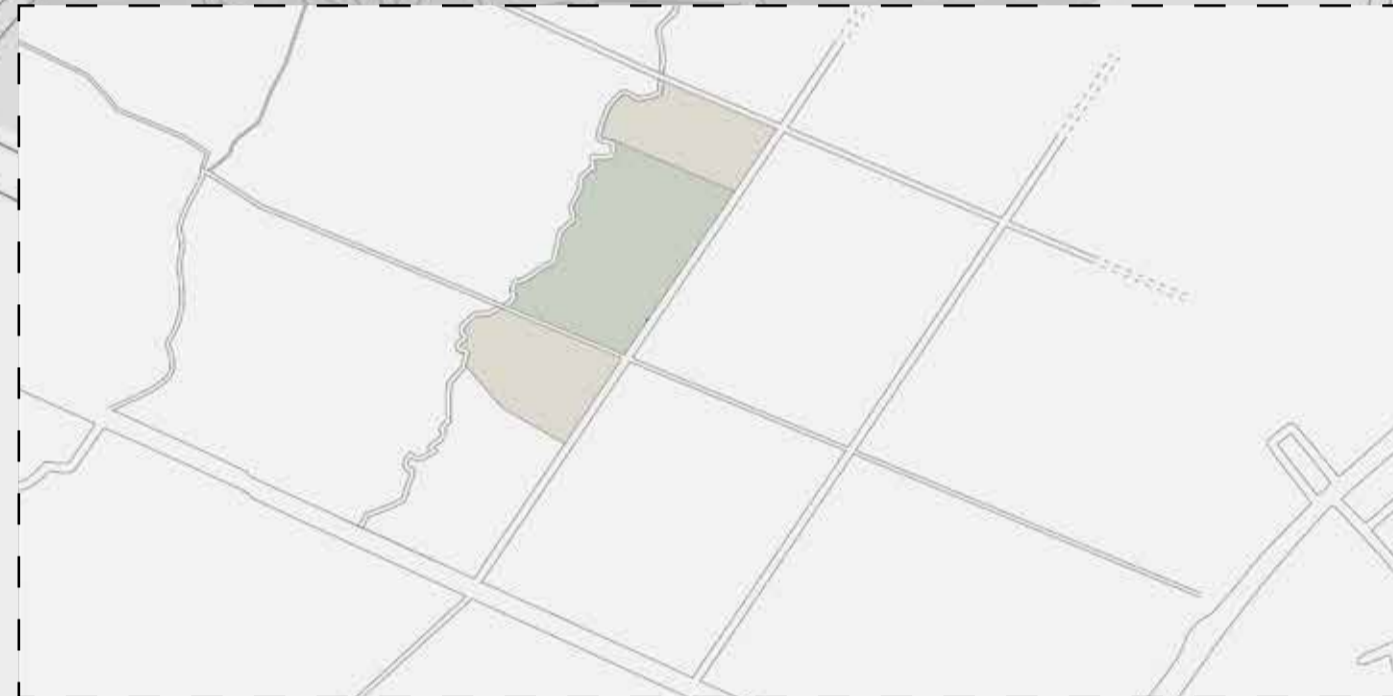
## SITE DEVELOPMENT

Following the intensive study of Abuja and the site location of the project, it is imperative to gradually and logically develop a masterplan that best suits the project, the users and the environment.

Stage 1, Acknowledging the presence of the water body and planning activities to flow in a linear manner



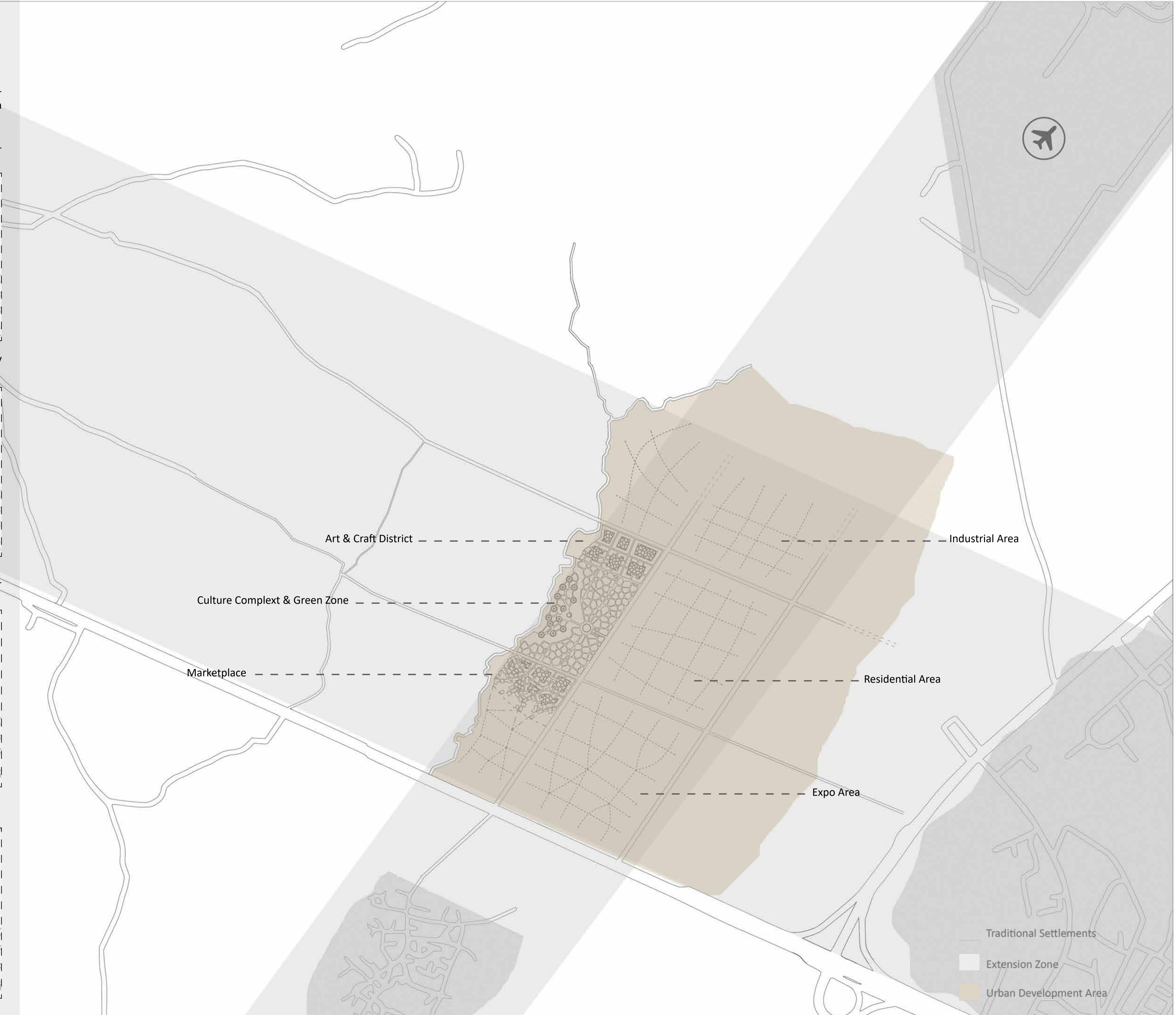
Stage 2 creation of master plan in 3 linear directions: Market place, Hotel/botanical Garden and Arts/crafts district



Stage 3 Introduction and planning of the Arts/craft district and Marketplace district following the historic and traditional settlement pattern



Stage 4 Planning of hotel settlement and tower into the green zone.



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# AFRICAN CULTURE COMPLEX

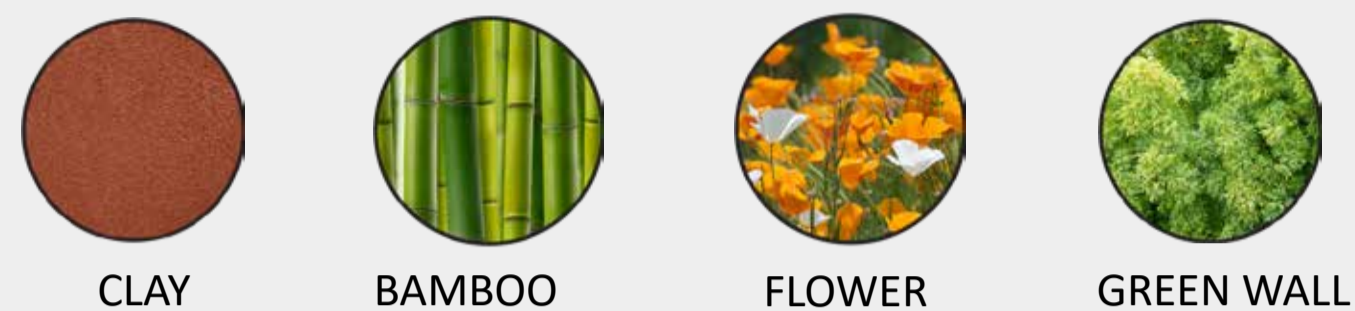
## ENVIRONMENTAL CONSIDERATIONS

### VEGETATION

Given the global 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 existence 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.

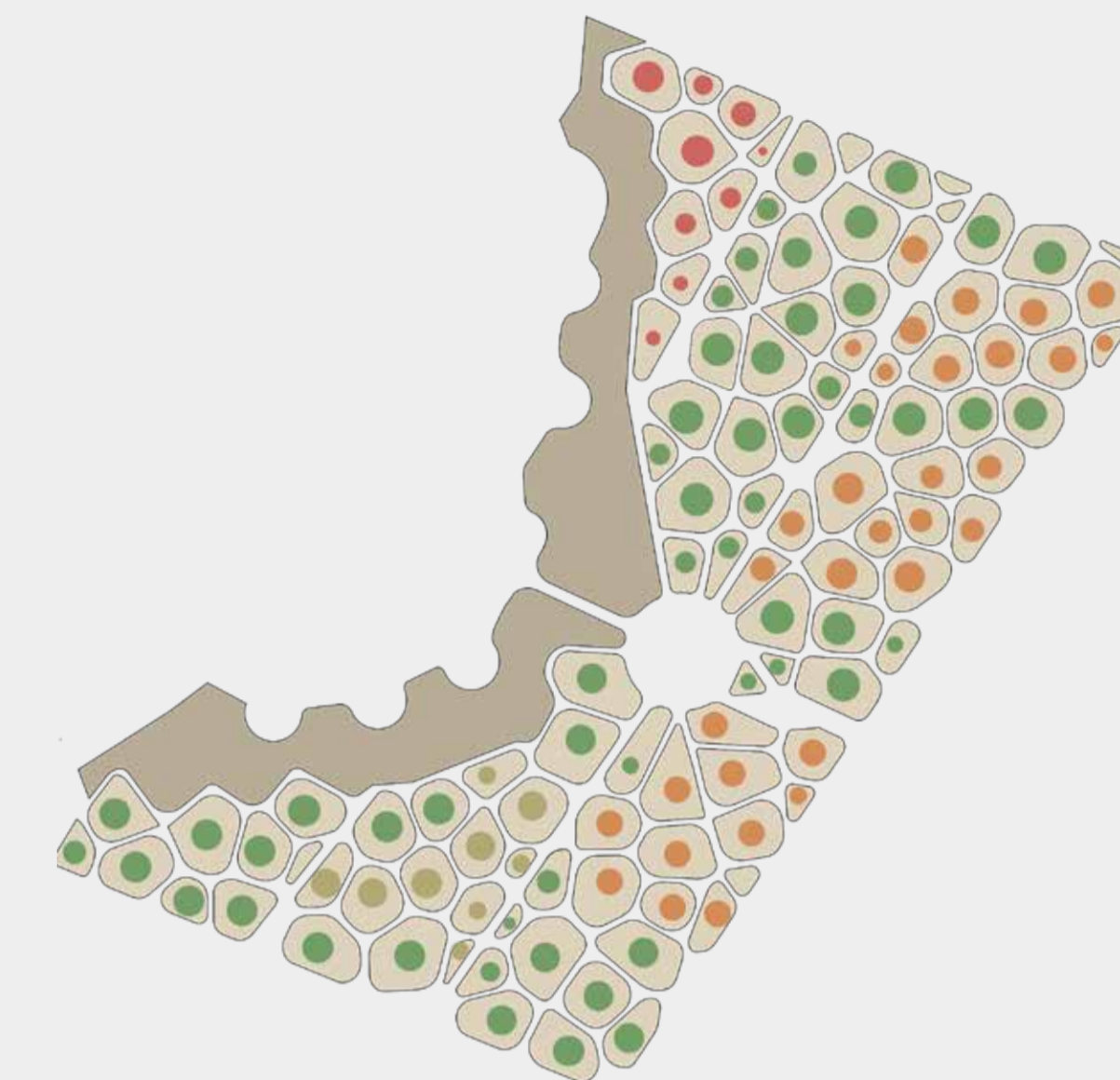
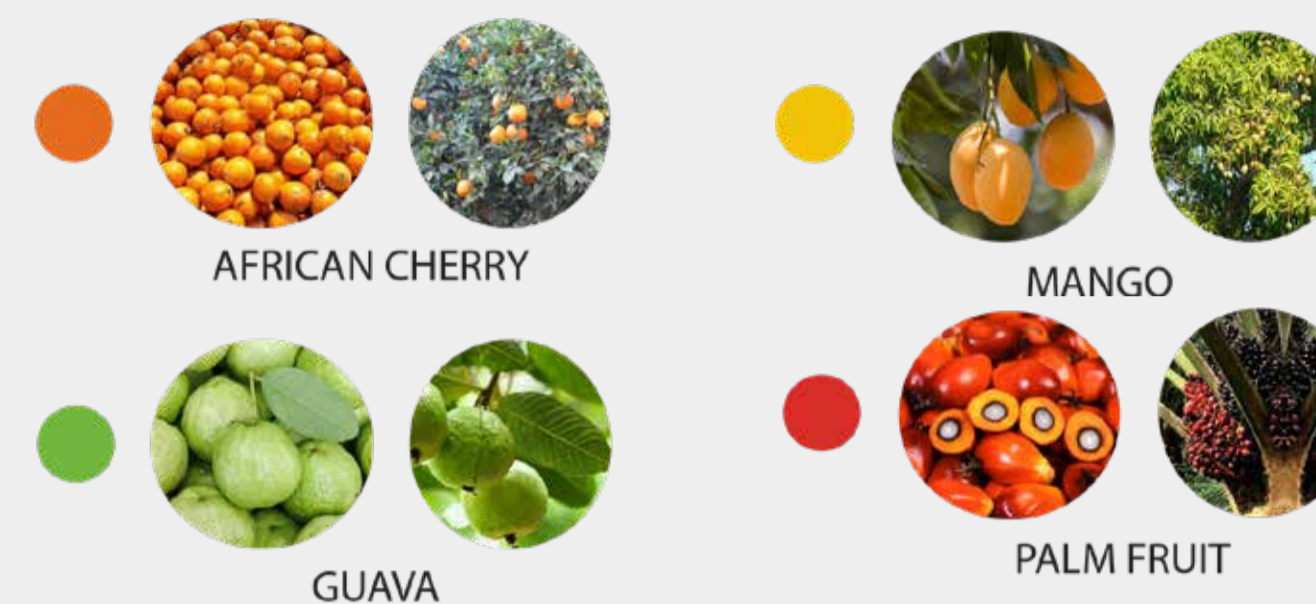
### MATERIAL CONSIDERATIONS

Clay as a building material provided by nature has numerous advantages for which energy efficiency is one of many. Bamboo as a natural composite material is energy efficient ,sustainable and self reliance. Plants flowers absorbs Co2 for sugar and oxygen 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 numerous research ethnics in our project from the enviromental point of view.



## 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 "mar-ufa" made from straw.

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.



Nomadic Women



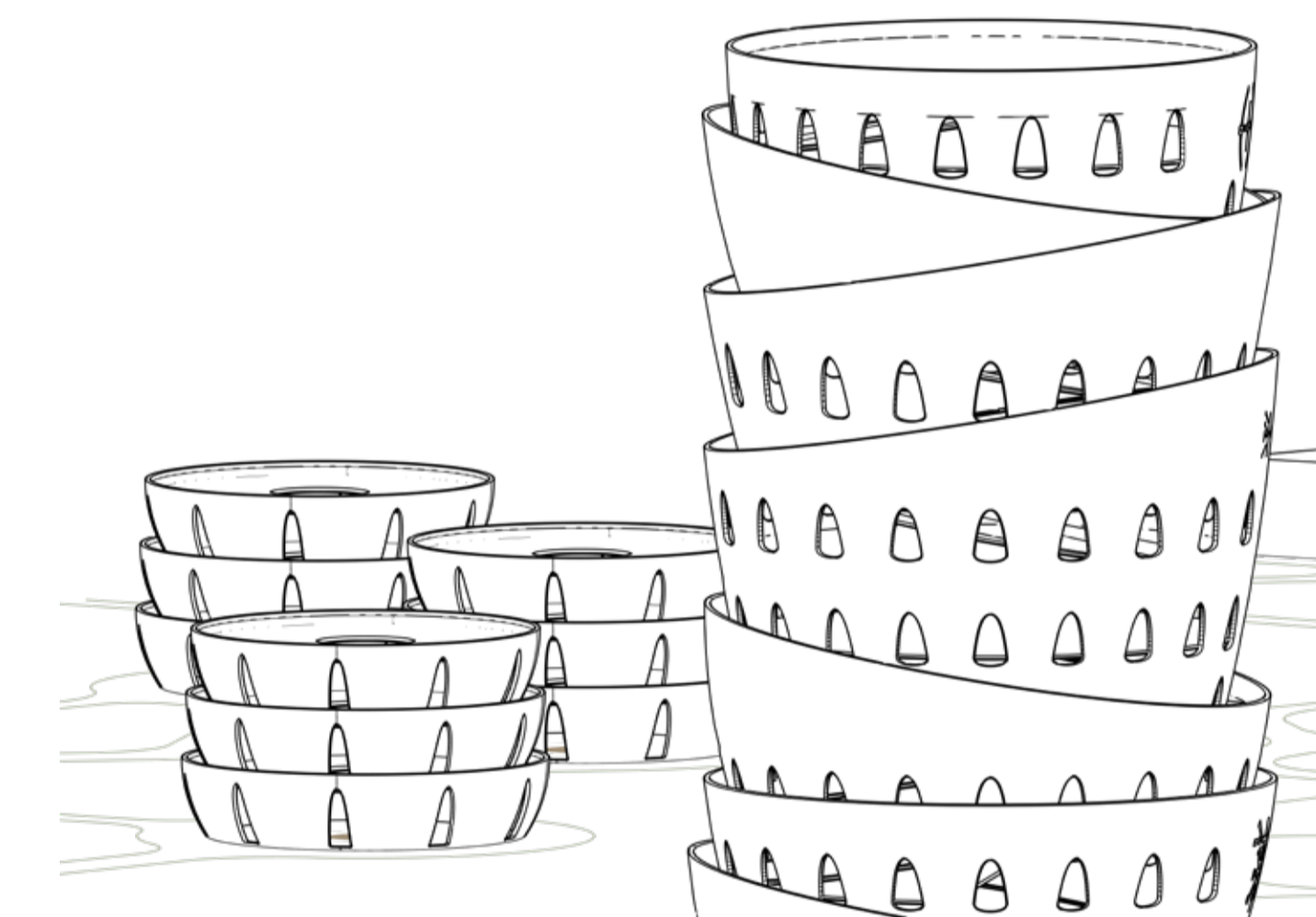
Inspiration



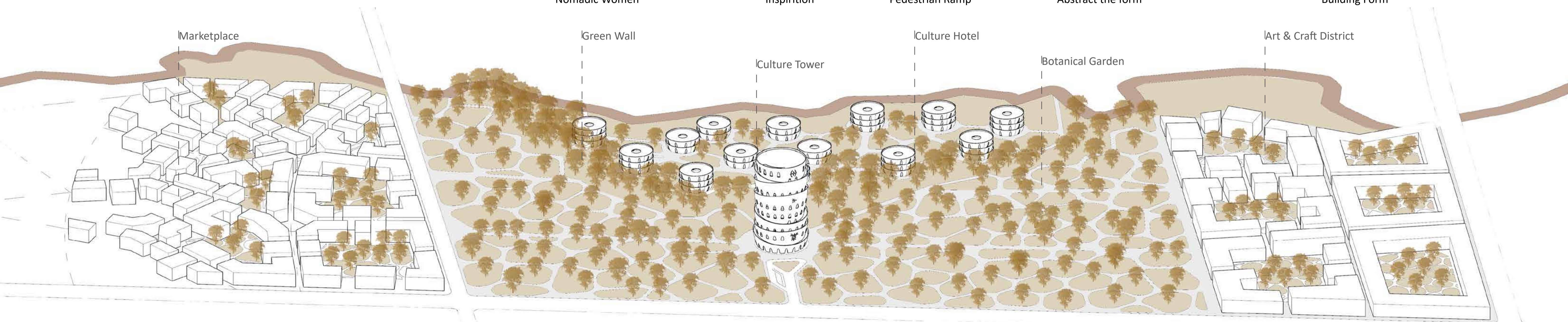
Pedestrian Ramp



Abstract the form



Building Form



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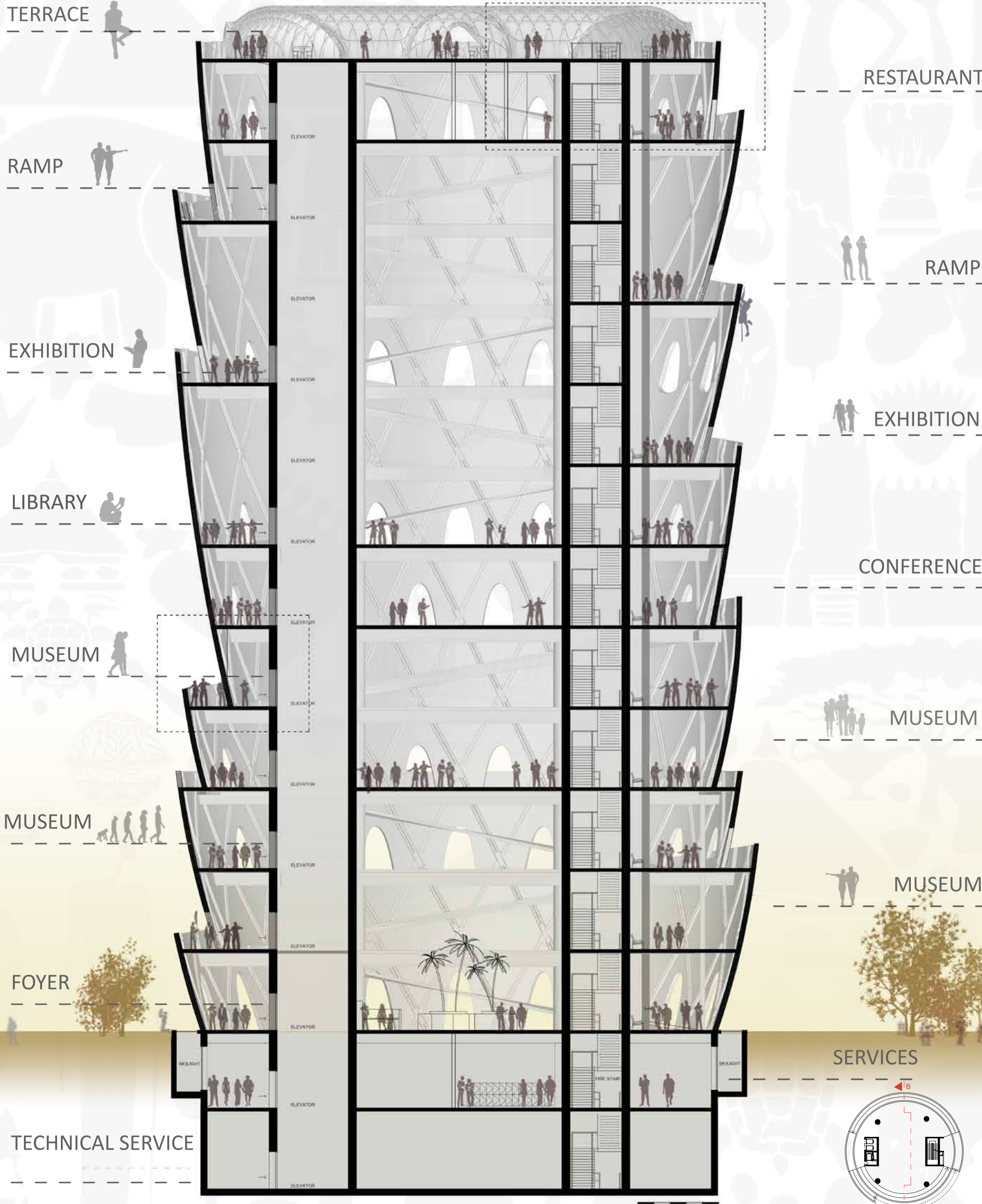


# AFRICAN CULTURE COMPLEX

## CULTURE COMPLEX & MASTERPLAN

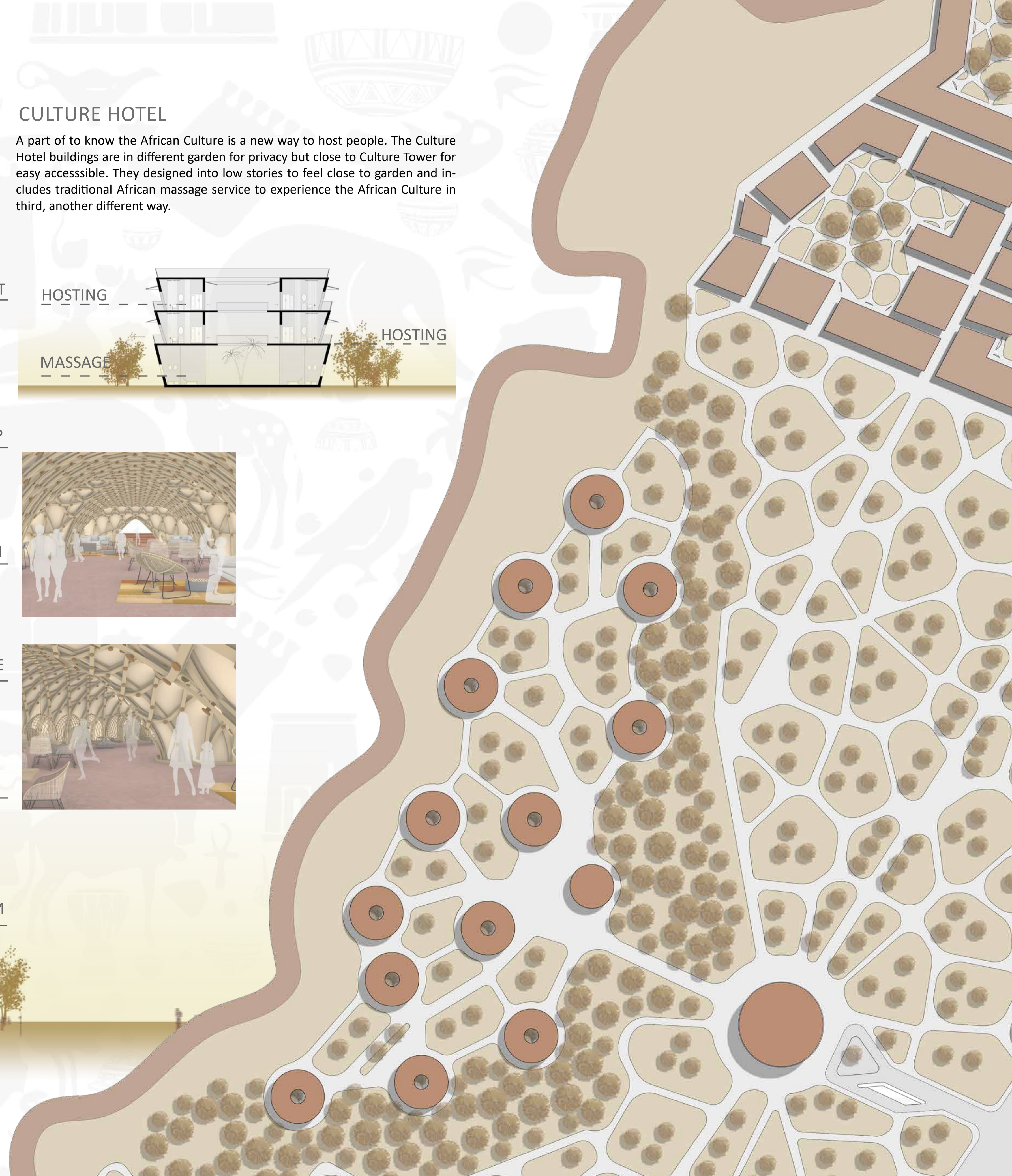
### CULTURE TOWER

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 exhibitions inside and by the landscape outside. Route starts with museum, conference area and continue with library and exhibition 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.



### 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 accessible. 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.



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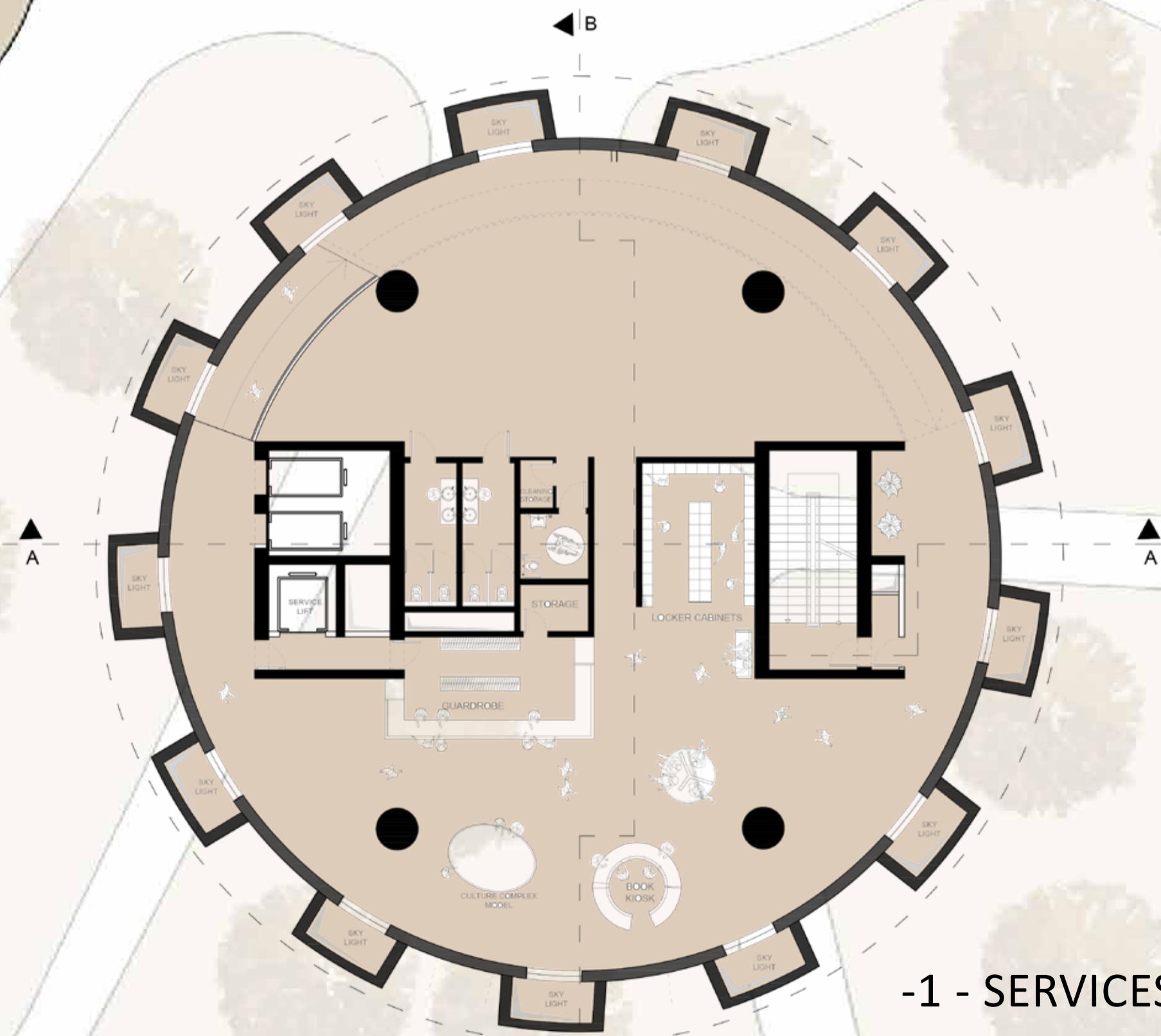
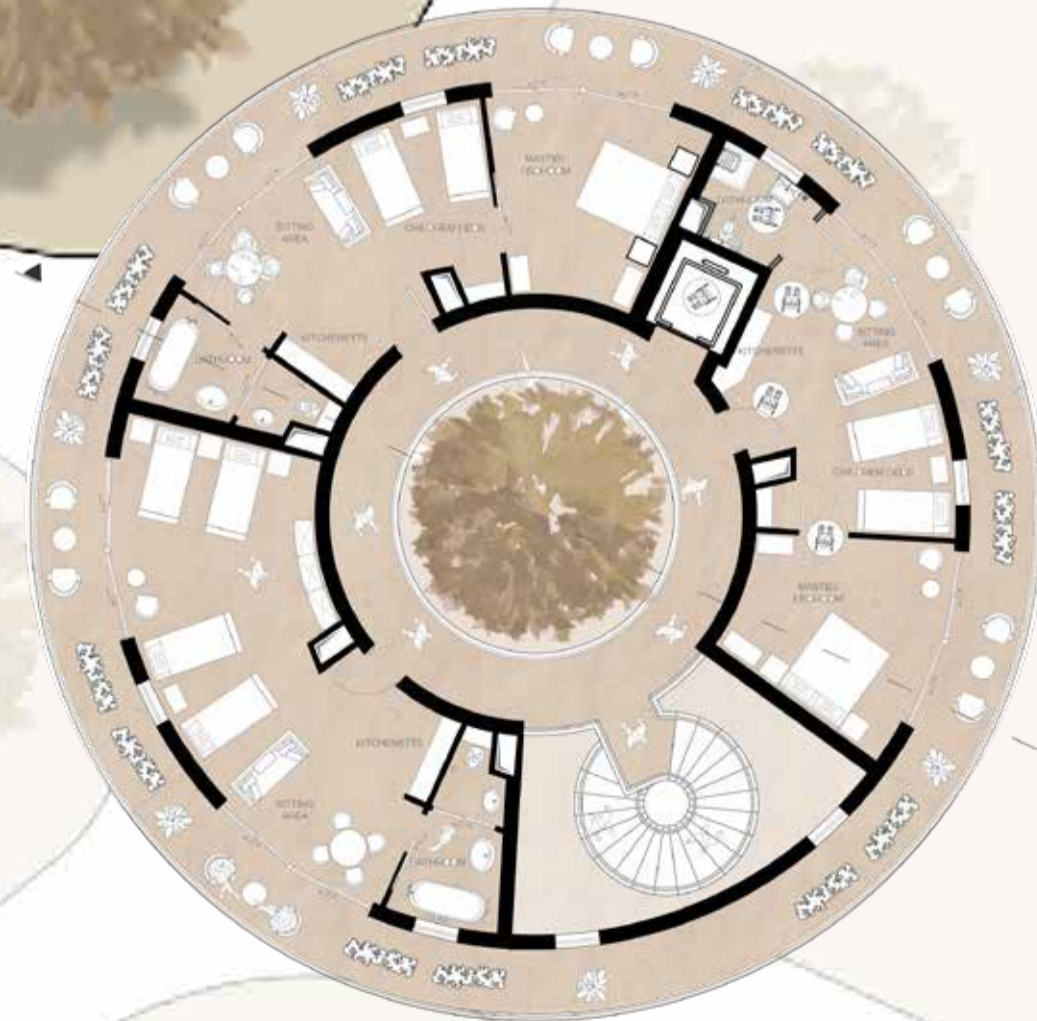
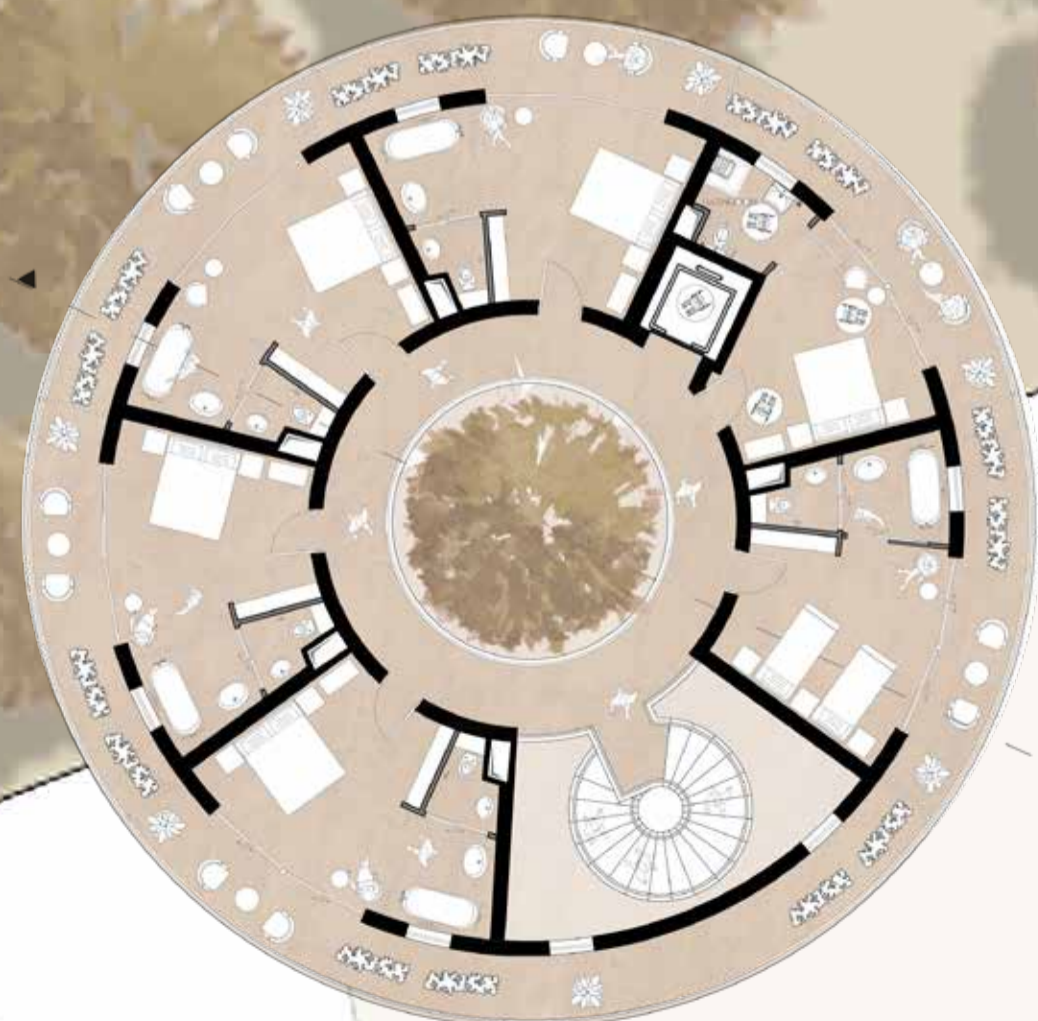
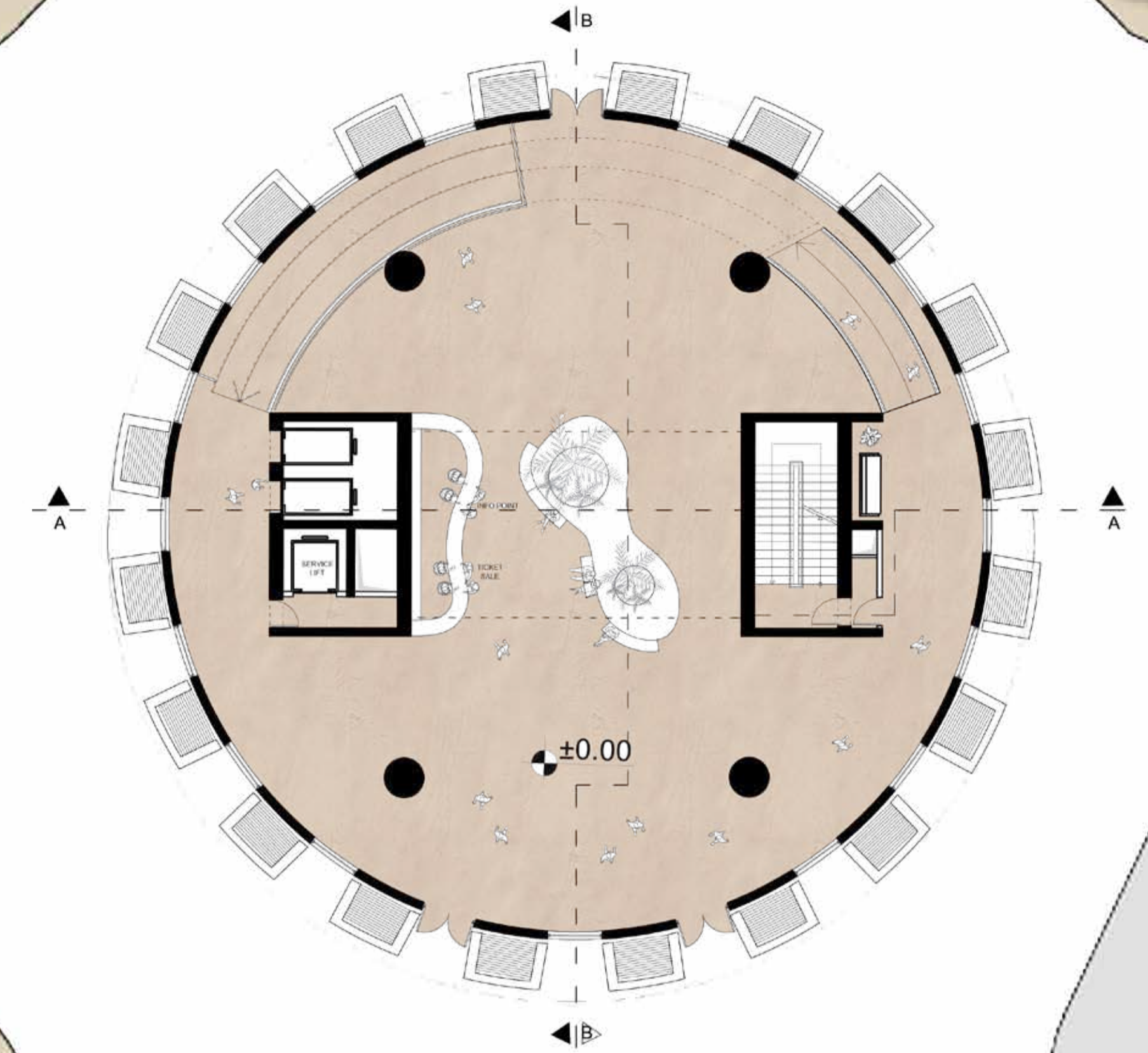
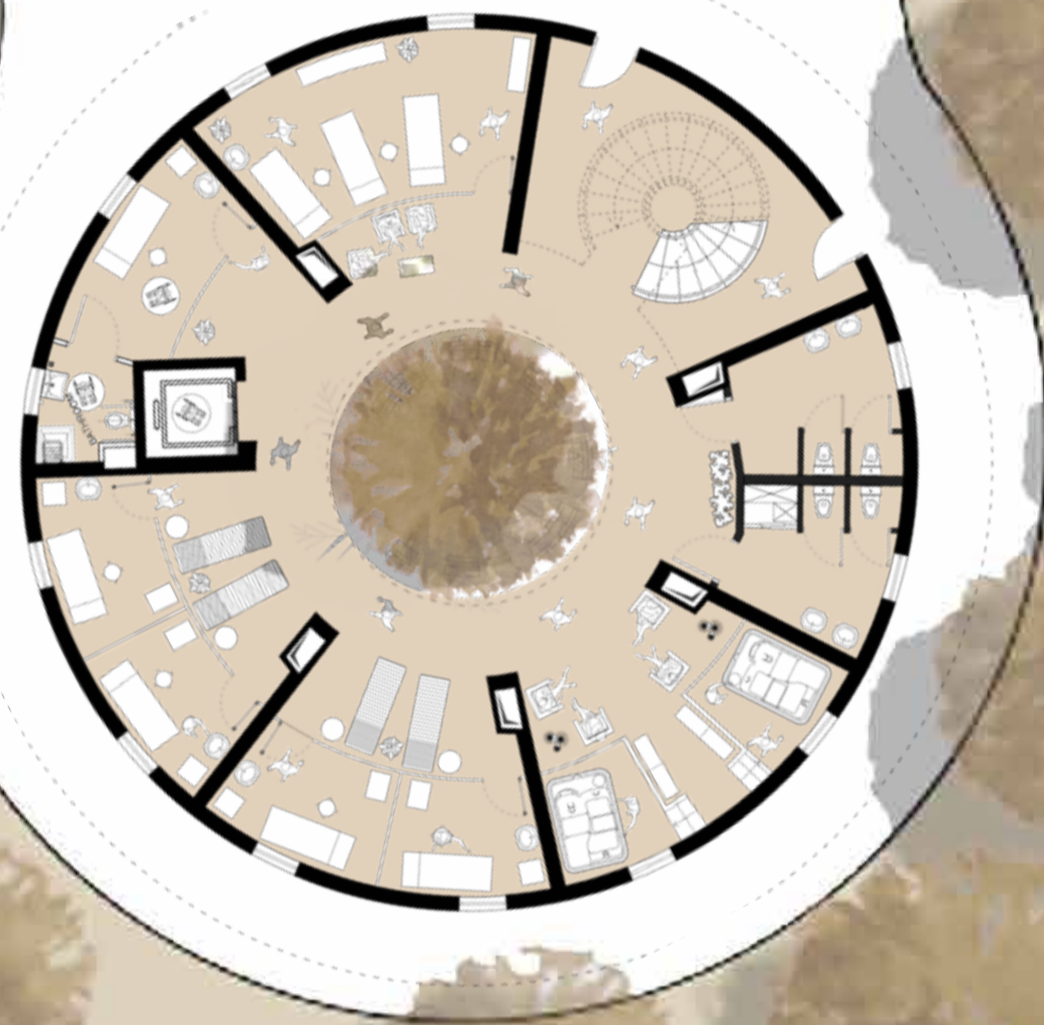
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AFRICAN CULTURE COMPLEX  
SITE PLAN



1 - COUPLE ROOMS

2 - LARGE ROOMS

-1 - SERVICES



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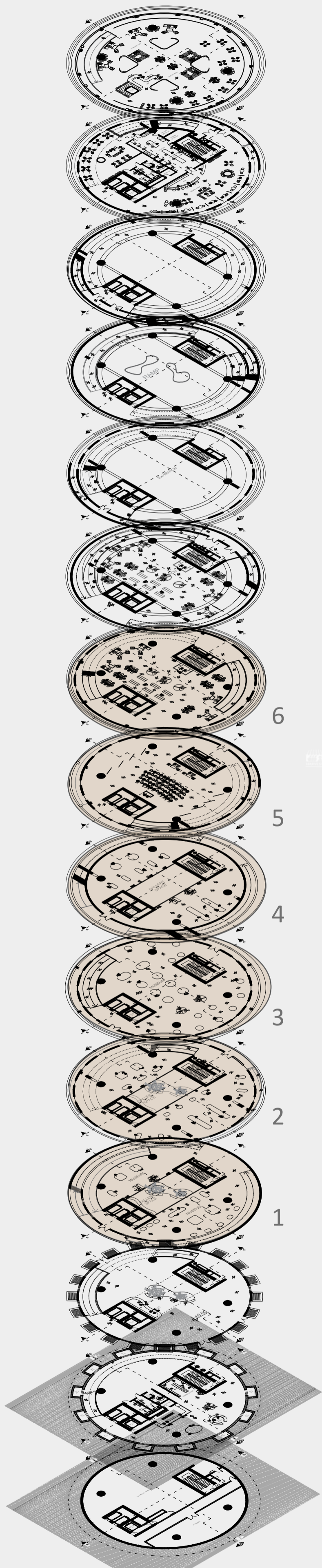
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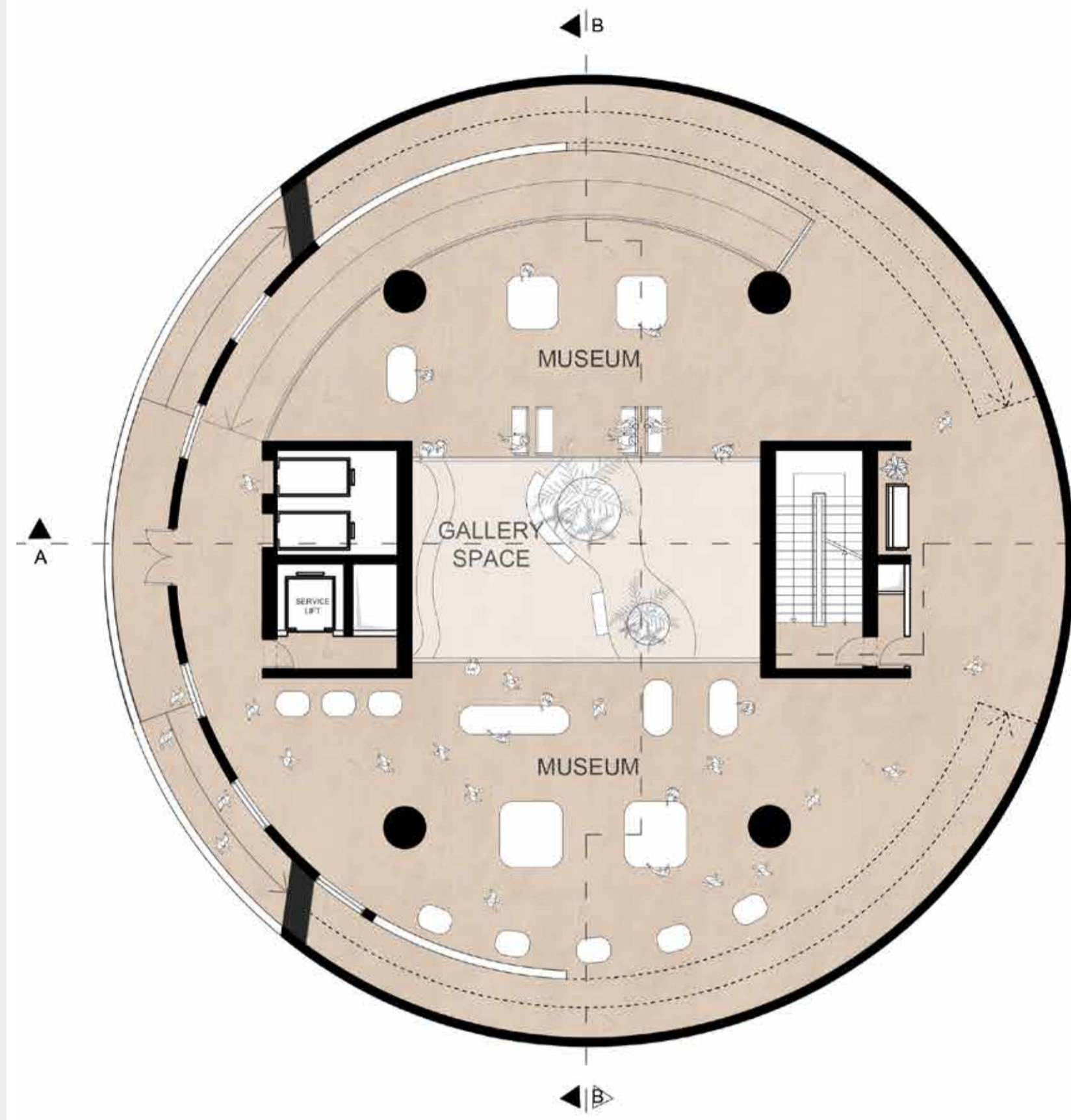
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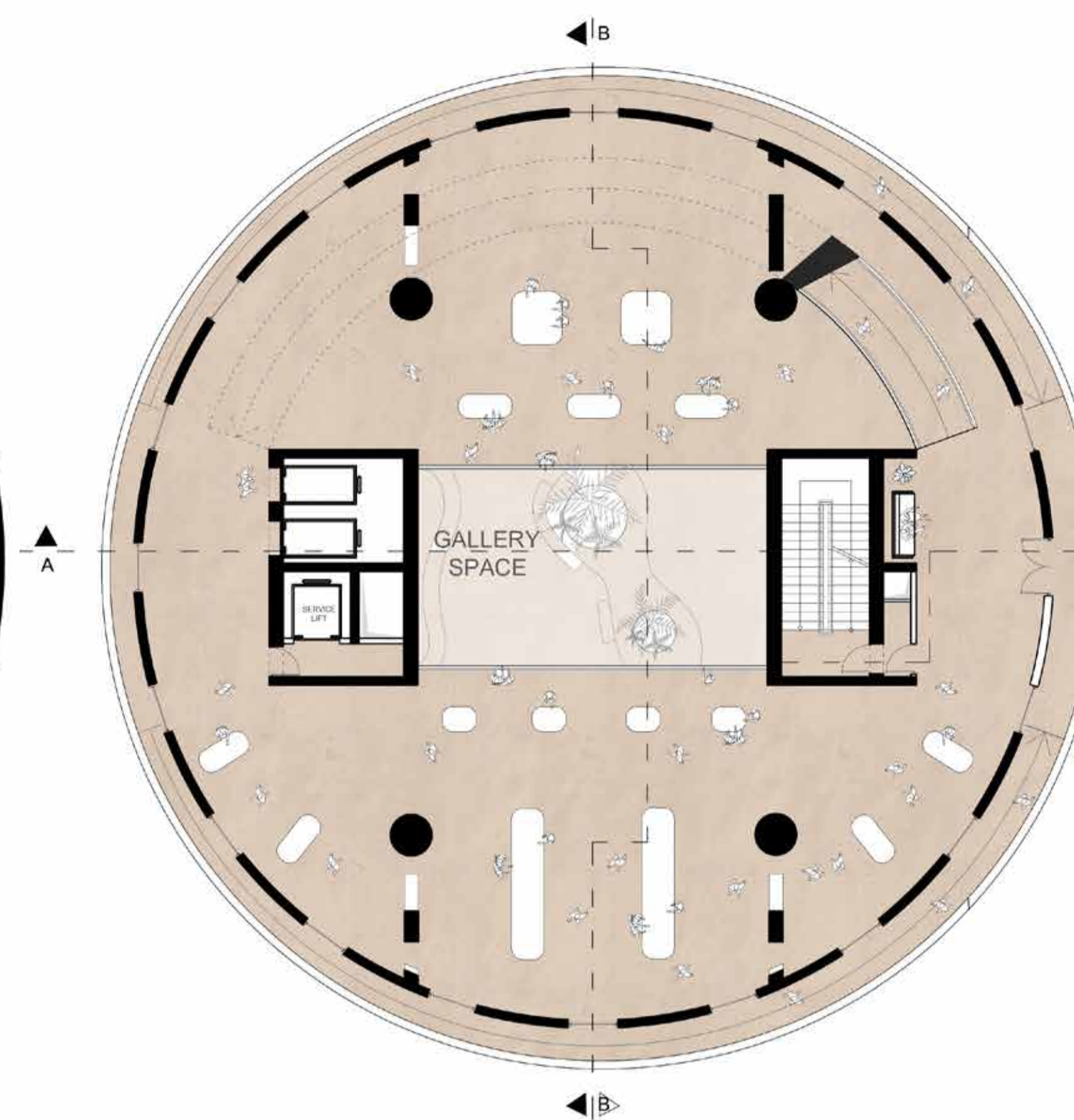
AFRICAN CULTURE COMPLEX  
FLOOR PLANS



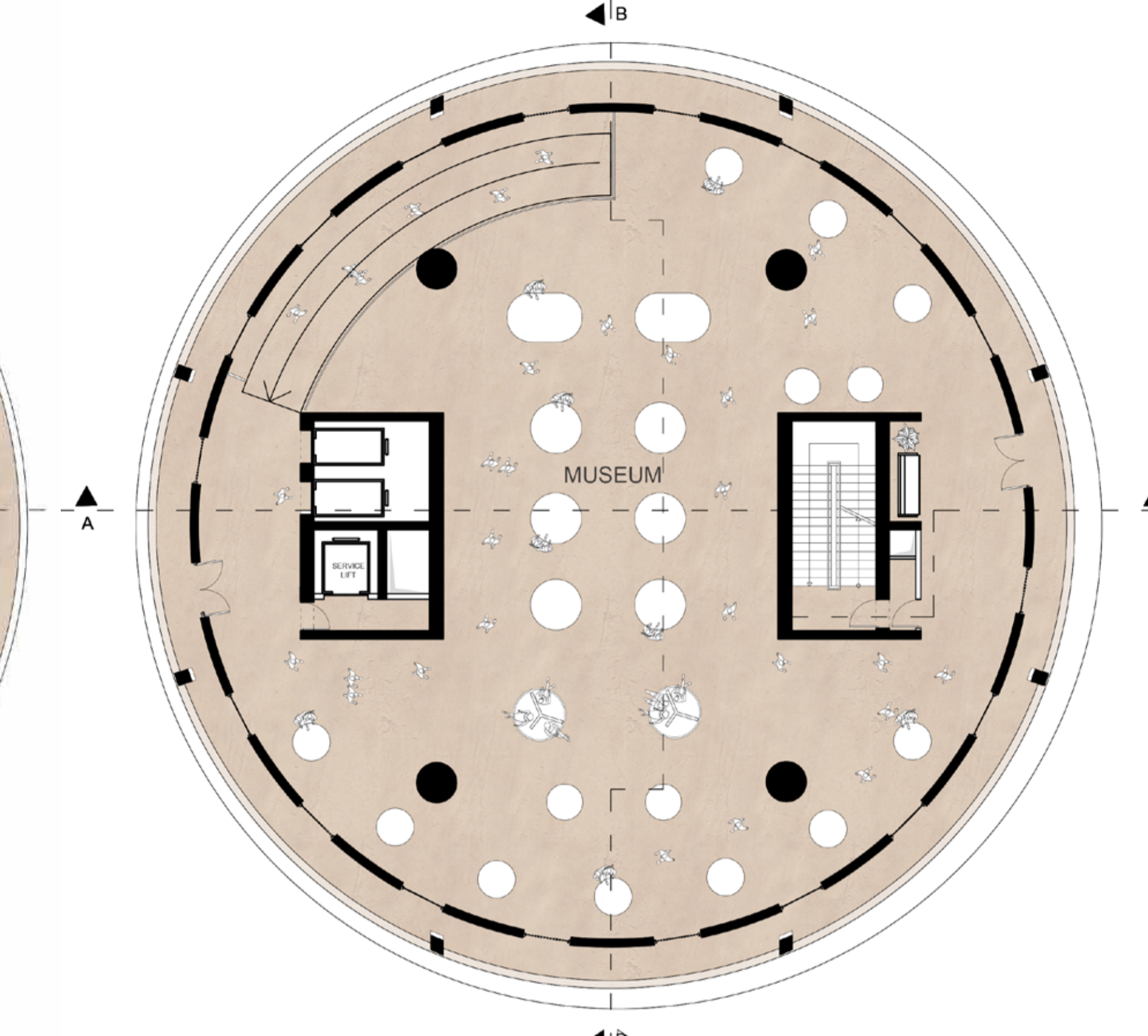
1 - MUSEUM



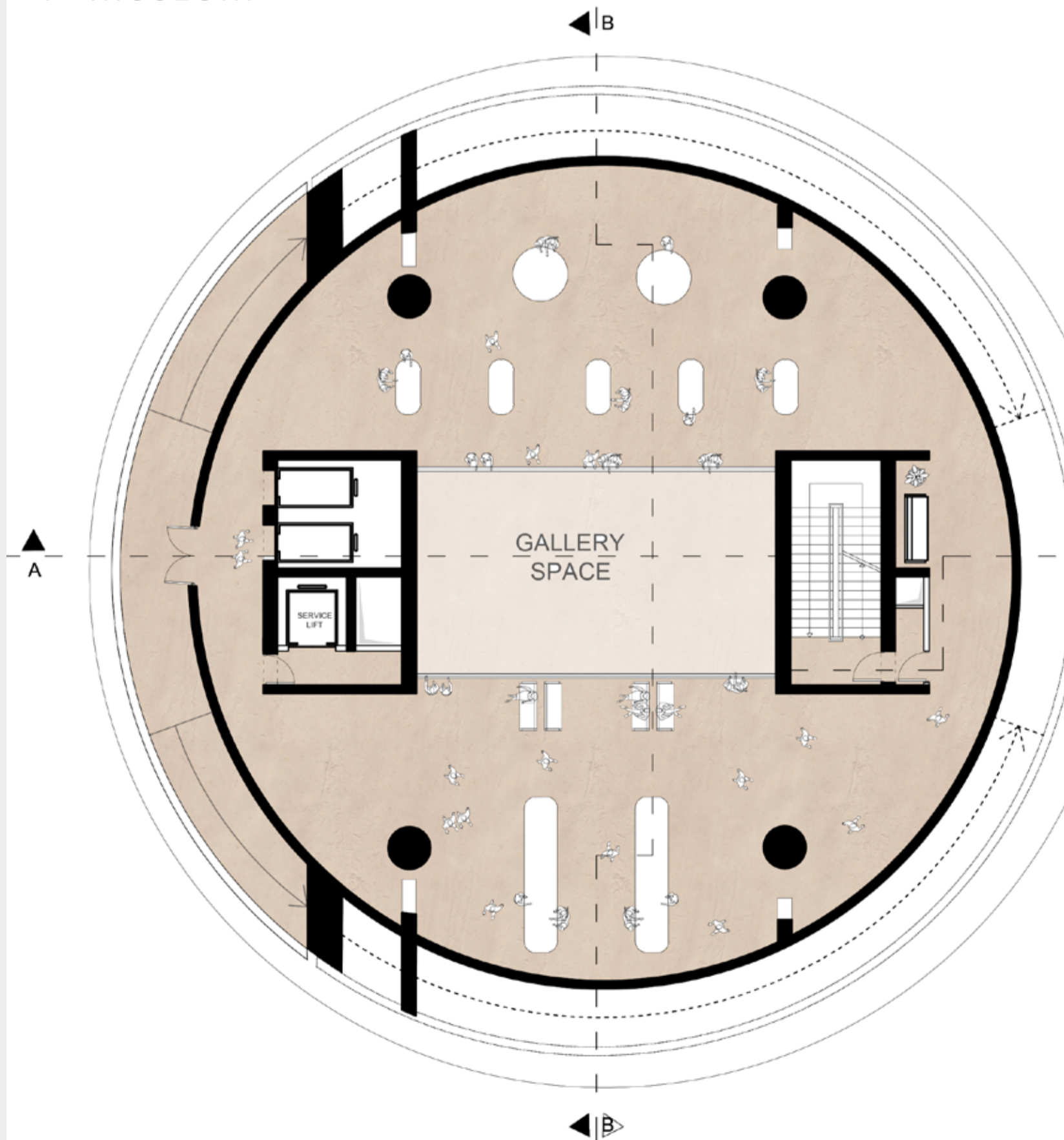
2 - MUSEUM



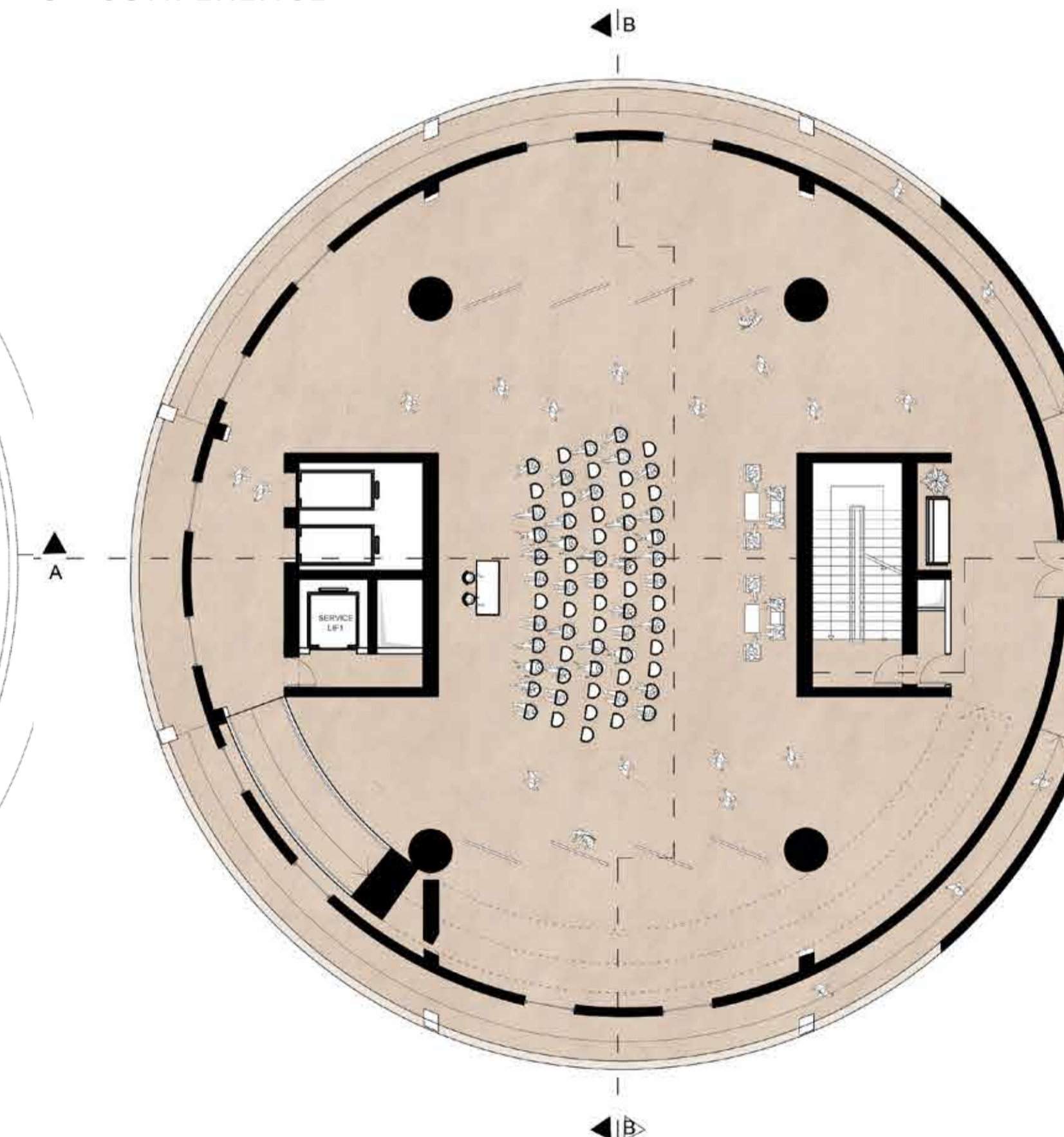
3 - MUSEUM



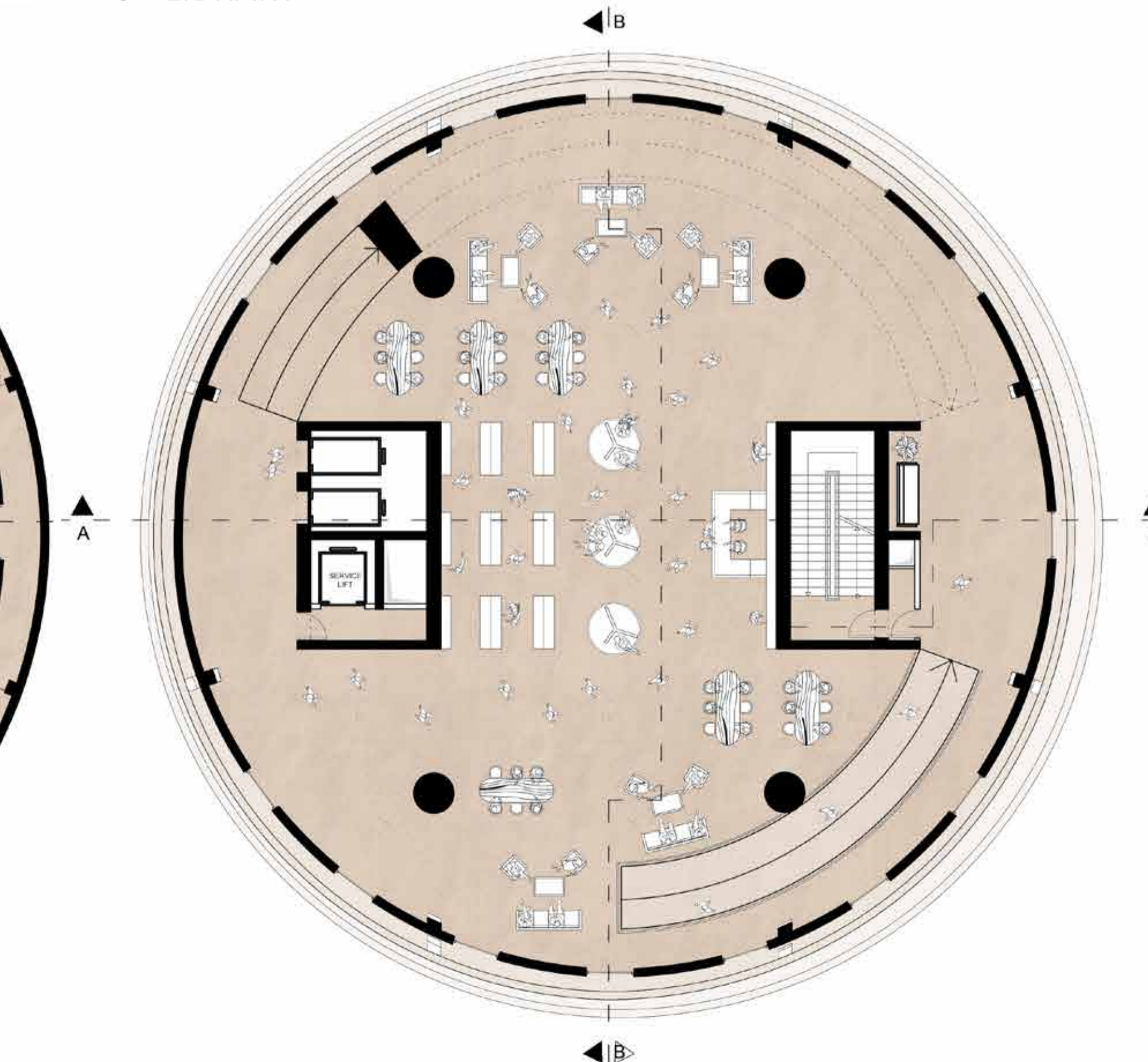
4 - MUSEUM



5 - CONFERENCE



6 - LIBRARY



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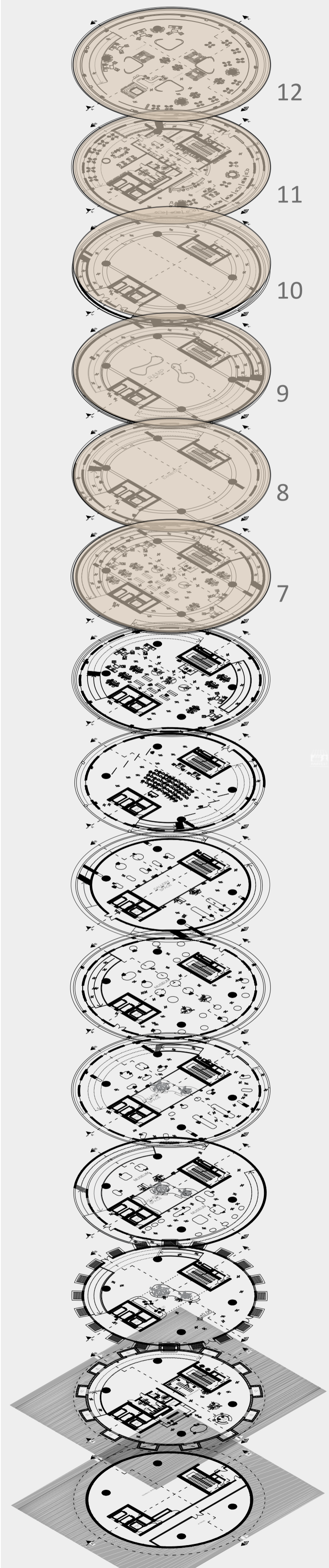
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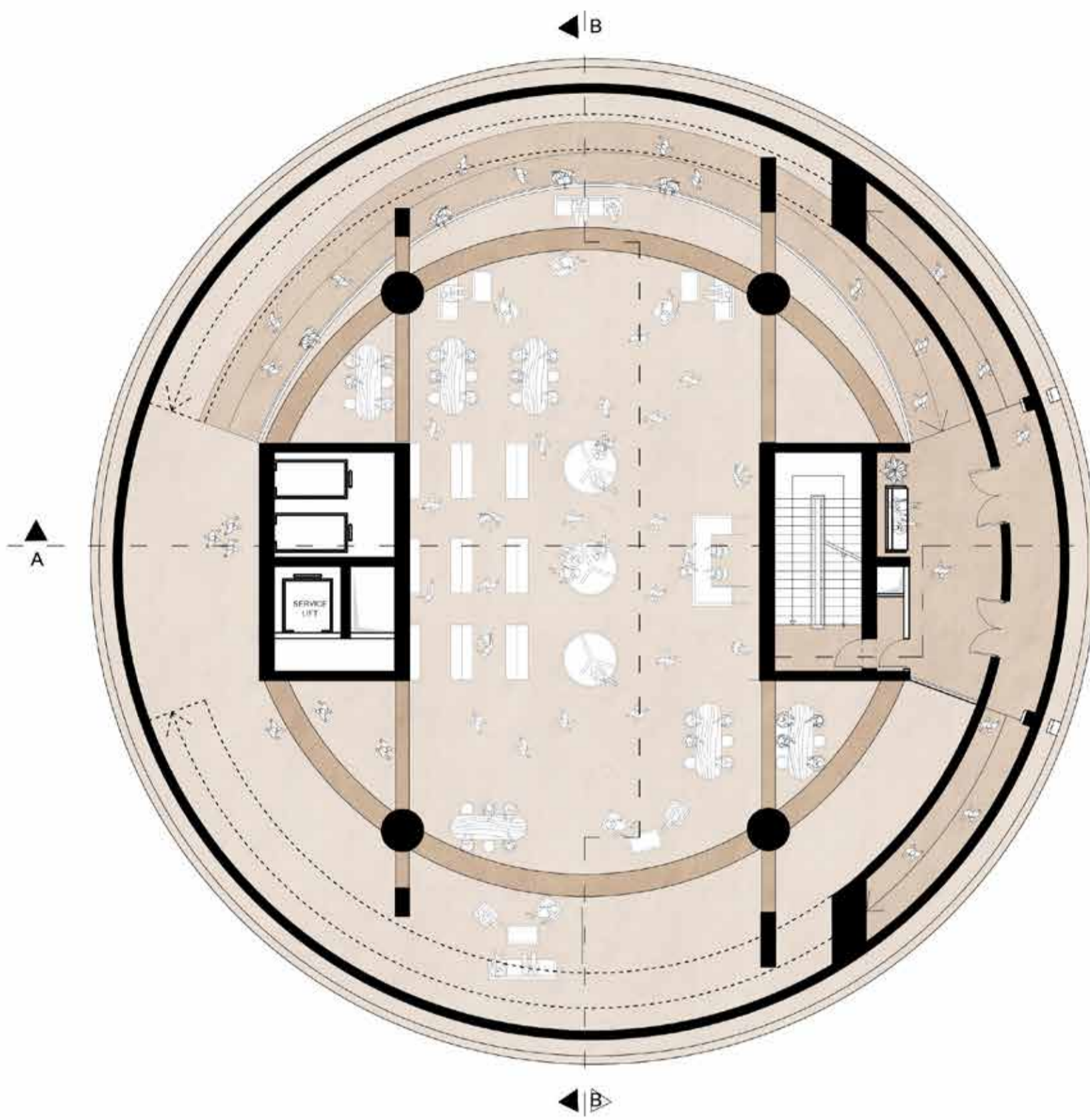
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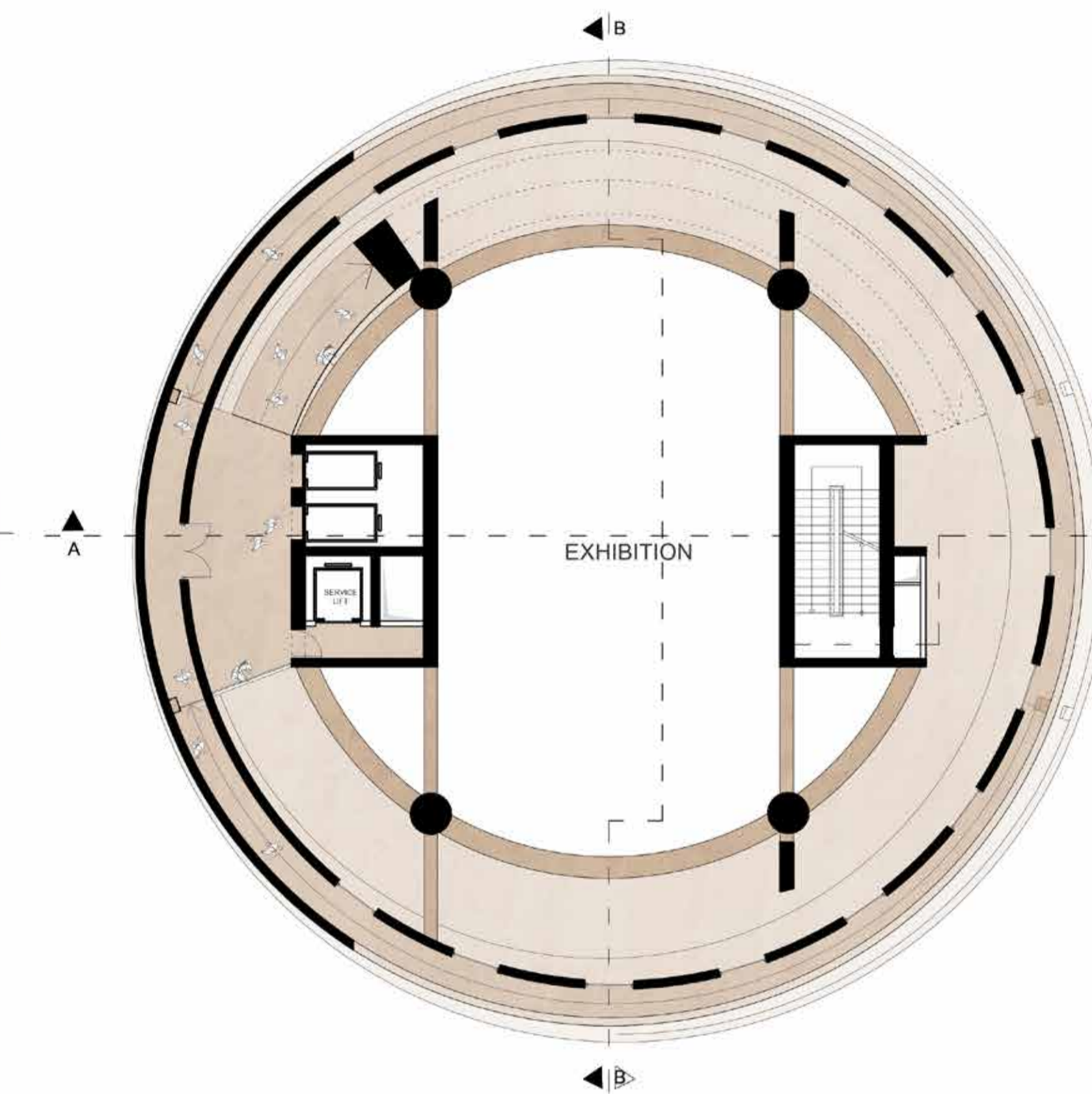
AFRICAN CULTURE COMPLEX  
FLOOR PLANS



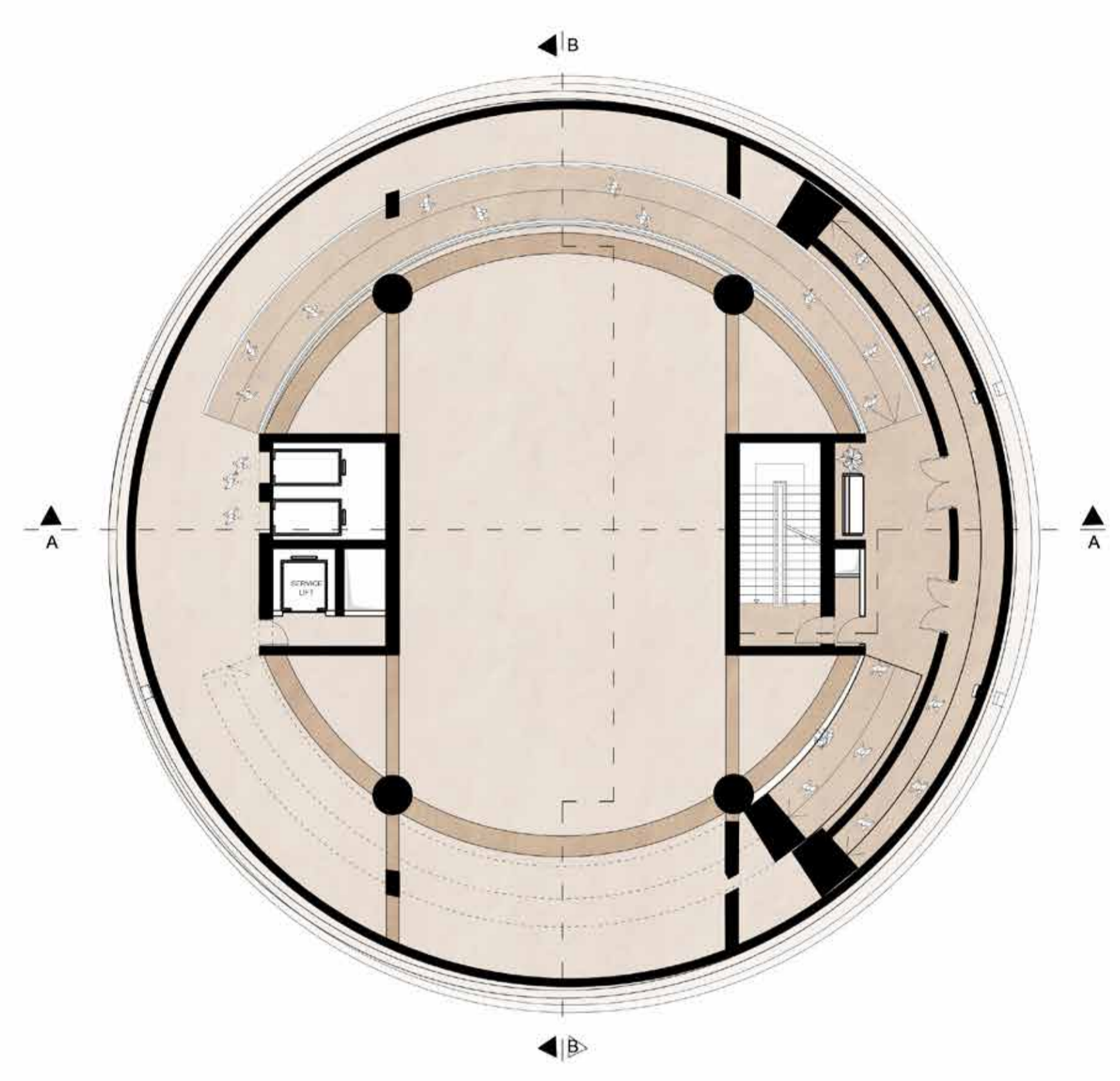
7 - EXHIBITION



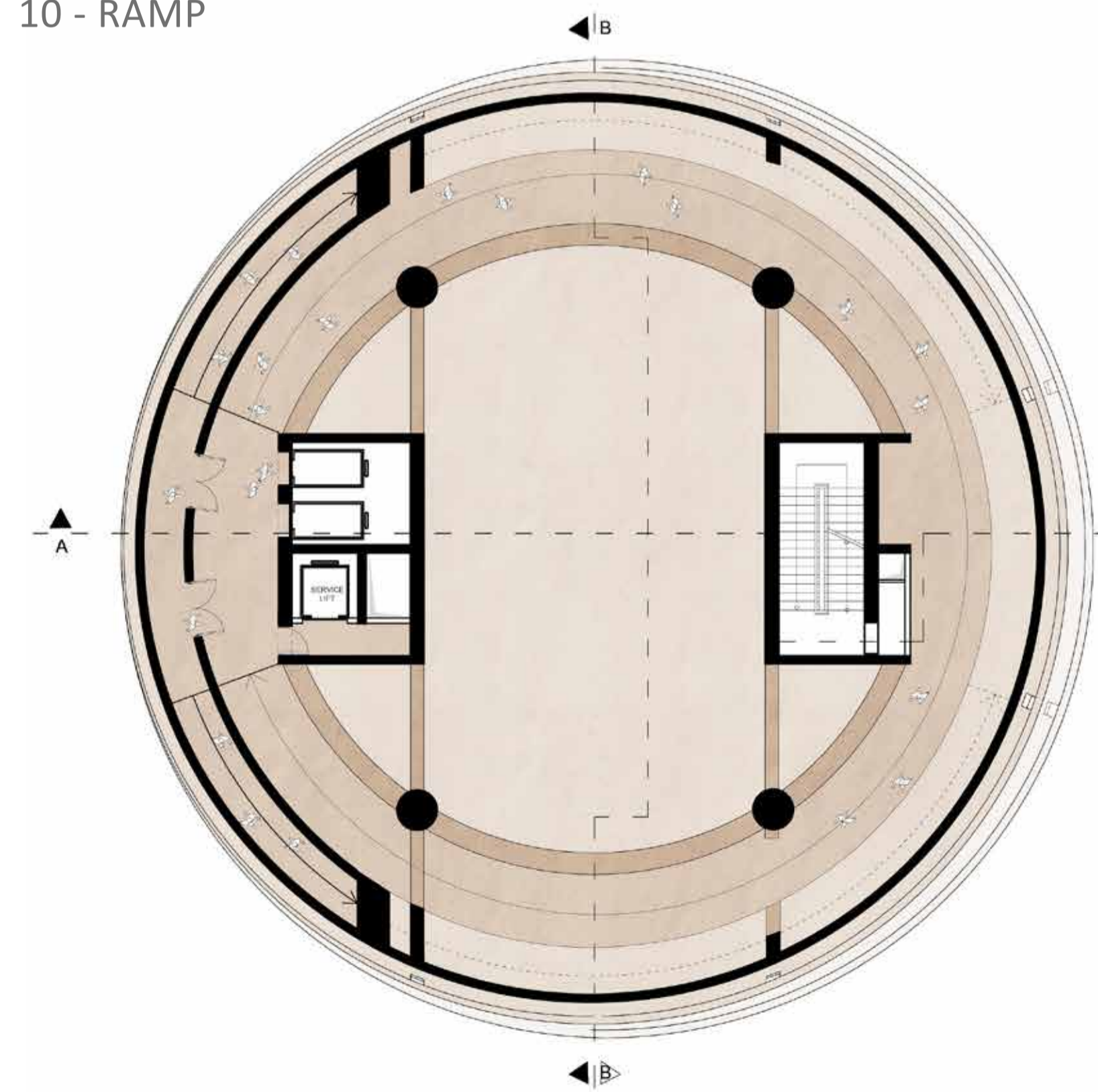
8 - EXHIBITION



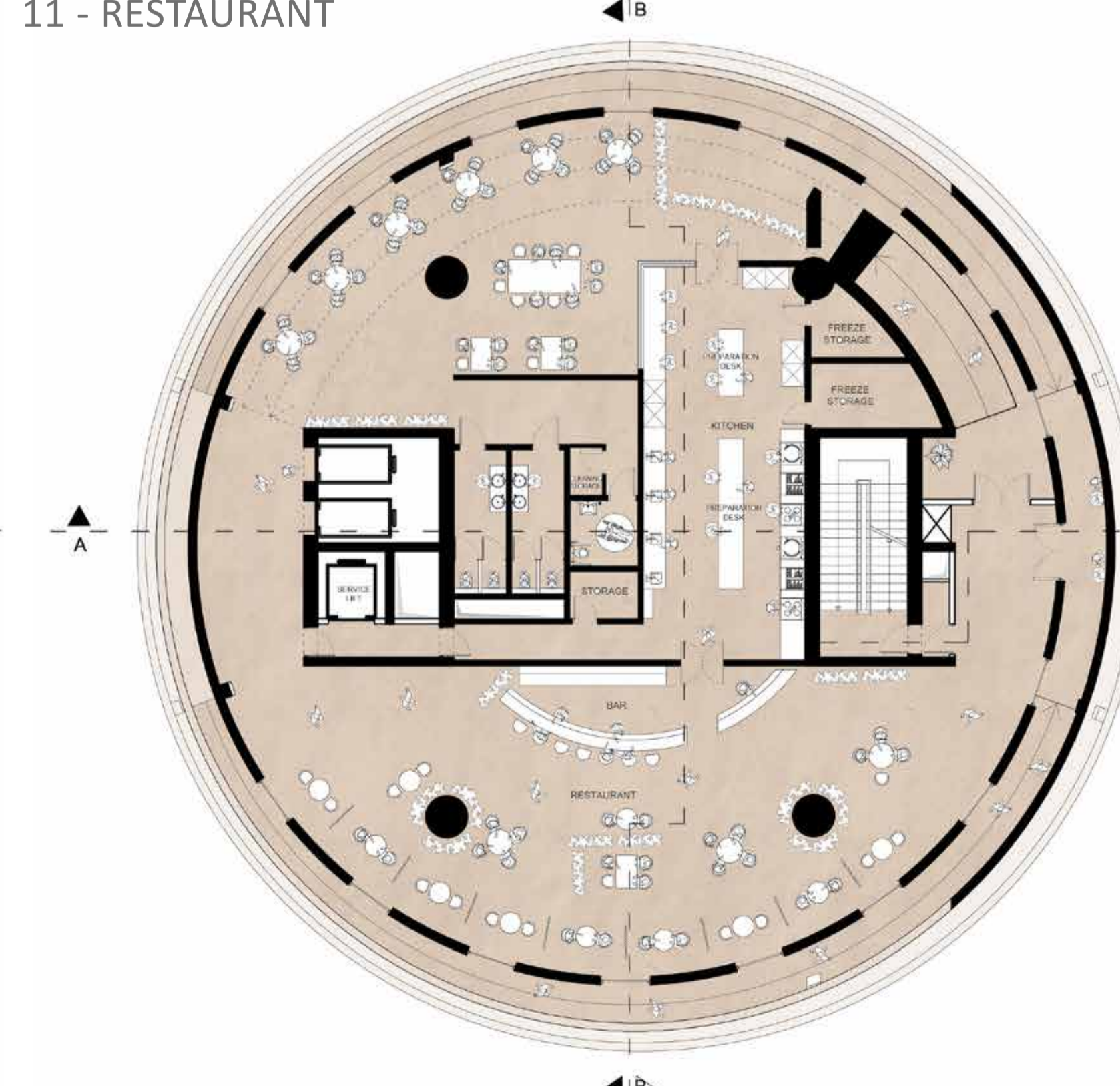
9 - RAMP



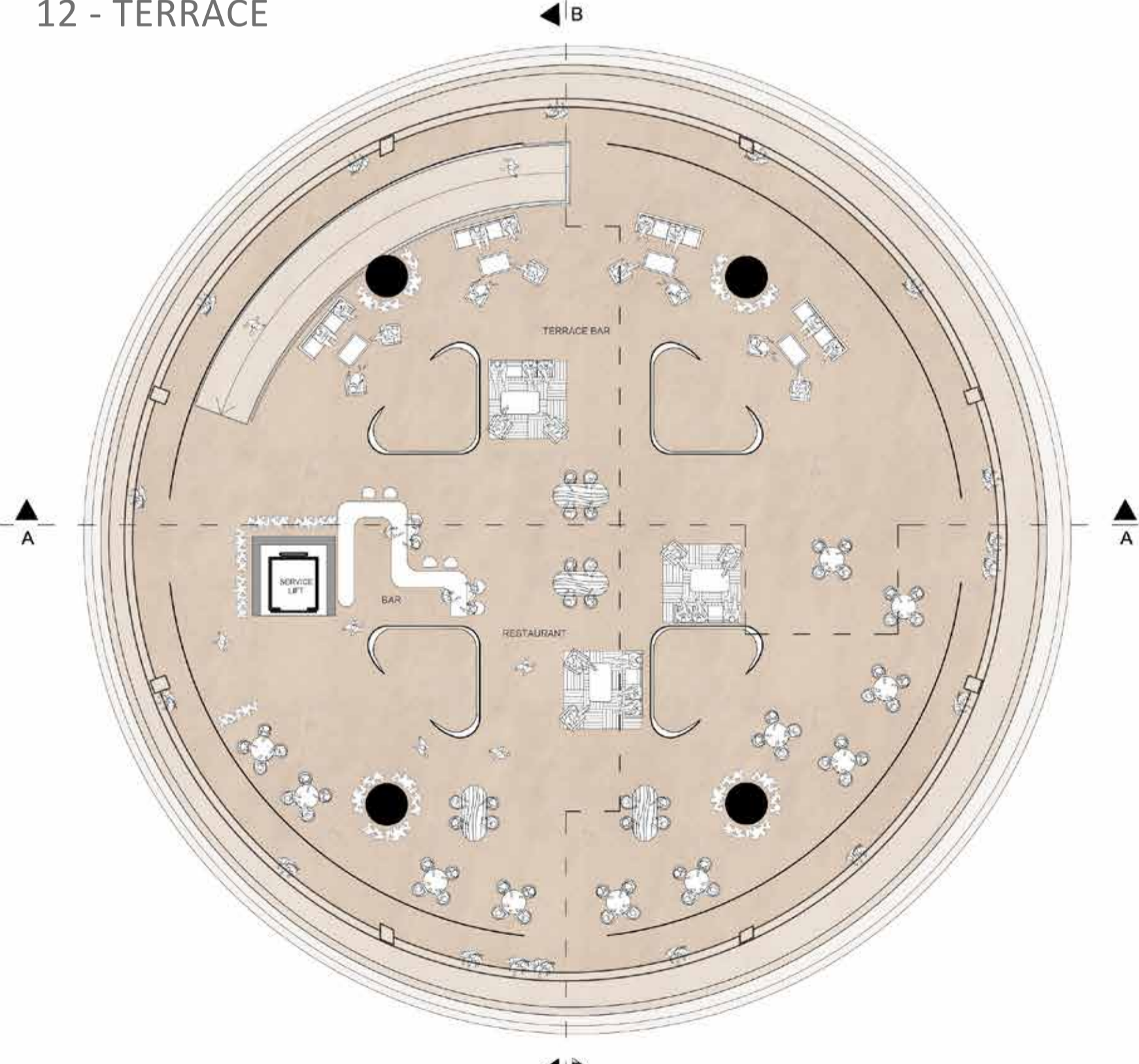
10 - RAMP



11 - RESTAURANT



12 - TERRACE



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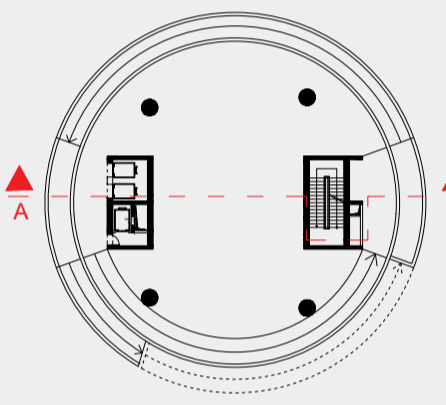
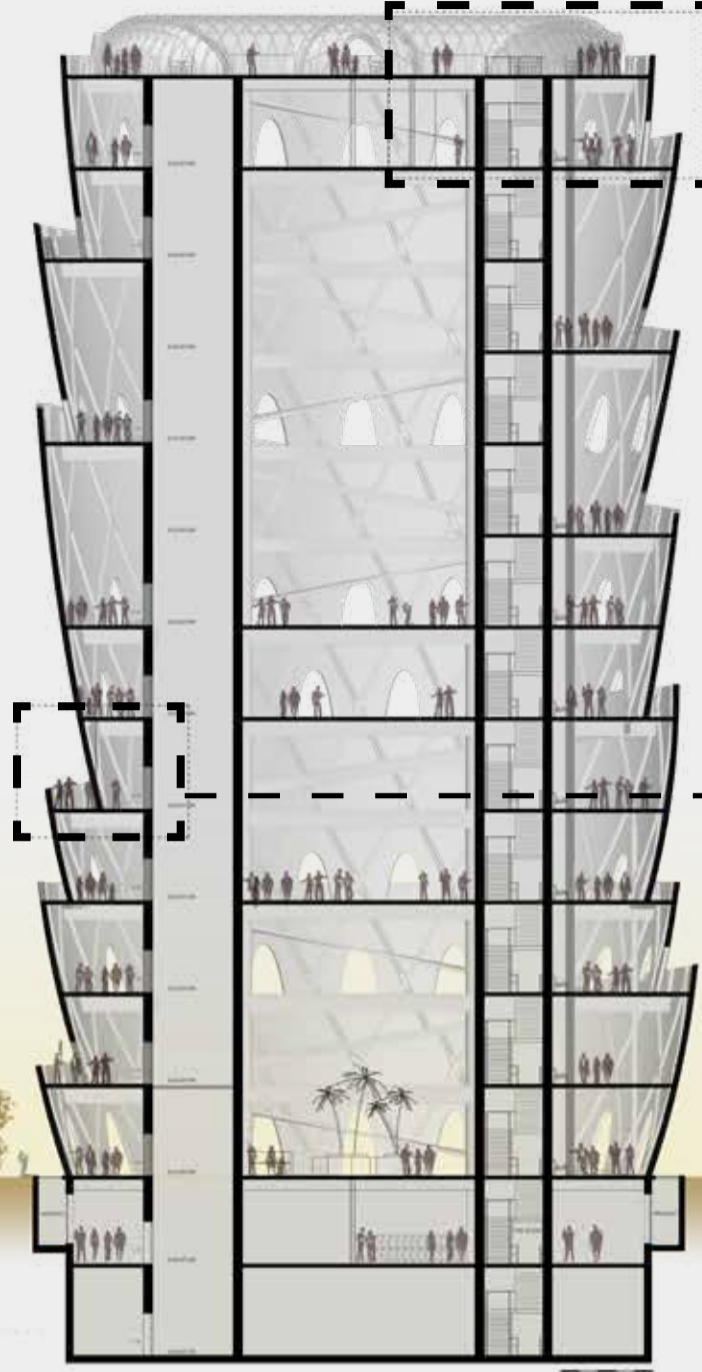
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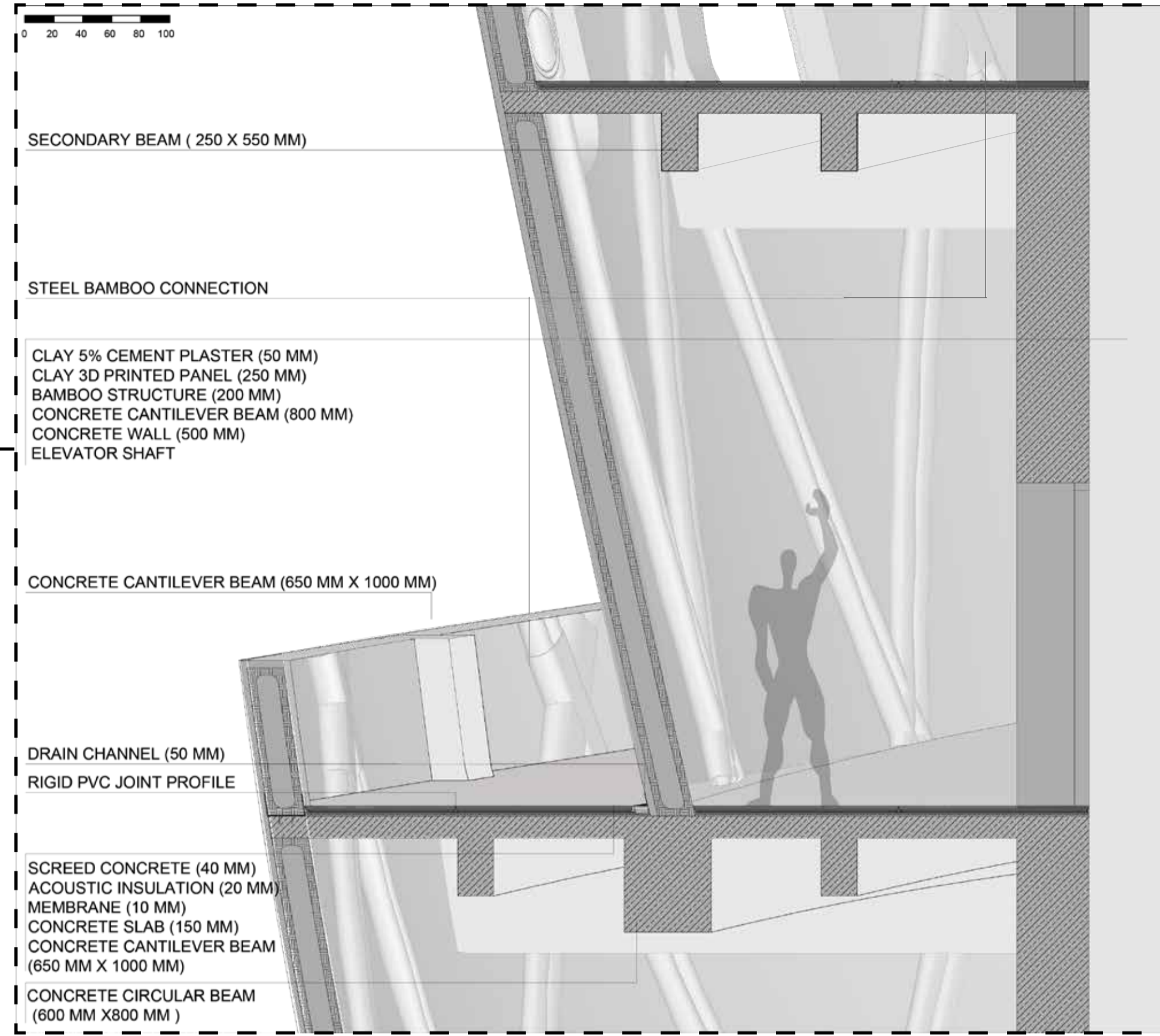
# AFRICAN CULTURE COMPLEX

## DETAILS

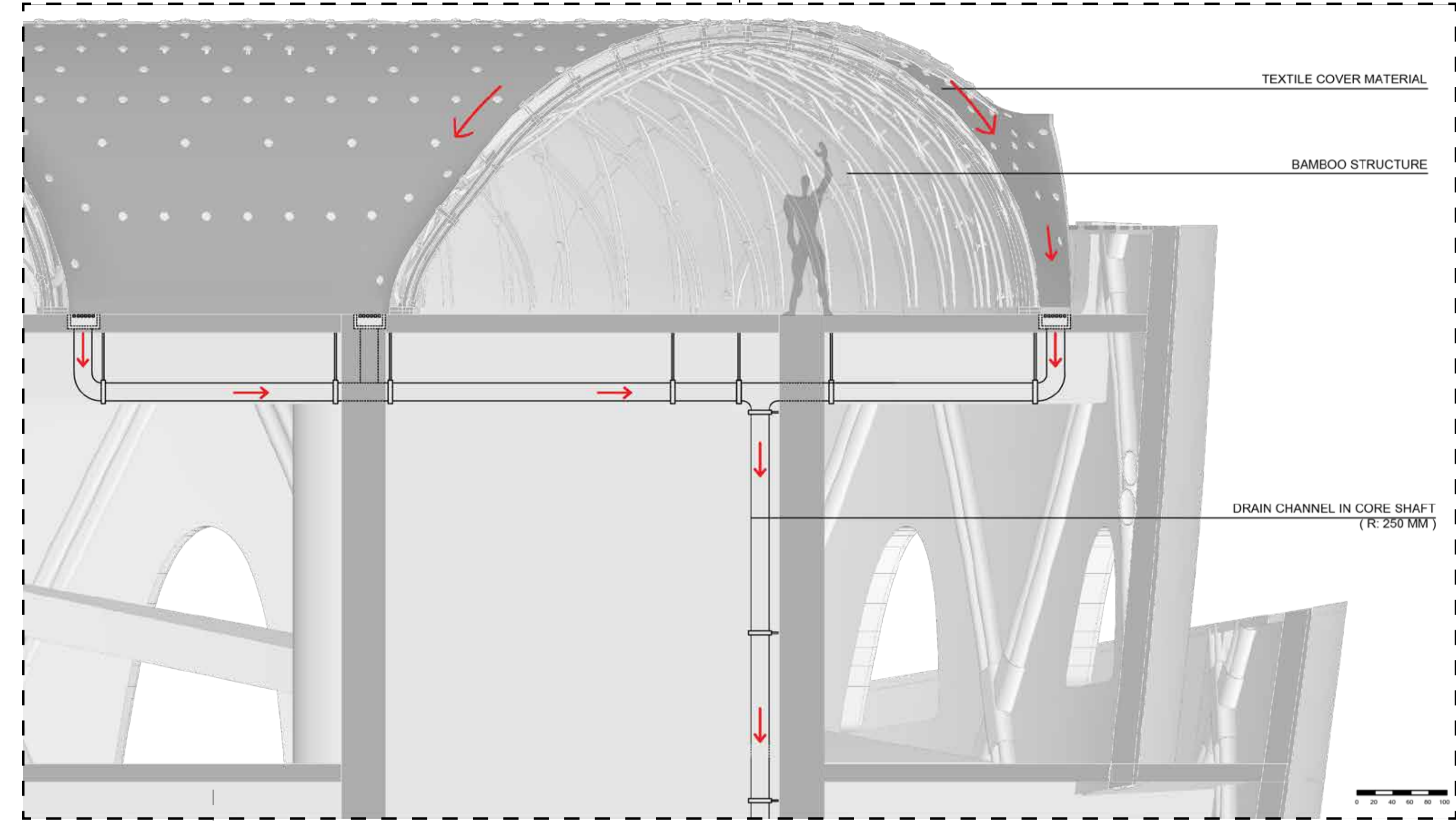
### SECTION N-S



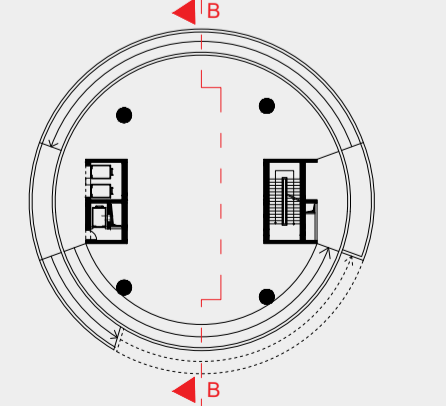
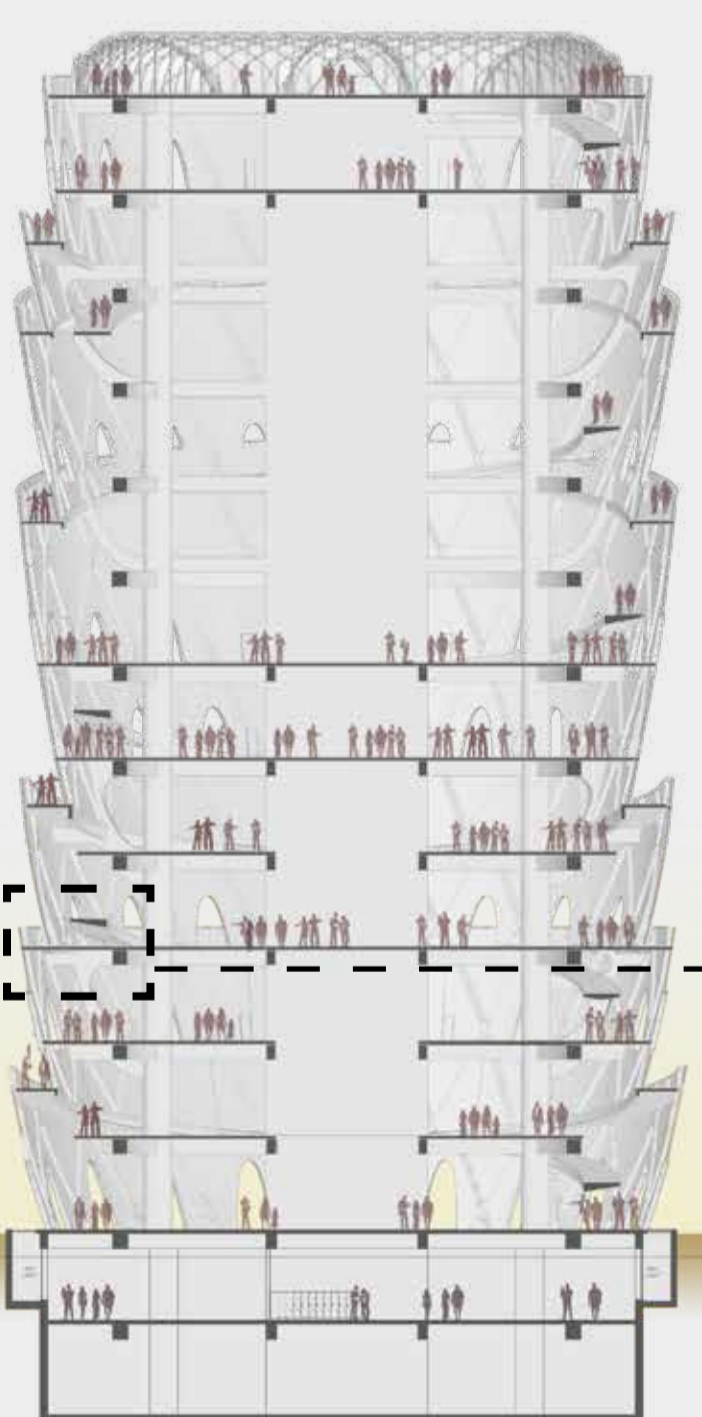
### CLAY WALL - CONCRETE SLAB



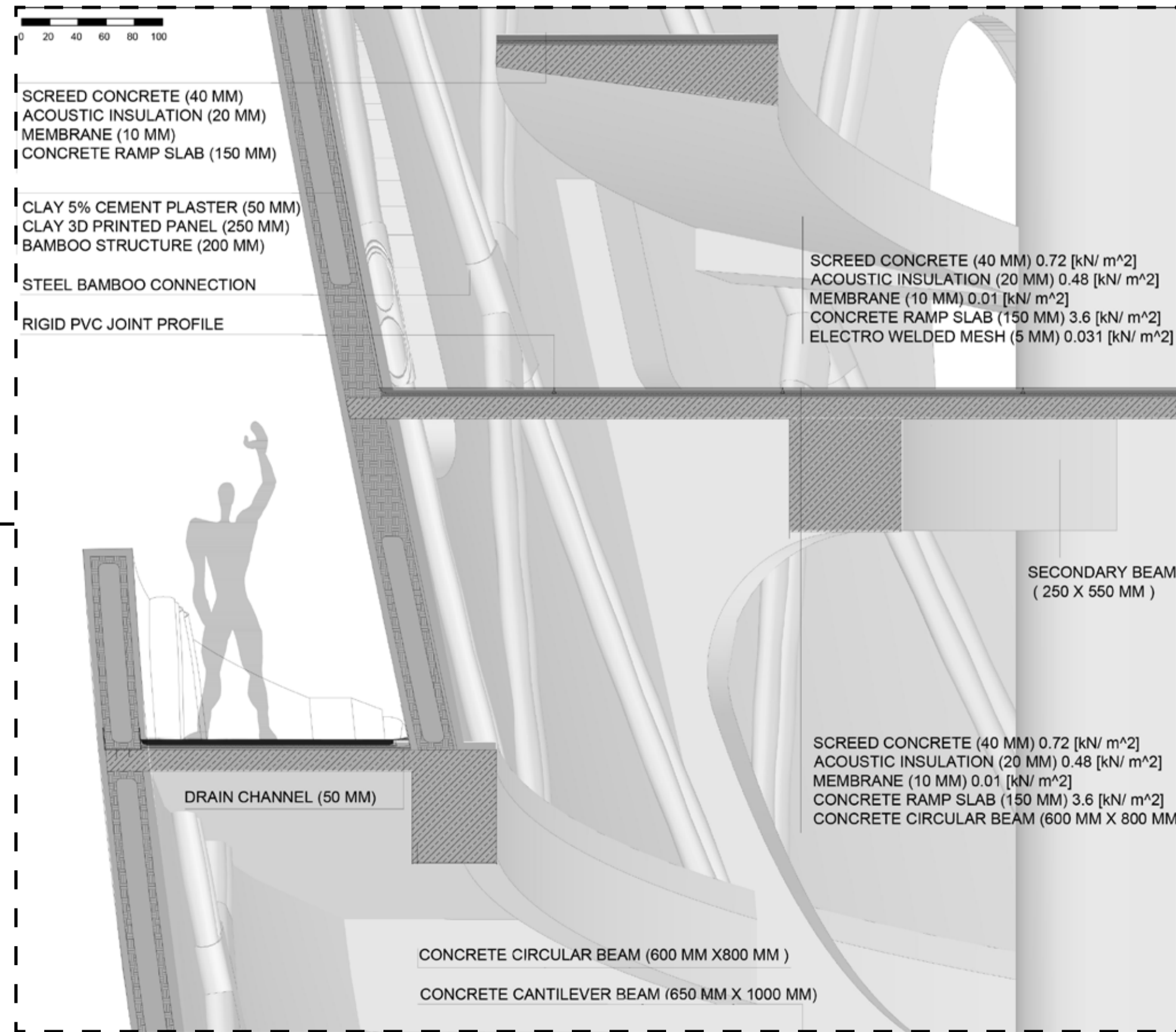
### TEXTILE ROOF



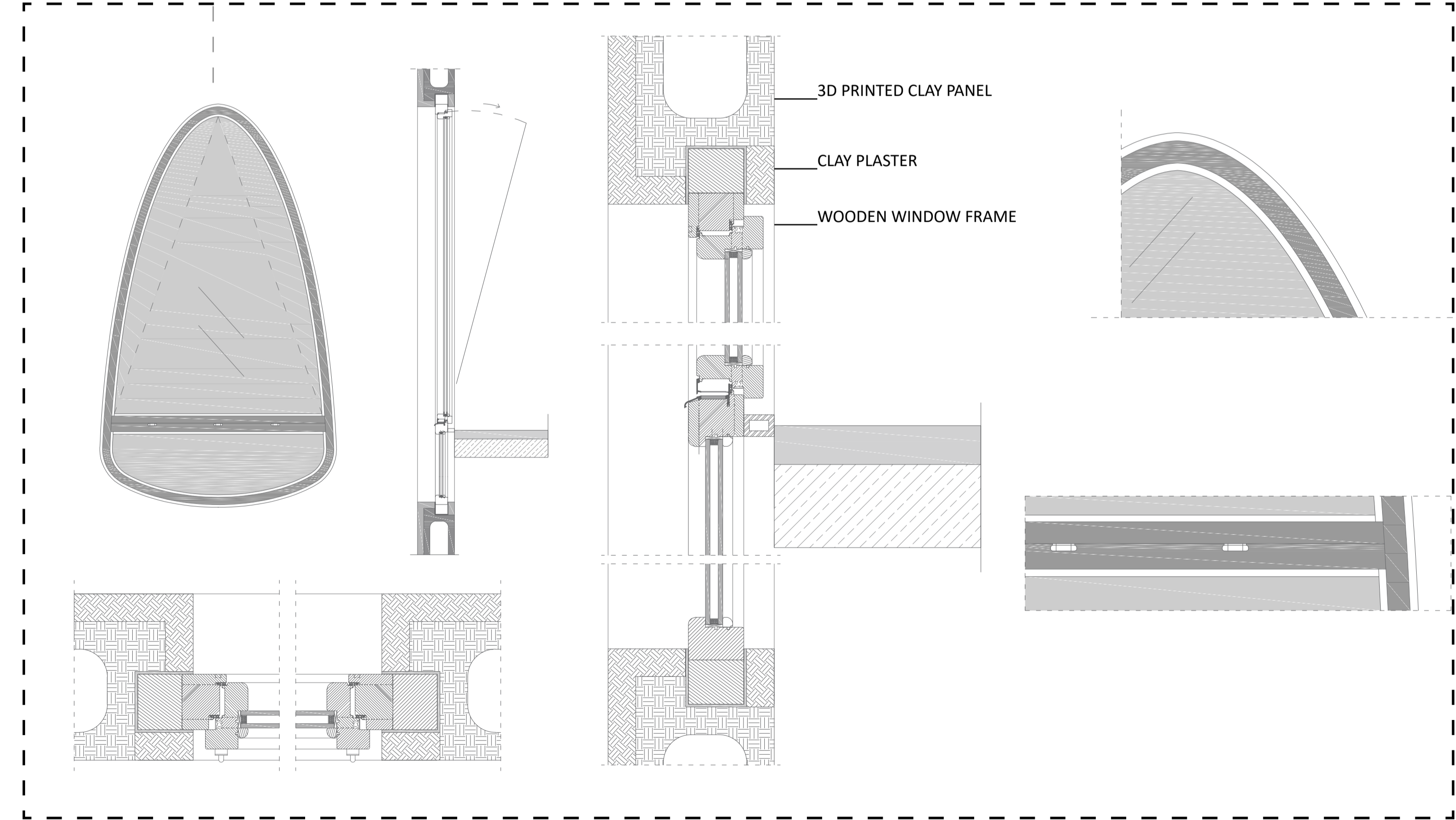
### SECTION W-E



### CLAY WALL - CONCRETE SLAB



### WOOD WINDOW DETAIL



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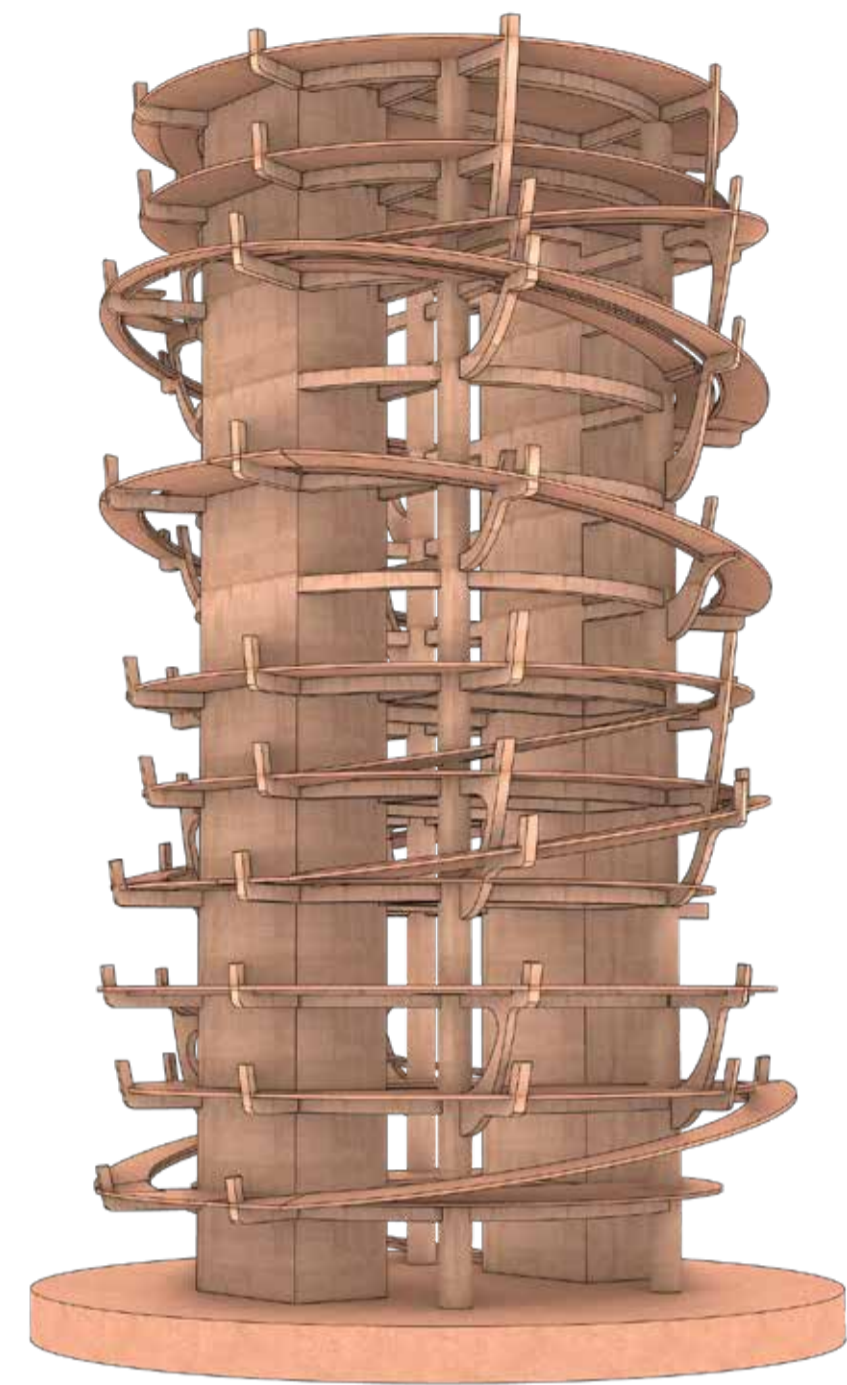
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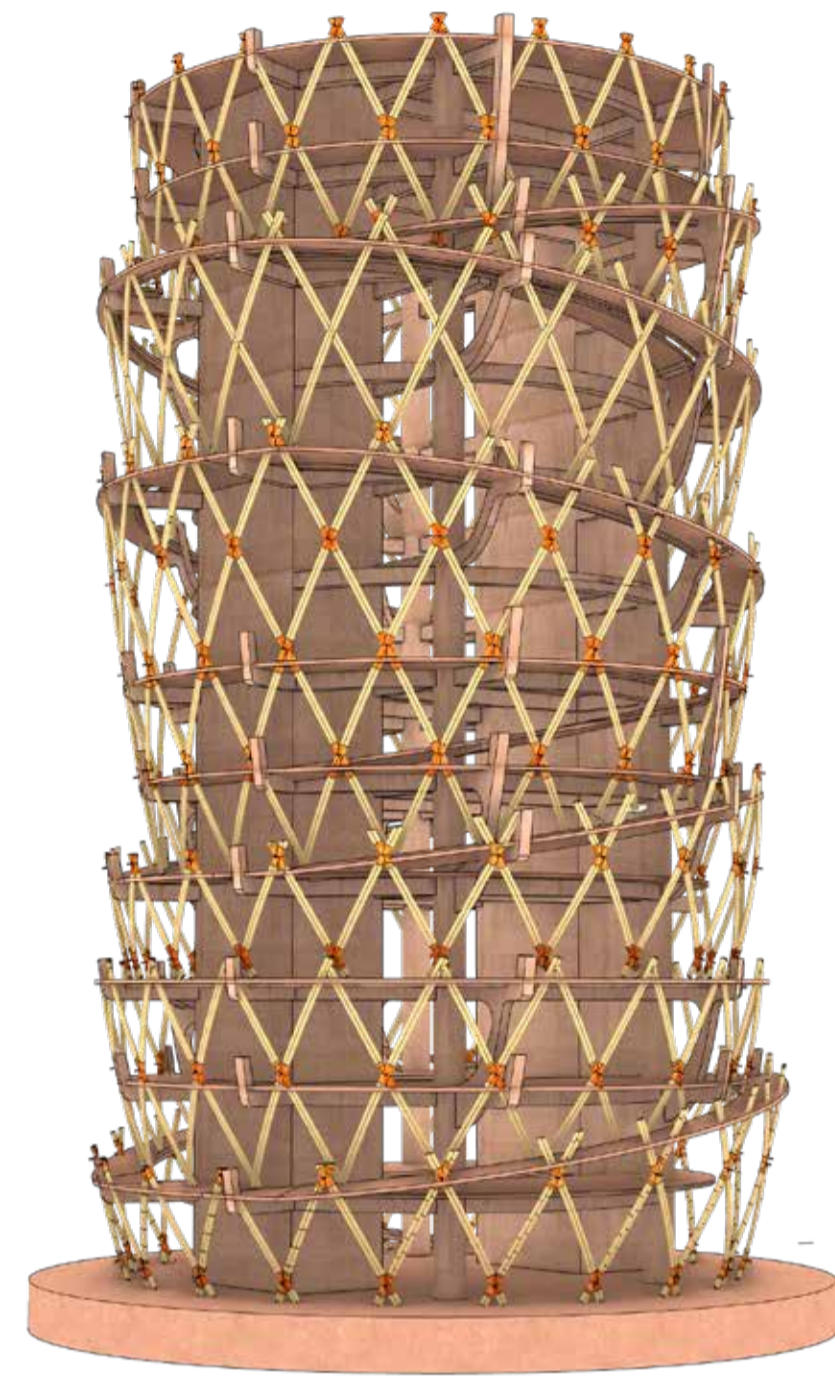




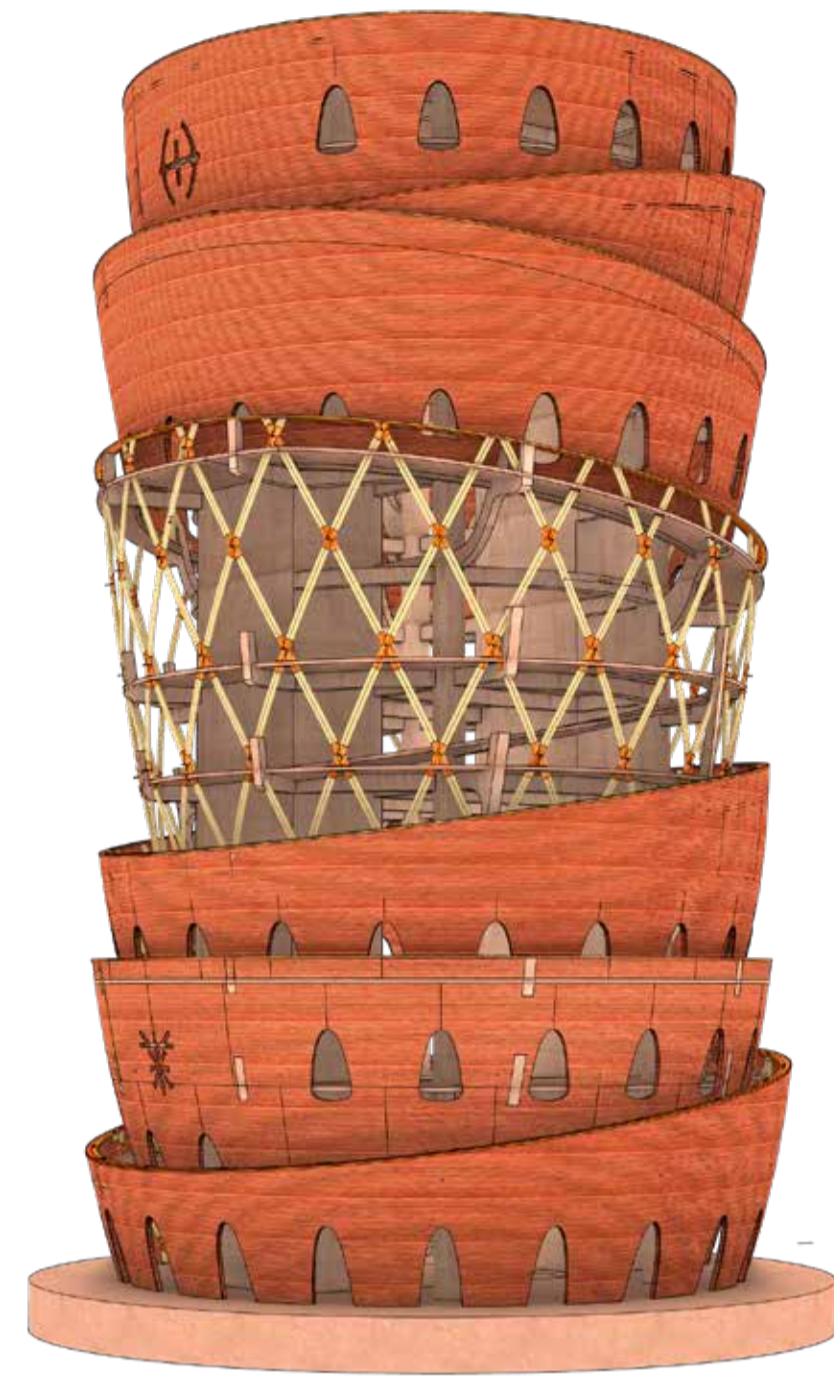
AFRICAN CULTURE COMPLEX  
STRUCTURE



CONCRETE

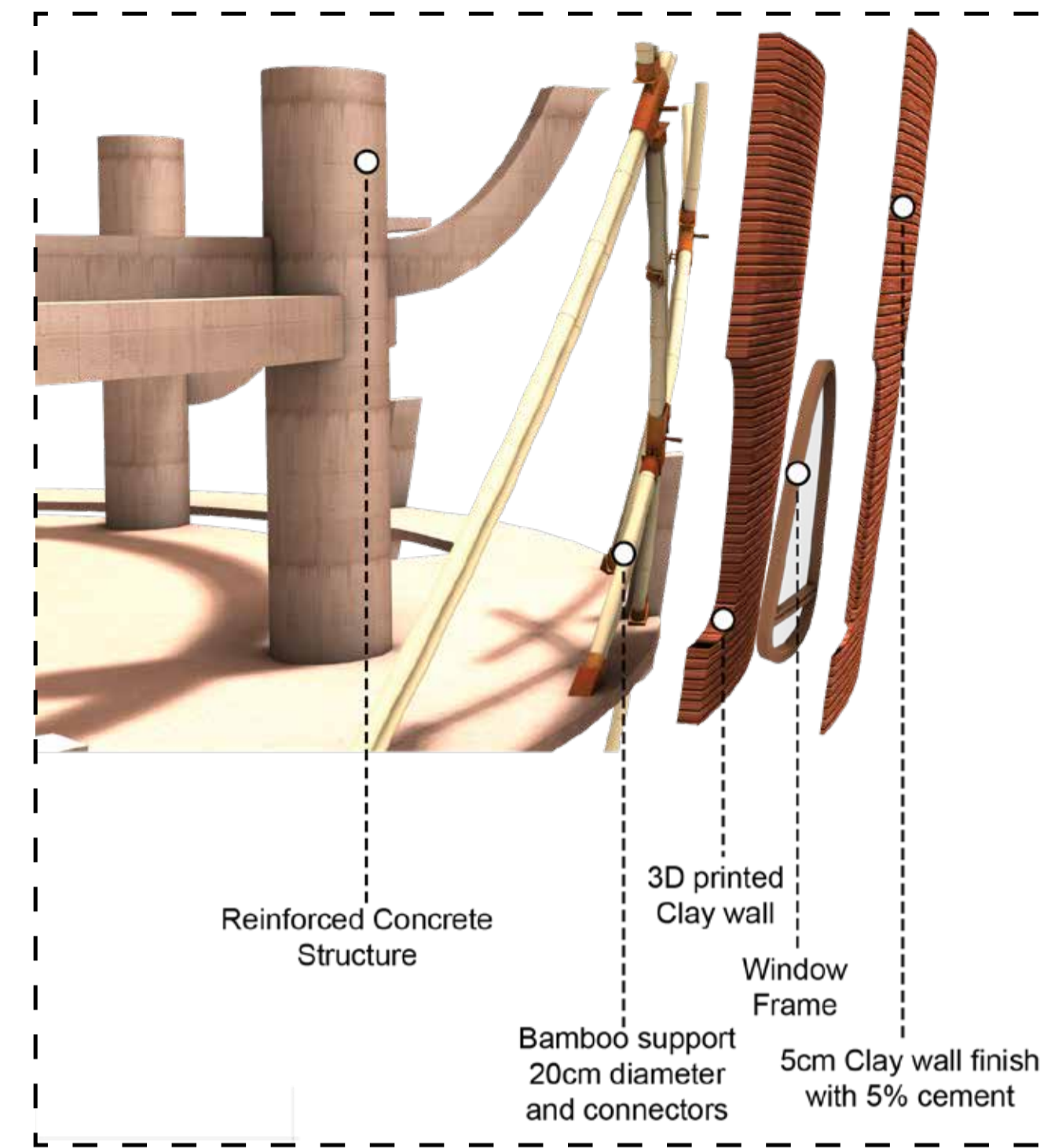


BAMBOO

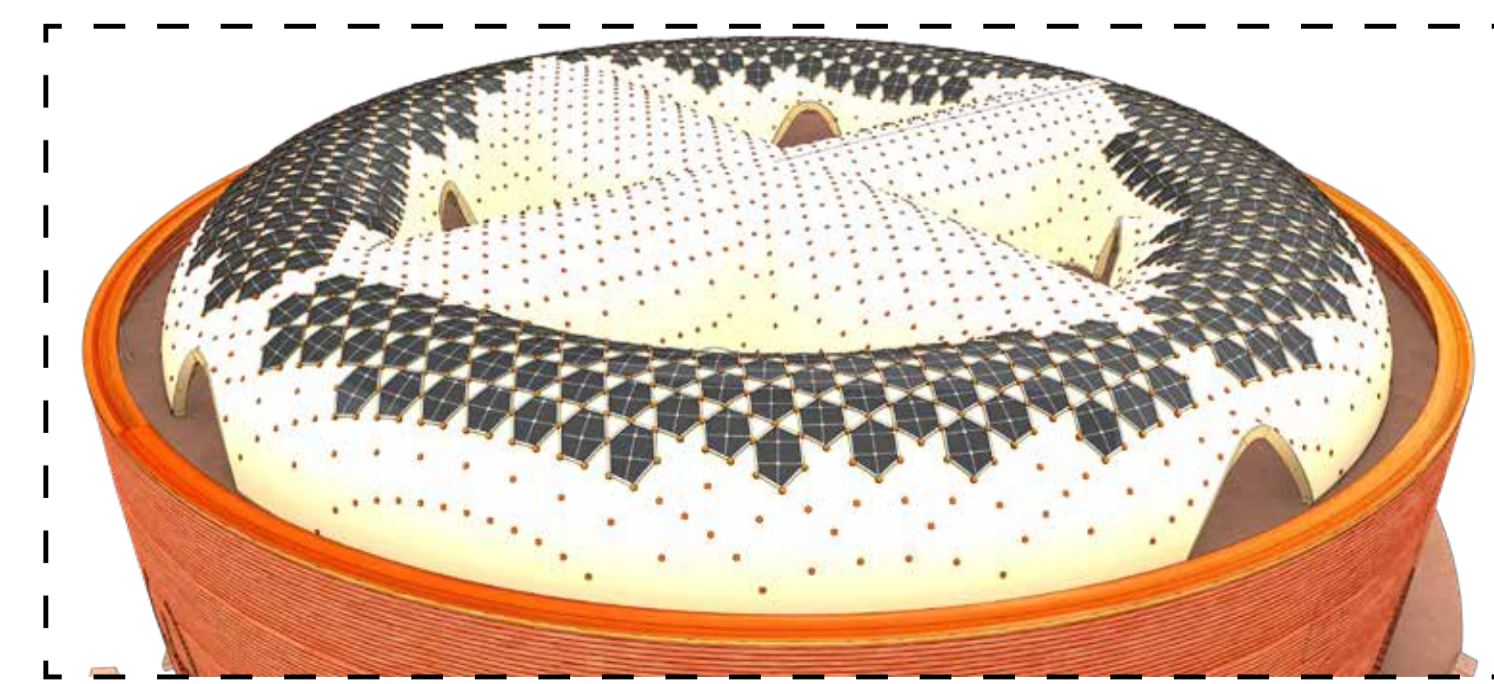
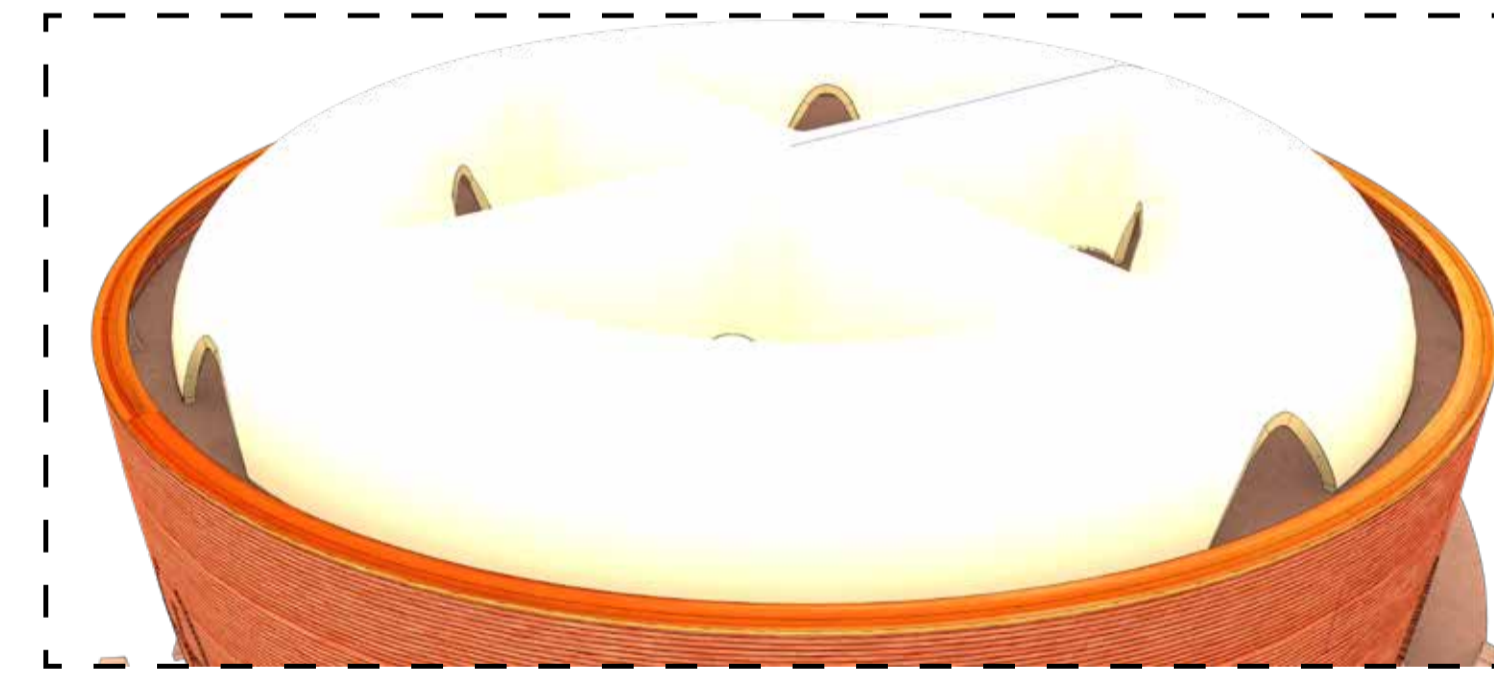
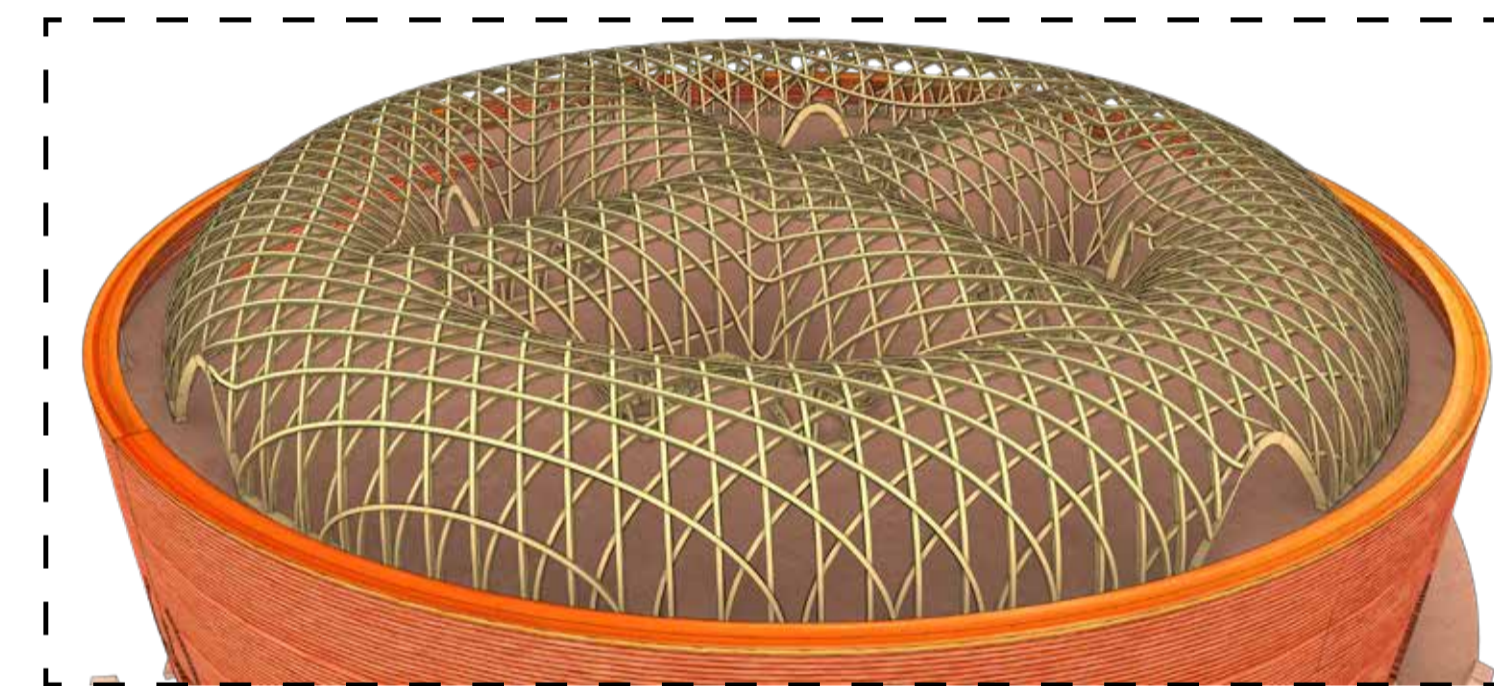
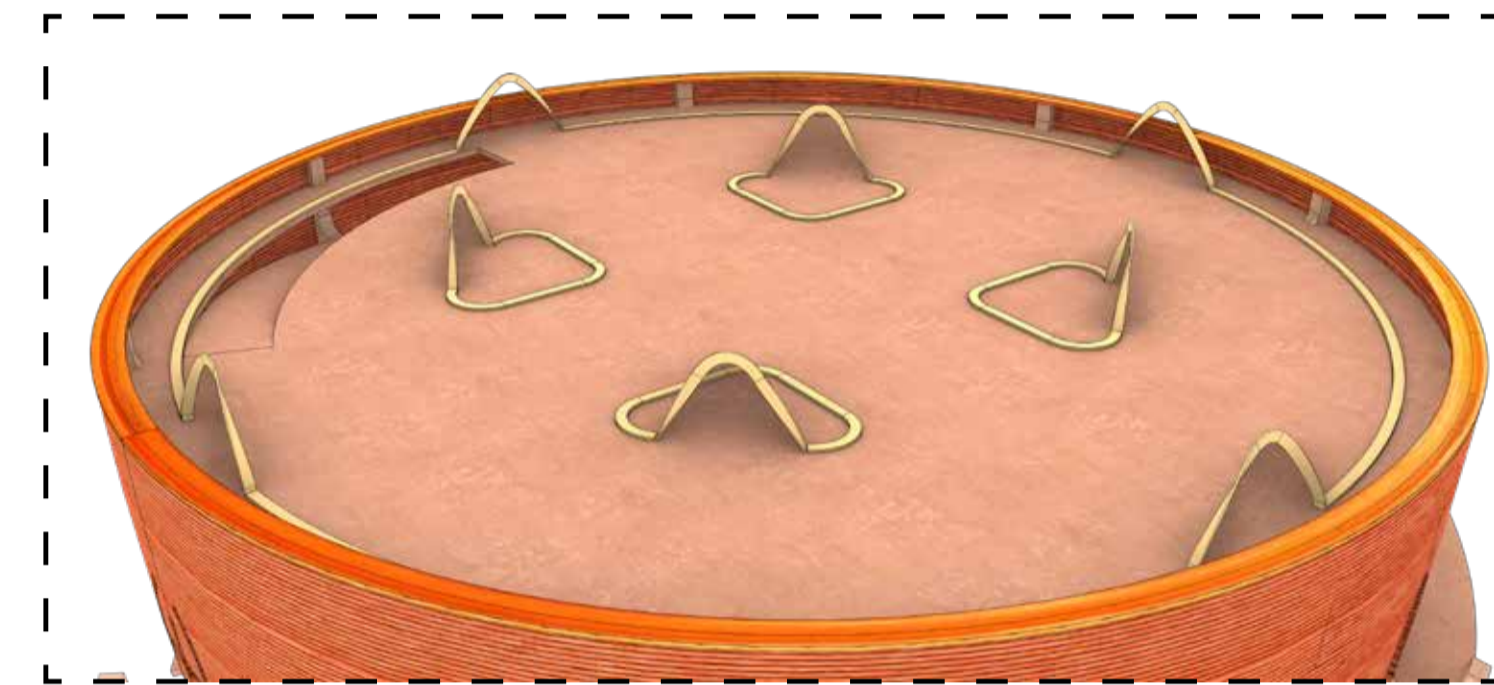
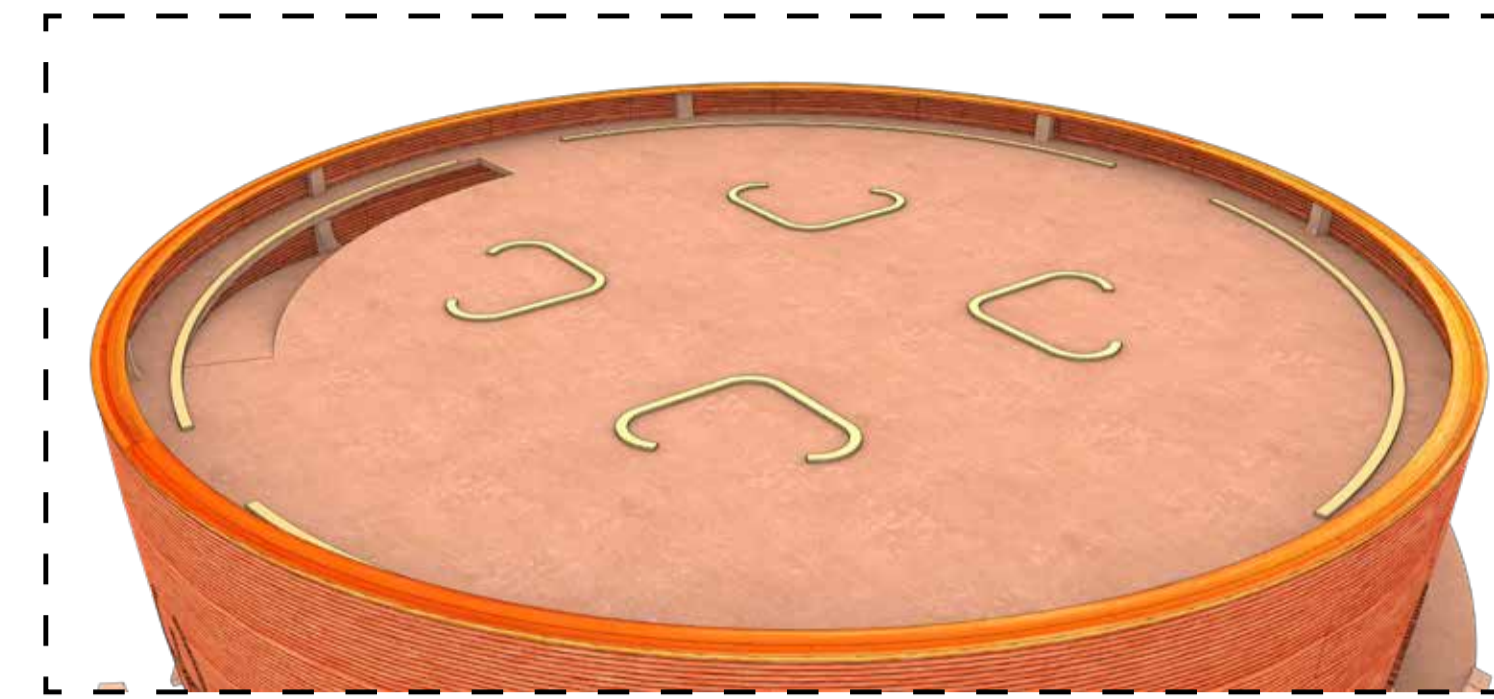


3D PRINTING CLAY

EXPLODED STRUCTURAL LAYERS



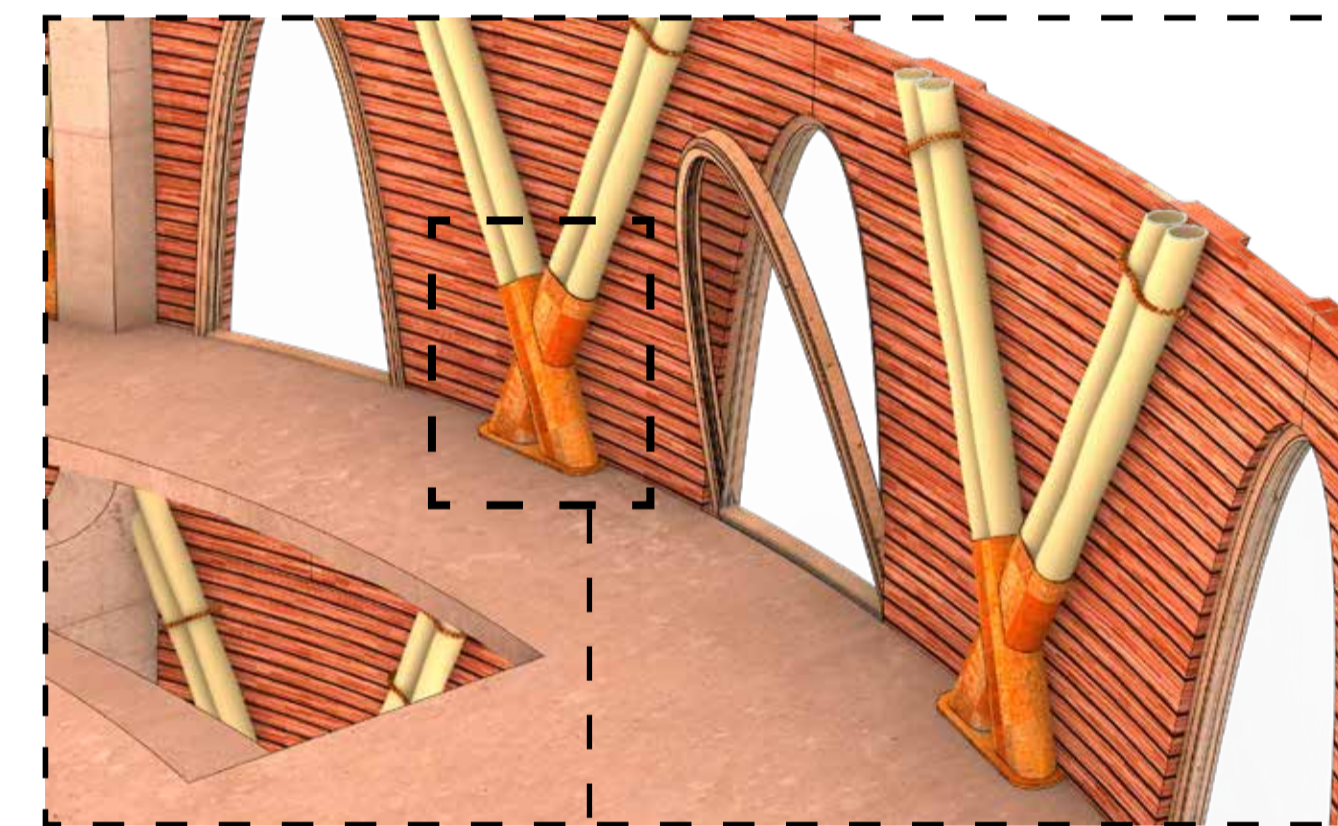
ROOF DEVELOPMENT



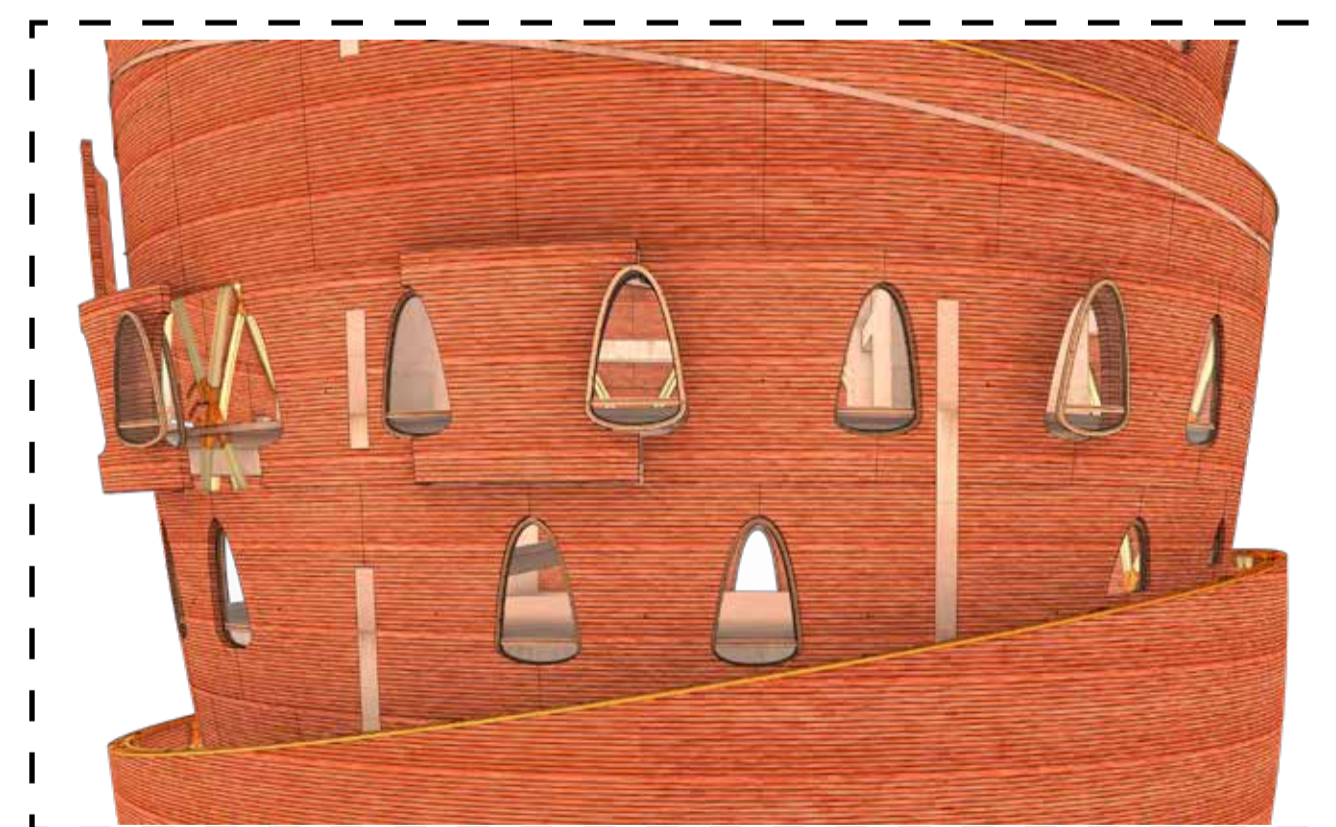
PANEL CROSS SECTION



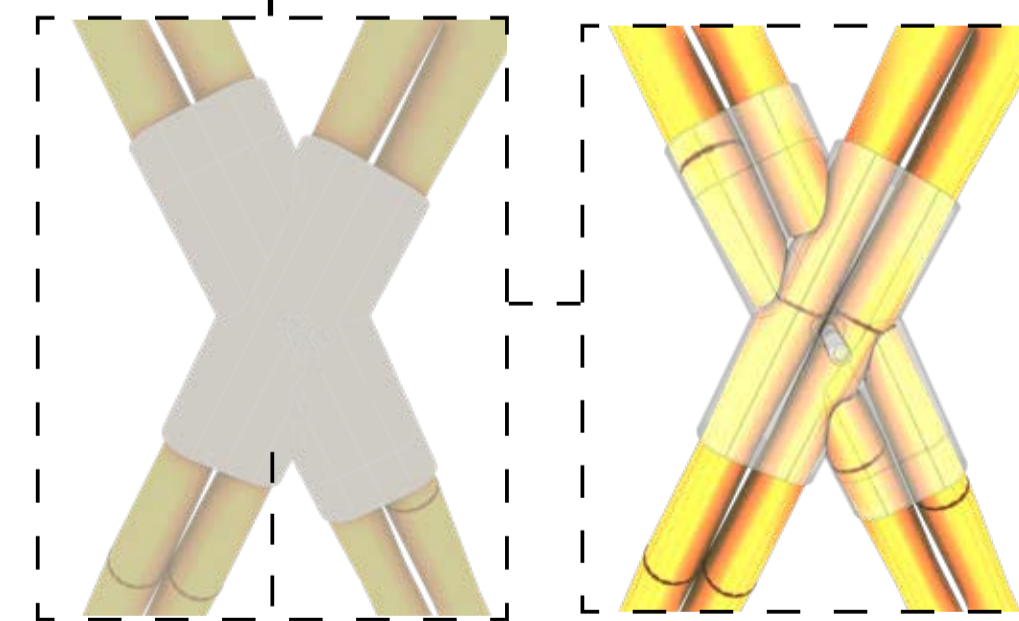
STEEL CONNECTION ELEMENT



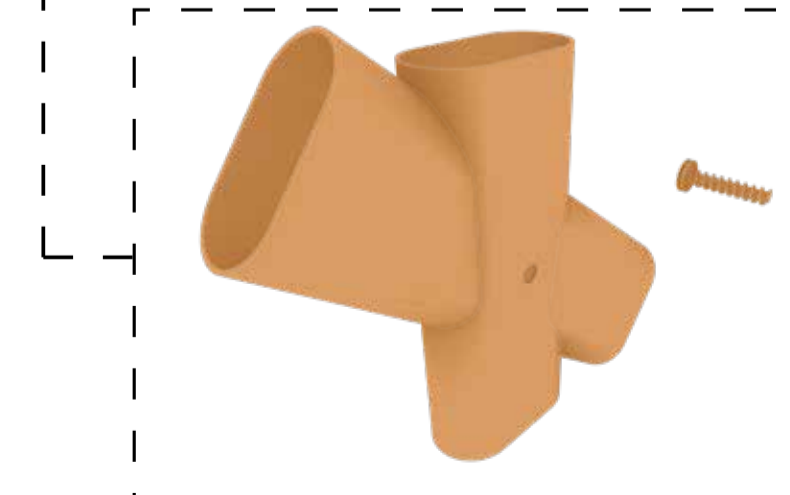
CLAY PANEL ASSEMBLY



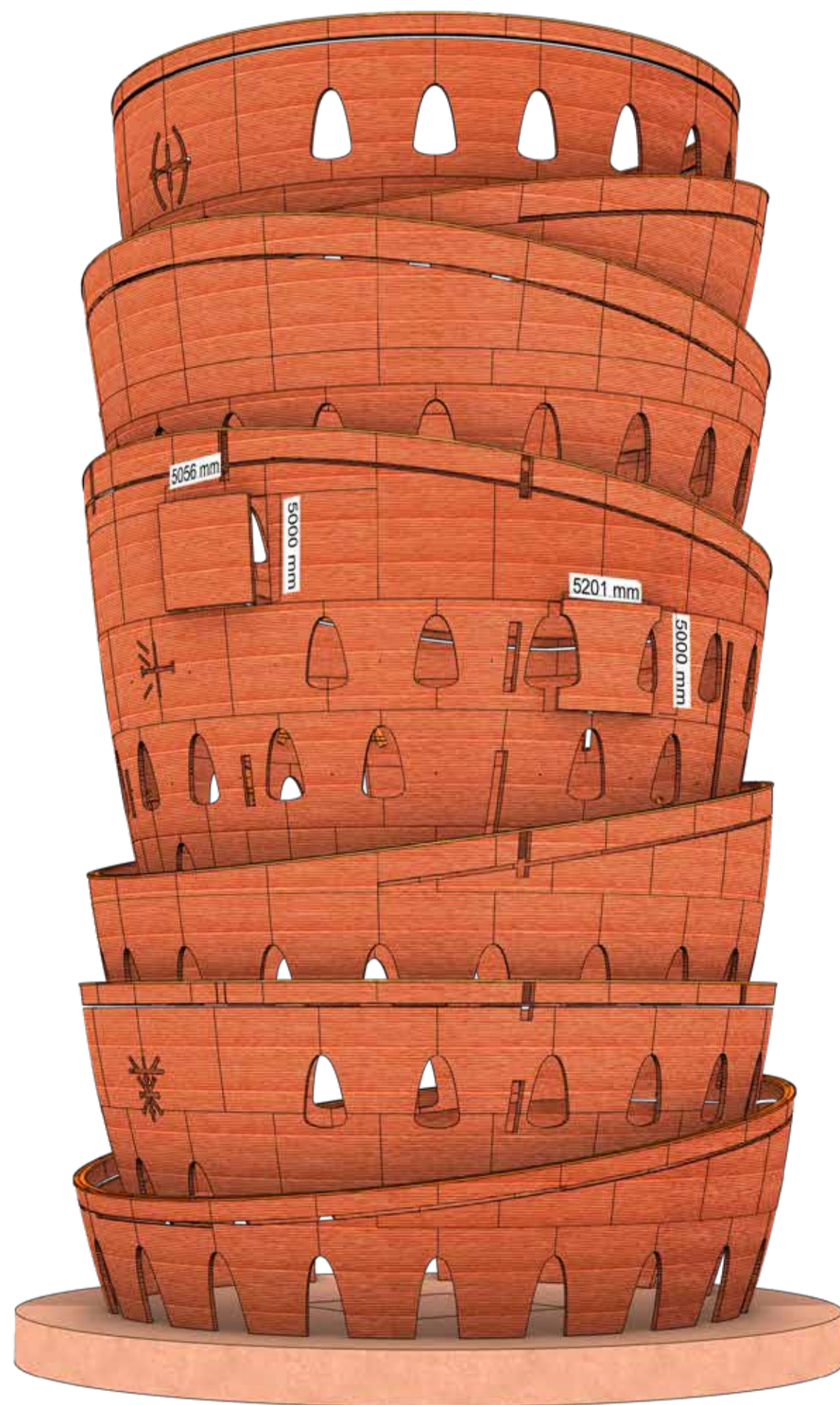
STEEL BAMBOO CONNECTION



STEEL CONNECTION ELEMENT



CLAY PANEL ORGANIZATION



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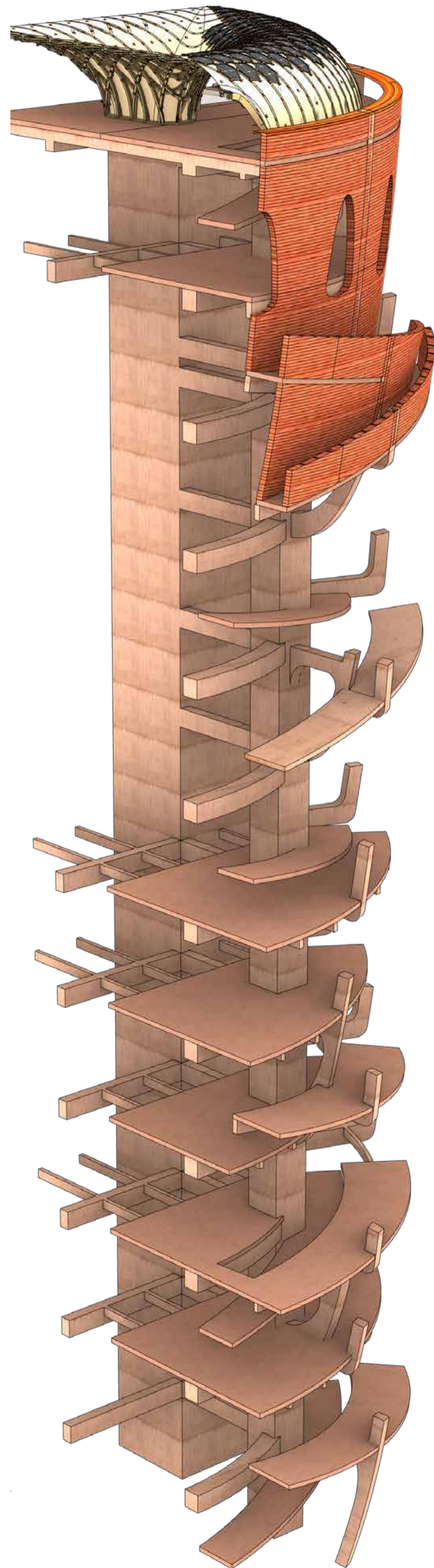
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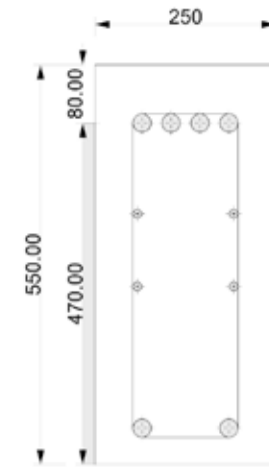
# AFRICAN CULTURE COMPLEX STRUCTURAL CALCULATION



## SECONDARY BEAM (cantilever) 1

We will have a secondary beam with the following characteristics:

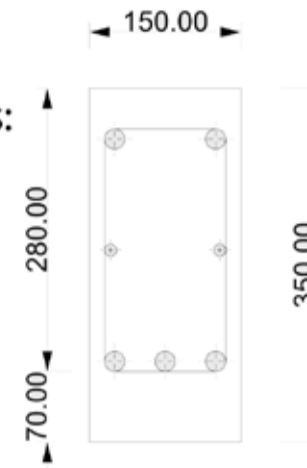
Length: 6.00 [m]  
 Width: 25.00 [cm]  
 Height: 55.00 [cm]  
 Interaxis between secondary beam: 1.10 [m]  
 Section concrete area: 900.00 [cm<sup>2</sup>]  
 Section steel area: 21.24 [cm<sup>2</sup>]  
 Rebars in tension: 4  $\phi$  26  
 Rebars in compression: 2  $\phi$  26  
 Stirrups  $\phi$  8/150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



## SECONDARY BEAM 2 (simply supported)

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

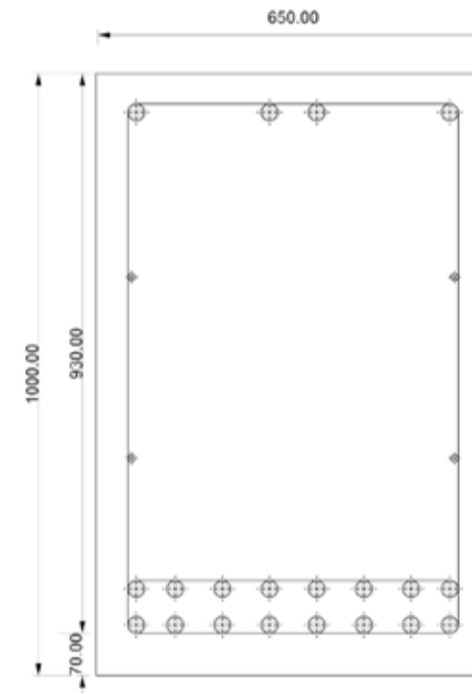
Length: 6.00 [m]  
 Width: 15.00 [cm]  
 Height: 30.00 [cm]  
 Interaxis between secondary beam: 1.10 [m]  
 Section concrete area: 900.00 [cm<sup>2</sup>]  
 Section steel area: 7.63 [mm<sup>2</sup>]  
 Rebars in tension: 3  $\phi$  20  
 Rebars in compression: 2  $\phi$  20  
 Stirrups  $\phi$  8/150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



## PRIMARY BEAM (simply supported)

We will have a primary beam with the following characteristics:

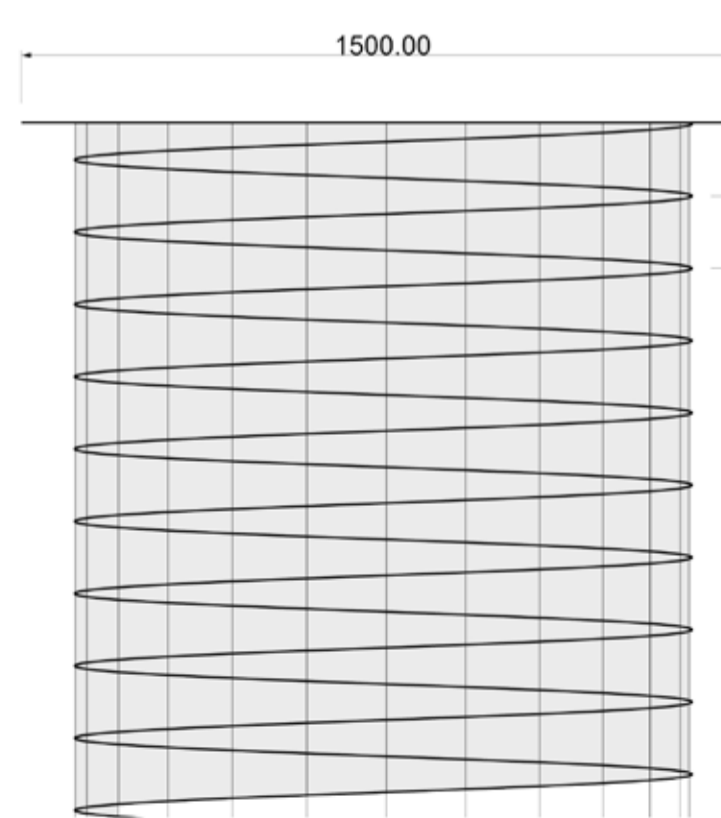
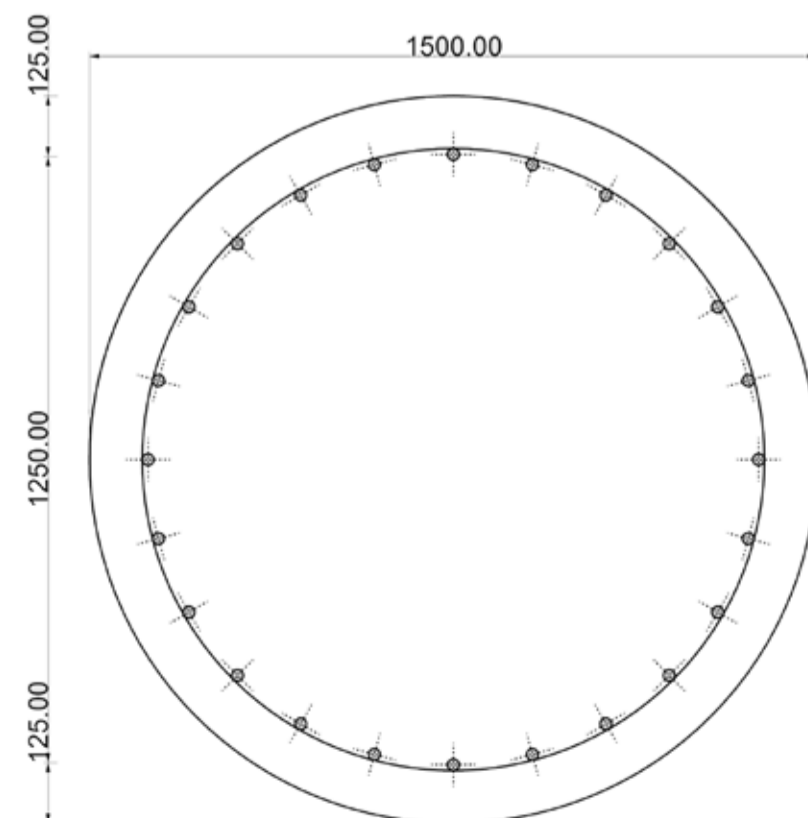
Length: 13.3 [m]  
 Width: 65.00 [cm]  
 Height: 100.00 [cm]  
 Interaxis between primary beam: 8.8 [m]  
 Section concrete area: 4'800.00 [cm<sup>2</sup>]  
 Section steel area: 98.52 [cm<sup>2</sup>]  
 Rebars in tension: 16  $\phi$  28  
 Rebars in compression: 2  $\phi$  28  
 Stirrups  $\phi$  8/150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



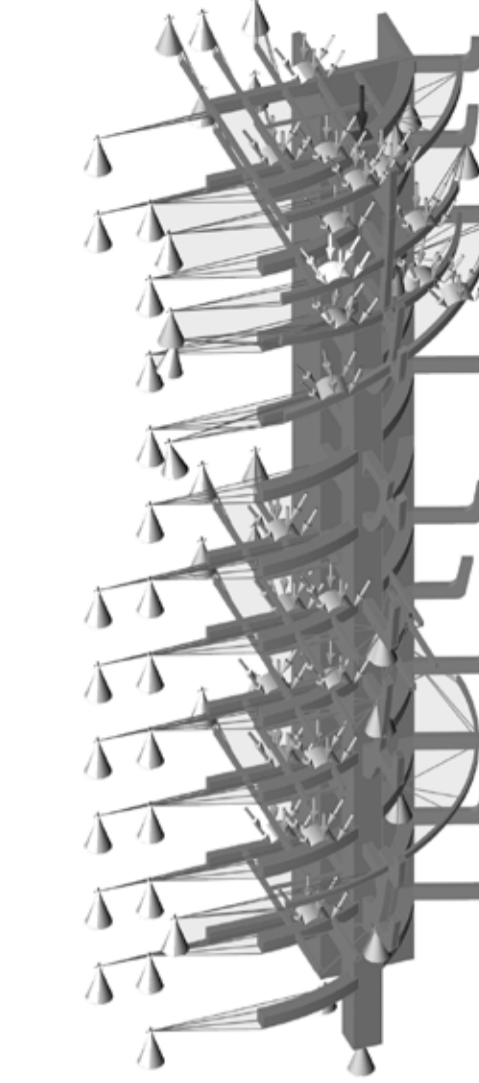
## COLUMN

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<sup>2</sup>]  
 Section steel area: 98.52 [cm<sup>2</sup>]  
 Rebars in tension: 16  $\phi$  28  
 Rebars in compression: 2  $\phi$  28  
 Stirrups  $\phi$  8/150 [mm]

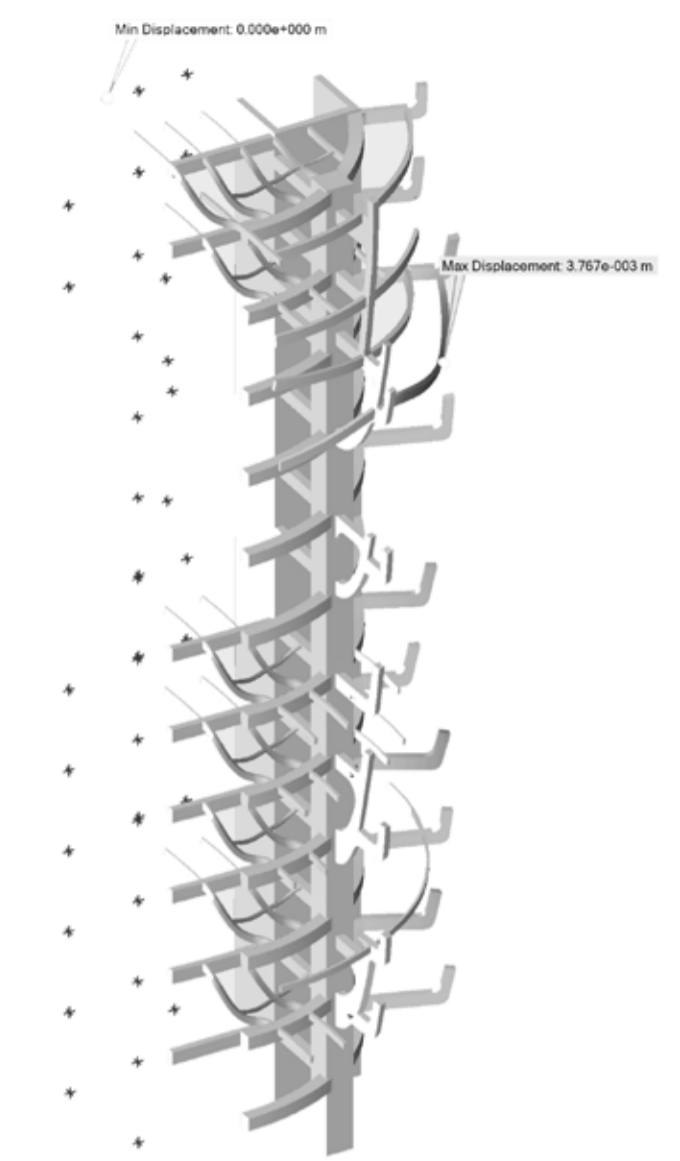


## OVERVIEW

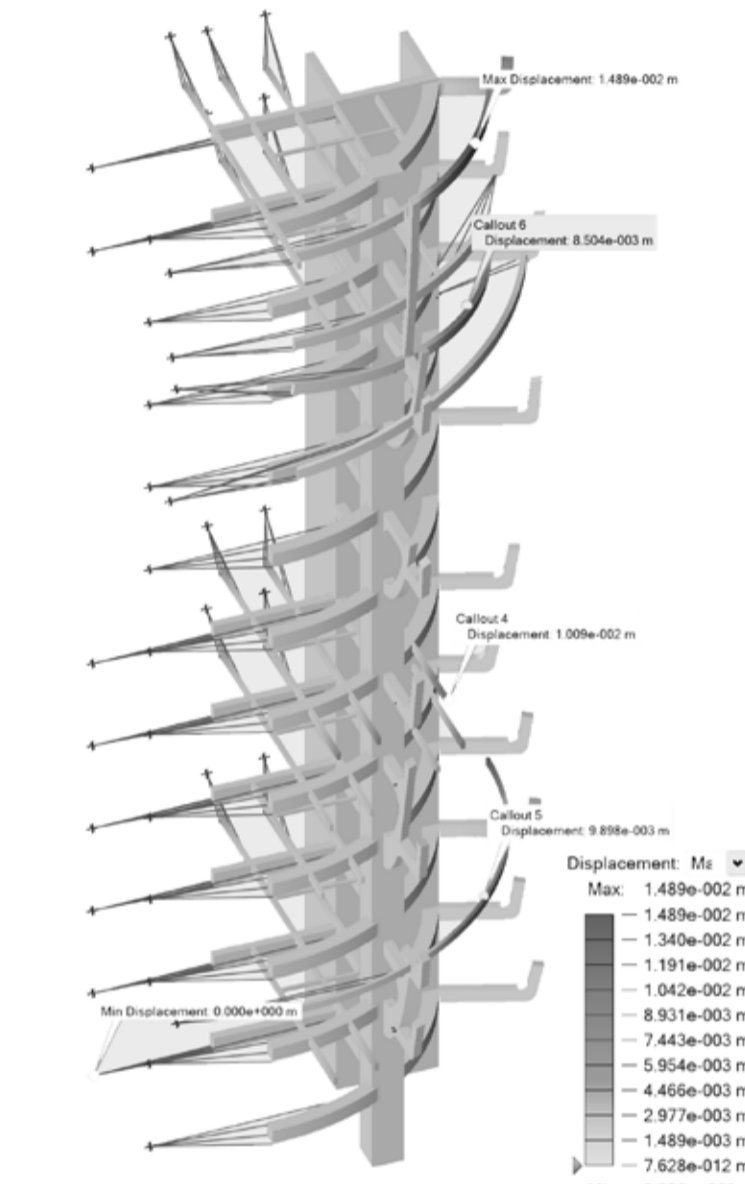


Load Name	Load Type	Magnitude	Position X	Position Y	Position Z	Applied To
Wall Load	Pressure	53507.20915 Pa	-3.09 m	15 m	54.8 m	Face
Wall Load	Pressure	53507.20915 Pa	-9.04 m	12.3 m	54.8 m	Face
Slab Load	Pressure	14719.33715 Pa	-4.34 m	11.2 m	59.8 m	Face
Variable Load	Pressure	13954.02053 Pa	-5.75 m	4 m	59.8 m	Face
Wall Load	Pressure	74348.05911 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	14556.1412 Pa	-3.95 m	3.95 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	14712.05844 Pa	-6.62 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	15511.5124 Pa	-11.2 m	12 m	49.2 m	Face
Slab Load	Pressure	17434.15983 Pa	-4.63 m	11 m	29.8 m	Face
Variable Load	Pressure	13352.47497 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	15228.59044 Pa	-4.04 m	4 m	9.81 m	Face
Variable Load	Pressure	15501.13313 Pa	-3.68 m	4.05 m	19.8 m	Face
Variable Load	Pressure	13358.1148 Pa	-4.6 m	4.04 m	24.8 m	Face
Roof Load	Force	412000 N	-6.61 m	9.96 m	60 m	Face

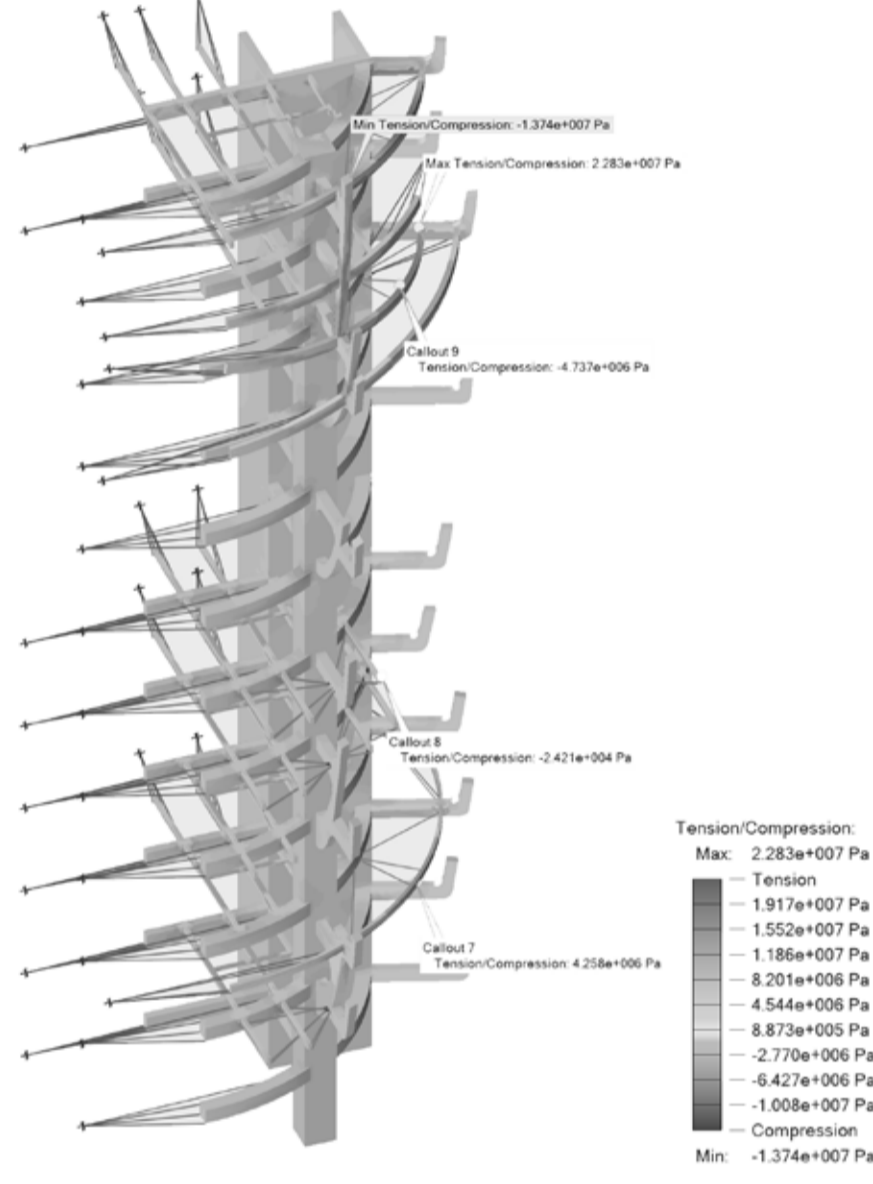
## BEHAVIOR OF DEFORMATION



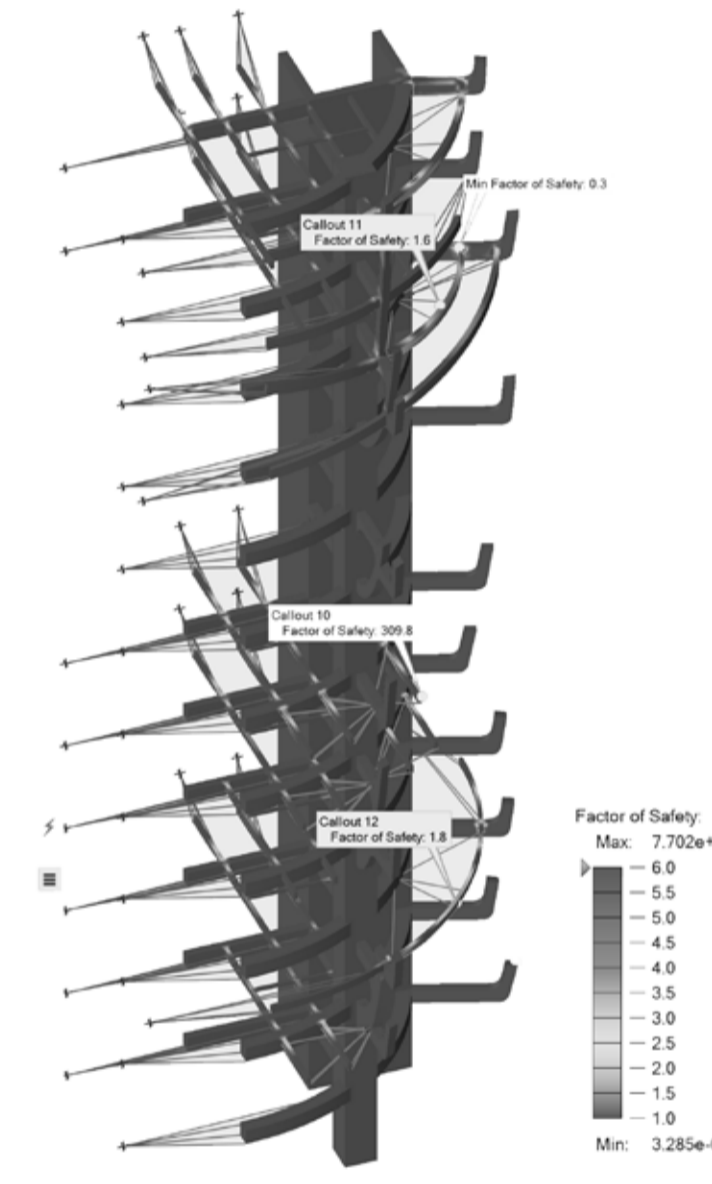
## DISPLACEMENT BEFORE



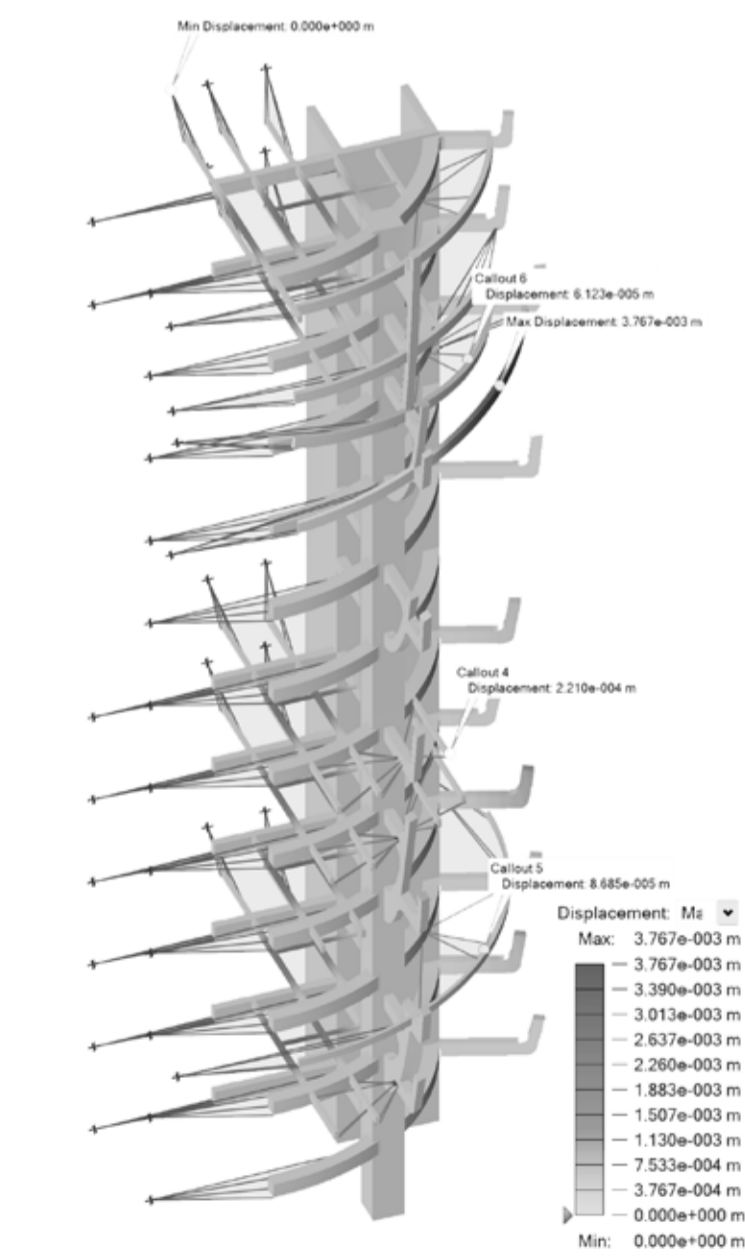
## TENSION COMPRESSION BEFORE



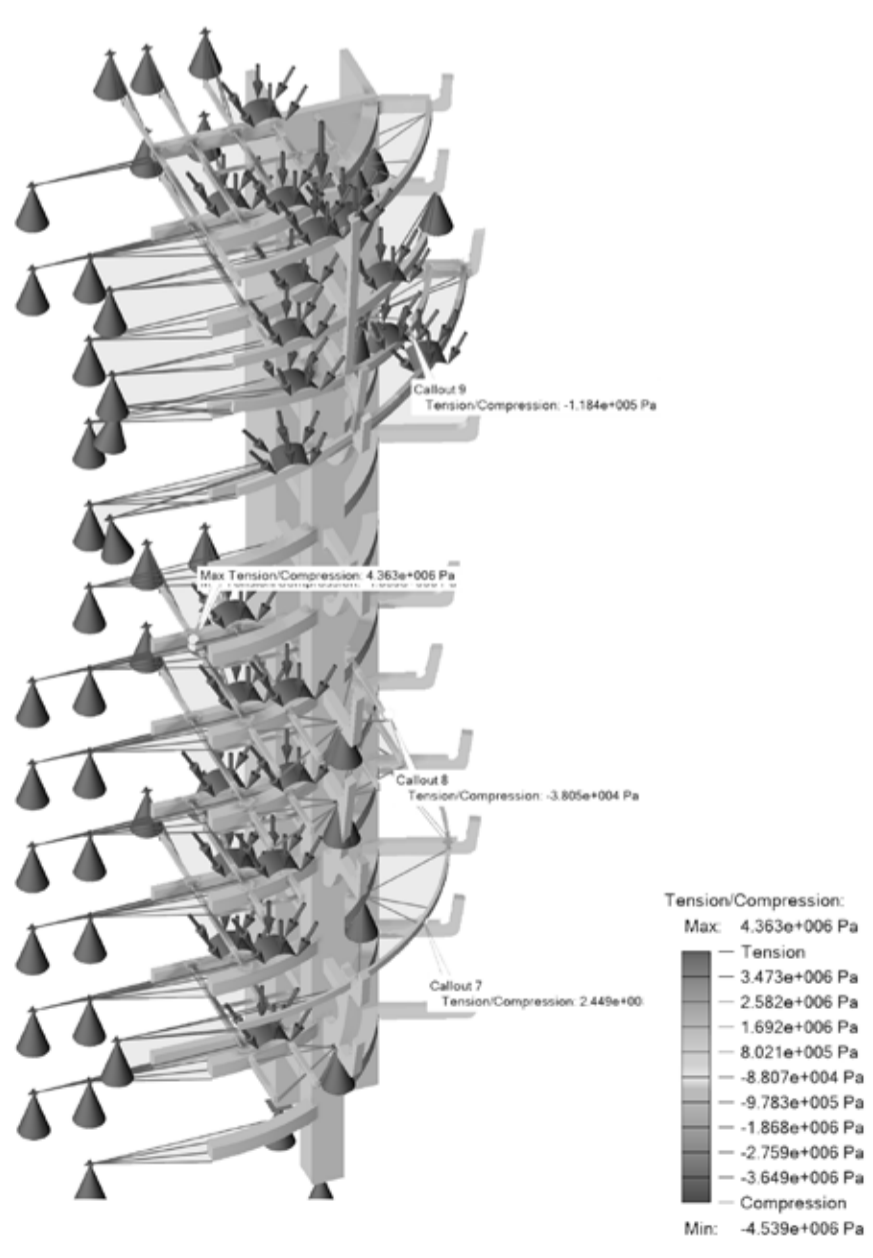
## FOS BEFORE



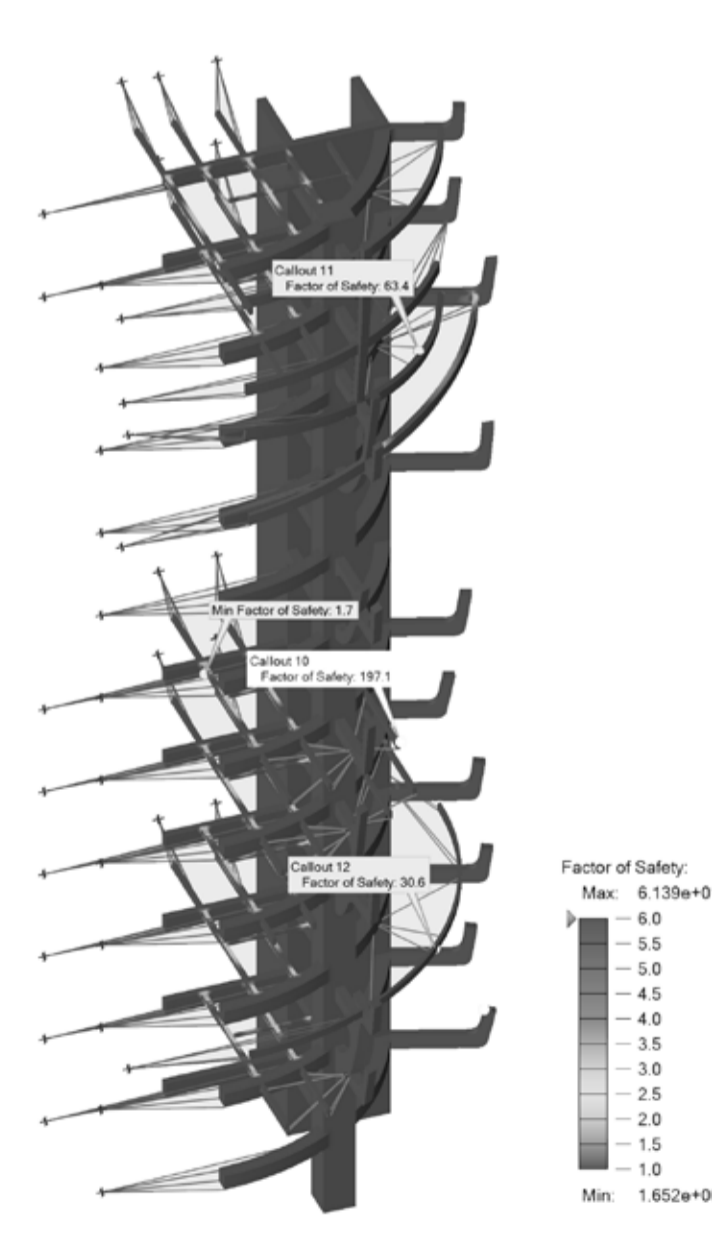
## DEFORMATION AFTER



## TENSION COMPRESSION AFTER

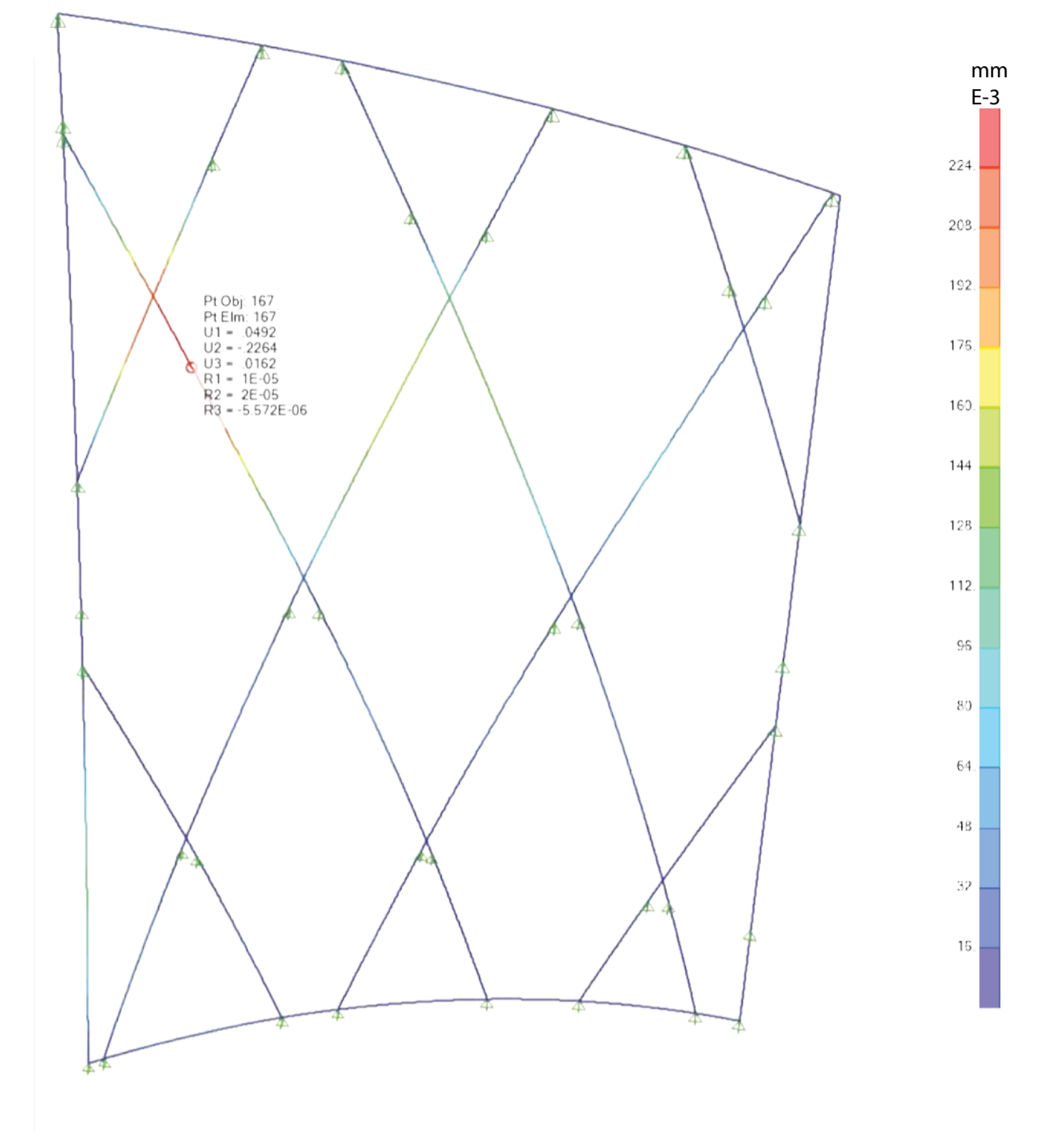
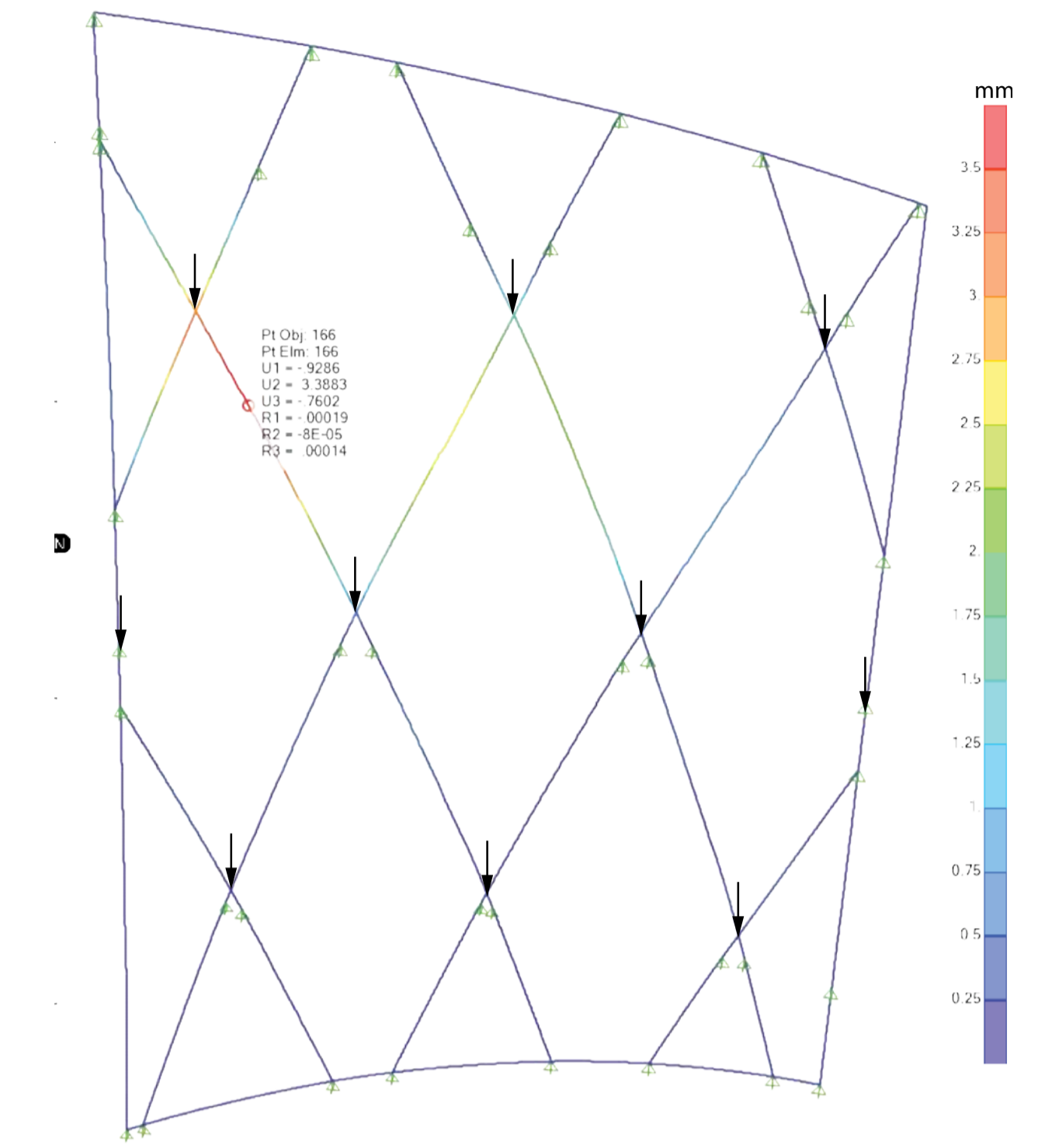
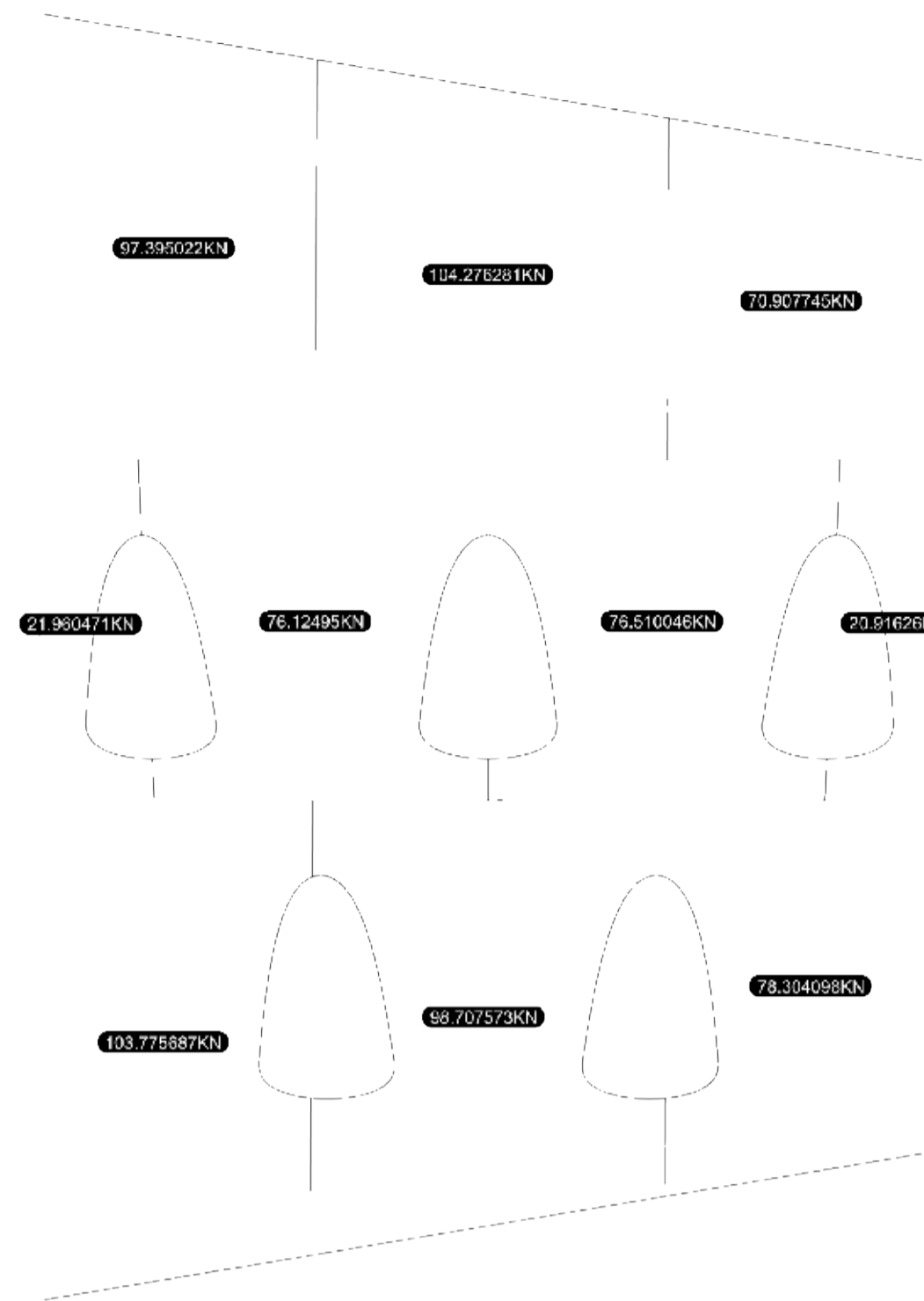
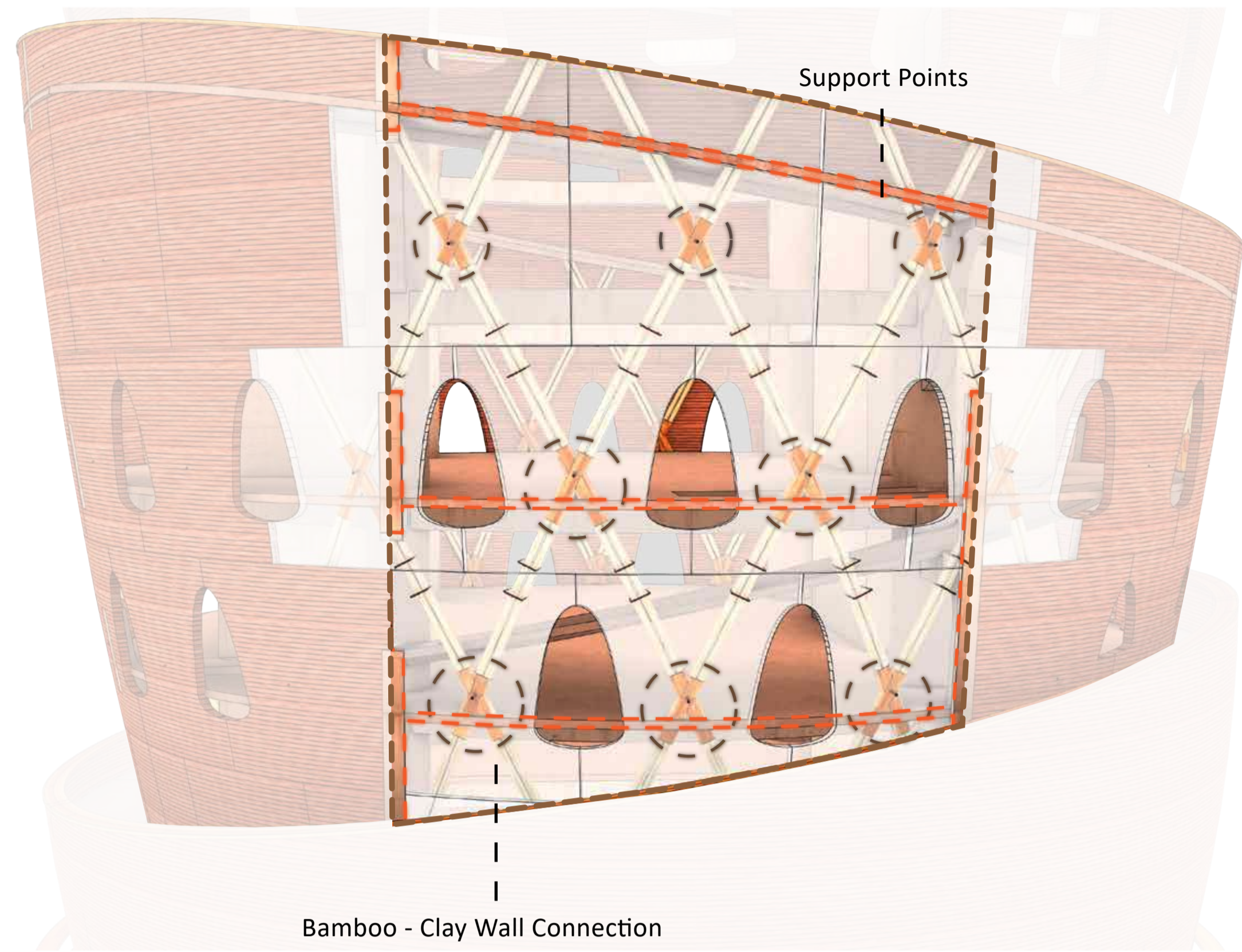


## FOS AFTER

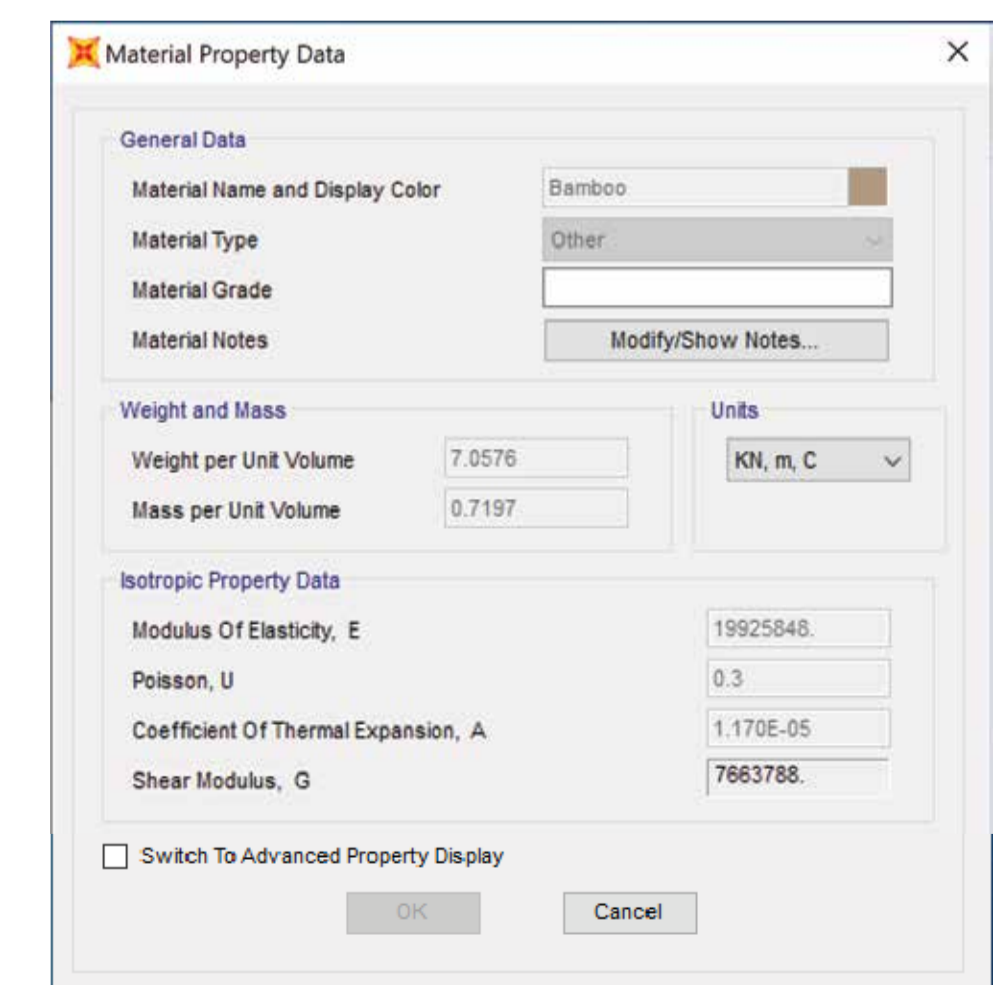
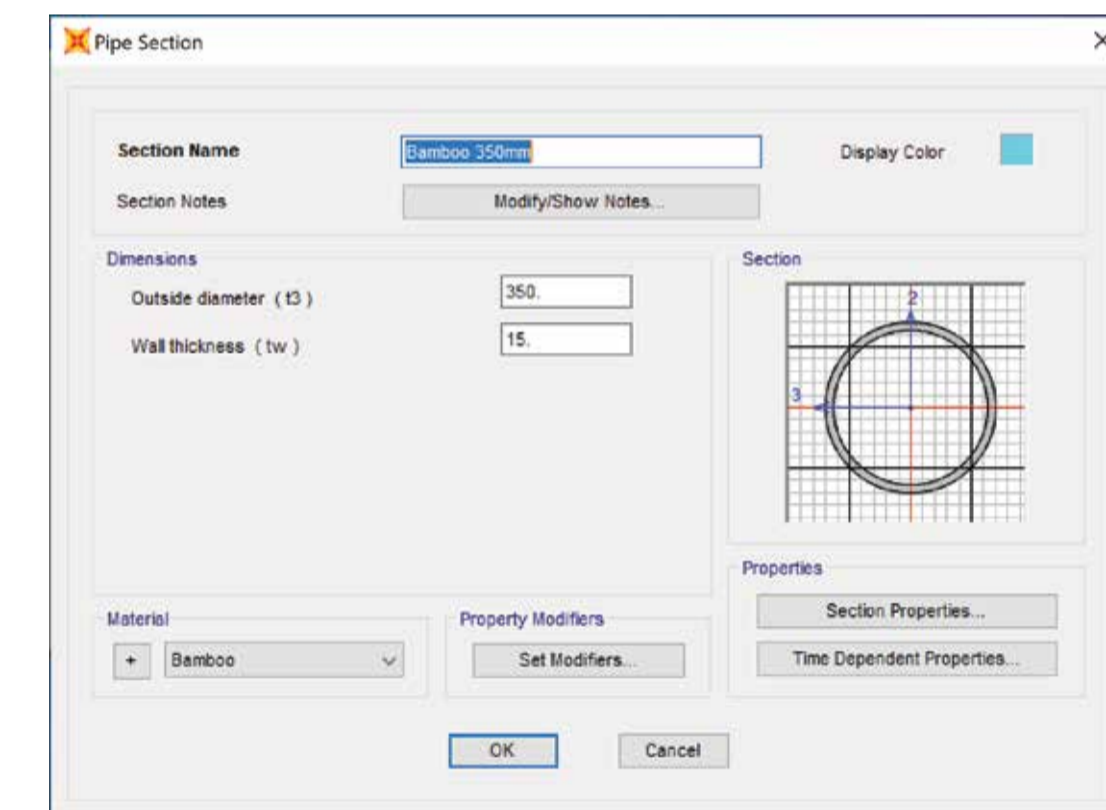
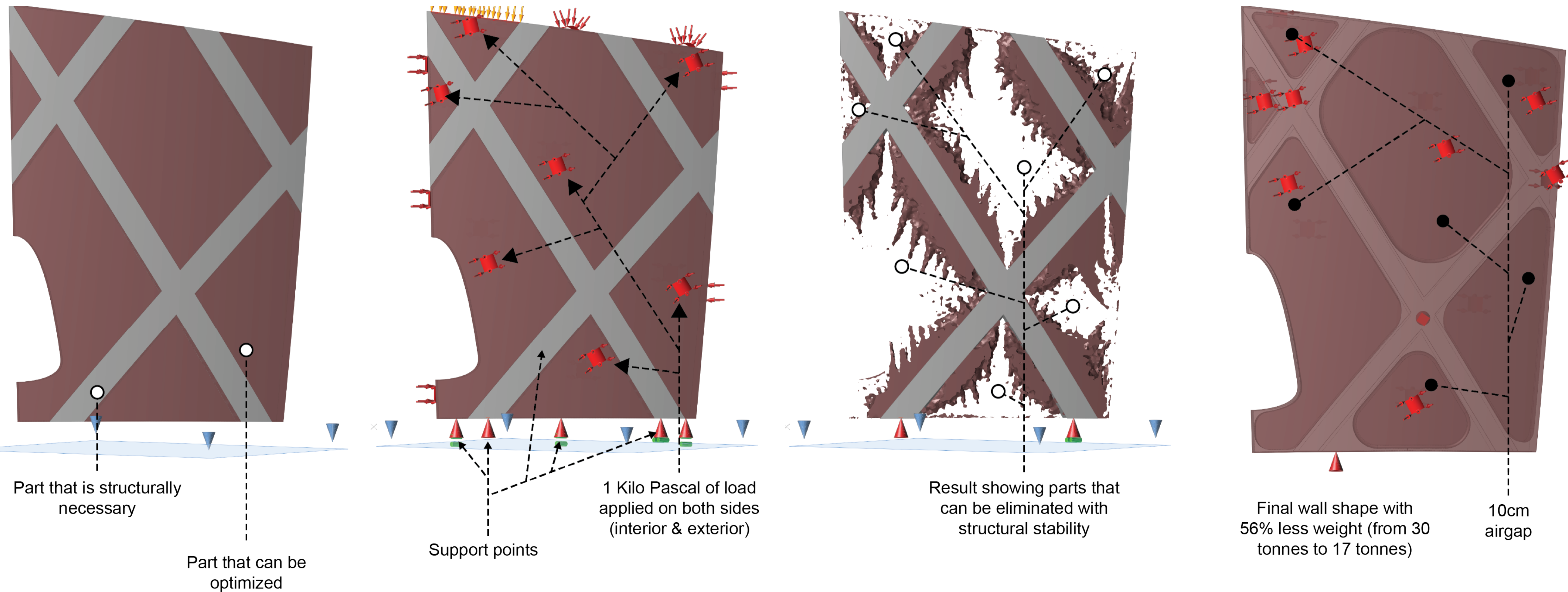


# AFRICAN CULTURE COMPLEX STRUCTURE

## FACADE STRUCTURAL ANALYSIS



## TOPOLOGY OPTIMIZATION OF CLAY WALL



Politecnico di Milano  
School of Architecture Urban Planning Construction Engineering  
2° level Corso di Laurea Magistrale Building Architecture

Supervisor : Prof. Maria Grazia Folli

Co-Supervisor : Prof. Corrado Pecora  
: Prof. Francesco Romano  
: Prof. Giovanni Dotelli  
: Prof. Lavinia Chiara Tagliabue

Authors : Abduljaleel Sabo Sodangi  
Ismail Cem Aslan  
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African Culture Complex - Hotel & Tower  
Abuja, Nigeria  
2019 - 2020



# AFRICAN CULTURE COMPLEX BIM

DESIGN & MODELLING

Autocad



Rhino



Grasshopper



Rhino



Grasshopper



Inspire



STRUCTURE

ENERGY

MANAGEMENT

LEED



Work Breakdown Structure



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

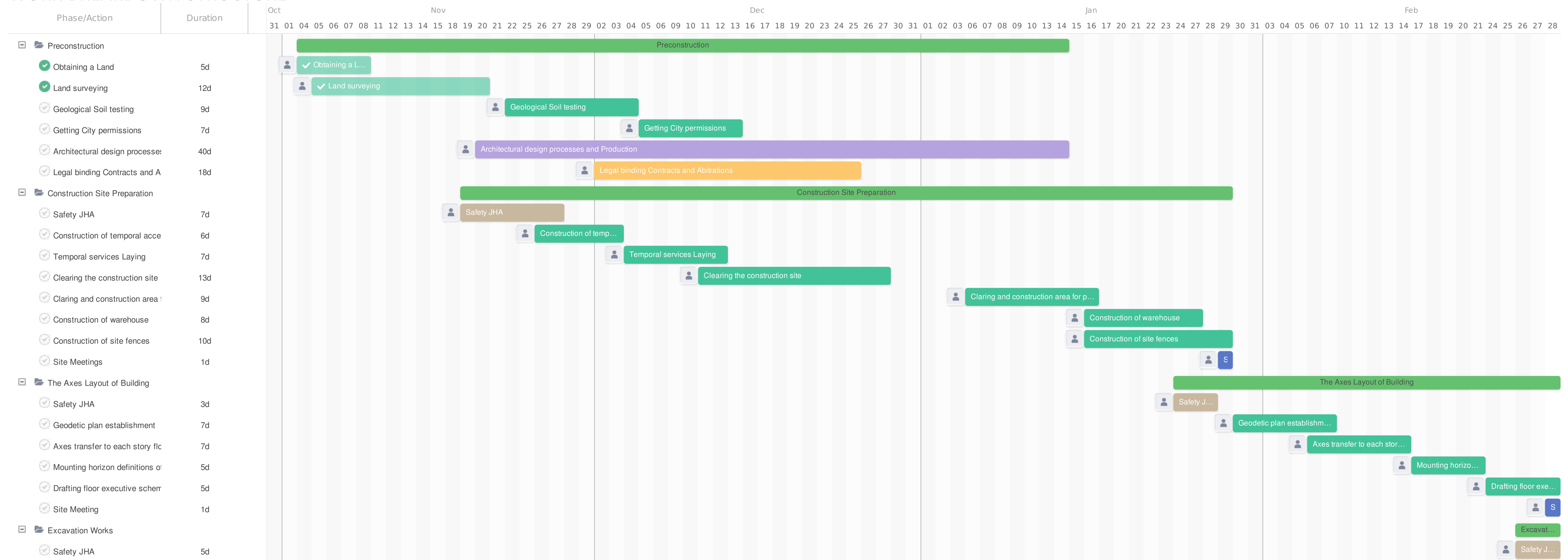
Project Name: **AFRICAN CULTURE COMPLEX**  
Date: 09/11/2019

Y	?	N	Credit	Integrative Process	1
13	0	0	16	<b>Location and Transportation</b>	<b>16</b>
Y			16	Prereq LEED for Neighborhood Development Location	16
1			1	Credit Sensitive Land Protection	1
2			2	Credit High Priority Site	2
4			5	Credit Surrounding Density and Diverse Uses	5
5			5	Credit Access to Quality Transit	5
			1	Credit Bicycle Facilities	1
1			1	Credit Reduced Parking Footprint	1
			1	Credit Green Vehicles	1
9	0	0	10	<b>Sustainable Sites</b>	<b>10</b>
Y			Required	Prereq Construction Activity Pollution Prevention	Required
1			1	Credit Site Assessment	1
2			2	Credit Site Development - Protect or Restore Habitat	2
1			1	Credit Open Space	1
3			3	Credit Rainwater Management	3
1			2	Credit Heat Island Reduction	2
1			1	Credit Light Pollution Reduction	1
8	0	0	11	<b>Water Efficiency</b>	<b>11</b>
Y			Required	Prereq Outdoor Water Use Reduction	Required
Y			Required	Prereq Indoor Water Use Reduction	Required
Y			Required	Prereq Building-Level Water Metering	Required
2			2	Credit Outdoor Water Use Reduction	2
5			6	Credit Indoor Water Use Reduction	6
			2	Credit Cooling Tower Water Use	2
1			1	Credit Water Metering	1
26	0	0	33	<b>Energy and Atmosphere</b>	<b>33</b>
Y			Required	Prereq Fundamental Commissioning and Verification	Required
Y			Required	Prereq Minimum Energy Performance	Required
Y			Required	Prereq Building-Level Energy Metering	Required
Y			Required	Prereq Fundamental Refrigerant Management	Required
5			6	Credit Enhanced Commissioning	6
15			18	Credit Optimize Energy Performance	18
			1	Credit Advanced Energy Metering	1
1			2	Credit Demand Response	2
			3	Credit Renewable Energy Production	3
			1	Credit Enhanced Refrigerant Management	1
2			2	Credit Green Power and Carbon Offsets	2

Y	?	N	Credit	Materials and Resources	13
13	0	0	13	<b>Materials and Resources</b>	<b>13</b>
Y			Required	Prereq Storage and Collection of Recyclables	Required
Y			Required	Prereq Construction and Demolition Waste Management Planning	Required
5			5	Credit Building Life-Cycle Impact Reduction	5
2			2	Credit Building Product Disclosure and Optimization - Environmental Product Declarations	2
2			2	Credit Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
2			2	Credit Building Product Disclosure and Optimization - Material Ingredients	2
2			2	Credit Construction and Demolition Waste Management	2
13	0	0	16	<b>Indoor Environmental Quality</b>	<b>16</b>
Y			Required	Prereq Minimum Indoor Air Quality Performance	Required
Y			Required	Prereq Environmental Tobacco Smoke Control	Required
1			2	Credit Enhanced Indoor Air Quality Strategies	2
3			3	Credit Low-Emitting Materials	3
1			1	Credit Construction Indoor Air Quality Management Plan	1
1			2	Credit Indoor Air Quality Assessment	2
1			1	Credit Thermal Comfort	1
2			2	Credit Interior Lighting	2
3			3	Credit Daylight	3
1			1	Credit Quality Views	1
1			1	Credit Acoustic Performance	1
6	0	0	6	<b>Innovation</b>	<b>6</b>
5			5	Credit Innovation	5
1			1	Credit LEED Accredited Professional	1
4	0	0	4	<b>Regional Priority</b>	<b>4</b>
1			1	Credit Regional Priority: Specific Credit	1
1			1	Credit Regional Priority: Specific Credit	1
1			1	Credit Regional Priority: Specific Credit	1
1			1	Credit Regional Priority: Specific Credit	1
92	0	0	110	<b>TOTALS</b>	<b>Possible Points: 110</b>

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

## WORK BREAKDOWN STRUCTURE



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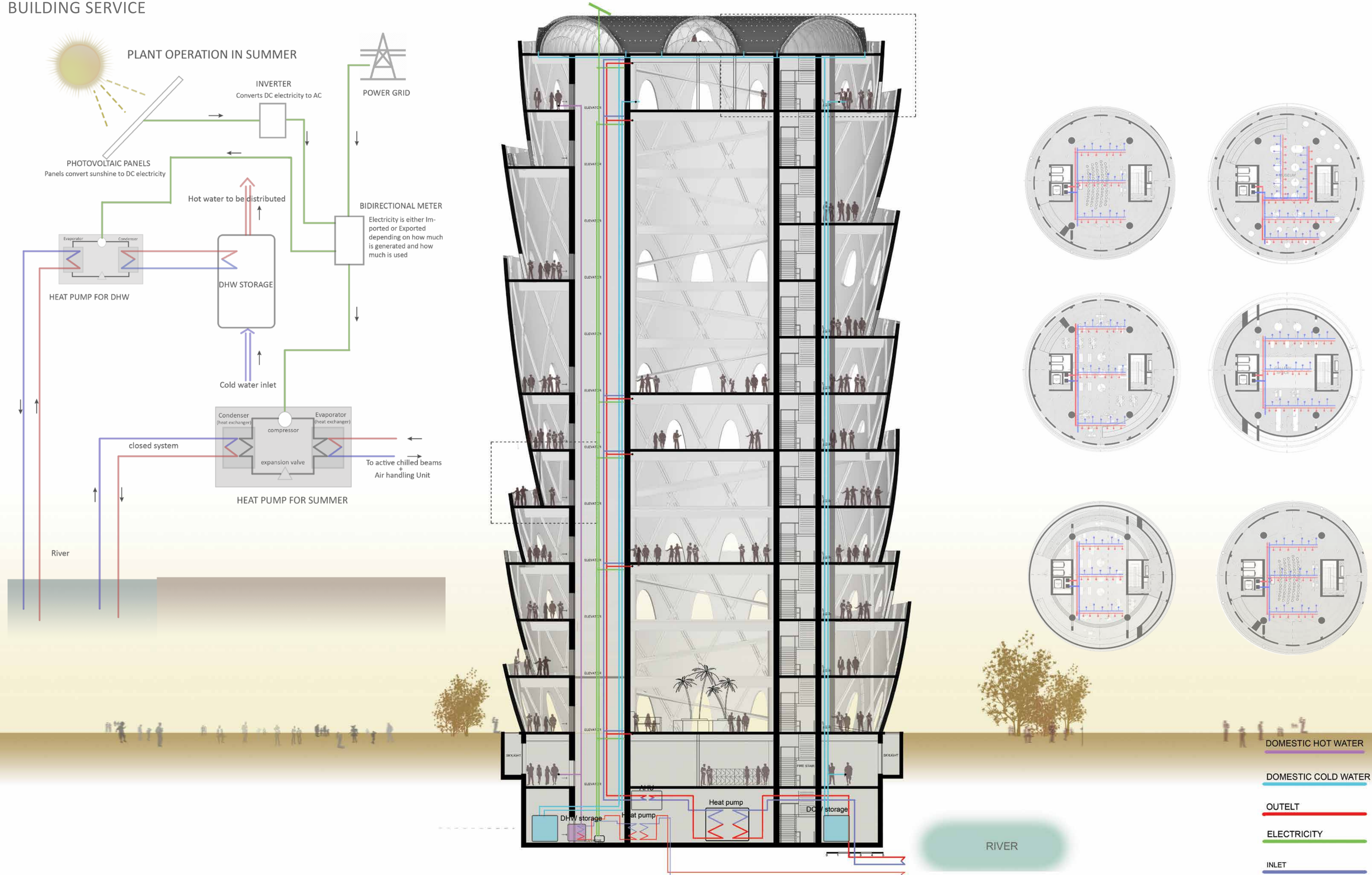
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Authors : Abduljaleel Sabo Sodangi | 896575  
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African Culture Complex - Hotel & Tower  
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# AFRICAN CULTURE COMPLEX BUILDING SERVICE



Politecnico di Milano  
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# 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 advantage 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  
Size: 1300mm x 2200mm



### HEAT RECOVERY 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

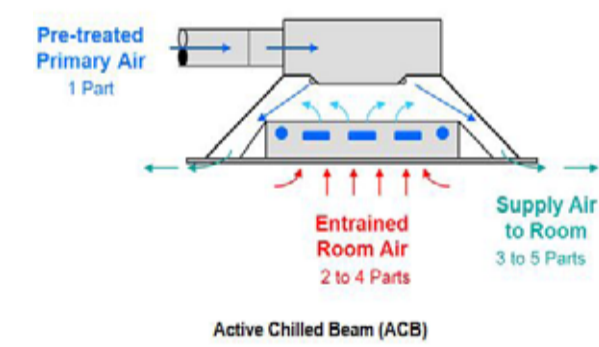
Applications: hotels, hospitals, sauna bath centers, factories and other area

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 energy in our project

#### Specifications

Dimensions (LxWxH): 64.96 x 39.06 x 1.38 inches

Weight: 40.57 lbs

60-cell monocrystalline module

Silver anodized aluminum frame

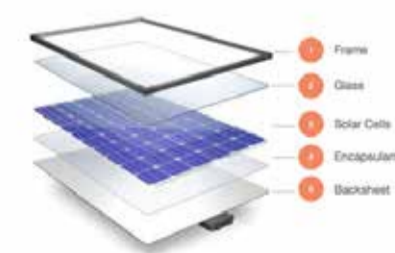
White backsheet material

0~+5W tolerance ratio

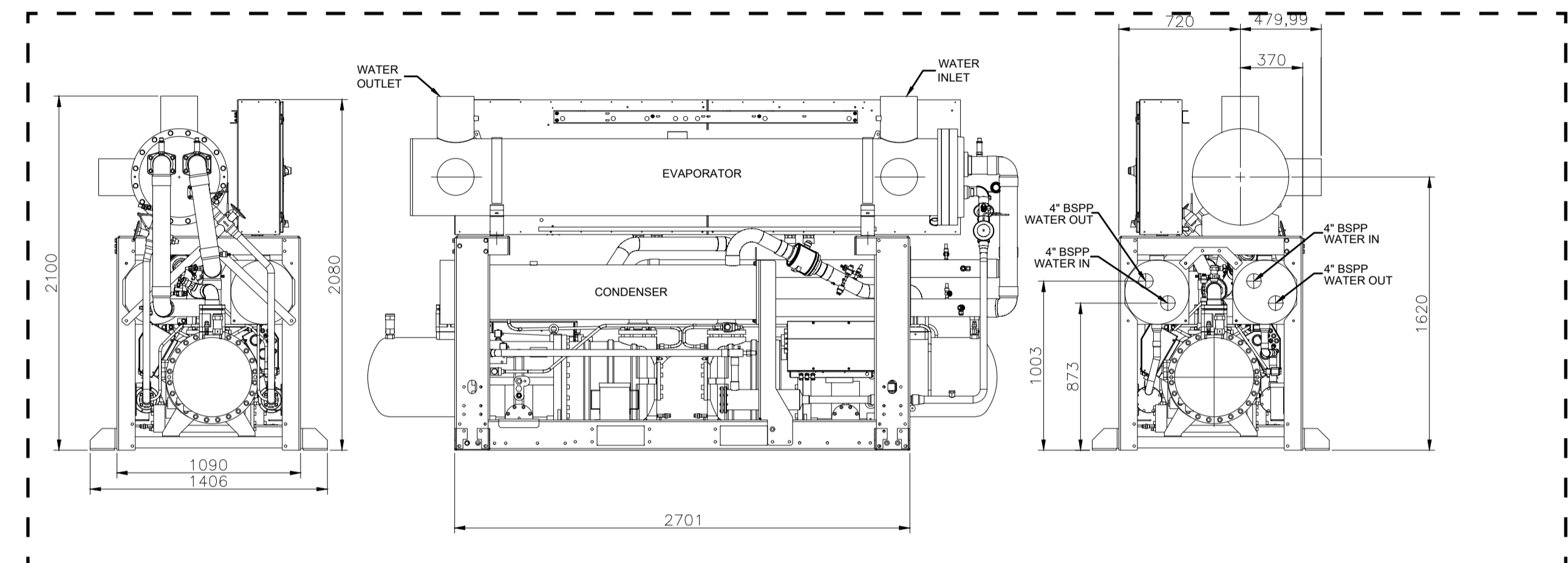
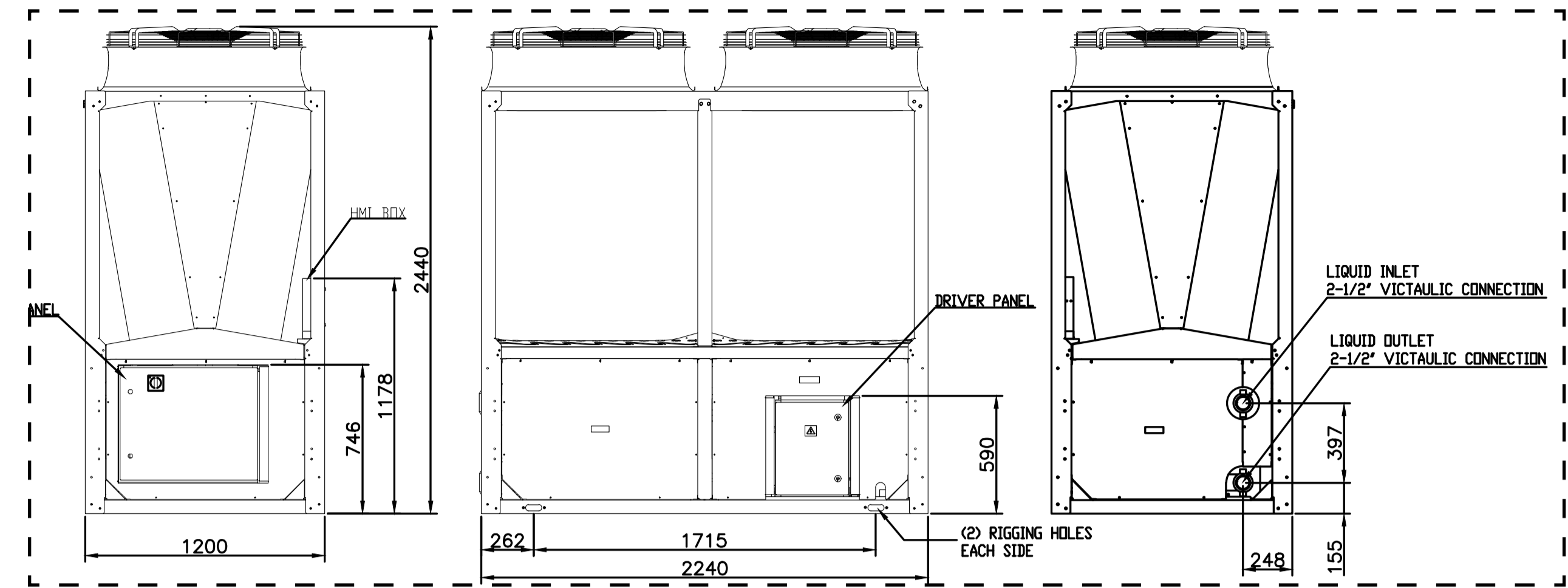
PID Resistant

UL and IEC listed

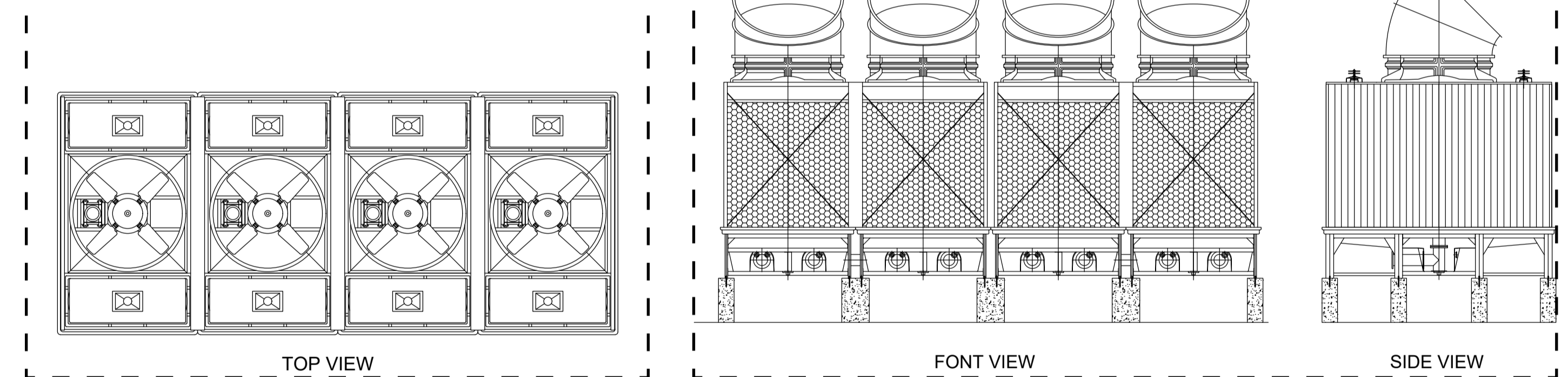
6000 Pa snow load / 3600 Pa wind load



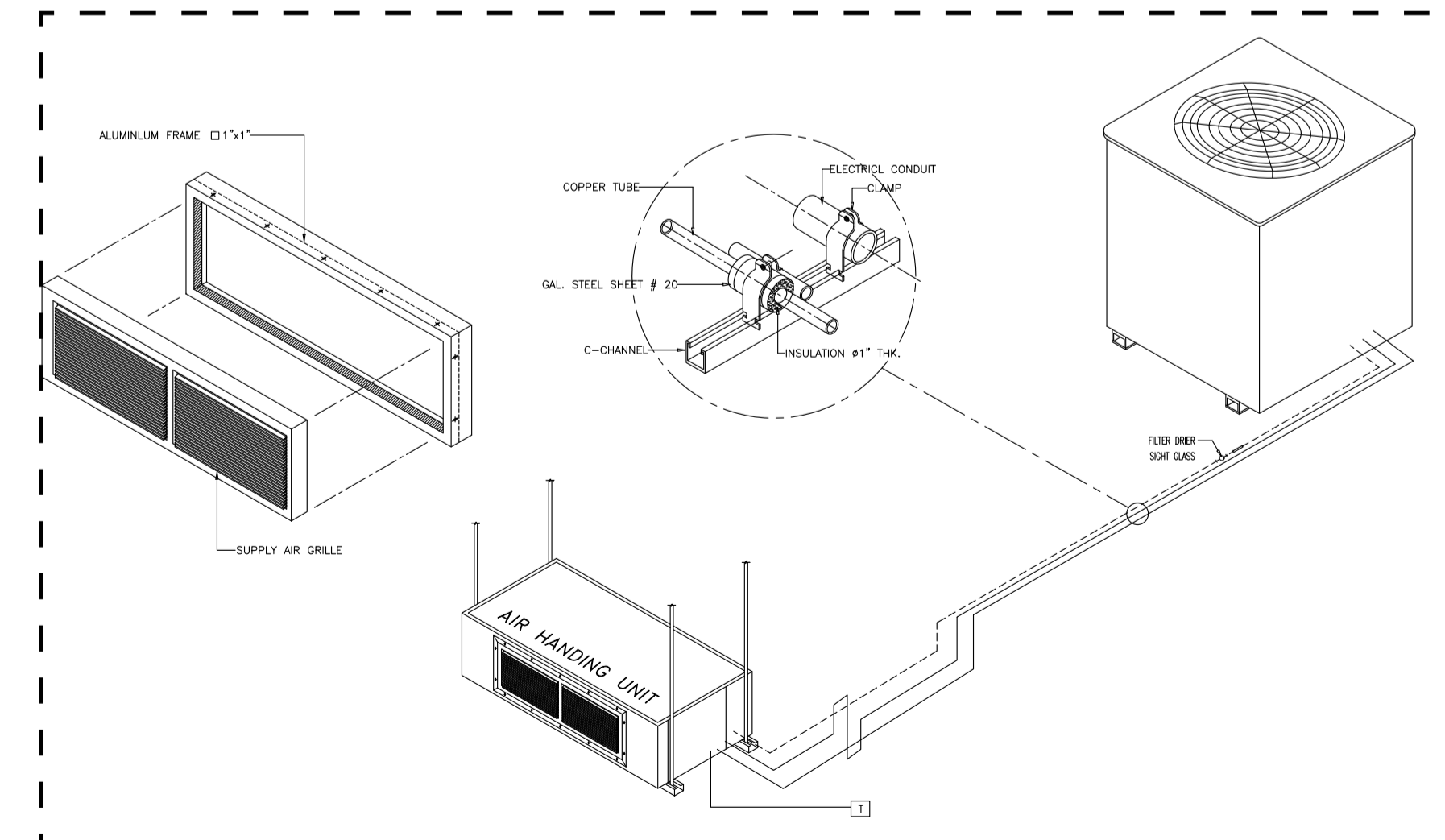
### CHILLERS AND HEAT PUMPS



### COOLING TOWERS



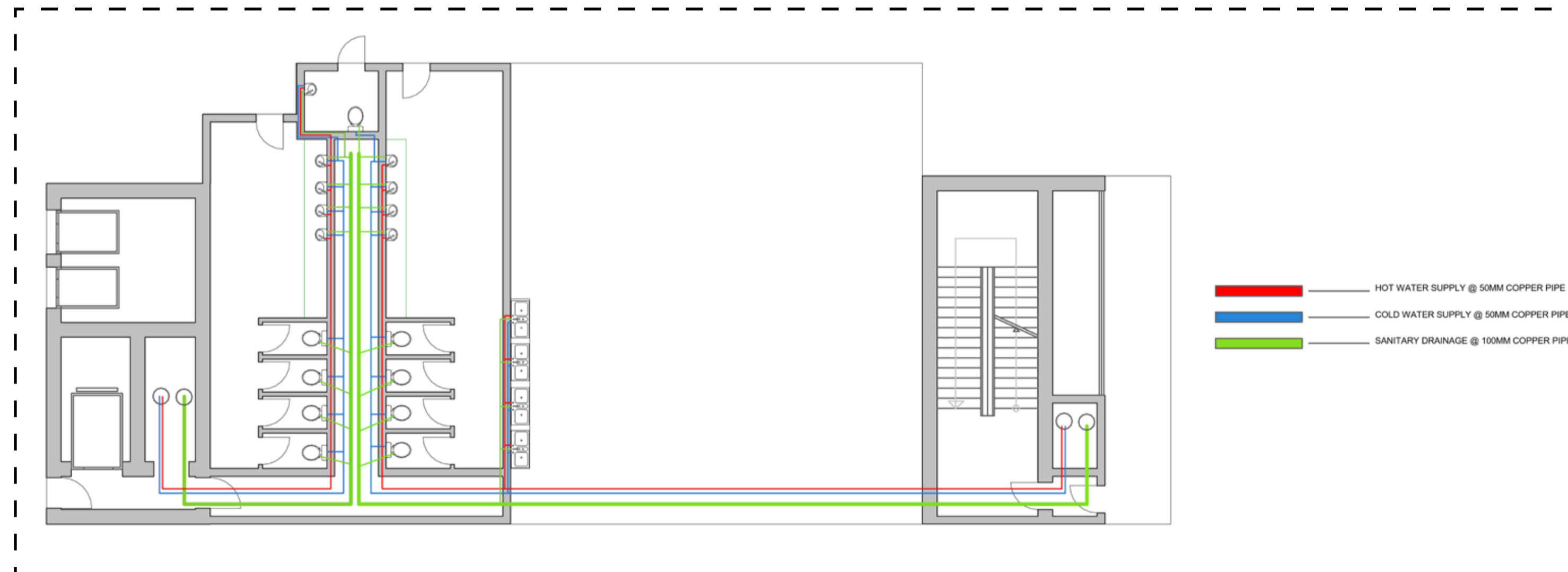
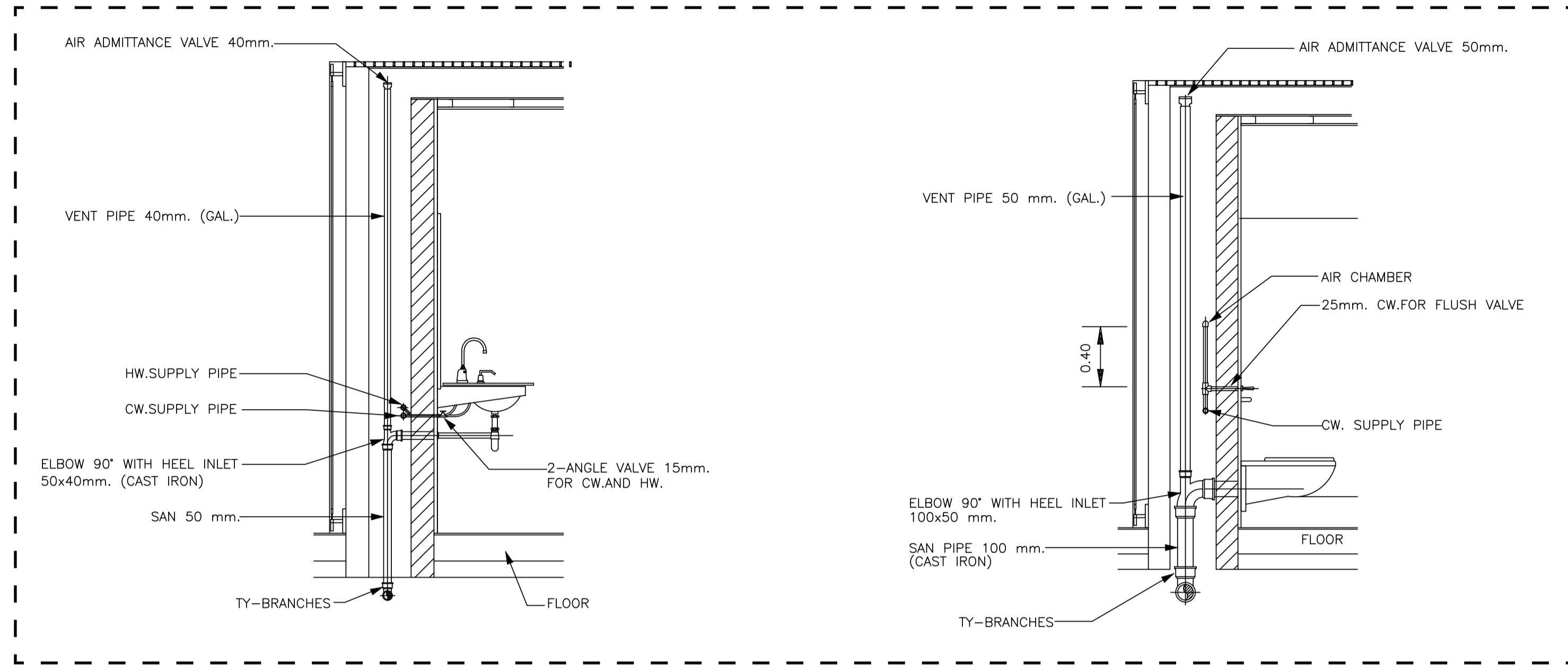
### AIR HANDLER



# AFRICAN CULTURE COMPLEX

## BUILDING SERVICE

### SANITARY SYSTEM



### CALCULATIONS

Heat Flux through transmittance-Summer										
Element	Area	$\lambda(w/mk)$	s(m)	Resistivity	hi	he	U Value w/m2k	Ti	Te	$\phi w$
Roof	710	1.55	0.1	0.064516129	8	30	4.487334138	24	28	12744
wall	1995	0.96	0.005	0.005208333	8	30	6.114649682	24	28	48794.9
window	1468	0.7	0.25	0.357142857	8	30	1.939953811	24	28	11391.4
Floor	4800	0.55	0.4	0.727272727	8	30	1.129170231	24	24	0
Total										72930.3

$$q = \frac{T_a - T_e}{\frac{1}{h_{AD,a}} + \sum R_{c,i} + \frac{1}{h_{AD,e}}}$$

Internal Gains					
	Sensible	Latent	Number	$\phi s$	$\phi L$
Seated	65	45	120	7800	5400
walking	75	100	470	35250	47000
Equipment	150	0	40	6000	0
Total				49050	52400

$$Q_{int} = Q_{int,S,pp} n_{pp} + \sum Q_{int,S,app}$$

Heat Flux Through Solar Gains							
Solar	Area total	Area Glazing	Incident	sc	solar factor	Summer	
Skylight	730	34	1000		0.9	1	30600
Envelope	3463	1995	1000		0.5	0.4	399000
Total							429600

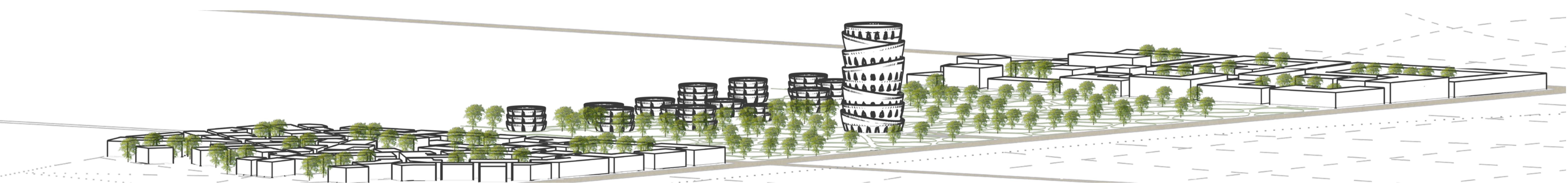
$$Q = \sum A * I * Fa$$

Heat Flux Through Ventilation						
	V m3	n/per h	nV	f of air	Cp	Delta T
Summer	35700	0.5	17850	1.225	1000	4

Delta X  
 $Q_V = \frac{V n}{3600} \rho c_p (T_a - T_e)$   
 24295.83333

Total Heat Flux					
Sensible	w	kw	Latent	w	kw
Summer	575876.18	575.8761755	Summer	76695.833	89.46923611

665.3454116



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