

# RESORT *Itza*

The background features a vibrant red-orange gradient. Overlaid on this are several abstract shapes: a large white circle on the left, a smaller white circle with a dotted pattern in the top right, and a wavy white line that loops from the middle right towards the bottom center. A series of small white dots forms a horizontal line near the bottom edge.

ENGG105 Engineering Design for Sustainability  
Milestone 4

Group 4

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# INTRODUCTION

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## The Alternative

- Utilizing cleaner, greener materials
- Ensuring a moral standard for construction

## Current state

- Construction is unsustainable
- Main materials are concrete, bricks and steel due to cheap cost
- Questionable ethical standards

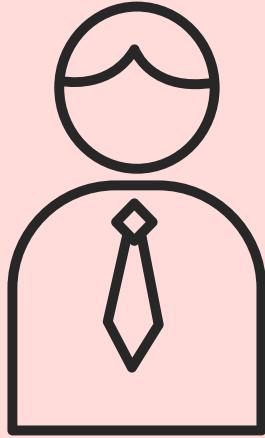


# THE CLIENT

02

# THE CLIENT

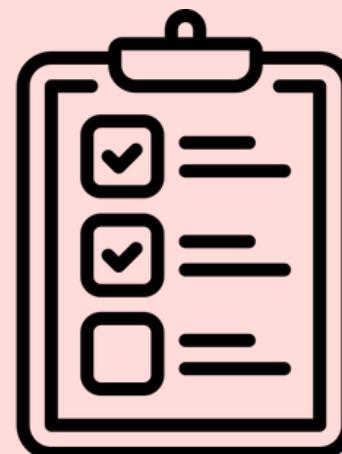
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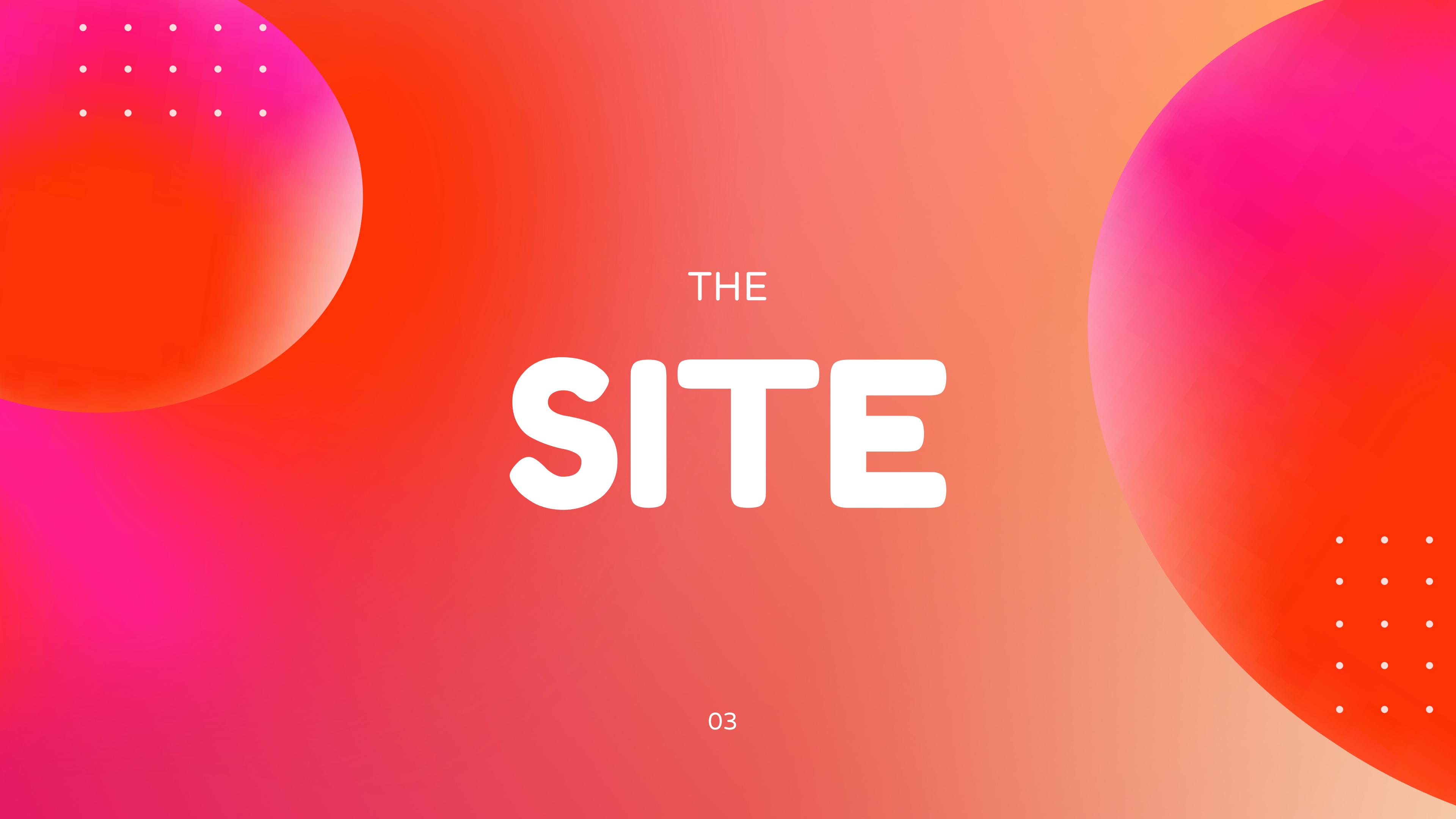
## Personal Info

- Mr. Ali Anwar
- Early 30s
- Businessman by profession
- Well known for philanthropic work
- Promotes sustainable development by investing in projects of the said nature

## Client Requirements



- Resort should be as sustainable as possible, including operation
- It should be located in a profitable developing country
- The project should not exceed the total budget

The background features a large, semi-transparent white circle on the left and a large, semi-transparent orange circle on the right, both containing a grid of small white dots. A thin white wavy line runs horizontally across the center.

# THE SITE

03

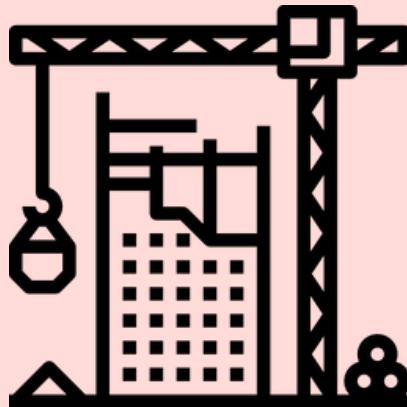
# LOCATION



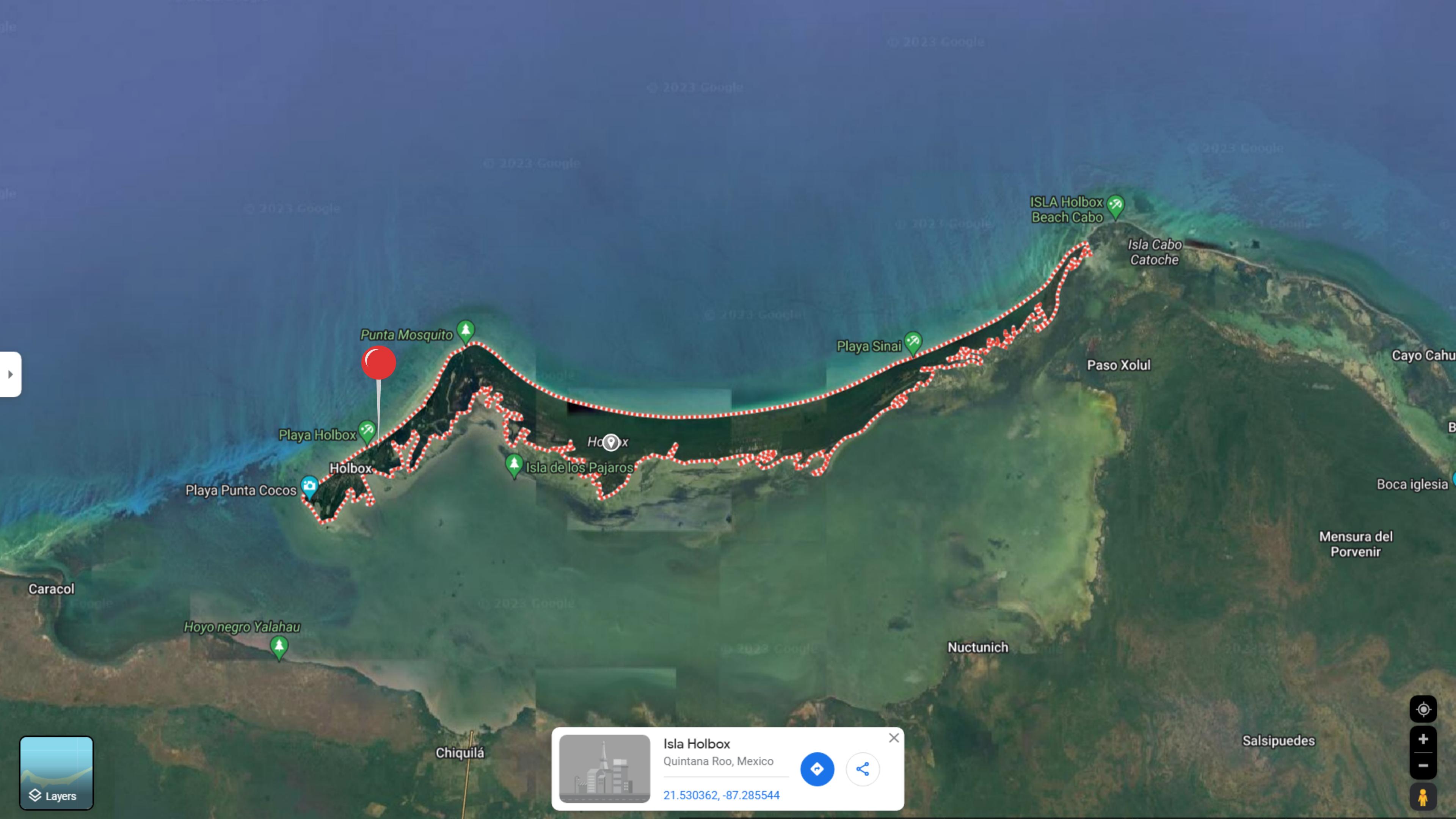
Isla de Holbox, Quintana Roo,  
Yucatán, Mexico

Area of island: ~55,948 sq. km

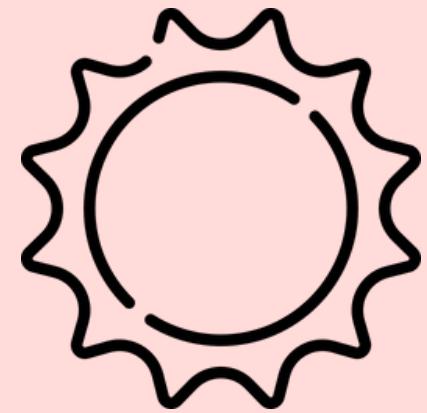
- Long beaches and rich wildlife
- Separated from mainland by shallow lagoon



- 1.2 km away from the airport
- Area of site: ~2,500 sq. ft.



# CLIMATE



Starts in March  
Ends in May



Starts mid-June  
Ends mid-October



Starts in November  
Ends in February

# SIGNIFICANCE

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Where is it?

Yucatan Region, Mexico

Why is it significant?

The Mayan civilization, which lasted from 250 - 1697, built their city around this now-famous monument



# CONSTRUCTION MATERIALS



04



# EXTERIOR MATERIALS

# Exterior Materials

## HEMPCRETE

### What is it?

Alternative to concrete; made with chopped hemp shiv mixed with lime-based binder

### Where is it used?

The entirety of the main building is made using hempcrete instead of concrete

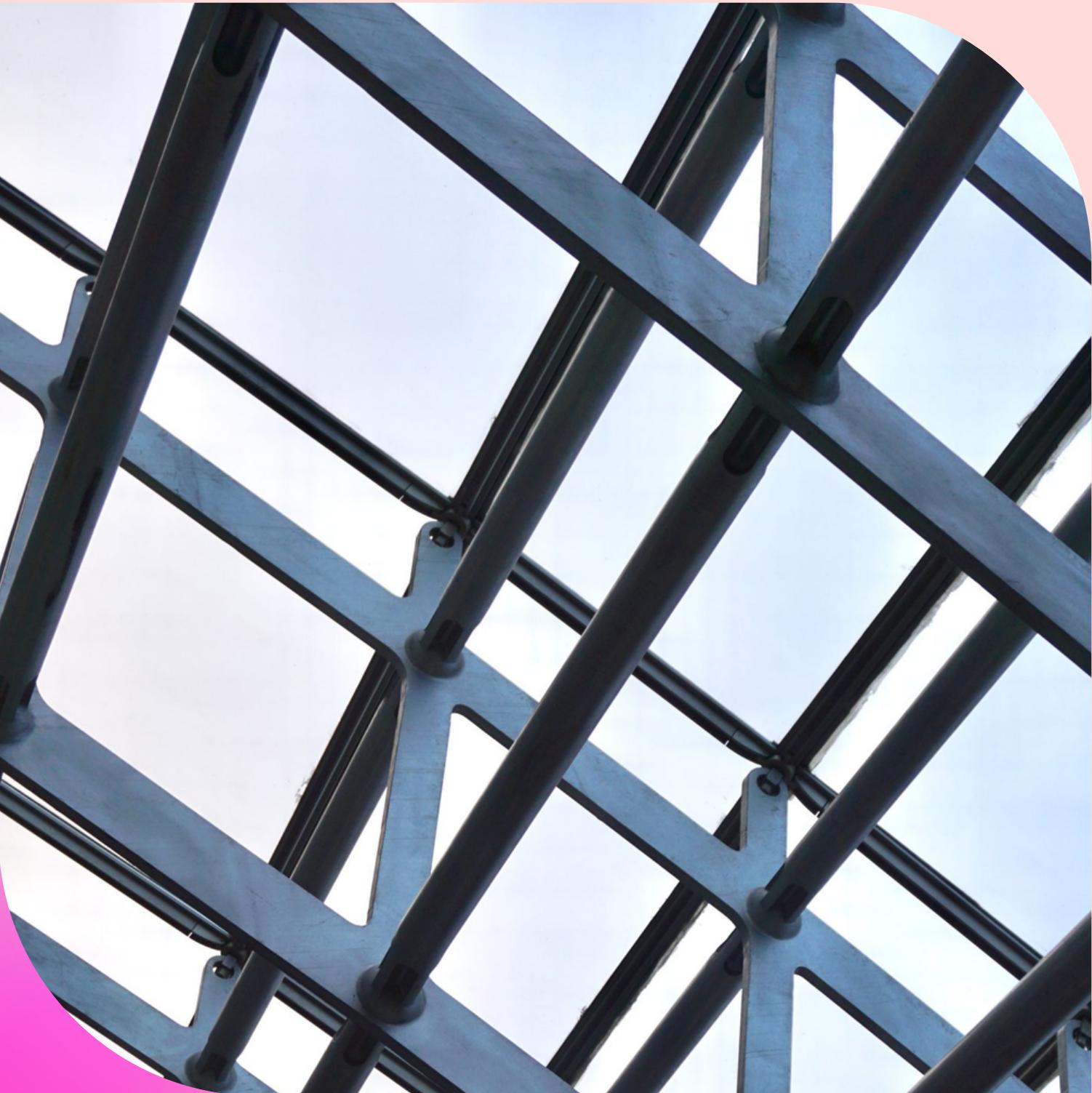
### Why hempcrete?

- Incredible insulation properties
- Resistant to water and its side effects



# RECYCLED STEEL

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## Exterior Materials

What is it?

Discarded steel that has been remade into new steel for various applications

Where is it used?

The structure of the resort to support hemp

Why recycled steel?

Reduces up to 74% of energy required to make new steel

# Exterior Materials

**TIMBER**

## What is it?

Naturally available wood used in various forms for construction and other applications

## Where is it used?

- Main frame of restaurants on the beach
- Pole of beach umbrellas

## Why timber?

- Readily and cheaply available everywhere
- Easy to work with and use in various ways



# RECYCLED GLASS

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## Exterior Materials

What is it?

Waste glass that is remade into new glass, reducing the need for new raw materials

Where is it used?

Windows and glass panes of the resort

Why recycled glass?

Recycled glass does not lose quality after the recycling process, i.e. it's as good as new

# Exterior Materials

JUTE

## What is it?

Long, tough fiber that is spun into coarse threads for different use cases

## Where is it used?

- Canopy of the beach umbrellas
- Rooftop of the restaurants on the beach

## Why jute?

- Provides natural thermal insulation
- High durability of fibers



# INTERIOR MATERIALS

# RECLAIMED WOOD

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## Interior Materials

What is it?

Processed wood retrieved from its original application for purposes of subsequent use

Where is it used?

Used in furniture such as beds and closets

Why reclaimed wood?

- Lower carbon footprint as it is not freshly cut
- Denser and stronger compared to new trees

# Interior Materials

## CERAMIC

### What is it?

Mixture of water, sand and clay that is heated to make a hard substance

### Where is it used?

- Bathroom walls and shower box
- Tiling for the infinity pool

### Why ceramic?

- Known for its strength and durability
- Does not stain easily and can be cleaned quick



# BAMBOO

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## Interior Materials

What is it?

A type of grass that can be made into construction wood and has a lot of strength

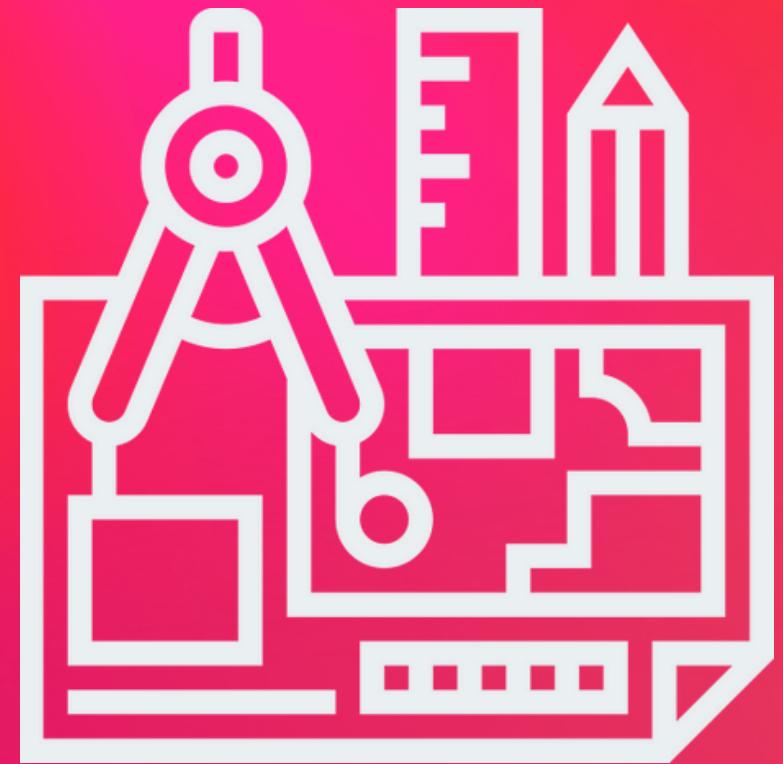
Where is it used?

Used for chairs and other decorative elements

Why bamboo?

- Has an aesthetically pleasing look
- Resistant to wear & tear and bending easily

# ARCHITECTURE



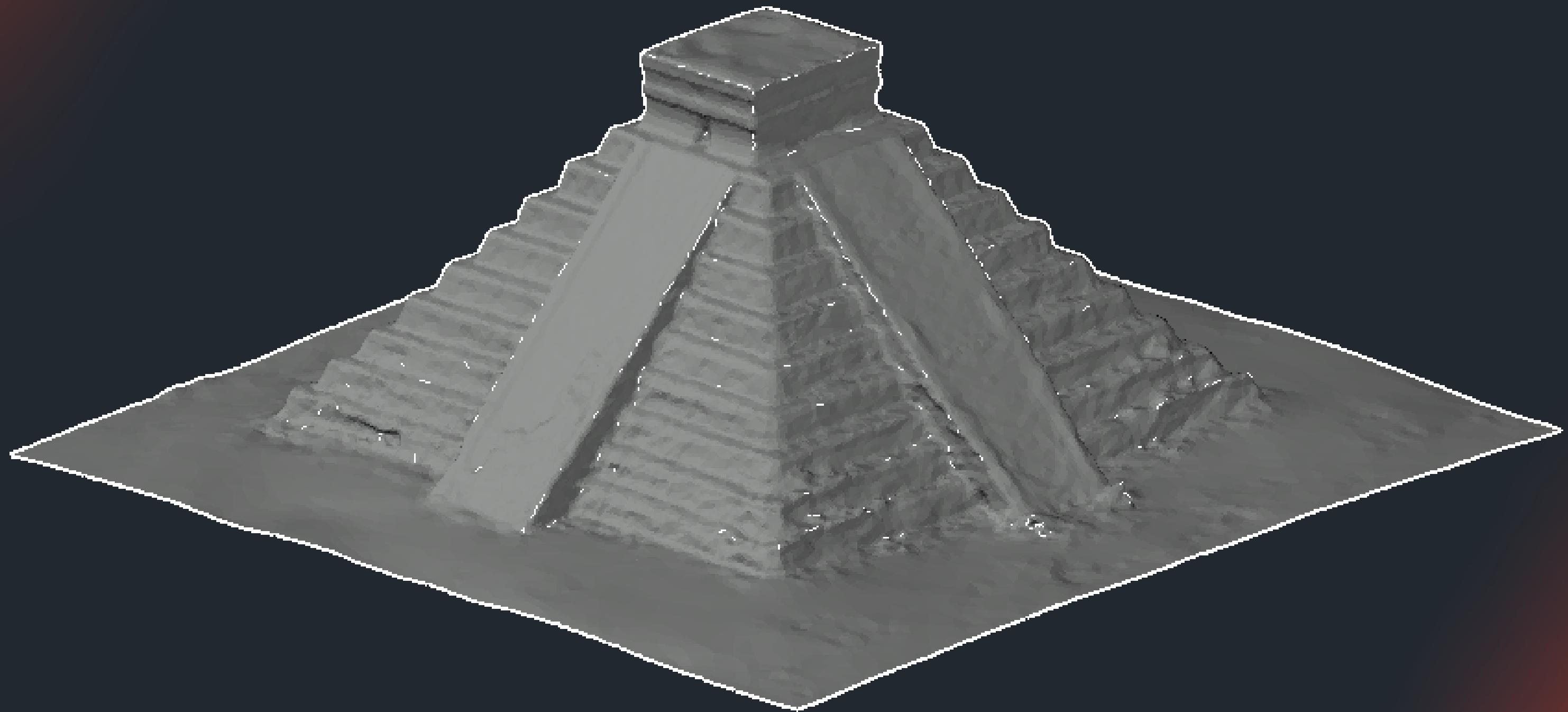
# EXTERIOR

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- Square based pyramid primarily made of hempcrete, steel, and glass
- Shaped similarly to the Chichen Itza to showcase culture of the Yucatán region
- Building is mainly made of hempcrete
- Infinity pool on the top offers breathtaking views
- Spacious designing to ensure comfort of guests
- Frequent inspections for maintaining building's structure and integrity

# 3D RENDER

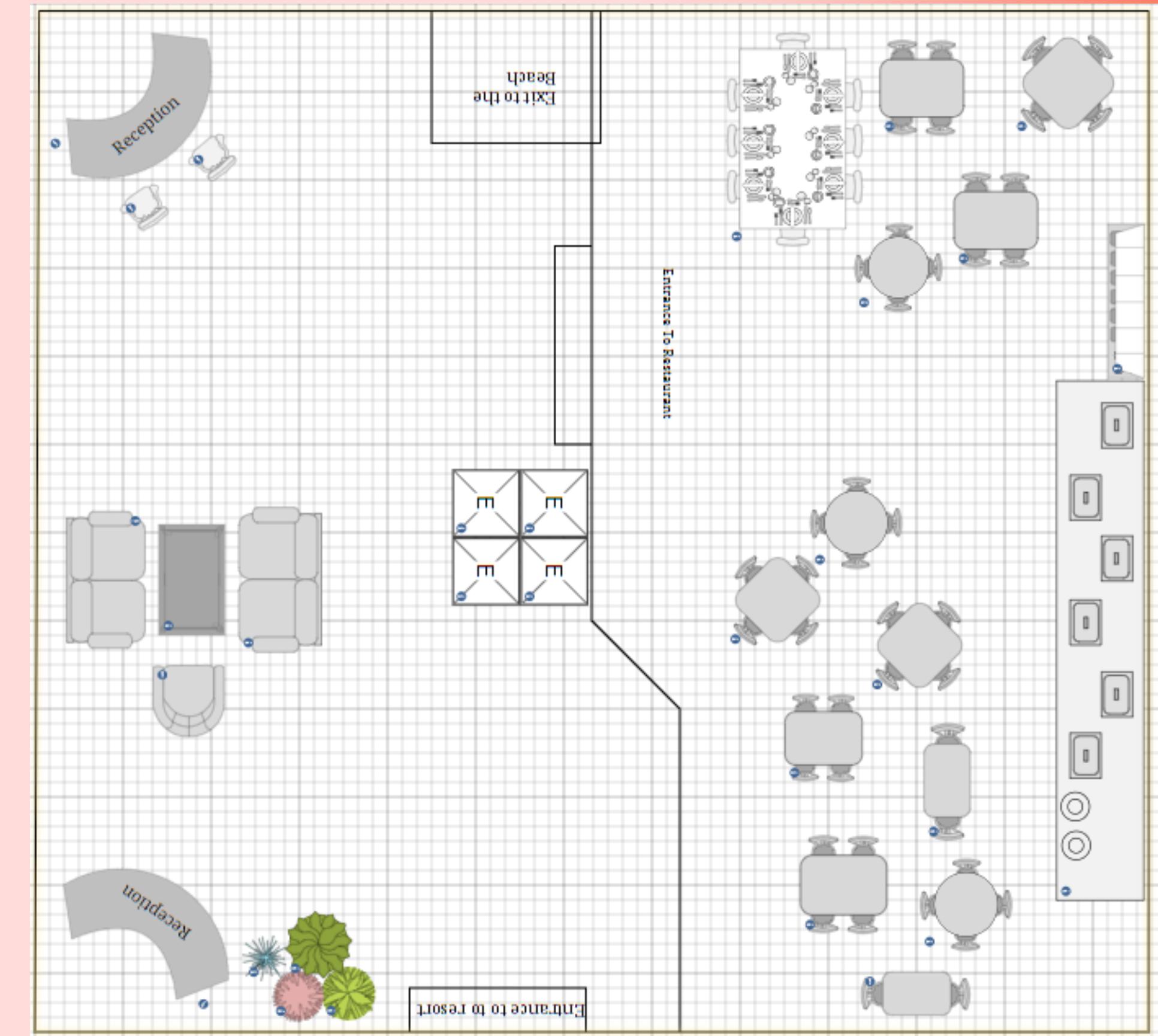
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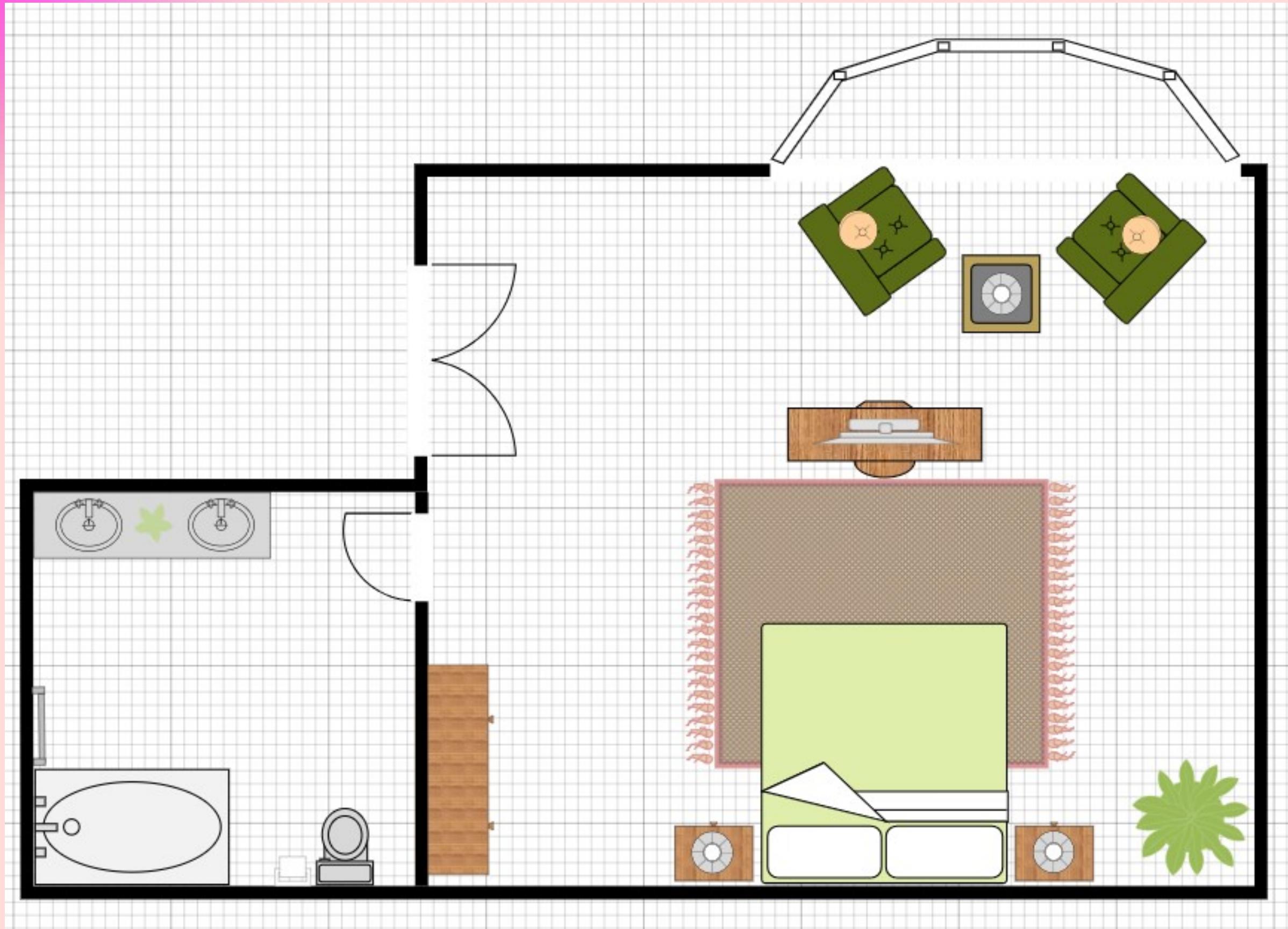
# FLOOR PLANS

# LOBBY

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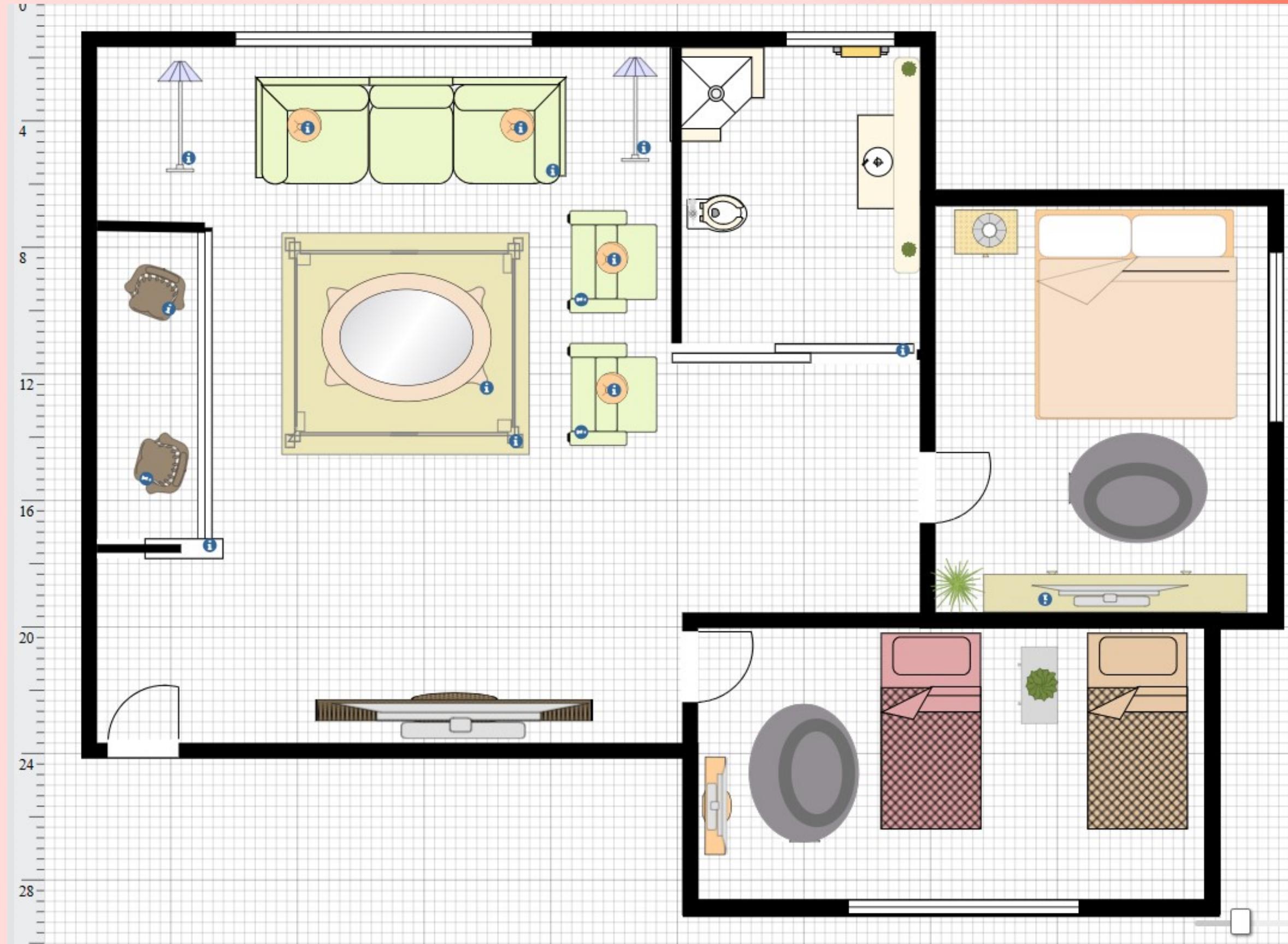


# STANDARD ROOMS



# SUITES

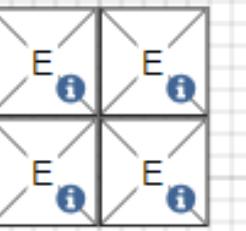
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# BALLROOM

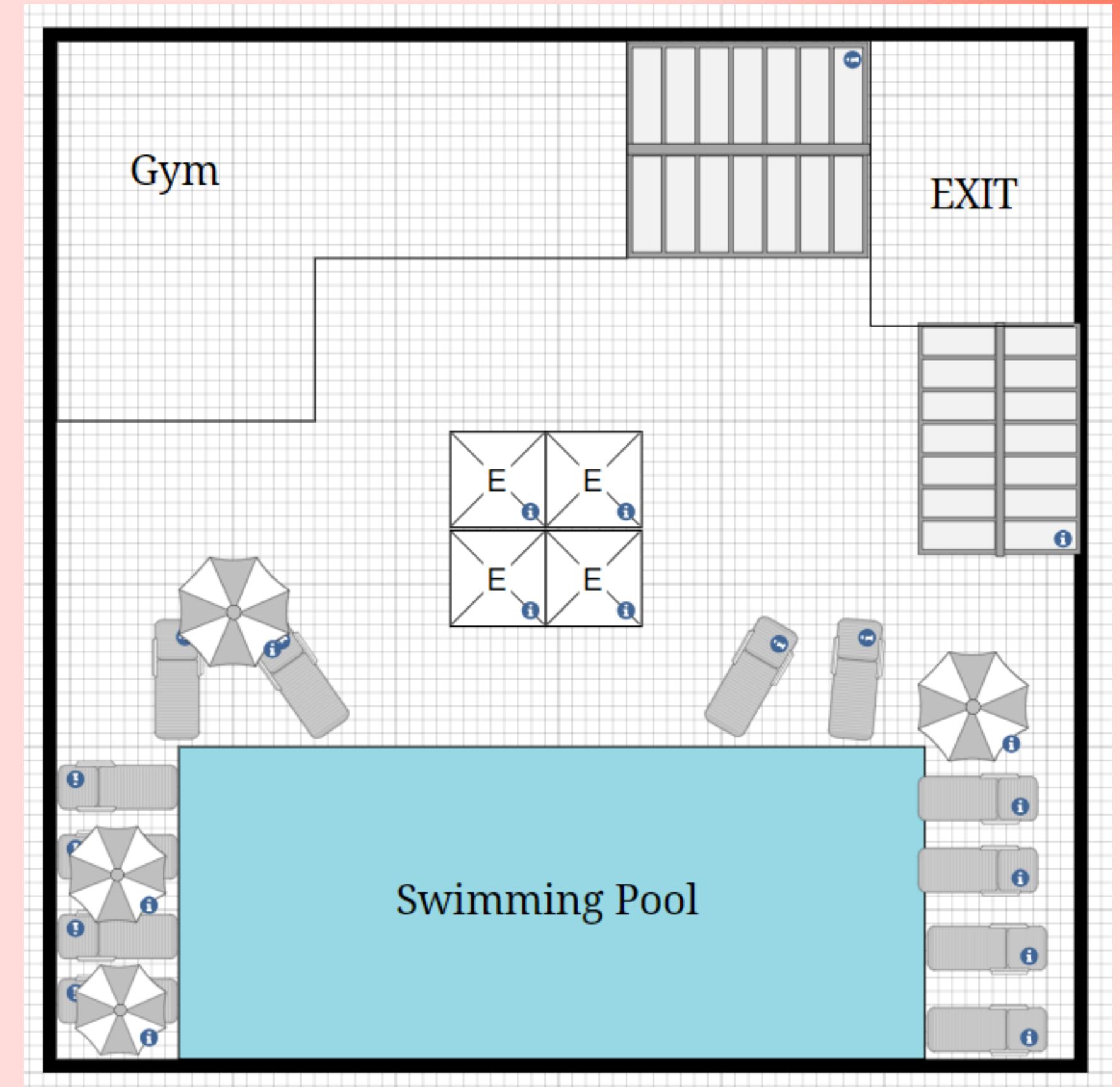
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Ballroom-2



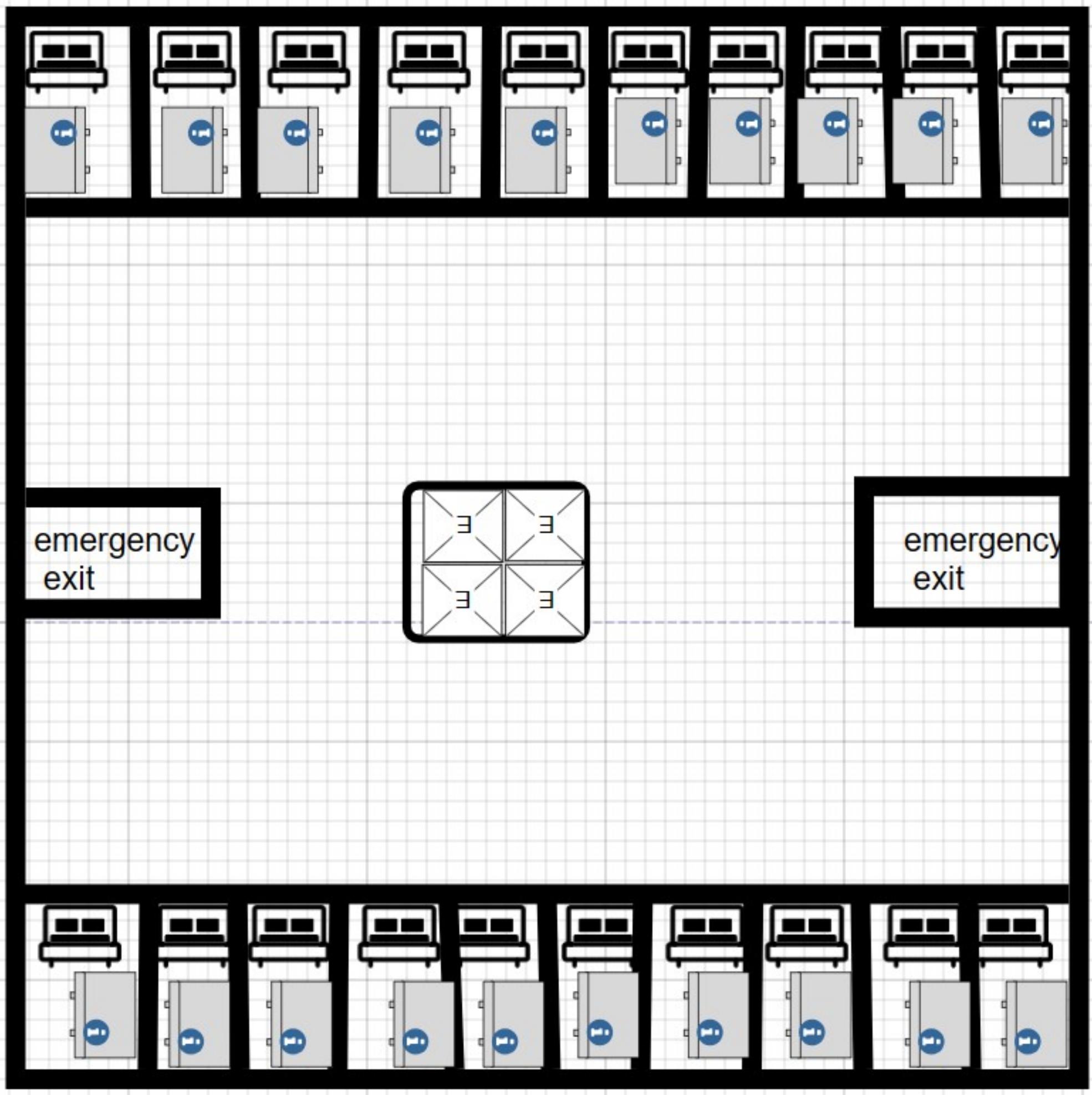
Ballroom-1

# ROOFTOP POOL

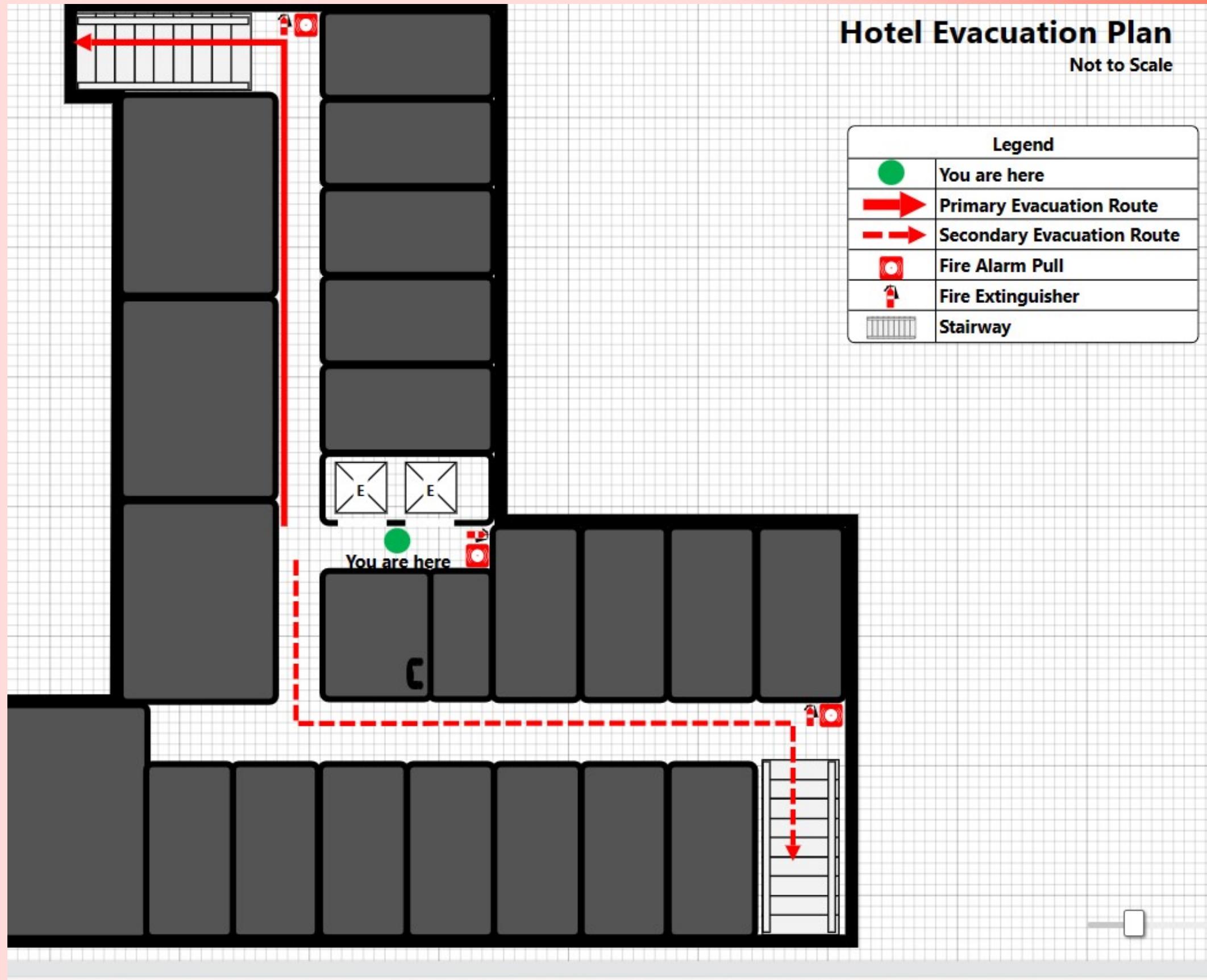


# FLOOR LAYOUT

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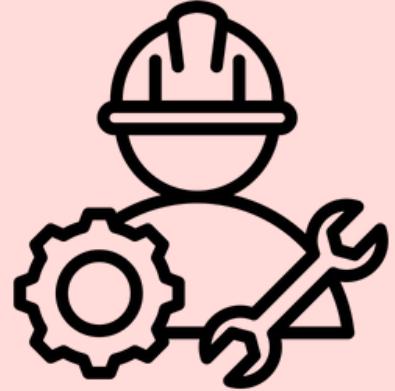
# EMERGENCY EXIT PLAN



# COMMUNICATIONS



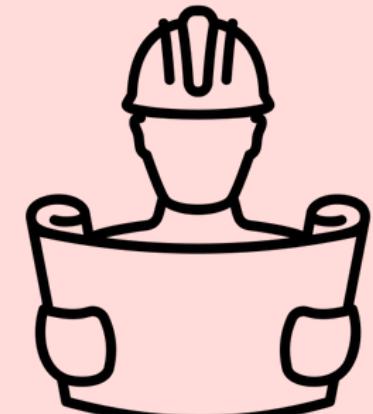
# SITE ENGINEERS



- Initial planning will include structural engineers and architects
- Weekly emails about quality control inspections for materials being used

# CONTRACTOR

- Communication about any unforeseen site conditions that may cause delays
- Reports every alternate day on work done, any challenges and HSE incidents

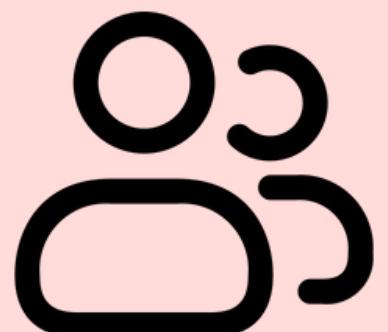


# CONSULTANT

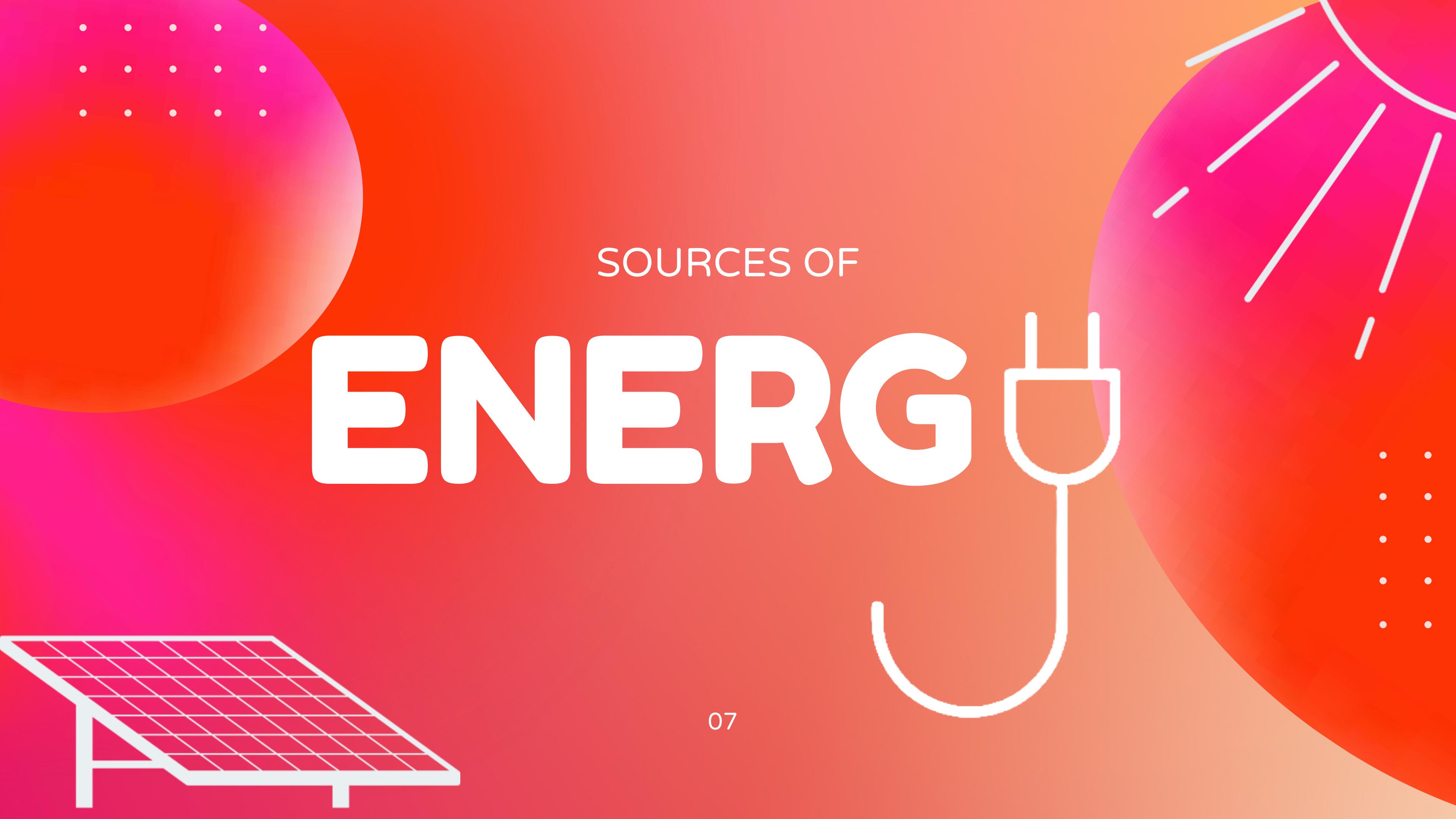
- Informing about technologies that could improve the resort's overall sustainability
- Identifying potential risks and suggesting mitigation strategies for the same



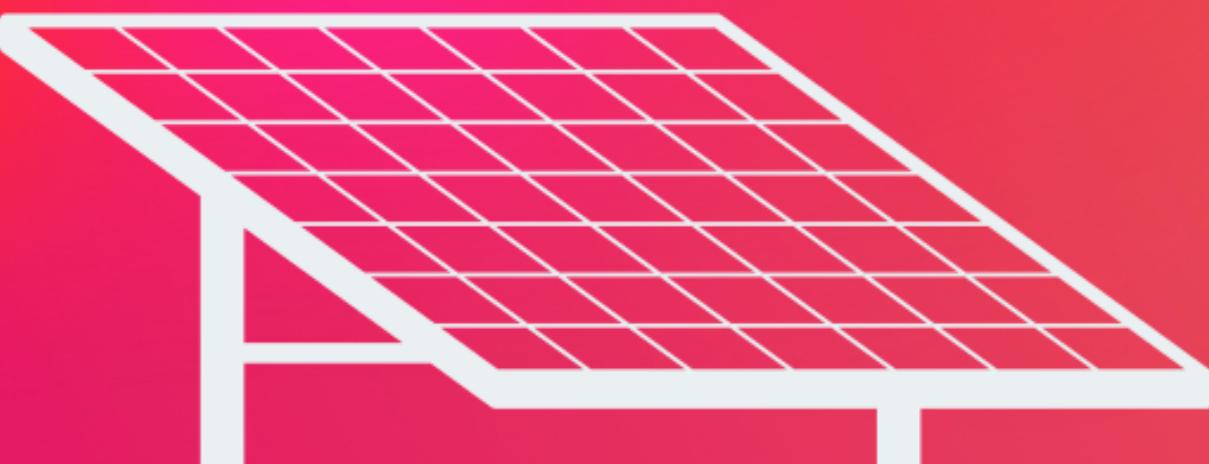
# CLIENT



- The client's approval would be required for any changes to the construction plan
- The timeline for the project will be given to the contractor to ensure completion on time



# SOURCES OF **ENERGY**



# ENERGY PRODUCED

	Solar	Wave
Efficiency	-15 - 20%	-49 - 70%
Output	550 - 850 kWh	350 - 650 kWh
Total	Avg. 700 kWh/day	Avg. 500 kWh/day



# C">\$T



Items	Price per Unit	Quantity	Total Cost
Land	400	2500 sq. ft.	1,000,000
Solar Panels	3000	200 panels	600,000
Wave Energy Converter	400,000	1 unit	400,000
Hempcrete	12	21,000 cu ft	252,000
Steel	800	15 metric ton	12,000
Recycled Glass	300	180 large panes	54,000
Reclaimed Wood	12	3000 kg	36,000

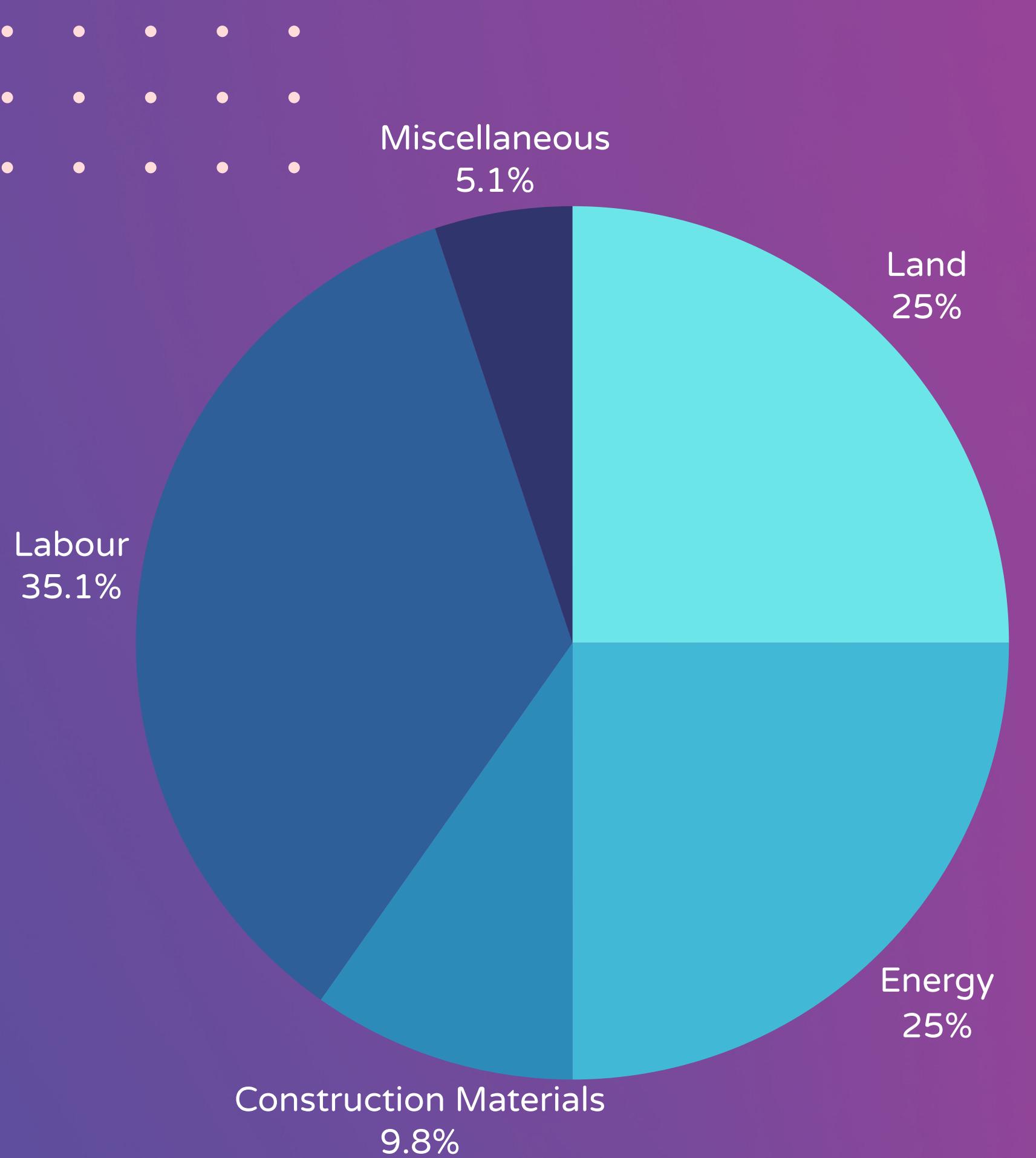
Items	Price per Unit	Quantity	Total Cost
Jute	2	400 kg	800
Bamboo	2	700 kg	1,400
Ceramic	5	7000 tiles	35,000
Engineers	46,750	10	467,500
Architects	46,875	4	187,500
Labourers	15,000	50 people	750,000
Miscellaneous	-	-	203,800

**US\$ 3.8M**

Used on land, labour, materials and energy

# COST BREAKDOWN

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# SUSTAINABILITY



09



# CARBON FOOTPRINT

# CONSTRUCTION FOOTPRINT

Interior Materials			
Emission Source	Emission Factor (kg CO2 / unit)	Quantity (per day)	Carbon Footprint
Reclaimed Wood	0.45 / kg	3 tonnes	1.35
Bamboo	0.75 / kg	0.7 tonnes	0.525
Ceramic	4.5 / piece	200 pieces	0.9

Emission Source	Emission Factor (kg CO2 / unit)	Quantity (per day)	Carbon Footprint
Exterior Materials			
Hempcrete	37.5 / kg	21 tonnes	787.5
Steel	2 / kg	10.5 tonnes	21
Glass	2.35 / window	180 windows	0.423
Timber	1 / kg	1 tonne	1
Jute	3 / kg	40 kg	0.12
Total Annual Carbon Footprint (tonnes CO2)			812.818

# OPERATIONAL FOOTPRINT

Emission Source	Emission Factor (kg CO2/unit)	Quantity (per day)	Carbon Footprint
Direct / On-Site			
Vehicles	0.25 / km	100 km	25
Electrical Generation	0.4 / kWh	60 kWh	24
Waste Disposal	2 / kg	10 kg	7.3

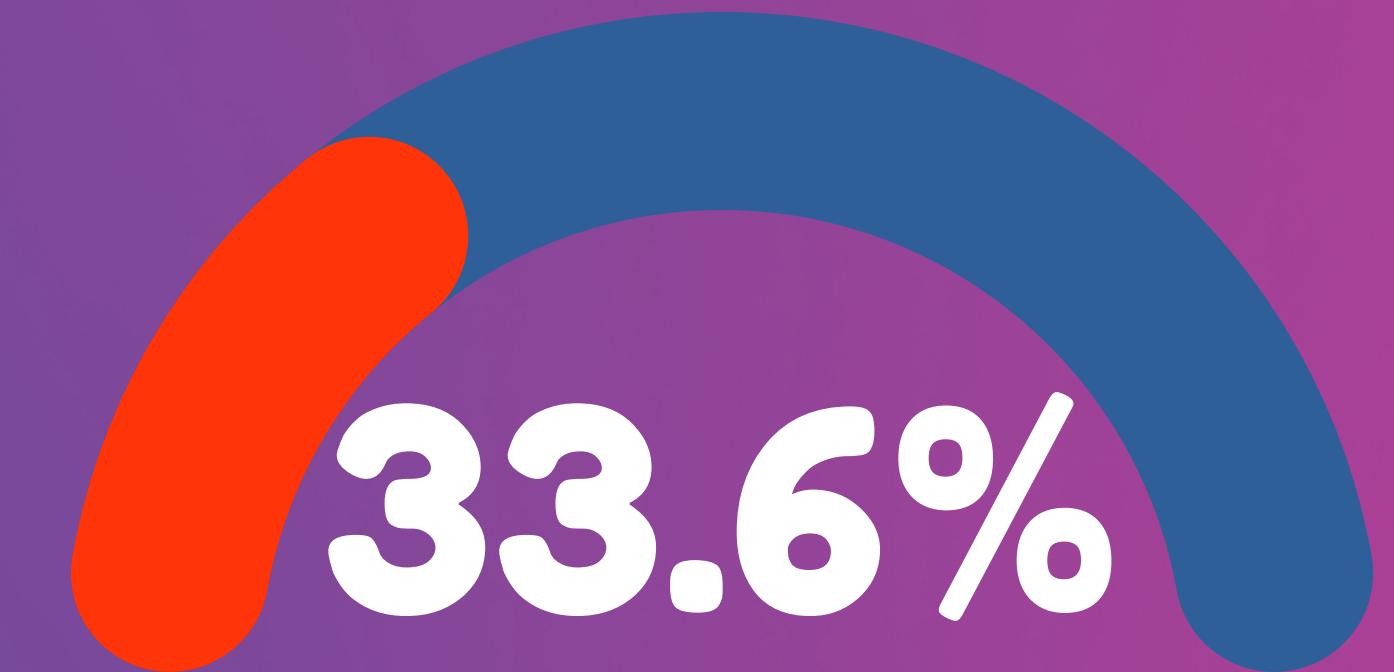
Emission Source	Emission Factor (kg CO2 / unit)	Quantity (per day)	Carbon Footprint
Indirect / Purchased			
Electricity	0.4 / kWh	100 kWh	40
Material Transport	1 /kg	100 kg	36.5
Total Annual Carbon Footprint (tonnes CO2)			132.8

# 132.8

Metric tonnes of CO2 released by  
our resort per year

# 200

Metric tonnes of CO2 released by  
similar sized resort per year



Less carbon emissions as compared to a  
conventional resort of similar size

# ECOLOGICAL FOOTPRINT

# BUILT UP LAND FOOTPRINT

Total Area

2500 sq. ft = 0.02322576 ha

Built-up Land Equivalence Factor

Factor = 2.17 gha / ha

Built-up Land Footprint

Area x Equivalence Factor = 0.02322576 (ha) x 2.17 (gha / ha) = 0.0504 gha

# ENERGY LAND FOOTPRINT

Total Carbon Output of Resort p.a.

133 metric tons

Total Carbon Intake by Mexican Forests p.a.

5.2 tons per hectare

Energy Land Equivalence Factor

Factor = 1.84 gha / ha

Energy Land Footprint

(Carbon Output / Uptake) x Equivalence Factor = 47.1 gha



The background features a large, semi-transparent white circle centered on the left side. To its right is a smaller, semi-transparent orange circle. A third, larger semi-transparent orange circle is positioned on the far right. The background is a vibrant red-orange gradient. In the top right corner, there is a vertical column of small white dots.

# BUILDING SERVICES

# BUILDING SERVICES

- The building will provide all standard services and amenities provided to guests in other resorts.
- Some of the amenities provided include:
  - WiFi
  - Room Cleaning
  - Complimentary Hygiene Kits
- Since Mexico is not known for being the most safe country, the resort will invest money in the security of the resort

The background features two large, semi-transparent circles. One circle is positioned in the upper left, transitioning from red at the top to orange at the bottom. The other is in the lower right, transitioning from orange at the top to red at the bottom. Both circles have a subtle gradient effect. In the upper left corner, there is a small cluster of white dots arranged in a circular pattern.

# ETHICS

# ETHICAL CONSIDERATIONS

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- Give utmost consideration to the safety, health and welfare of their workmen and the general public
- Perform services in areas of their competence
- Build their reputation on the merit of their services and not compete unfairly with others
- Act for each employer or clients as faithful agents or trustees
- At all times refrain from corrupt practices and avoid deceptive acts

# CONCLUSION

# QUESTIONS?

# THANK YOU!