RESORT Itza

ENGG105 Engineering Design for Sustainability
Milestone 5

Group 4

UNIVERSITY
OF WOLLONGONG
IN DUBAI

Team Assignment Cover Sheet

Complete all sections of this coversheet.

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Student declaration and acknowledgement (must be read by all students)

By submitting this assignment online, the submitting student declares on behalf of the team that:

1. All team members have read the subject outline for this subject, and this assessment item meets the requirements of the subject detailed therein.
2. This assessment is entirely our own work, except where we have included fully documented references to the work of others. The material contained in this assessment item has not previously been submitted for assessment.
3. Acknowledgement of source information is in accordance with the guidelines or referencing style specified in the subject outline.
4. All team members are aware of the late submission policy and penalty.
5. The submitting student undertakes to communicate all feedback with the other team members.

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1. INTRODUCTION

The client wants to invest in constructing a seaside resort in a developing country with a budget of approximately 4,000,000 USD. The client needs the resort to bring in profit and follow the sustainability trends on all levels of the investment [1].

The client expects to receive a proposal that provides sustainable solutions for the construction of the resort, which addresses the following:

- Site and location analysis
- Communication to the site during construction and operation
- Architecture
- Materials
- Structural and construction solutions
- Building Services
- Waste Management
- Safety and ethical considerations
- Cost and Sustainability

A sustainable seaside resort is being pursued, aiming to be sustainable throughout its lifecycle, from construction to operations when it will be fully functional.

Being sustainable in the construction industry is difficult as the most common building materials are concrete, bricks and metals. These materials are sourced unsustainably but are commonly used as they are the cheapest option available and due to the lack of general availability of greener, sustainable alternatives in the market. Nonetheless, the resort focuses on utilizing as much sustainable materials as possible, while maintaining the client's budget for the construction. Being sustainable does not only mean using greener alternatives for materials, but also includes feasibility for the economy in the long run and being culturally acceptable to society.

2. CLIENT RESEARCH

2.1 Background

The client is Mr. Ali Anwar, a high-profile businessman in his early 30s, who owns multiple businesses across the world. He is well known for his philanthropic work, as well as his interest in sustainable development. He is always ready to invest in projects that are sustainable at the core as he believes that development will become sustainable when the materials required for it are readily available everywhere, for which demand must be generated for these materials. He recently expressed an interest to invest AED15,000,000 (US$ 4,000,000) towards a resort in the Palm Jumeirah, however, he decided to use this money to build a seaside resort which is highly sustainable and profitable at the same time. He did this to show that hotels and resorts, which are currently highly unsustainable with their construction materials as well as during their operation, can become more nature friendly.

He also decided to build this resort in a developing country, so that it could add value to the society there and generate jobs, both short-term and long-term, for the inhabitants over there. The resort would also generate tourism, thus benefiting the overall economy positively.

2.2 Requirements

The client's main aim is for the resort to be as sustainable as possible, starting from its construction to its operations. Hence, he has forbidden the use of concrete which is highly unsustainable and has a huge carbon footprint. He also requires that the resort follow the Sustainable Development Goals set by the United Nations.

The client has maintained that it is essential the resort be situated in a profitable, developing economy.

The budget of the resort should not exceed the budget specified, i.e., the total budget of USD 4,000,000 should not be exceeded.

The client also requires that the resort displays, through its design choices, the diversity and culture of the area where it is being built.

The client has requested all amenities to be provided for the guests, such as parking, swimming pool, gym, etc.

2.3 Target Audience

The client is aiming for this resort to serve families and international tourists, as they generate a lot of income for the resort as well as the market around it. However, the resort is open to all people regardless of their background.

3. CULTURAL FEATURES

The country chosen to build this resort is Mexico. It has cheap labor, and its long white sandy beaches are the perfect place to build this resort, which will attract tourists from all around the world.

3.1 Wildlife

Mexico has some of the most diverse exotic animal wildlife in the world. The Mexican ecosystem, which encompasses temperate and tropical America, is a diverse mix of deserts and shrublands, grasslands, temperate forests, tropical forests, mountains, and wetlands. While Mexico is abundant in native species, it is also a popular stopover for birds and insects migrating from the north.

The golden eagle is Mexico's official national animal and bird. It is featured everywhere as an important symbol of Mexican culture dating back to Pre-Columbian times. The golden eagle eating a rattlesnake is even depicted on the country's flag. Other notable animals in Mexico include the jaguar (the country's national mammal) and the Xoloitzcuintli (the country's national dog) [2].

Figure 1: Coat of arms of Mexico depicting a golden eagle eating a rattlesnake [3].

Figure 2: Flamingos off the coast of Holbox Island [4].

3.2 Infrastructure & Arts

Mexico City's most recent generation of graffiti artists, taggers, and street muralists have redrawn the country's long-standing tradition of public murals. The street murals' vibrant, stunning colors will draw your attention everywhere you glance, making you want to reach for your camera. The best pieces are up high, blanketing the sides of public buildings and hospitals.

Figure 3: Mexican artist creating an ephemeral work of street art in chalk on the streets of the Historical Center of Mexico City [5].

A new trend has emerged in Mexico City over the last decade. Vertical gardens are sprouting up on the sides of buildings, public sculptures, and food courts, creating lush, magnificent canvases that highlight the city's greener side; they're everywhere, and create the perfect setting for a vibrant photo library [6].

3.3 Architecture

Mexico is well-known for many things, including the ancient ethnic groups that populate the country. The ancient American country is well-known for its traditions, which have survived centuries and centuries of modern lifestyle. Though the country is not fond of arts, it does have its own contribution to the artistic world, ranging from cotton garments to Mexican folk art.

When it comes to infrastructure, Mexico has some of the world's oldest forms of such as Mayan architecture; it is still the world's oldest, and we can see some of it on old American soil. Puuc is one of Mexico's most well-known architectural styles. Puuc represents the hill on which most of the Mayan architectural structures are located.

It is still a bit of a puzzle how the ancient Americans used the correct and extraordinary use of geometry to construct towers with precise ratios. Colors are especially important when building Mexican-style houses, which represent a combination of inside and outside architecture.

Another important feature is the roof, which serves as both a covering material and helps people bear the heat in the desert areas [7].

3.4 Tourism

There is no dearth of tourist attractions in Mexico. Some of the most popular tourist attractions include the Chichen Itza, Tulum, and Catedral Metropolitana [8].

Within Holbox Island, Refugio Holbox, or the Holbox Animal Shelter, is voted the top attraction in Holbox [9]. It welcomes in animals in desperate conditions and treats them and restores the rescued animals' health.

Mexico is the 40th most visited country in the world as of 2021 [10].

Figure 4: The Chichen Itza, one of the most popular tourist spots in Mexico [11].

4. SITE ANALYSIS

4.1 Location of Resort

The resort is located on Holbox island in the Quintana Roo state on the Yucatán Peninsula in Mexico [12]. The island has an area of around 55,948 km^2 [13]. The island is characterized by its long beaches and rich birdlife [14]. It is separated from the mainland by shallow water that is home to flamingos, pelicans, and other exotic creatures. The island has a small airport for public use [15].

The resort is located approximately 1.2km away from the airport. It takes only 6 minutes to drive to the resort, or 14 minutes if one prefers to walk. There is no public transit available to the hotel [12].

The site of the resort has an area of around 2500 ft^2 [16].

Figure 5: Approximate location of the resort on Holbox Island, Mexico [17].

4.2 Climate

Mexico has a diverse range of climatic conditions due to its vast size and topographic diversity. More than half of the country is located south of the Tropic of Cancer. Tropical maritime air masses from the Gulf of Mexico, the Caribbean, and the Pacific are drawn to those areas by the relatively low pressures that exist over land. The maritime air masses are the primary source of precipitation, which is heaviest from May to August. Tropical hurricanes, which form in the oceans on both sides of the country, are common from August to October in the coastal lowland areas. The Sonoran and Chihuahuan deserts dominate northern Mexico, and arid and semiarid conditions prevail across much of the Mexican Plateau [18].

Holbox Island's climate is primarily tropical. When compared to the summertime, there is a huge reduction in rain fall within Holbox during the winter season. March is the driest month, with only 24 mm of rain. The month of September has the highest amount of precipitation, with an average of 115 mm.
The month of August is the warmest of the year. The average temperature in August is 28.3 °C. The month of January has the lowest temperatures, with an average temperature of 23.2 °C [19].

4.3 SWOT Analysis

Strengths

The resort is one of the closest to the airport. It is also the most sustainable hotel on the island, which would appeal to tourists considering the shift in consumer trends towards a sustainable lifestyle.

Weaknesses

The area already has resorts established, so it may be harder to break into the market [20].

The proximity to the sea is worrisome as the effects of climate change could be felt within the next 10 – 20 years. These could include floods or rising sea levels, both of which would be catastrophic and detrimental.

Opportunities

Despite the competition, the resort has a uniqueness with its sustainable theme throughout, which could appeal to tourists.

The resort is constructed from materials that can be reused and recycled if the resort ever shuts down.

Threats

The press in general does not portray Mexico and its people in good light. They choose to highlight issues such as drug dealers instead, which makes people uncomfortable and reconsider travelling to such a location [21]. Despite this, Mexico still has a great tourism economy, which should not affect the resort in any way [10].

5. CONSTRUCTION MATERIALS

5.1 Exterior Materials

Hempcrete

'Hempcrete' refers to a hemp-lime composite building material. It is made by wet-mixing chopped woody stems of hemp plants (hemp shiv) with a lime-based binder to produce a material that can be cast into molds. This results in a non-load bearing, sustainable, 'breathable' (vapor permeable), and insulating material that can be used to construct walls, floor slabs, ceilings, and roof insulation in both new construction and restoration projects [22, 23]. Hempcrete is known for being more sustainable than concrete and is used for other sustainable development projects as well [24].

Usage

The entire structure of the resort is made using hempcrete instead of concrete.

Significance

Hempcrete has incredible insulation properties compared to concrete and other sustainable alternatives [25]. It is also resistant to water and its side effects [26], which makes it a good material for a seaside resort.

Recycled Steel

Steel is an alloy of iron and carbon in which the carbon content ranges up to 2 percent. It is by far the most widely used material for building the world's infrastructure and industries, and to fabricate everything from sewing needles to oil tankers [27].

Laboratory tests on steel structures built to industry standard practices demonstrate excellent service life of steel.

Barrier coatings like paint and galvanization are available to coat the steel surface and isolate it from water and oxygen. Without water and oxygen, the steel cannot corrode [28].

Recycled steel is the leftover steel that is made available by the production of manufacturing waste and recovered steel found in structures, machinery, automobiles, and end-of-life products.

Usage

Steel is used primarily as the structure of the resort to support the hemp.

Significance

Using 1 kg of recycled steel saves 1.5 kg CO_2-e emissions, 13.4 MJ primary energy and 1.4 kg iron ore from being used to create regular steel. With respect to 100% primary production, this translates to 73, 64, and 90% savings, respectively [29].

Timber

Timber is a natural material used in many forms for building and construction. It is readily available and can be easily sourced from many building material suppliers. It is non-toxic. It is safe to handle and even as it ages, it will not cause damage to the environment. It is safe to reuse or recycle and maximizes Green Star Energy rating and carbon credits. Most timbers these days are endorsed or sustainably harvested to return a great life cycle [30, 31, 32].

Usage

Timber would be used primarily in making the restaurants on the beach. It would also be used to make the pole of beach umbrellas.

Significance

Timber is available throughout the world and is extremely cheap. It is also easy to work with and has various applications [33].

Recycled Glass

Glass is made from raw materials found in nature such as sand, soda ash and limestone, as well as recycled glass (known as cullet) [34]. Recycled glass is processed waste glass that is crushed, cleaned, and remelted to create new glass products [35]. It is a sustainable alternative to producing new glass from raw materials, as it conserves energy and reduces greenhouse gas emissions [36]. Recycled glass can be used to make a variety of products, including bottles, jars, windows, and fiberglass insulation [37].

Usage

Recycled glass will mainly be used for making the windows and glass panes, as well as some interior decorations such as mirrors, glass cups, and vases.

Significance

Glass is completely recyclable and has no quality or purity loss when recycled indefinitely [38].

Jute

The jute plant is used to make jute fabric, a type of textile fiber. It is long and tough, and for industrial applications, its durability and roughness are perfect [39].

Because of its amazing durability properties, some designers are misled when it comes to jute. Jute can be made into wall coverings and rugs and curtains and reusable shopping bags [40].

The tree matures extremely quickly (4 to 6 months), thus bringing significant yields to the planted area. This makes jute a renewable material [40].

Usage

With respect to the resort, jute is used for the rooftops of the restaurants on the beach, as it gives an aesthetically pleasing look.

Jute will additionally be used for constructing the canopies of the umbrellas on the beach.

Significance

Jute is cheap yet exceptionally durable and material [41]. Additionally, it is known for providing good thermal insulation [42].

5.2 Interior Materials

Reclaimed Wood

Historically, reclaimed wood was utilized for construction projects ranging from the 18th to the early 20th century. To meet the ever-increasing demand for environmentally friendly, sustainable homes and businesses, wood is recycled and reused [43].

Usage

Reclaimed wood will primarily be utilized for beds, wardrobes, and doors inside the rooms.

Significance

Reclaimed wood carefully repurposes wood while reducing the catastrophic effects of deforestation and preventing the waste of valuable resources in landfills. Significantly lower emissions than those resulting from logging, transportation, and processing of new wood are among the other benefits [44].

Because they have had more time to mature and grow, older trees have denser fibers. Trees with slower growth have more compact growth rings, which means the wood is more resistant to rot and is less likely to split, splinter, or warp [45].

Bamboo

Bamboo, a wood derived from a giant bamboo species called Moso, is neither hardwood nor softwood. When the bamboo is mature—that is, when the cellulose has fully grown, and the wood is firm and hard—the bamboo stem is harvested from the bamboo forest [46].

Usage

Bamboo will be required for making chairs in the resort, in addition to being used as a decorative element.

Significance

Bamboo is wonderful in all its forms. It is a unique, sophisticated, and understated material for fine furniture and flooring because of the delicate grain, whether it is natural or has an amber tone. Its stylish texture complements any style of house [47]. Hence it is being used for decoration within the resort.

Bamboo also has incredible strength and resistance to normal wear and tear [48], which is why it is being used for manufacturing chairs.

Ceramic

Ceramics are materials that can be shaped at room temperature from a variety of raw materials that are inorganic, nonmetallic, and primarily polycrystalline. They sinter at high temperatures to acquire their characteristic properties [49].

Ceramic is known for its hardness and strength as well as their long lasting and hard-wearing features. It is obtained from different raw materials in the form of powder or paste to shape easily then design and paint them on desire [50].

Usage

Ceramic will be used in the swimming pool, bathroom floors, and shower boxes.

Significance

Because ceramic tiles are water-resistant, they are a perfect fit for any shower or bathroom. They are simple to clean and non-absorbent in nature [51].

6. ARCHITECTURE

Architecture plays an important role in building resorts. One of the main steps in building a construction is having a strong building base.

6.1 Exterior Design

This segment reviews the exterior design structure and will provide adequate information and reasoning for the chosen design. The chosen design has been considered considering all factors relevant to sustainability. The design has also been chosen to represent the cultural features of the area it is in.

Preparing an outline design for the resort, the exterior design of the resort is a square based pyramid made of steel, glass, hempcrete, and other sustainable materials. Hempcrete will be mainly used in the construction of the building. The resort is spacious enough to include several activities while still being easy to maintain. Frequent inspections for maintenance will take place, details of which are outlined in the "Building Services" section.

Features of the Exterior

Shape: Since the Chichen Itza is one of the most famous monuments of the Yucatán region, we have decided to shape the resort similarly to the Chichen Itza, to showcase the culture of the region as the client requires.

Cladding: The building will be made using hempcrete, and will be sufficiently thick to provide insulation, thus eliminating the need for another material for the same.

Roof: The roof of the resort will be occupied by an infinity pool with scenic views of the beach from the comfort of the pool. Pool-related services will also be available, such as showers, towels, and a spa among others. A gym will also be placed on the rooftop.

Exterior Building Maintenance

Exterior building maintenance is the simplest and most cost-effective way to extend the life of a building. Because the client intends to use the resort for commercial purposes, the structure has been designed to last a long time. While the structure is built to last, proper maintenance is required to keep it in good working order and provide a safe space for activities to continue.

Inspections will be conducted to ensure that the resort's exterior is in good condition while keeping the budget in mind. Touch-ups will be performed on a regular basis, as needed.

More information regarding this is available in the "Building Services" Section

6.2 Interior Design

Ground Floor / Lobby

The resort's ground floor was planned with the goal of giving visitors a warm and enjoyable stay. This floor's main attraction is the large lobby, which has a sophisticated yet welcoming vibe. Two receptions are positioned for easy access and shorter wait times during the check-in and checkout processes to guarantee efficient service. The entrance and departure points to the beach are strategically positioned across from the resort's, giving a smooth transition between the two settings.

Standard Rooms

Floors 1 to 5 of the resort are dedicated to standard hotel rooms. These rooms are thoughtfully designed to accommodate the needs of small families, ensuring a seamless and enjoyable stay. These rooms are equipped with a well-appointed bedroom featuring a cozy and spacious bed, providing a serene haven for rest and relaxation. The combination of comfortable furnishings, modern amenities, and panoramic views creates a tranquil and memorable experience for guests.

Royal Suites

Luxurious royal suites on floors 6 through 8 of the resort accommodate larger families looking for elegant and roomy lodging. Two luxurious bedrooms are included in every executive suite, giving family members plenty of space to relax and enjoy their privacy. The bedrooms have elegantly appointed beds and decor that embodies a sophisticated style. Families can enjoy time together as well as private leisure with this configuration. The executive suites' private balconies are a highlight feature; they offer families a special outdoor area where they can take in the surrounding natural beauty.

Ballroom

The resort's ninth floor is an advanced event space with two exquisite ballrooms and a lobby area that can be customized to meet the specific needs of visitors hosting special events. The goal of this floor is to offer a flexible and fashionable space for a range of occasions, including conferences, weddings, birthday parties, and business meetings.

Rooftop Health & Recreational Facilities

With its well-equipped gym, cool swimming pool, and handy showers, the resort's rooftop is set to become the ultimate destination for leisure and enjoyment. This raised area combines leisure, fitness, and breath-taking panoramic views to give visitors a complete experience. It is the epitome of luxury and wellbeing, guaranteeing that visitors can relax and revitalize themselves while taking in the natural beauty all around them.

Aesthetics

The goal of the room design is to provide our visitors with a peaceful, restful atmosphere that is characterized by calming and soothing aesthetics. To add to the overall feeling of peace and quiet, warm, soft lighting will be used in the rooms as well as throughout the hotel. To guarantee that each visitor has a harmonious stay, all rooms will retain a uniform aesthetic appeal. Paintings and artwork from various cultures will be displayed in the hallways, bringing some visual appeal and cultural diversity to the communal spaces.

3D Rendering

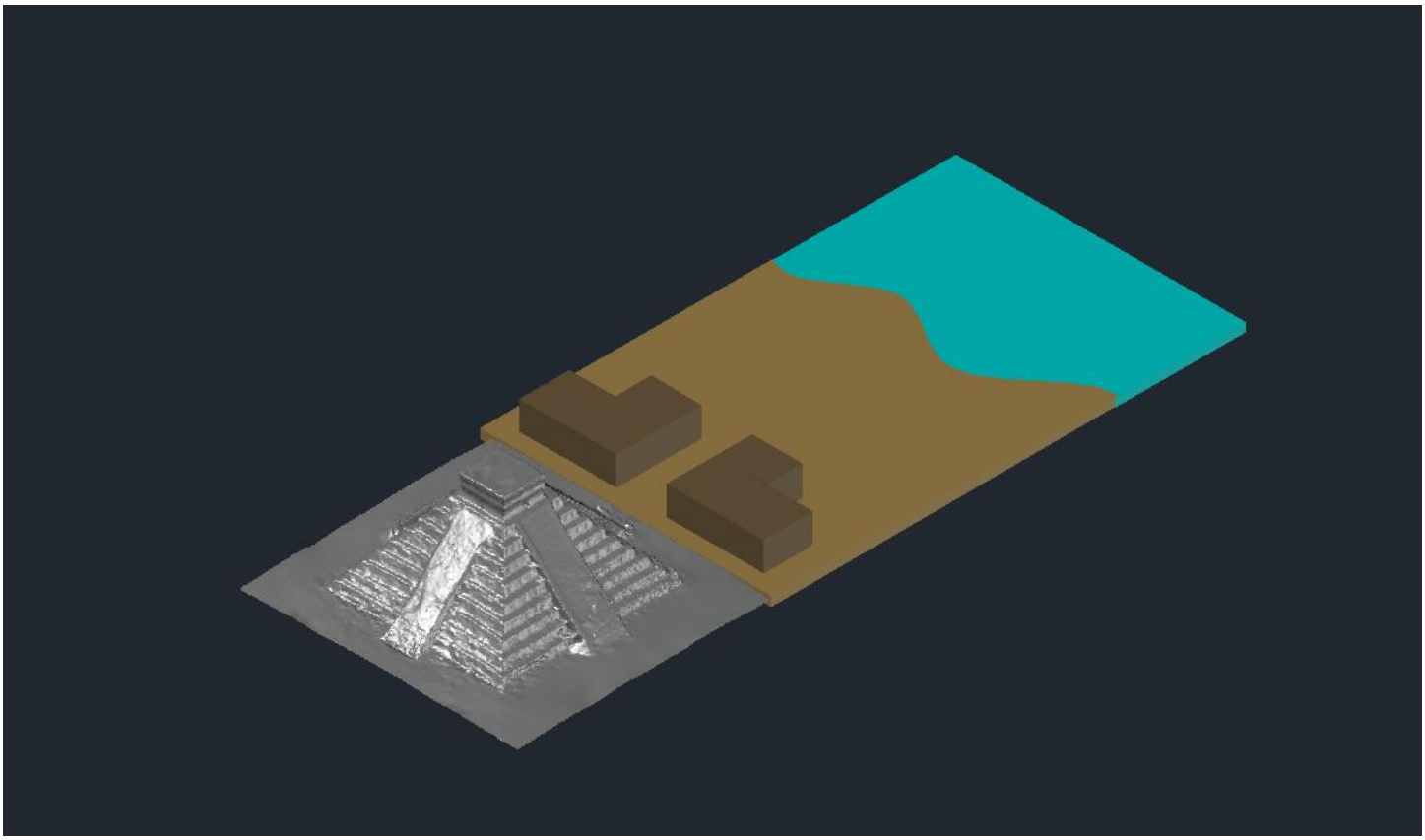

Figure 6: Aerial view of Resort Itza

Floor Plans

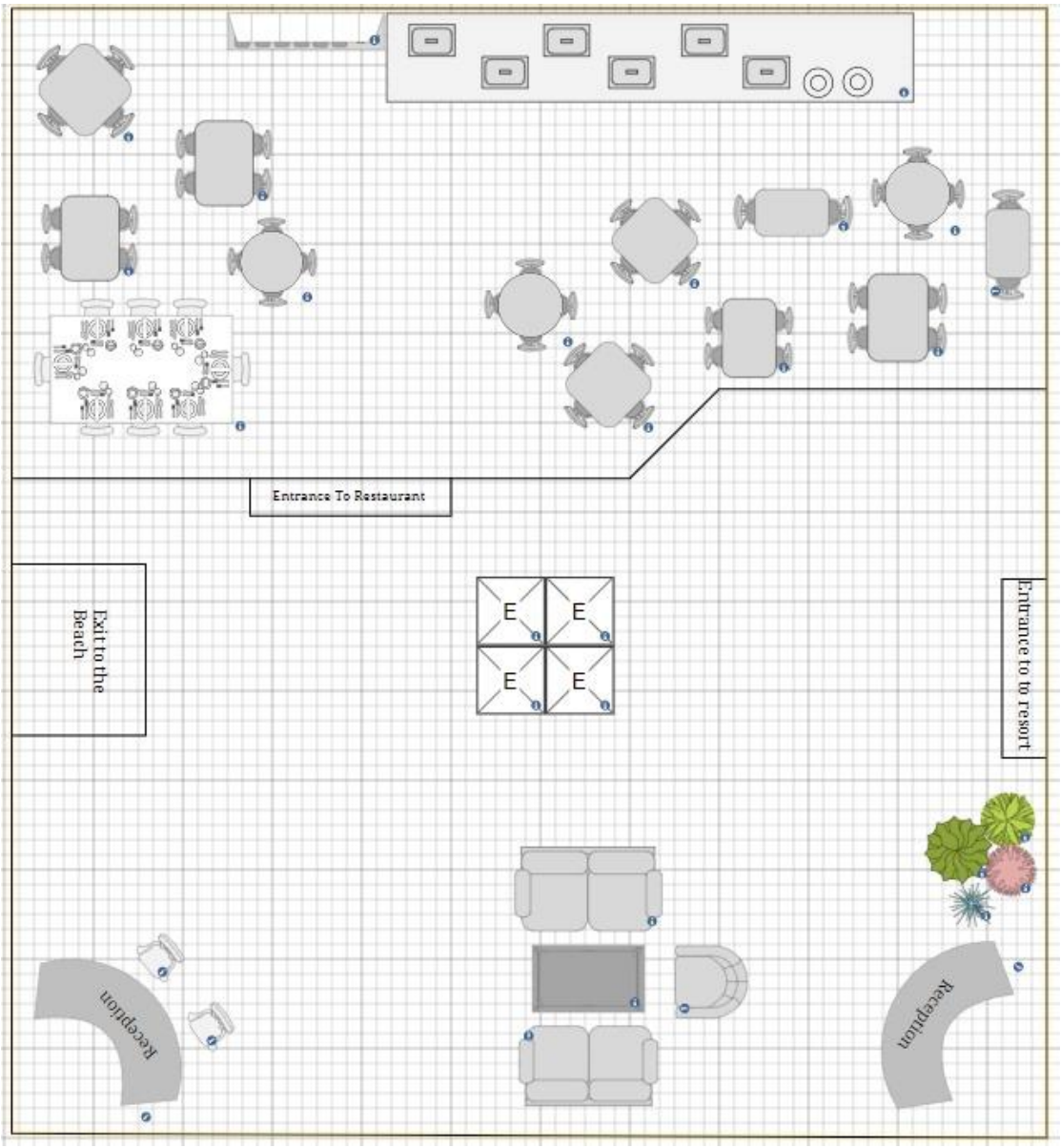

Figure 7: Layout of the ground floor lobby

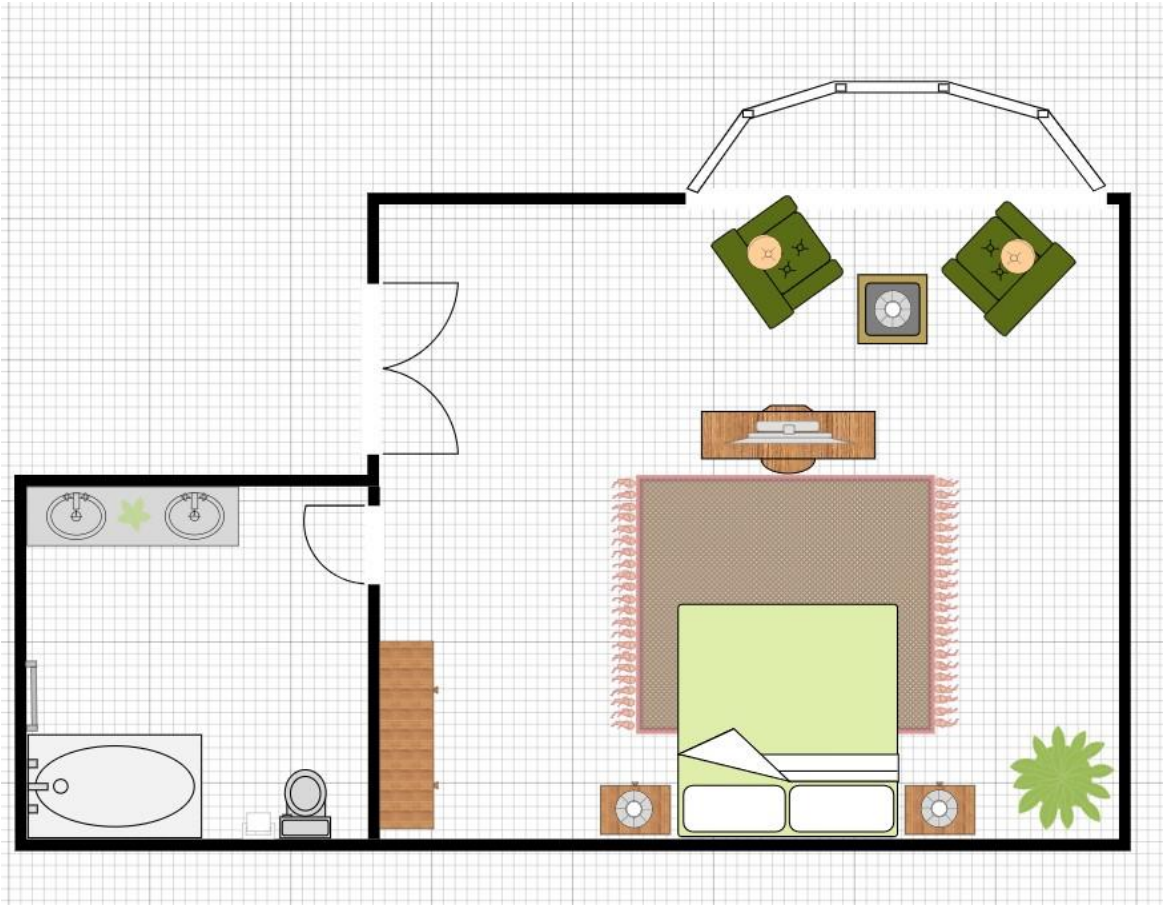

Figure 8: Layout of the standard room

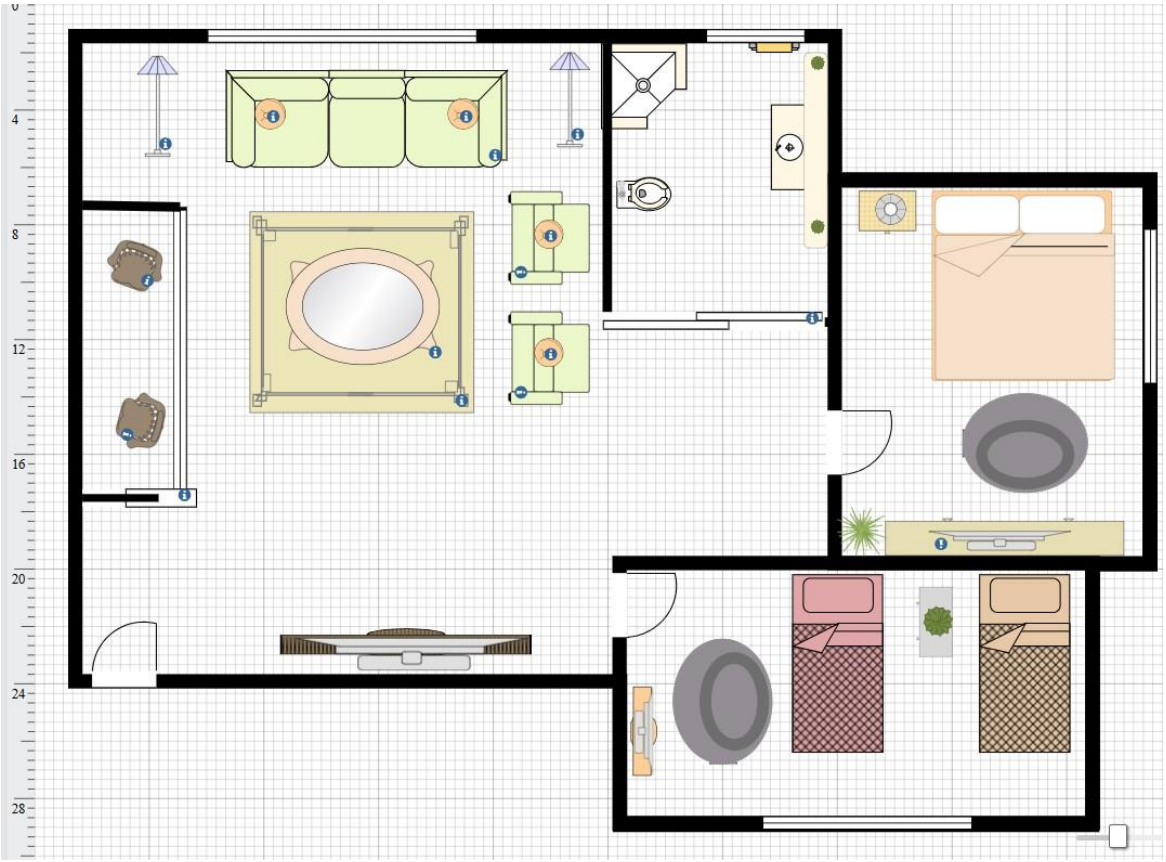

Figure 9: Layout of the Royal Suite

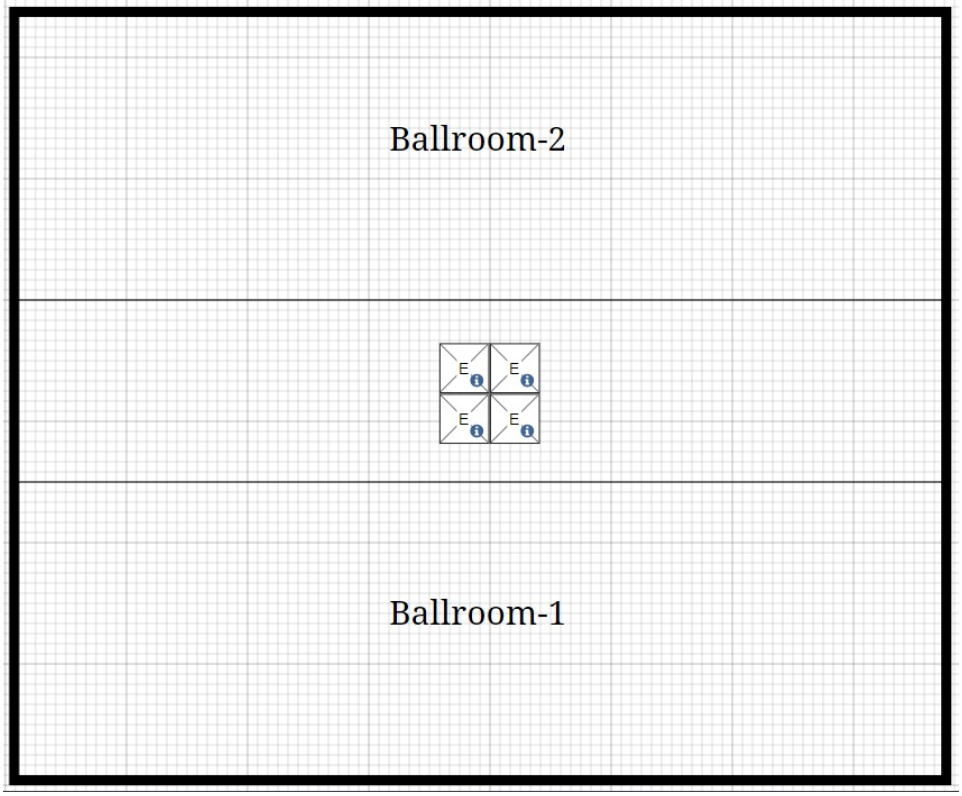

Figure 10: Layout of the ballroom

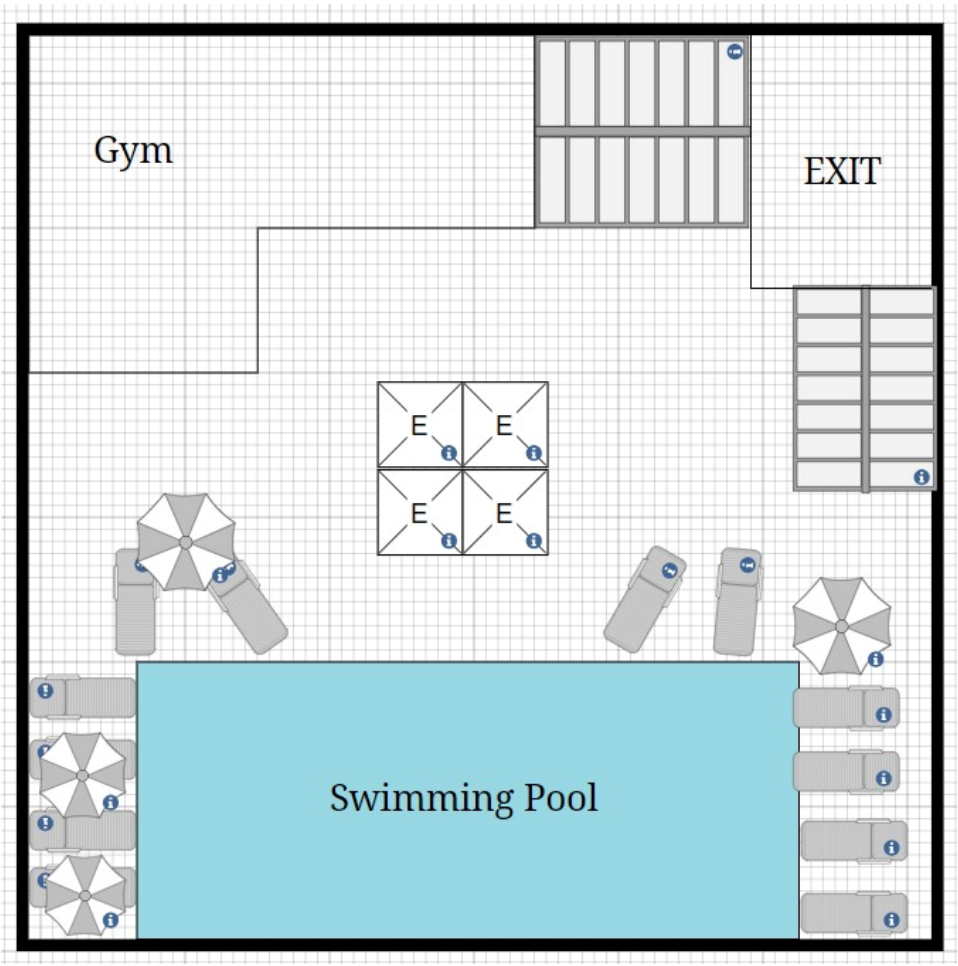

Figure 11: Rooftop Health & Recreational Facilities Layout

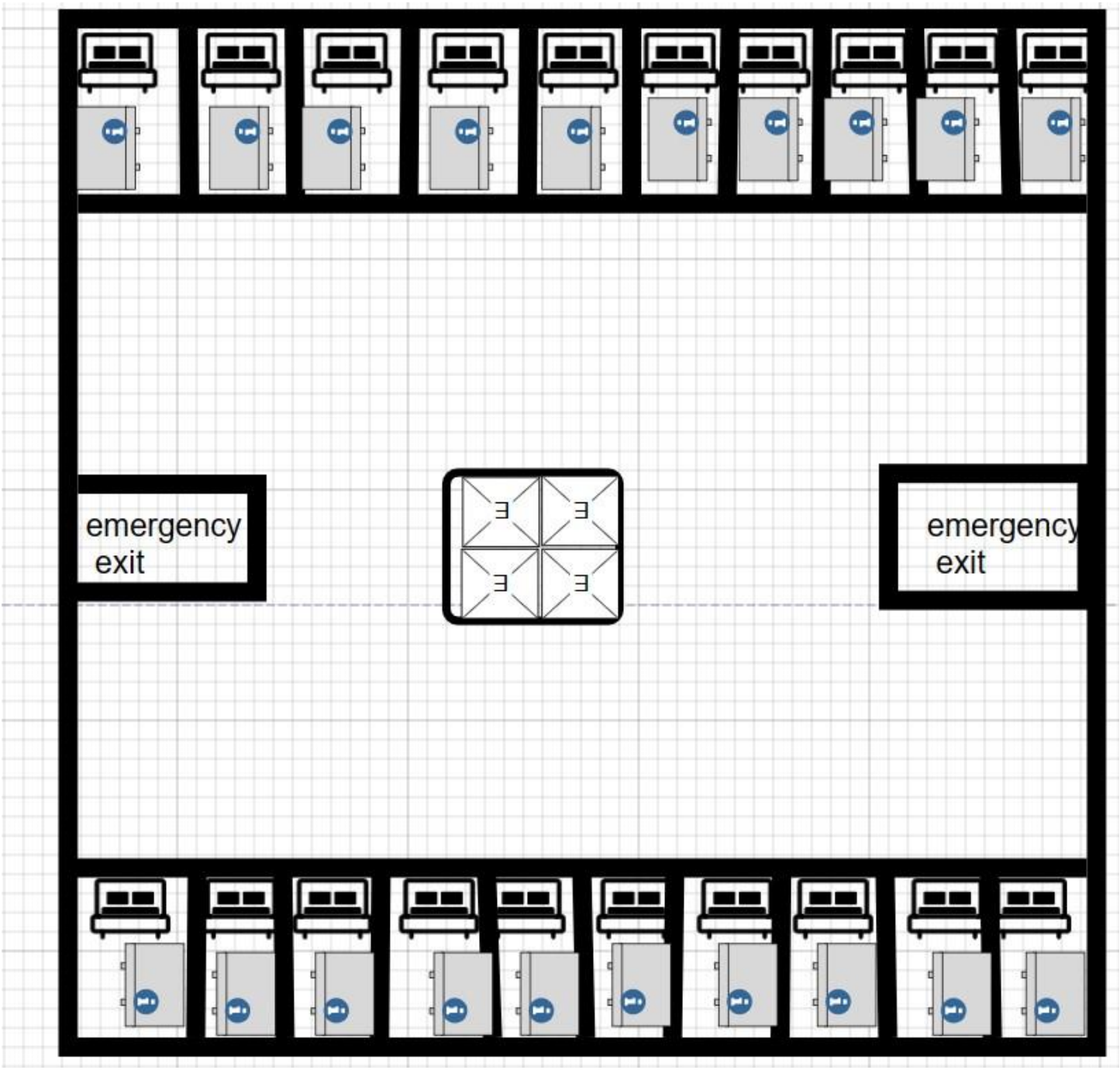

Figure 12: General Floor Layout

7. CONSTRUCTION

The construction phase of a hotel or resort is usually the longest part of the hotel development process, lasting up to 24 months (about 2 years). Because of this, it's critical to actively try to keep construction on time and within budget by carefully allocating teams, making sure the proper resources are made accessible, and constantly keeping an eye on the work. The resort will be constructed using **standard construction techniques**.

7.1 Construction Techniques

There are six phases to construction which are necessary to carry out the building of the resort safely and efficiently.

Phase 1: Building site closure

Every construction site must prioritize workers and public safety, so securing the area is always the first step in the process. While construction trailers or management offices are erected on the site, the entire working area is fenced off to keep the public safe. To facilitate project operations, added amenities such as power, internet access, and restrooms are installed at the site.

Phase 2: Terrain and base

The vegetation and debris removed to be leveled and ready for a sturdy foundation. The foundation is essential for the structure and transportation of all necessary tools and supplies. Therefore, a precise calculation and execution must take place to maintain the highest standards.

Phase 3: The construction's framework

Every building project has a framework, or skeleton, that keeps the structure in position. This would be the structural pillars of a bridge. It would be a steel and hempcrete frame in a building.

With the help of AutoCAD, a 3D model-based process used to plan, design, construct, and manage the building and infrastructure, during this phase and for the duration of the project.

Phase 4: Plumbing, Electrical, and Mechanical (MEP)

A specialized engineering firm is typically responsible for designing the structure's mechanical (HVAC), electrical, and plumbing systems. This covers everything, including water and air conditioning systems, roof drains, ventilation, & lighting.

Phase 5: Waterproofing and Insulation

This stage shields the structure from the outside environment and everything within. Since these structures are intended to be long-lasting, 100-year flood and storm probabilities are considered.

Phase 6: Completion and closure

At this point, the last flourishes are added. Glassware, doors, completed carpentry, tiling, carpeting, and other materials are among them. A final walkthrough with the building owner is conducted after everything is finished and final inspections have been completed to ensure the structure is ready for occupancy [52].

7.2 Challenges & Solutions

During construction, it's highly likely to face technical challenges which include, but are not limited to foundational problems such as settling or cracking, structural issues such as inadequate support and insulation issues.

Therefore, the construction of the resort has been done with precise planning and discussions to avoid such concerns as said above.

Hempcrete is quite water resistant and unlikely to cause cracks in the foundation, but in case cracks develop, it is fixed by building expansion joints and movement joints to avoid the situation. Allowing for these subtle movements during construction can prevent problems later. Expansion joints are carefully positioned spaces in building construction that let concrete slabs expand and contract without weakening the structure. They serve as a barrier, absorbing the heat being transferred. To allow for the expansion and contraction of the concrete, these joints are usually filled with felt or wood. An annual inspection of joints would take place by the maintenance team of the resort [53].

Along with hempcrete as the resort's foundation, steel will be used to increase the load-bearing ability of the resort. Steel provides concrete with exceptional tensile strength, enabling it to support large loads and lowering the possibility of structural failures. It can withstand strong physical impacts and forces, keeping building occupants safe. The addition of steel would make the resort more studier and durable in the long run.

Maintenance of a ductless HVAC system in the resort would prevent any issues related to insulation. HVAC system insulation lowers operating costs, lowers carbon emissions, and increases efficiency. It contributes to maintaining consistent interior temperatures while using the least amount of energy possible, creating a cozy space for the guests.

7.3 Communication to the Site

Effective communication will be paramount to ensuring project success. Clear, consistent, and timely communication among all stakeholders, including the client, consultant, contractor, and site engineers, will be essential for coordinating efforts, resolving issues promptly, and maintaining transparency throughout the project lifecycle.

Client – Consultant Communication

To ensure that the resort meets the client's expectations, regular communication between the consultant and the client will lay the foundation for project alignment. This correspondence will cover:

Frequent Project Updates: The consultant will give the client regular updates on the status of the project, outlining any deviations from the original plan, potential obstacles, and milestone accomplishments.

Clear and Concise Communication: Information will be provided in a clear, concise manner that is appropriate for the client's technical understanding level. Jargon will be avoided, and the main project details and implications will be the main focus.

Open and Collaborative Approach: The client will be encouraged to offer input, voice concerns, and take part in decision-making processes through the promotion of an open and collaborative approach.

Consultant – Contractor Communication

For the project to be executed smoothly, the consultant and contractor must have effective communication. This correspondence will consist of:

Clear and Comprehensive Project Documentation: Drawings, specifications, and technical requirements are all part of the project documentation that the consultant will give to the contractor.

Frequent Site Meetings and Coordination: To ensure that the contractor is following the project schedule and quality standards, regular site meetings will be held to coordinate activities and address any issues that may arise.

Utilizing Technology for Enhanced Communication

Technology will be essential for improving stakeholder communication, enabling real-time information sharing, optimizing workflows, and encouraging teamwork. This will consist of:

Project Management Software: To track project progress, manage documents, centralize communication, and encourage stakeholder collaboration, project management software will be used.

Video Conferencing and Collaboration Tools: To enable remote participation in site meetings and design reviews, as well as virtual meetings and real-time discussions, video conferencing and collaboration tools will be utilized.

Apps for Mobile Communication and Reporting: These apps will be used to facilitate real-time communication from the construction site, as well as task assignments, progress reporting, and issue identification.

7.4 Environmental Impact Assessment

The Environmental Impact Assessment is a process of predicting and evaluating the environmental impact of a project considering physico-chemical environment, biological environment, socio-economic environment, and ecosystem [54].

The table in Appendix A shows the weighted total impact scores for each of the environmental factors of hempcrete and concrete. The weighted total impact scores are calculated by multiplying the impact score of each factor by its weightage. The weightage of each factor is determined by its importance to the overall environmental impact.

Physico-chemical environment

The weighted total impact score for the physical-chemical environment is 0.6 for hempcrete and -0.9 for concrete. This means that hempcrete has a positive impact on the physical-chemical environment, while concrete has a negative impact.

Biological environment

The weighted total impact score for the biological environment is 0.2 for hempcrete and 0 for concrete. This means that hempcrete has a slightly positive impact on the biological environment, while concrete has no impact.

Socio-economic environment

The weighted total impact score for the socio-economic environment is 1.4 for hempcrete and 0 for concrete. This means that hempcrete has a positive impact on the socio-economic environment, while concrete has no impact.

Ecosystem

The weighted total impact score for the ecosystem is 0.3 for both hempcrete and concrete. This means that both hempcrete and concrete have a neutral impact on the ecosystem.

Overall

The overall weighted total impact score for hempcrete is 2.5 and –0.6 for concrete. This means that hempcrete has a positive impact on the environment, while concrete has a negative impact.

Conclusion

Based on the table, hempcrete is a more environmentally friendly building material than concrete. Hempcrete has a positive impact on the physico-chemical environment, biological environment, and socio-economic environment and the ecosystem. Meanwhile concrete has a negative impact on the physico-chemical environment and the ecosystem and no impact on the biological environment and socio-economic environment.

Detailed calculations of the Environmental Impact Assessment can be found in Appendix A**.**

8. ENERGY

8.1 Energy Requirements

The energy needed in the resort is estimated to range between 1000-1300 kWh/day. This has been estimated by considering the number of rooms, as well as looking at other resorts with a similar layout and structure. The resort has 60 rooms, with each room estimated to use up to 20 kWh/day, which means if all rooms are in use, then at least 1200 kWh/day will be needed, factoring other energy uses, it can be said the maximum energy requirements will be 1400 kWh/day [55].

8.2 Solar Energy

Solar radiation is light – also known as electromagnetic radiation – that is emitted by the sun. While every location on Earth receives some sunlight over a year, the amount of solar radiation that reaches any one spot on the Earth's surface varies. Solar technologies capture this radiation and turn it into useful forms of energy [56].

Each panel is the same size, being 65 inches by 35 inches, providing 3 to 5 kWh/ day each [57, 58]. The plan is to use 200 solar panels. which will be distributed evenly across the resort, by placing the majority of the panels on the main building, with the aim of harnessing the most amount of light. Remaining panels will be distributed evenly along the beach with a mini solar farm to fit in the last panels.

When harnessing the 200 solar panels, the total energy output ranges from 550 – 850 kwh/ day, averaging 700 kwh/day [59, 60].

The efficiency of the panels ranges between 15-20%. It is also possible to go up to 23% depending on the quality of the PV cells [61].

8.3 Wave Energy

Wave energy is the harnessing of waves with the use of a wave energy converter to form sustainable energy. It is a type of ocean energy or marine energy that captures the kinetic and potential energy present in the movement of waves and converts it into electricity or other usable forms of power [62].

To gain proper and the most effective use out of waves, it has been decided to buy a more expensive wave energy converter as it is more efficient and economical in the long run. Waves are rather difficult to predict how much energy they will produce.

Wave height, wave period, and water density are some of the factors that affect how much energy waves produce. The vertical distance between a wave's crest and trough, or wave height, directly affects how much energy is produced. Higher energy yields are also a result of longer wave periods, or the amount of time it takes for two successive wave crests to pass a fixed point The total energy content of waves is also influenced by water density, which is the mass of water per unit volume [63, 64, 65, 66].

On average, a single meter of wave can generate approximately 20 kilowatt-hours (kWh) of energy. This translates to a daily energy production range of 350 to 650 kWh, with an average of around 500 kWh [67].

The efficiency of the wave energy converter ranges from 49 to 70 %. The range is quite large as waves are far more unpredictable compared to solar panels [67].

8.4 Backup Power Sources

Standby generators are automatically activated and use natural gas. They do have diesel powered counterparts, but they have a limited tank capacity and are very expensive.

Natural gas standby generators have a key benefit, that being they will go on running indefinitely if they are connected to the main gas line (including biogas). They are, however, slightly flammable and need regular maintenance.

Portable generators using gasoline, diesel and propane could also be used during outages in the case that the automatic standby generators fail. They are inexpensive but have limited utility compared to permanent generators and battery backups, but they have a smaller storage space to compensate. They are very useful to use for a short period of time.

Battery backups would also be useful, as they will work in tandem with the UPS generators. All these generators will make sure that the hotel will not lose power for longer than a couple minutes. Since battery banks are usually used together with off-grid power generation systems, the battery need not constantly supply power. They are often sized to provide critical power during times when generation is not possible, giving sufficient time to switch to an alternative generation source [68, 69, 70].

9. BUILDING SERVICES

9.1 Guest Services

Upon entering the resort's premises, visitors will experience a cordial reception. Dedicated personnel will help with baggage handling and give guests a thorough rundown of the resort's features. A concierge service will be on hand to help with any needs, including booking reservations for dining establishments, transportation, and tickets to nearby attractions [71].

Guests can expect an exceptional level of hospitality throughout their entire stay. A team of committed guest service representatives will be on hand around-the-clock to attend to any needs or issues, making sure that visitors feel taken care of and pampered. The core of the guest service philosophy will be anticipating guests' needs, with staff members taking steps to resolve any potential issues and ensuring a seamless and pleasurable experience [72].

The resort's guest services team will make recommendations based on each visitor's interests to assist them in discovering Holbox Island's special treasures. To guarantee that visitors enjoy everything Holbox Island has to offer, the team will offer insider advice and plan excursions, whether it's discovering hidden beaches, snorkeling in colorful reefs, or getting a taste of local culture [73].

A major factor in encouraging visitors' cultural immersion will be the guest services provided. To help visitors better understand the rich cultural legacy of Holbox Island and Mexico, they will host cultural events like traditional dance performances, cooking demos, and language lessons [74].

The resort's extensive training and development program for all employees will demonstrate its dedication to providing outstanding guest services. A culture of hospitality will be ingrained through this program, with a focus on the value of empathy, attentiveness, and anticipating the needs of visitors. Frequent training sessions guarantee that staff members stay current on the newest developments in guest services and are prepared to provide each guest with an extraordinary experience [75].

The resort aims to create a welcoming and personalized experience for all its guests by investing in staff training, anticipating their needs, offering local recommendations, promoting cultural immersion, and placing a high priority on personalized attention.

9.2 Dining

The resort will provide dedicated Halal and Kosher kitchens to accommodate guests who follow these dietary guidelines, guaranteeing complete compliance with religious standards and preparation practices. Experienced chefs with training in preparing Halal and Kosher cuisine, utilizing only approved ingredients, and adhering to strict hygiene protocols, will work in these kitchens [76, 77].

The resort will offer a wide variety of plant-based options in all its dining establishments for visitors looking for vegetarian or vegan food. These choices will highlight the inventiveness and adaptability of plant-based cuisine by going beyond traditional vegetarian and vegan fare. Many salads, appetizers, main courses, and desserts are available for guests to savor, all of which are made with fresh ingredients [78, 79].

The resort will accommodate a variety of standard diets in addition to the specialty menus, such as low-sodium, dairy-free, and gluten-free options. Clear labeling and menu icons make it simple for customers to find dishes that satisfy their unique dietary requirements, enabling them to make educated decisions and confidently savor their meals [80].

A committed staff of culinary specialists will be on hand at the resort to help with any special dietary needs or allergies. These professionals will collaborate closely with visitors to ascertain their individual requirements and produce customized meals that satisfy their dietary requirements while maintaining a tasty and pleasurable dining experience [81].

The resort will attempt to accommodate every guest's culinary preference and dietary needs by providing a wide variety of dining options, such as dedicated Halal and Kosher kitchens, an abundance of vegetarian and vegan options, and personalized attention to regular diets and unique requests. This will guarantee that every meal is a celebration of flavor and satisfaction.

9.3 Communications

A contemporary phone system will be installed in each guest room, enabling easy access to local and international calls. To facilitate easy communication between guests and resort staff as well as family and friends, these phones will have clear voice quality, intuitive interfaces, and direct access to resort services [82].

The entire resort will have high-speed Wi-Fi available, providing visitors with uninterrupted internet access during their visit. While enjoying the peace and quiet of the resort, visitors can stay connected to the digital realm with this strong Wi-Fi network, which will allow them to check emails, work, browse the web, and use streaming services [83].

Satellite phone rentals will be offered for visitors who plan to venture outside of the resort's immediate area. In the event of an emergency, guests will be able to stay in touch with loved ones and emergency services thanks to the satellite phones' dependable communication, even in remote areas [84].

For the resort to run smoothly, staff members must communicate effectively with one another. Real-time communication between departments will be made possible by a dedicated staff communication system, allowing for effective coordination and quick response to visitor requests. Additionally, this system will give staff members access to crucial resort data, enabling them to be prepared for any eventuality [85].

Through the provision of an extensive array of communication choices, such as satellite phone rentals, resort-wide Wi-Fi, and in-room phones, the resort will be able to accommodate the varied requirements of its visitors and guarantee guests' continuous connectivity.

9.4 Laundry & Dry Cleaning

Laundry facilities will be available for visitors looking for quick and easy laundry services. Guests will be able to conveniently launder their clothing while visiting thanks to the facilities' modern washers, dryers, and ironing boards [86].

The resort will have a special dry-cleaning service for clothing that is delicate or needs expert care. A reputable third-party provider will offer this service, guaranteeing that guests' attire gets the best care and attention possible [87].

To ensure that their belongings are handled with care and returned on time, guests can place their laundry or dry-cleaning items in special hampers inside their rooms, and resort staff will take care of the pick-up, cleaning, and return. [88]

Laundry and dry-cleaning services provided by the resort will follow stringent environmental sustainability guidelines. The resort's environmental effect will be reduced by using water- and energy-efficient washing machines, eco-friendly detergents, and energy-saving techniques [89].

Through the provision of laundry facilities, expert dry-cleaning services, easy delivery options, and an unwavering dedication to sustainability, the resort guarantees that visitors' clothes stay fresh, clean, and well-maintained indefinitely.

9.5 Lighting

The resort's lighting design places a strong emphasis on sustainability, meeting the stringent standards of BREEAM (Building Research Establishment Environmental Assessment Method), LEED (Leadership in Energy and Environmental Design), and other accredited green building certifications [90]. These certifications support the resort's dedication to sustainability by encouraging resource conservation, energy efficiency, and environmental stewardship.

The resort's lighting system will be built around LED (light-emitting diode) bulbs, which have a long lifespan and excellent energy efficiency [91]. The energy utilization and ecological impact of the resort are greatly decreased by using these bulbs, which use as much as 80% less energy than conventional incandescent bulbs.

LED bulbs are energy-efficient, and they can be designed to create a wide range of aesthetically beautiful, cozy, and warm lighting effects. The resort's architecture will be lighted by carefully placed LED fixtures, creating an alluring glow that improves the atmosphere without sacrificing sustainability [92].

The resort will be equipped with smart lighting control systems to maximize energy efficiency even more. By allowing for the real-time monitoring and adjustment of lighting levels in response to occupancy and the availability of natural light, these systems will guarantee that energy is only used when and where it is required [93].

The resort will set a new benchmark for sustainable hospitality by utilizing intelligent control systems, energy-efficient LED lighting, and sustainable building practices. All these measures will also make the resort visually appealing and welcoming.

9.6 Elevators

The resort will use regenerative braking in its elevators, which uses the energy produced by elevator descents to operate the system. This creative method lessens dependency on outside power sources and consumes less energy [94].

Variable-frequency drives (VFDs), which control motor speed and lower energy consumption during times of low traffic, will also be featured on the elevators. Moreover, VFDs enhance elevator performance, guaranteeing a smooth and effective run [95].

The resort's elevators will offer outstanding guest experiences in addition to being environmentally friendly. Fast elevators will reduce wait times and guarantee that visitors can get where they're going as soon as possible. The elevator's design will be complemented by the elegant finishes and spacious cabins that can comfortably accommodate guests [96].

When designing and operating the elevator system, safety will come first. Modern safety measures, such as alarm systems and emergency brakes, will guarantee the security of both visitors and employees. In accordance with the most recent accessibility guidelines, the elevators will be completely accessible to people with disabilities [97].

The resort's general operations will be completely integrated with the elevator system. Elevator routing will be optimized by destination dispatch systems, cutting down on traffic and waiting times. Elevator buttons will be placed in strategic locations to improve ease of use and accessibility [98]. The elevator system will improve the resort's overall functioning and guest satisfaction by adopting sustainable technologies, putting the guest experience first, and guaranteeing safety and accessibility.

9.7 HVAC

The resort places a high priority on creating an atmosphere that is welcoming and comfortable as it is driven by its objective of guest satisfaction. This goal includes efficient indoor climate control. Heating, ventilation, and air conditioning systems, or HVAC systems for short, are essential for controlling temperature, humidity, and air quality so that visitors can relax and enjoy their stay to the fullest.

Many considerations, such as the resort's size and design, the local climate, and financial limitations, play a role in choosing the right HVAC system. Split systems, which are identified by having separate indoor and outdoor units, are a popular option because they are simple to install and maintain. They efficiently move air around each room as the outside unit heats or cools the air coming in. [99]

Variable refrigerant flow (VRF) systems use a variable speed compressor to precisely control temperature in individual rooms or zones, thereby increasing energy efficiency [100]. With this focused approach, energy consumption is reduced, and guest comfort is maximized.

Owing to the distinct climate of Holbox Island, a Variable Refrigerant Flow (VRF) system is the best option for the resort. VRF systems meet the needs of the resort by providing several benefits.

Energy Efficiency: VRF systems are well known for their remarkable energy efficiency. By controlling refrigerant flow precisely with the use of inverter technology, it can save up to 50% on energy consumption when compared to conventional systems [101]. The resort's dedication to sustainability and lessening its environmental impact is in line with this.

Zoned Cooling: VRF systems excel at zoned comfort by allowing independent regulation of temperatures in particular spaces or areas [100]. This allows guests to customize their in-room climate according to their individual needs, increasing their overall satisfaction and comfort.

Year-Round Comfort: VRF systems are well-suited to Holbox Island's changing climate, as they provide both cooling and heating capabilities [102]. During the warmer months of the year, the system effectively cools guest rooms, while on cooler days, it can provide mild heating to keep the indoor environment comfortable.

Quiet Operation: VRF systems operate remarkably quietly, emitting minimal noise that won't disturb the tranquility of the resort's natural surroundings [103]. This contributes to a serene and relaxing atmosphere for guests.

Several extra steps can be implemented to improve the efficacy of the VRF system. These consist of, but aren't restricted to, installing occupancy sensors in guest rooms that may automatically regulate cooling or heating based on room occupancy, as well as preventing unwarranted energy consumption when rooms are vacant [104].

9.8 Electricity

Optimizing energy consumption and minimizing losses require a well-designed electrical distribution system. The resort's numerous structures and amenities will be connected by underground cabling, reducing visual impact, and safeguarding the fragile island ecology [105].

Every guest room will have smart meters installed, allowing for real-time energy consumption monitoring, and giving visitors the ability to make educated decisions about how much energy they use. The resort's overall energy efficiency will be improved even more by this data-driven strategy [106].

The resort's architectural style, which draws inspiration from Chichen Itza's grandeur and harmony, will carefully incorporate the electrical infrastructure. Power lines will be kept out of the way thanks to underground cabling, which will also maintain the resort's attractive appearance and allow it to blend in naturally with its surroundings [107].

Traditional Mayan designs will serve as the inspiration for the lighting fixtures, which will give the entire resort a cozy, welcoming glow. The intended ambience will be preserved while minimizing energy consumption thanks to the use of low-energy LED bulbs [108].

The electrical facilities will not just power the resort but also contribute to its sustainability, visual appeal, and overall guest experience by putting an emphasis on renewable energy sources, putting in place efficient distribution systems, and harmonizing with the resort's design inspired by Chichen Itza.

9.9 Water & Plumbing

A key component of the resort's water management plan will be water conservation. The resort will be equipped with low-flow showerheads, toilets, and faucets to cut down on water usage without sacrificing visitor comfort [109].

Systems for harvesting rainwater will be put in place to collect rainwater during the rainy season and store it for use in the off-season. This strategy will encourage water sustainability and lessen dependency on the island's supply of freshwater [110].

Water loss will be reduced and water flow throughout the resort will be optimized with a well-planned plumbing layout. The strategic routing of pipes will minimize pressure drops and stop leaks. Water-efficient fixtures will be incorporated into the resort's architecture with ease.

The resort's water infrastructure will be sustained over time by regular service and leak detection systems that will detect and address any possible problems quickly, minimizing water loss [111].

Through the implementation of efficient plumbing design, rainwater harvesting and recycling systems, and a priority on water conservation, the resort will not only minimize its environmental impact and ensure that guests have ample access to clean water but will also operate sustainably.

9.10 Maintenance

The resort's maintenance will revolve around a strict schedule of preventive maintenance. This plan will include routine maintenance, cleaning, and lubrication of all infrastructure, equipment, and common areas as well as HVAC, plumbing, and electrical systems in addition to guest rooms and common areas [112].

Preventive maintenance will reduce downtime, increase the lifespan of infrastructure and equipment, and improve the overall visitor experience by proactively addressing possible issues before they become serious ones [113].

There will be committed maintenance staff on hand to handle any unforeseen problems. The team will possess the requisite tools, expertise, and resources to expeditiously diagnose and rectify any issues, guaranteeing the resort's infrastructure and amenities stay in optimal condition [114].

A guest feedback mechanism will be put in place to improve responsiveness even better, enabling visitors to communicate any maintenance issues promptly to the resort personnel [115]. The team will take note of this feedback right away and make sure that any problems are fixed quickly and effectively.

The resort will incorporate sustainable practices into its maintenance strategy. The efficient operation and contribution of solar panels, tidal energy systems and rainwater harvesting systems to the resort's environmental objectives will be guaranteed by routine inspection and maintenance [116].

Furthermore, to reduce the resort's environmental effect while upholding a high level of cleanliness, the use of environmentally friendly cleaning supplies and methods will be given priority [117].

The resort will maintain its architectural integrity, operational effectiveness, and environmental sustainability by implementing a comprehensive maintenance strategy that incorporates proactive repair, preventive measures, and a dedication to sustainable practices. This will guarantee that guests will always have an amazing experience.

10.WASTE MANAGEMENT

10.1 Construction Waste

Construction waste includes materials that are produced during the construction of new buildings and civil engineering structures as well as during the maintenance of existing buildings and structures. Construction waste, if not managed properly, can cause many environmental hazards. With the ability to process and recycle any kind of waste produced by the construction industry and turn it into new materials for new constructions, Concretos Sustentables Mexicanos (CSMX) recently installed the first C&D waste recycling plant in Mexico. This process not only achieves the conservation of natural environments by reducing the amount of waste dumped in landfills and the extraction of raw materials, but it also reduces CO_2 emissions by 80% by shortening waste transportation distances [118]. Steel can be recycled indefinitely because it can be melted and reformed without deteriorating. When it comes to reducing, reusing, and recycling construction and demolition (C&D) materials, the SMM plan serves as a great manual.

10.2 Operational Waste

Guest Waste

It is inevitable that guests will generate waste during their stay at the resort. The best way to tackle this is to segregate the waste before reusing or recycling it and prevent as much as possible from being incinerated or going to a landfill.

Plastic

Plastic waste in hotels is usually generated from cups, straws, coffee lids, shampoo bottles and amenity kits.

We will partner with a company called “Polyfloss” which specializes in recycling plastic materials to create fibers for manufacturing products such as textiles and packaging. [119]

Paper

Paper waste will be generated from the usage of brochures, flyers, or receipts. It could also be generated by paper cups and other paper-based materials.

To combat paper waste, we will be partnering up with “Bio Pappel”, which is known in Mexico for creating paper-based products without cutting down a single tree. [120]

Metal

Metal waste generally comes from cans, such as tinned food and soft drink cans.

“Hormesa” will be tasked to recycle metal waste. [121]

Glass

Glass waste would primarily be generated by accident, such as the breakage of a vase or a jar or something similar.

A Mexican company “Promapi” would be the best fit for recycling glass. [122]

Non-Recyclable Waste

Non-recyclable waste includes items such as styrofoam cups and utensils. This is waste that cannot be reused or recycled, and hence will be sent to the local garbage collection point, where it may be incinerated or sent to a landfill.

Kitchen Waste

Kitchen waste is mainly composed of food items or items used to prepare the food. This type of waste is rich in nutrients which makes it a perfect fuel for generating biogas to power up the resort’s kitchen.

Textile Waste

The hotel industry has a large impact when it comes to generating textile waste such as sheets, bathrobes, pillowcases, and towels. Hence when used over time, these can be recycled and remade into something new, such as clothes.

Soap Bars & Toiletries

Soap bars and toiletries are one of the biggest contributors to waste from a resort, as these are personal hygiene items that cannot be reused by other guests. To tackle this problem, a foundation called “Clean the World Foundation” has come up with an innovative solution. They take in used soap bars and other toiletries that they may need from hotels and other companies in the hospitality sector. The used bars of soap are ground into pellets and finely refined to eliminate any foreign particles. Then, they are sterilized, refined again, and manufactured into brand-new bars of soap. These processed soap bars are sold in countries where there is a lack of accessibility of personal hygiene products. [123]

All toiletries and soap bars will be by Clean the World Foundation to support their noble initiative, which also aligns with the client’s image as a philanthropist.

11.SAFETY & SECURITY

11.1 Surveillance & Access Control

The resort will be surrounded by a safe perimeter fence that is outfitted with security cameras and motion detectors to prevent unwanted actions [124]. To guarantee that only individuals with permission can access the resort, security personnel will be stationed strategically and in charge of the access gates [125].

Digital locks and key cards will be installed in guest rooms to give visitors safe and easy access to their lodgings. Key cards that are lost or stolen will be deactivated swiftly to avert unauthorized access [126].

The resort will have a full surveillance system installed, with high-resolution cameras placed in key locations to keep an eye on public spaces, guest rooms, and other areas of concern. Security staff will be able to quickly detect and address any possible security breaches thanks to the cameras' real-time footage that is sent to a central monitoring station [127].

The resort will install access control systems that limit access to specific areas, such as staff-only areas and restricted spaces within the resort, in addition to visual surveillance [128].

11.2 Security Personnel

The resort's safety infrastructure will be anchored by highly skilled security personnel. These employees will receive training in a variety of security procedures, such as incident response, access control, and guest screening. To guarantee prompt coordination and reaction to security incidents, they will also be outfitted with cutting-edge communication devices [129].

To make sure that security personnel are equipped to handle a variety of security scenarios, such as fire emergencies, medical emergencies, and criminal acts, regular security drills and training sessions will be held [130].

Regular crisis management training and drills will be conducted to ensure that all staff members are prepared to respond effectively in the event of an emergency. These drills will simulate various crisis scenarios, allowing staff to practice their roles, communication protocols, and evacuation procedures [131].

The resort will continue to work closely with the local law enforcement to guarantee a well-coordinated security strategy. It will be easier for the resort to prevent and handle security incidents if there is regular interaction and the sharing of information with local authorities [132].

By investing in staff training and preparedness, the resort will ensure that its workforce is equipped to handle a wide range of crises with professionalism, calmness, and efficiency [133].

11.3 Fire Safety

Strategic fire safety measures will serve as the foundation of the resort's immediate response plan. Staff members will receive regular fire drill training on evacuation protocols and extinguisher usage, ensuring timely and well-coordinated action in the unfortunate event of a fire [134].

The resort will put strict safety measures in place, such as installing sprinkler systems and smoke detectors in every room, to reduce the risk of fire. The risk of fire can be further decreased by performing routine maintenance and inspections on electrical equipment and wiring [135].

The entire resort will have a cutting-edge fire detection and alarm system installed to provide early notice of any possible fire hazard. The resort's central monitoring station will be integrated with this system, allowing emergency responders to be notified promptly [136].

Visual indicators will be placed strategically to alert guests and staff in the event of a fire, in addition to audible alarms, so that every person is made aware of the situation and can initiate the necessary action [137].

There will be a clear fire suppression plan in place that outlines the duties of personnel and emergency responders in the event of a fire. Firefighters will have quick access to water thanks to the resort's thoughtful placement of fire hydrants and hoses [138].

The evacuation routes shall be conspicuously marked and illuminated to guarantee a safe and orderly departure of guests and staff from the buildings. Employees will receive training on how to help guests with disabilities and make sure they leave safely [139].

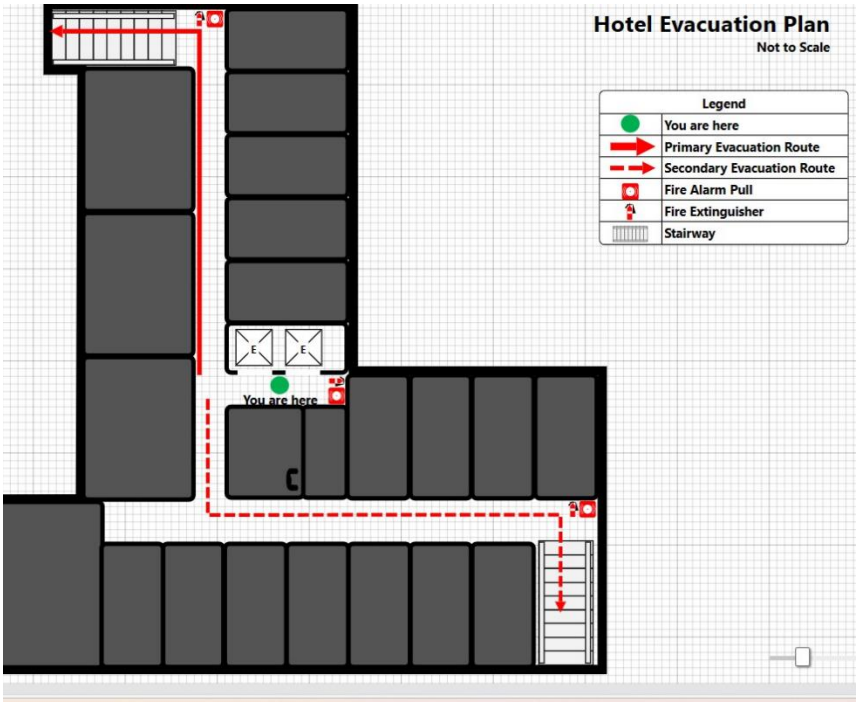

Figure 13: Resort's Emergency Exit Plan

11.4 Pool Safety

During the resort's period of operation, certified and trained lifeguards will be positioned at every pool area. These lifeguards will keep a close eye on everything occurring in the pool and react quickly to any possible emergencies or safety issues. Their presence will offer prompt assistance in the event of an incident and serve as a comforting reminder of the value of safety [140].

All pool areas will have strategically placed signage that is clear and concise and provides guests with important safety information. To ensure that visitors are informed and make responsible decisions while using the pools, these signs will include information on emergency protocols, depth restrictions, and pool rules [141].

11.5 Crisis Management

At the heart of the resort's crisis management strategy lies a robust risk assessment process. This process will involve identifying potential threats, such as natural disasters, security breaches, and reputational damage, and developing comprehensive mitigation plans to minimize their impact [142].

Regularly conducting risk assessments and updating mitigation plans will ensure that the resort is prepared to respond effectively to a wide range of crises, preventing or minimizing potential harm to guests, staff, and the resort's property [143].

Regular communication updates will keep all stakeholders informed of the situation, providing information, and addressing any concerns promptly. This open and transparent approach will foster trust and cooperation, ensuring that everyone is aligned in their efforts to resolve the crisis [144].

In the face of a crisis, timely and decisive action is crucial to minimize harm and restore normalcy. The resort's crisis management team will be empowered to make prompt decisions, drawing upon their expertise and experience to implement appropriate response measures [145, 146, 147]. This team will have access to all necessary resources and support, including security personnel, medical assistance, and legal counsel, ensuring that they can effectively manage the crisis and protect the resort's interests.

The resort will maintain strong relationships with external stakeholders, such as local authorities, emergency services, and insurance providers, to ensure a coordinated response in the event of a crisis. Regular communication and joint training exercises will foster collaboration and ensure that all parties are prepared to work together effectively [148, 149]. This network of support will provide access to additional resources, expertise, and assistance, further strengthening the resort's ability to navigate crises successfully.

12.COST

12.1 Cost Breakdown

The budget provided is 4 million dollars. The aim is to use US$ 3.8M, leaving US$233,800 as the cost of the unexpected cost as well as other miscellaneous things.

The main costs include:

Items	Price per unit ($)	Quantity	Total cost ($)
Land	400	2500 ft^2	1,000,000
Solar Panels	3000	200 panels	600,000
Wave energy converter	400,000	1 unit	400,000
Hempcrete	12	21 000 ft^3	252,000
Steel	800	15 metric ton	12,000
Recycled glass	300	180 large panes	54,000
Reclaimed wood	12	3000 kg	36,000
Jute	2	400 kg	800
Bamboo	2	700 kg	1,400
Ceramic	5	7000 tiles	35,000
Engineers	46,750	10 people	437,500
Architects	46,875	4 people	187,500
Laborers	15,000	50 people	750,000
Total			3,766,200

The secondary costs will include furniture, lighting, and other small items required to set up the resort and to make it fully functional.

To summarize, the cost distribution for the resort is as follows: an expenditure of 1 million on land, another 1 million on energy, around 1.4 million allocated to labor, and 400,000 designated for materials, resulting in a cumulative expenditure of 3.8 million.

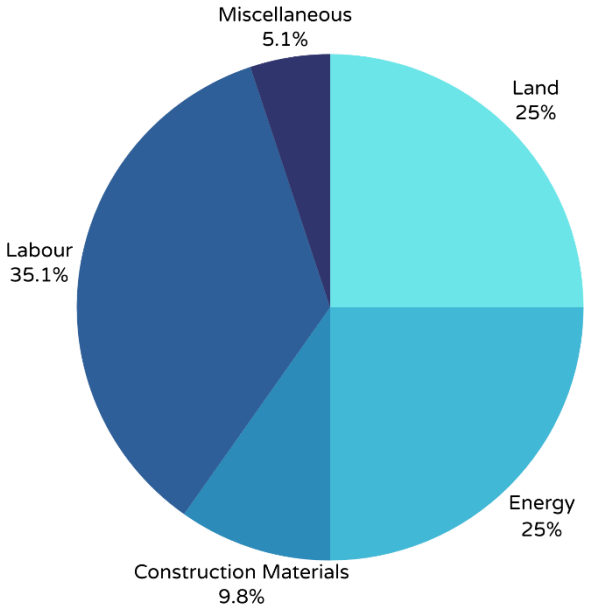

Figure 14: Breakdown of the budget

12.2 Cost Benefit Analysis

Creating a sustainable resort in Mexico offers several potential advantages, including economic growth, reduced environmental impact, and social benefits. This cost-benefit analysis aims to evaluate the financial feasibility and other associated benefits of establishing such a resort.

Costs

Initial Investment

- Land acquisition and infrastructure development.
- Procurement and construction of accommodations, facilities, and amenities.
- Implementation of sustainable technologies and practices.

Operational Costs

- Hiring and training staff skilled in sustainability practices.
- Maintenance and periodic upgrades to ensure sustainable practices continue.
- Ongoing costs for energy efficient systems, water conservation, waste management, and eco-friendly transportation.

Benefits

Economic

- Increased employment opportunities, benefiting local communities.
- Revenue from tourism, including accommodation, dining, and activities.
- Positive impact on local businesses, supporting sustainable development.
- Boosting the local economy through increased tourist spending.

Environmental

- Reduced carbon footprint due to sustainable construction practices.
- Conservation of natural resources through energy-efficient systems.
- Implementation of renewable energy sources, reducing dependency on non-renewable resources.
- Promotion of local biodiversity through responsible land use and conservation activities.

Social

- Enhanced community welfare through infrastructure development.
- Promotion of cultural exchange and preservation of local traditions.
- Improved local education and skills development opportunities.
- Enhanced community pride and civic engagement.

Analysis and Evaluation:

- Initial investment costs may be significant but can be offset by potential long-term revenue generation.
- Operational costs may be higher compared to conventional resorts, but increased energy efficiency and reduced resource consumption will lead to savings over time.

- Economic benefits such as increased employment, revenue, and local business support could outweigh initial costs.
- Environmental benefits are crucial in an era of increasing environmental concerns and can enhance the resort's reputation as an eco-friendly destination.
- Social benefits contribute to the overall sustainability and positive image of the resort, attracting environmentally conscious tourists.

Establishing a sustainable resort in Mexico presents initial investment costs and higher operational costs. However, the long-term financial gains, combined with environmental and social benefits, make it a viable and desirable venture. By prioritizing sustainability, the resort can contribute positively to the local community, environment, and the overall tourism industry in Mexico.

More information regarding the Cost Benefit Analysis can be found in Appendix B.

13.SUSTAINABILITY

13.1 Carbon Footprint

Carbon footprint is a measure of the total amount of greenhouse gases, such as carbon dioxide (CO_2), emitted directly or indirectly by any entity, be it individual or an organization [150, 151].

Calculating the carbon footprint is essential for accurately quantifying greenhouse gas emissions and understanding how sustainable alternatives can mitigate these impacts. It provides organizations with valuable insights into areas where efficiency is lacking and guides strategies for positive change.

The calculation of carbon footprint involves two primary subdivisions: Constructional and Operational footprint. The Constructional footprint addresses emissions stemming from the manufacturing of both exterior and interior materials [152].

On the other hand, the Operational footprint deals with the technical aspects of a resort. Emissions from these activities are further categorized into direct and indirect emissions. Direct emissions are linked to on-site activities such as human transportation and waste production. In contrast, indirect emissions are associated with the daily electricity consumption and the transportation of materials for the resort's construction. The emissions can be calculated using the formula, E = Activity Done * Carbon Emission per unit, where activity done may be the miles travelled by a vehicle, the kilograms of waste produced by the resort, etc.

The carbon footprint for Resort Itza was calculated first kg CO_2/unit and then converted into tonnes/year.

The operational carbon footprint assessment calculates direct emissions as follows: 2 kg CO_2/kg for waste disposal and 0.25 kg CO_2/km for autos. By applying emission factors, the total amount of direct emissions is 32.3 tons CO_2 per year. The calculation of indirect emissions yields an annual total of 76.5 tonnes CO_2 based on energy usage (0.4 kg CO_2 per kWh for 100 kWh) and material transport (1 kilogram CO_2 per kg for 100 km). When direct and indirect emissions are taken into account, the total operational carbon footprint is 108.8 tons CO_2 annually [152].

The total carbon footprint for interior materials, including reclaimed wood, bamboo, and ceramic, is 2.775 tonnes CO_2. For exterior materials, encompassing hempcrete, steel, glass, timber, and jute, the total carbon footprint is 810.043 tonnes CO_2. Combining both interior and exterior materials, the overall construction footprint is calculated to be 812.818 tonnes CO_2.

The total footprint comes up to 921.618 tonnes CO_2/year.

Detailed calculations can be found in Appendix C.

13.2 Ecological Footprint

The ecological footprint holds significance as it precisely measures the environmental impact of human activities and resource consumption. Through this calculation, we can properly understand the depth of our dependence on natural resources and ecosystems. Understanding the ecological footprint aids in efficient resource management, which further enables us to optimize resource use and prevent overconsumption. Overconsumption contributes to habitat destruction and loss of biodiversity, saving the planet begins with the seemingly insignificant step of ecological footprint calculation [153, 154, 155].

There are a total of 6 types of land which influence the value of ecological footprint, those being cropland, forest land, energy land, built up land, permanent pasture and marine or fishing ground. Each of these have their respective equivalence factors.

Built-up land, forest land, and energy land are the three components of the resort's ecological footprint analysis. Using the formula Built-up Land Footprint = Total Area × Equivalency Factor, the built-up land footprint is calculated, yielding a total area of 0.05039 gha. A total of 1.586 gha is obtained by computing the forest land footprint using the following formula: Forest Land Footprint = (Total Wood Used / Wood Production per hectare per year) × Equivalency Factor. Using the formula Energy Land Footprint = (Total Carbon Output / Carbon Uptake by Forests per hectare per year) × Equivalency Factor, the energy land footprint during operation is calculated, yielding a total of 25.024 gha. The total comes up to 213.60039 gha [156, 154, 153].

13.2.1 Built-up Land

Built-up land contributes to the ecological footprint by altering natural landscapes, reducing biodiversity, and increasing the demand for resources. It is crucial to calculate the ecological footprint of built-up land to understand its environmental impact. The conversion of natural land to built-up areas often results in increased resource consumption, energy use, and waste generation. Calculating the ecological footprint helps quantify the demands placed on ecosystems to support human activities in these developed areas.

It is given by the formula [Built-up Land = Total Area (in hectares) × Equivalence Factor]

13.2.2 Energy Land

Constructional Footprint

The construction footprint of energy land assesses the environmental impact of building infrastructure for energy production. It involves checking how many resources are required, the energy needed, emissions, and land changes when constructing energy projects.

It is given by the formula:

$$\text{Energy (Construction) Land} = \frac{\text{Total Carbon Output of resort during construction}}{\text{Uptake of Carbon by forests per hectare per year}} \times \text{Equivalence Factor}$$

Here the carbon uptake is given by the carbon absorbed by the surrounding Mexican forests per hectare.

Operational Footprint

The operational footprint of energy land refers to the ongoing environmental impact associated with the day-to-day activities and operations of energy-related infrastructure. It considers the sustained ecological effects resulting from the operational activities, maintenance, and energy production over time.

It is given by the formula:

$$\text{Energy (Operation) Land} = \frac{\text{Total Carbon Output of resort per year}}{\text{Uptake of Carbon by forests per hectare per year}} \times \text{Equivalence Factor}$$

13.2.3 Forest Land

Constructional Footprint

The constructional footprint of forest land refers to the impact of building or developing structures within or near a forest. This includes changes like habitat disruption, deforestation, soil erosion, and shifts in biodiversity due to construction [156, 154, 157, 158].

It is given by the formula:

$$\text{Forest Land} = \frac{\text{Total Wood Required}}{\text{Production of Wood per hectare per year}} \times \text{Equivalence Factor}$$

Detailed calculations can be found in Appendix D.

14.ETHICS

14.1 Public Safety

Throughout the construction process, the environment, workers, and the general public's safety will be of the utmost importance, as outlined in the Engineers Australia Code of Conduct. This dedication will consist of:

Respect for Building Codes and Safety Standards: To guarantee the resort facilities' structural integrity, safety, and accessibility, all construction operations will closely abide by the applicable building codes, safety rules, and industry standards [159].

Thorough Risk Assessment and Management: To identify and reduce potential hazards during the construction process, in-depth risk assessments will be carried out. There will be frequent safety inspections, and suitable safety precautions like emergency protocols, hazard warning signs, and personal protective equipment will be put in place [160].

Safe Working Conditions: Priority will be given to creating a safe and healthy work environment. This entails putting in place the proper safety precautions, carrying out routine checks, and educating employees on how to avoid mishaps and injuries. There will be a dedicated security manager on site to supervise safety protocols and swiftly handle any issues [161].

14.2 Integrity & Responsibility

Throughout the project, ethical engineering practice will be based on the principles of integrity and professional responsibility, as outlined in the Engineers Australia Code of Conduct. This commitment will consist of:

Accountability and Transparency: All parties involved in the project, including clients, authorities, and the public, will be kept informed about its status, possible hazards, and any problems that may occur in an open and transparent manner [159, 162].

Conflict of Interest Avoidance: Engineers working on the project will declare any possible conflicts of interest and stay out of circumstances that might impair their objectivity or professional judgment [159, 163].

Honesty and Accuracy in Reporting: When it comes to all project-related reports, calculations, and technical documentation, engineers will uphold the highest standards of honesty and accuracy [159, 164].

14.3 Ethical Labor

Tight adherence to fair labor standards will serve as a guide for the resort's construction. This pledge will cover the following:

Respect for Labor Laws: Every employee will have a valid job, guaranteeing that they get paid overtime, the minimum wage, and other benefits required by Mexican labor laws. There will be frequent audits to ensure adherence to labor regulations and legislation. [165]

Prioritizing Local Hiring: Employing people from the area, creating job opportunities, and advancing Holbox Island's economy will all be given top priority. To improve the employability of locals, hiring fairs will be held and skill development courses will be provided. [165]

Respectful Workplace: To ensure that employees are treated with dignity, have their rights upheld, and are not subjected to harassment or discrimination, a respectful and inclusive workplace culture will be promoted. There will be a grievance procedure in place to enable employees to voice any problems or worries without worrying about facing consequences. [166]

14.4 Minimizing Environmental Impact

To minimize its impact on the island's fragile ecosystems, the construction process will be carried out with the utmost respect for Holbox Island's pristine environment. This pledge will consist of:

Adopting Sustainable Construction Practices: Throughout the project, eco-friendly building techniques and supplies will be used, lowering the resort's carbon footprint, and protecting natural resources. Prioritization will be given to energy-efficient technologies, water conservation measures, and the use of recycled and renewable materials [167].

Putting a Comprehensive Waste Management Plan into Practice: This will reduce the amount of waste produced, encourage recycling, and reuse of waste, and make sure that hazardous materials are disposed of properly. To find ways to reduce waste and ensure environmental regulations are being followed, regular waste audits will be carried out [168].

Preserving Wildlife Habitats and Sensitive Ecosystems: During construction, sensitive ecosystems like mangrove forests and coral reefs will be protected. By carefully planning construction sites, reducing noise and disturbance, and putting precautions in place to avoid encountering wildlife, wildlife habitats will be preserved [136].

By adhering to the principles of the EA Code of Ethics, emphasizing public safety, integrity, and sustainability, the resort will demonstrate its commitment to ethical engineering practice, leaving a positive on the island. It will not only be a place of leisure and relaxation for guests, but also a model of sustainable and responsible development, showcasing the power of engineering to create a harmonious future for Holbox Island, and consequently, the entire world.

15.CONCLUSION

This report set out to pursue a sustainable and economical resort to be constructed in a profitable developing economy in a way that it could meet the client’s requirements.

The resort's unique design blends seamlessly with the natural beauty of Holbox Island, creating a captivating destination that not only offers a luxurious retreat but also contributes positively to the island's environment and community. The resort's legacy is one of responsible development, ethical practices, and a commitment to preserving the island's precious heritage for future generations.

The resort prioritized sustainability in its design, incorporating eco-friendly practices wherever feasible. Although some unsustainable materials were unavoidable due to limited alternatives, the resort maintains a notably lower overall carbon footprint compared to similar-sized conventional resorts.

To optimize revenue, the resort provides a wide range of premium amenities, such as infinity pools, a cutting-edge fitness center, and convenient beachfront access. Every detail of the resort's design and operation was meticulously planned to align with the client's vision while ensuring optimal cost-effectiveness.

The resort, shaped like the architectural grandeur of Chichen Itza, stands as a testament to the power of ethical construction practices, effective communication, and a commitment to sustainability. Guided by the principles of the EA Code of Ethics, a comprehensive crisis management strategy, and an extremely detailed cost analysis, the resort's construction will result in a unique and captivating destination while preserving the delicate ecosystems of Holbox Island.

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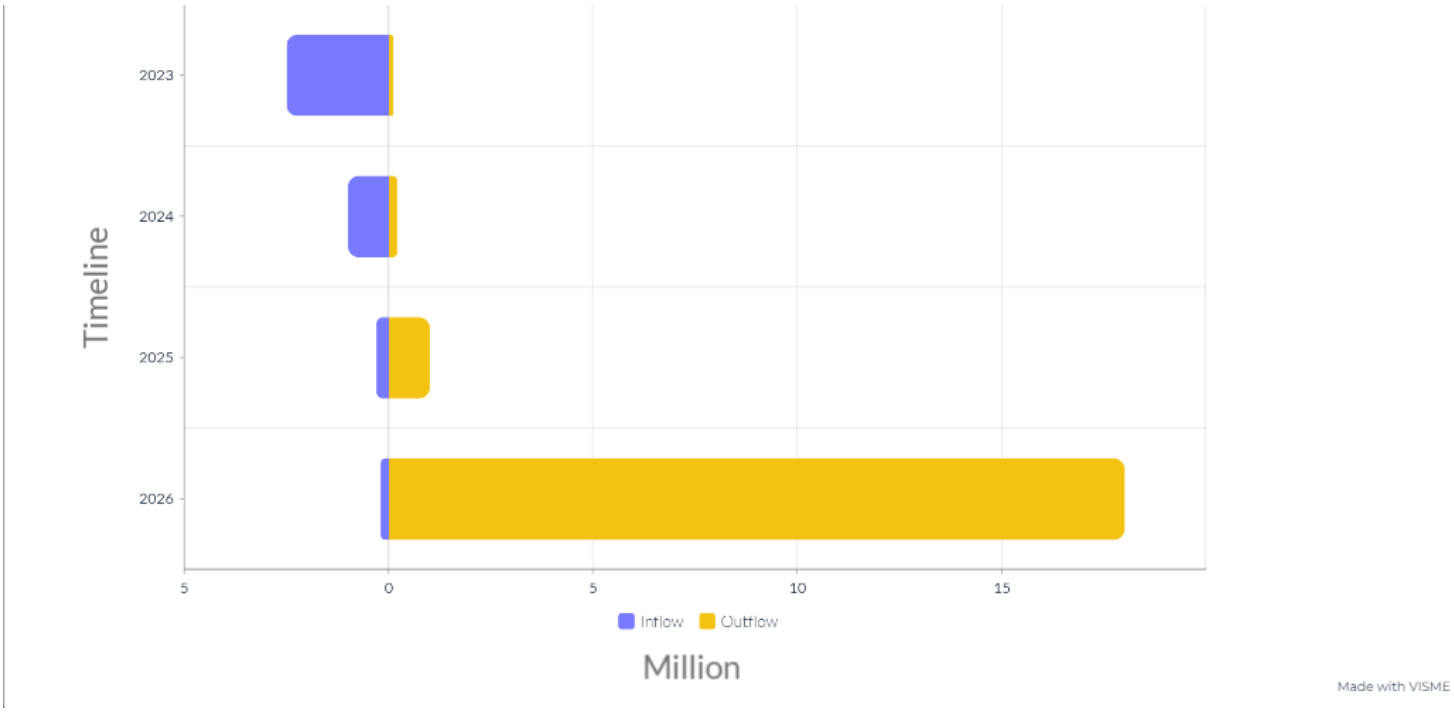
APPENDIX

A. Environmental Impact Assessment

Environmental Factors	Building Material Alternatives	
	Hempcrete	**Concrete**
1. Physico-chemical Environment	**Weightage: 0.3**	
a. Earth	+1	-1
b. Water	+1	-1
c. Atmosphere	0	-1
d. Processes	0	0
Weighted Total Impact Scores	**0.6**	**-0.9**
2. Biological Environment	**Weightage: 0.2**	
a. Flora	0	0
b. Fauna	+1	0
Weighted Total Impact Scores	**0.2**	**0**
3. Socio-Economic Environment	**Weightage: 0.2**	
a. Land Use	+2	-1
b. Recreation	+2	-1
c. Aesthetics and Human Interest	+2	0
d. Cultural Status	+1	+2
e. Constructed Facilities and Activities	0	0
Weighted Total Impact Scores	**1.4**	**0**
4. Ecosystem	**Weightage: 0.3**	
a. Salination of water resources	0	0
b. Disease-insect vectors	0	0
c. Food chains	0	0
d. Salination of surficial material	+1	+1
e. Brush encroachment	0	0
Weighted Total Impact Scores	**0.3**	**0.3**
Total Score	**2.5**	**-0.6**

B. Cost-Benefit Analysis



C. Carbon Footprint

Construction Footprint

Interior Materials

Emission Source	Emission Factor (kg CO_2/unit)	Quantity	Carbon Footprint (tonnes CO_2)
Reclaimed Wood	0.45	3 tonnes	1.35
Bamboo	0.75	0.7 tonnes	0.525
Ceramic	4.5	200 pieces	0.9

Exterior Materials

Emission Source	Emission Factor (kg CO_2/unit)	Quantity	Carbon Footprint (tonnes CO_2)
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 Carbon Footprint (tonnes CO_2)			**812.818**

Operational Footprint

Direct Emissions

Emission Source	Emission Factor (kg CO_2/unit)	Quantity	Carbon Footprint (tonnes CO_2/pa)
Vehicles	0.25/km	100 km	25
Waste Disposal	2/kg	10 kg	7.3

Indirect Emissions

Emission Source	Emission Factor (kg CO_2/unit)	Quantity	Carbon Footprint (tonnes CO_2/pa)
Electricity	0.4 / kWh	100 kWh	40
Material Transport	1 / kg	100 km	36.5
Total Annual Carbon Footprint (tonnes CO_2)			**108.8**

D. Ecological Footprint

Built Up Land

Built-up Land = Total Area (in hectares) × Equivalence Factor

Total Area used for resort = 2500 ft^2 = 0.02322576 ha

Equivalence Factor = 2.17 ($^{gha}/_{ha}$)

Built-up Land Footprint = 0.02322576 × 2.17 $^{gha}/_{ha}$ = **0.05039 gha**

Forest Land

$$\text{Forest Land} = \frac{\text{Total Wood Required}}{\text{Production of Wood per hectare per year}} \times \text{Equivalence Factor}$$

Total wood used for resort = 9525 kg = 9.52 tonnes

Production of wood per hectare per year = 8.1 tonnes

Equivalence Factor = 1.35 ($^{gha}/_{ha}$)

Forest Land Footprint = $\frac{9.52}{8.1}$ × 1.35 $^{gha}/_{ha}$ = **1.586 gha**

Energy Land

Operational Footprint

$$\text{Energy (Operation) Land} = \frac{\text{Total Carbon Output of resort per year}}{\text{Uptake of Carbon by forests per hectare per year}} \times \text{Equivalence Factor}$$

Total carbon output of resort per year = 133 tonnes

Carbon Uptake of Mexican Forests per hectare per year = 0.714 tonnes

Equivalence Factor = 1.84 ($^{gha}/_{ha}$)

Energy Land Footprint = $\frac{133}{0.714}$ × 1.84 $^{gha}/_{ha}$ = **342.7451 gha**

Constructional Footprint

$$\text{Energy (Construction) Land} = \frac{\text{Total Carbon Output of resort during construction}}{\text{Uptake of Carbon by forests per hectare per year}} \times \text{Equivalence Factor}$$

Total carbon output of resort during construction = 812.818 tonnes

Carbon Uptake of Mexican Forests per hectare per year = 0.714 tonnes

Equivalence Factor = 1.84 ($^{gha}/_{ha}$)

Energy Land Footprint = $\frac{812.818}{0.714}$ × 1.84 $^{gha}/_{ha}$ = **2094.657 gha**

Total Ecological Footprint = 0.05039 + 1.586 + 342.7451 + 2094.657 = 2439.046 gha

CONTRIBUTION TABLE

1	Introduction	Taha
2	Client Research	Taha
2.1	Background	
2.2	Requirements	
2.3	Target Audience	
3	Cultural Features	--
3.1	Wildlife	Leen
3.2	Infrastructure & Arts	
3.3	Architecture	
3.4	Tourism	Taha
4	Site Analysis	--
4.1	Location of Resort	Taha
4.2	Climate	
4.3	SWOT Analysis	Leen
5	Construction Materials	Taha
5.1	Exterior Materials	
5.2	Interior Materials	
6	Architecture	Leen
6.1	Exterior Design	
6.2	Interior Design	
7	Construction	--
7.1	Construction Techniques	Neha
7.2	Challenges & Solutions	
7.3	Communication to the Site	Taha
7.4	Environmental Impact Assessment	Leen, Taha
8	Energy	--
8.1	Energy Requirements	A. Hadi
8.2	Solar Energy	
8.3	Wave Energy	
8.4	Backup Power Sources	Caleb
9	Building Services	Taha
9.1	Guest Services	
9.2	Dining	
9.3	Communications	
9.4	Laundry & Dry Cleaning	
9.5	Lighting	Taha
9.6	Elevators	
9.7	HVAC	

9.8	Electricity		
9.9	Water & Plumbing		
9.10	Maintenance		
10	Waste Management		Neha
10.1	Construction Waste		
10.2	Operational Waste		
11	Safety & Security		Taha
11.1	Surveillance & Access Control		
11.2	Security Personnel		
11.3	Fire Safety		
11.4	Pool Safety		
11.5	Crisis Management		
12	Cost		A. Hadi
12.1	Cost Breakdown		
12.2	Cost Benefit Analysis		
13	Sustainability		Caleb
13.1	Carbon Footprint		
13.2	Ecological Footprint		
13.2.1	Built-up Land		
13.2.2	Energy Land		
13.2.3	Forest Land		
14	Ethics		
14.1	Public Safety		Taha
14.2	Integrity & Responsibility		
14.3	Ethical Labor		
14.4	Minimizing Environmental Impact		
15	Conclusion		Taha
Citations			--
Appendix			--

Editing, polishing and refining: Taha

Floor Plans

- Rooms: Leen
- Fire Exit: Leen
- General Floor Layout: Leen
- Rooftop: Neha
- Ballroom: Neha
- Ground Floor Lobby: Neha