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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:

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4. All team members are aware of the late submission policy and penalty.
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Place compressed photo of your structure or team here (optional)

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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

Keeping this in mind, we are going for a sustainable seaside resort which aims to be sustainable all throughout its lifecycle, from its construction to its 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, our 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 Client Background

Our 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 has to be generated for these materials. He recently wanted 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 Client Needs

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.

The client also requires that the resort displays, through its design choices, the diversity and the 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 Client's 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

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]

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.

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.[3]

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 the majority 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.[4]

3.4 Tourism

As of 2017, Mexico was the 6th most visited country in the world [5] and had the 15th highest income from tourism in the world which is also the highest in Latin America.
The vast majority of tourists to Mexico come from the United States and Canada, followed by Europe and Asia. A small number of tourists also come from some Latin American countries.[6]
Mexico is the 40th most visited country in the world as of 2021.[7]

4. SITE ANALYSIS

4.1 Location of Resort

The resort is located on Holbox island in the Quintana Roo state on the Yucatán Peninsula [8]. The island has an area of around 55,948 km^2.[9] The island is characterized by its long beaches and rich birdlife [10]. 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. [11]

Our 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. [8]

Our resort will be built on a site that has an area of around 230 m^2. [12]

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. [13]

Holbox'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. [14]

4.3 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.

4.4 Weakness

The area already has resorts established, so it may be harder to break into the market. [15]

The close 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.

4.5 Opportunities

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

The resort is made out of materials that can be reused and recycled if the resort ever shuts down.

4.6 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.[16] Despite this, Mexico still has a great tourism economy, which should not affect the resort in any way.[7]

5. CONSTRUCTION MATERIALS

5.1 Materials for Exterior

Hempcrete

The term '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' (vapour permeable), and insulating material that can be used to construct walls, floor slabs, ceilings, and roof insulation in both new construction and restoration projects. [17,18]

Usage

Hempcrete is widely used in our project. The entire structure of the resort is made using hempcrete as it is more sustainable than concrete.

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.[19]

Laboratory and field 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.[20]

Usage

Steel would be absolutely vital in almost every aspect of the construction, primarily supporting rebar for concrete and in a variety of different machinery for heating, water, etc.

Recycled Glass

Glass is made from raw materials found in nature such as sand, soda ash and limestone, as well recycled glass (known as cullet).[21] However, we will be using recycled glass as it is more sustainable, considering it is being repurposed from other older pieces of glass.

Usage

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

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. [22,23,24]

Usage
Timber is an easy resource to find in Mexico with a plethora of available sellers and local businesses. Our main use of timber will be in the huts as well as the hotel bar located close to the beach.

Jute
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. [25]

The tree matures extremely quickly (4 to 6 months), thus bringing significant yields to the planted area. This makes jute a renewable material. This growth efficiency means we need less land to grow jute compared to other crops; therefore, we do not need to expand and encroach on natural habitats and ecosystems with our agricultural efforts. [25]

Usage
Jute's usage is mainly aimed towards curtains and roof coverings for the beach restaurants.

5.2 Materials for Interior

Reclaimed Wood
Reclaimed wood is known to be highly durable and aged. It is old lumber that has been recycled for new projects. One of its main characteristics is that it is eco-friendly. That's a benefit as it decreases demand for new lumber, which reduces the number of trees cut. Reclaimed wood can be expensive because of the long procedures to repurpose of the older wood. One main reason for its high cost is its rarity. Reclaimed wood is used in factories, old barns, wooden ships, and warehouses. [26,27]

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

Bamboo

Bamboo is known to be found naturally in Mexico. Bamboo is the fastest growing plant growing up to 4cm in an hour. They can be expensive, but they are viewed as a premium product that is stronger than hardwood. Bamboo has relatively the highest compressive strength (ability for material to resist forces). Using bamboo can form an aesthetic called 'rustic'. Nowadays, bamboo is used in architecture, landscape, furniture, and for fishing poles. In Japan bamboo is used for garden fences.[28]

Usage

The chairs and interior design of the room are the main places where bamboo will be used in the resort.

Ceramic

Ceramic is known for its hardness and strength (as it has silicate and sand content) 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. Cooking utensils or carrying water or even in weddings and funerals ceramic is used. Gas turbine engines, dental implants, and synthetic bones all contain ceramic. In our daily life ceramics can be everywhere around us like our kitchen.[29]

Usage

Ceramic will be used in the swimming pool and in our bathroom floors and the walls of the shower box.

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 taking into account all factors relevant to sustainability. The design has also been chosen to represent the cultural features of the area it is in.

We have tried our best to ensure that the resort is spacious enough to include several activities while still being easy to maintain.

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.

Based on a broad reference, the construction waste generated in Mexico is assumed to be about 14,000 tons of construction and demolition (C&D) waste.[30] Through our resort, we will minimize wastage and we will advocate the use of more recyclable, reusable, and sustainable materials in Mexican architecture.

Figure 1: The Chichen Itza, which has inspired the shape of our resort.[31]

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, so as 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.

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.

6.2 Interior Design

Floor plan

The resort will be 10 floors apart from the ground floor. Floors 1 – 4 will be standard hotel rooms. Floors 5 – 7 will be executive suites. Floor 8 will be a gym and a game room. Floor 9 will be a ballroom. Floor 10 will be an infinity swimming pool with a gym.

The ground floor will consist of the lobby, having 2 entrances/exits. One of the doors will be towards the beach, while the other is towards the road. The elevator shaft will be placed in the middle of the lobby, as it is the most suitable place for all the floors considering the sloping nature of our resort.

Aesthetics

The aesthetics of the rooms will be calm and soothing to make our guests feel relaxed. The lighting in and around the hotel will have dim warm colors.

The hallways will be adorned with cultural art and paintings.

Materials
The materials planned for the interior are:

Bamboo: Bamboo will be used for decorative purposes within the room, as well as to make comfortable chairs to sit in.

Reclaimed wood: This material will mainly be used to create the beds and wardrobes, as well as the doors.

Ceramic: Ceramic will be used inside the bathrooms for the walls and the basin.

7. ENERGY SOURCES

7.1 Solar

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.

Solar power works by converting energy from the sun into power. There are two forms of energy generated from the sun for our use – electricity and heat. Both are generated through the use of solar panels, which range in size from residential rooftops to 'solar farms' stretching over acres of rural land.

Solar panels are usually made from silicon, or another semiconductor material installed in a metal panel frame with a glass casing. When this material is exposed to photons of sunlight (very small packets of energy) it releases electrons and produces an electric charge.

This PV charge creates an electric current (specifically, direct current or DC), which is captured by the wiring in solar panels. This DC electricity is then converted to alternating current (AC) by an inverter. AC is the type of electrical current used when you plug appliances into normal wall sockets. [32,33,34,35,36]

Usage
In our resort we will be mainly using solar power by placing solar panels on our building as well as building a solar panel farm to gain the maximum amount of energy.

7.2 Hydro-electric Power

Hydropower, or hydroelectric power, is one of the oldest and largest sources of renewable energy, which uses the natural flow of moving water to generate electricity. Hydropower currently accounts for 28.7% of total U.S. renewable electricity generation and about 6.2% of total U.S. electricity generation.

At hydropower plants water flows through a pipe, or penstock, then pushes against and turns blades in a turbine that spins to power a generator to produce electricity. Conventional hydroelectric facilities include Run-of-the-river systems, where the force of the river's current applies pressure on a turbine.[37]

Usage
We will place linked cylindrical generators, each about the size of a train car, that will wriggle back and forth in the waves. A resistance system inside each section generates electricity.

7.3 Biogas

Biogas is a renewable and clean source of energy. It is non-polluting and uses gas produced from organic waste such as food scraps and animal manure as a form of energy, so it's a great way to counter the effect of LPG cylinders.

The biological matter that is used to produce biogas will naturally decay anyway, so using the gases produced by this decomposition, and using them as an energy source, causes less harm to the environment than allowing them to escape into the atmosphere.

Biogas byproducts include organic digestate, which is a good substitute for chemical fertilizer. This will greatly accelerate plant growth without any toxic effects. Biogas generation may improve water quality as anaerobic digestion deactivates pathogens and parasites. [38,39,40]

Usage
Organic waste taken from the kitchen would reduce both the waste management costs and our carbon footprint. Over 150 to 200kg of food waste can be processed in a single day through vermicomposting.

Biogas tanks can easily be set up and connected to the resort kitchens, where they will be used almost exclusively for cooking, the waste produced would be put back into the tanks.

7.4 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 as long as 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 fairly 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. [41,42,43]

8. WASTE MANAGEMENT

8.1 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. [44]

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. [45]

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

"Hormesa" will be tasked to recycle metal waste. [46]

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. [47]

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.

8.2 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.

8.3 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.

8.4 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 soap bars are sold in countries where there is a lack of accessibility of personal hygiene products. [48]

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