

SHARK AQUALIFE RESEARCH COMPLEX

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Abstract

Sharks play a vital role in maintaining the stability of the oceans and their ecosystems. However, there are many fisheries operating along the Red Sea coast in Saudi Arabia that have caught sharks and offered them for sale. This has caused an imbalance in the Red Sea ecosystem as the shark population are in danger of extinction. The government's vision for 2030 therefore aims to empower shark conservation through the establishment of research center. Thus, this work presents the development of Shark Aqualife Research Complex in Jeddah, Saudi Arabia. Three case studies related to the marine research center have been analysed in this work. Based on the analysed case studies, for the proposed research complex, the estimated gross floor area is 2954.64 m². The research complex is comprised of several zone, such as main entrance, research center, awareness center, diving station, restaurant, and administration and business center. In this work, two potential sites were proposed for the development. Based on the site evaluation analysis, site 2 attained the highest score of 61 and it was selected as the proposed development site. The architectural design of the research complex is based on the shape of a shark. This research complex is expected to enhance the conservation of sharks in the Red Sea and also enhance the tourism and economy of Saudi Arabia.

Keywords-- sharks, marine life, ecosystem, research center, Saudi Arabia

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INTRODUCTION

Sharks are a significant part of the marine environment. Most of these shark species are moderately contrasting compared to other marine fishes [1]. They are believed to be seemingly perpetual and to have low conceptual rates, and therefore likely to be the most crucial segments of the ocean biological system [2].

Sharks have a crucial role to play in preserving the health of the ocean. Several species of the sharks are natural predators, contributing to control habitat abundance and diversity while preserving an ecosystem equilibrium of the ocean life [3].

Furthermore, studies have shown that the removal of sharks can have an impact on food chain cascades [4]. Sharks usually live a long life, develop steadily and breed less than many other marine species.

Such features make them vulnerable to overexploitation, and several shark species globally are in danger [5]. In addition, around the globe, habitat losses have been recorded in many shark species, mainly due to fisheries activities and habitat destruction over the last decade [6]. Nevertheless, the implications of these changes on the ecological structure and function remain sceptical [6].

There are many fisheries operating along the Red Sea coast of the Kingdom of Saudi Arabia (KSA). The work of Spaet and Berumen [7] reported that sharks are caught by these fisheries and some of the rare shark species are offered for sale. Despite the apparent concern about the current status of KSA Red Sea shark populations, which resulted in a royal decree prohibiting all shark-fishing activities, there is a serious lack of awareness of the sustainable exploitation of marine resources in general and sharks in particular [8].

Sharks are ambassadors of the ocean, and it is therefore important to teach new generations about the importance of conserving of these species. In line with the vision of Saudi

Arabia for 2030 [9], the empowerment and advancement of shark conservation through the establishment of research centers will help to spread awareness to society. Therefore, this work presents the development of Shark Aqualife Research Complex in Jeddah, Saudi Arabia.

CASE STUDIES

This work has analysed three case studies related to marine research center. The details of the case studies is presented as follow:

- Okinawa Churaumi Aquarium
- King Abdullah University for Science and Technology
- NOAA Southwest Fisheries Science Center

Okinawa Churaumi Aquarium

Okinawa Churaumi Aquarium is located at Motobu, Okinawa, Japan (Figure 1). This building was designed by architect Yukifusa Kokuba. The footprint of the building is 10000 m². The building structure is comprised of 4 story steel reinforced concrete.

The aquatic center consists of four stories, with deep sea animal pools, whales, sharks, reef and exotic fish. The Okinawa Churaumi Aquarium was built with an entrance of the building on the third level, an aquarium on the fourth level and a display room on the first and second levels.

The aquarium is divided into four zone, which are invitation to the great sea (37%), journey to a coral reef (16%), journey to the "Kuroshio" (34%) and journey into the deep sea (13%). The first zone has main entrance, event hall and restaurants. The second zone has touch pool and exhibition area. The third zone has indoor theater, research lab, and aquarium area. The fourth zone has an exhibition area and an aqua lab. This aquarium is one of the largest aquarium in the world and it is Japan's best aquarium center.



Figure 1. Okinawa Churaumi Aquarium

King Abdullah University for Science and Technology

King Abdullah University for Science and Technology (KAUST) is located at Thuwal, Saudi Arabia (Figure 2). It was designed by Hellmuth, Obata, and Kassabaum Architects. The building was constructed with recycle materials. The Red sea research center is located right on campus. The Red Sea Research Center has an open office and a laboratory. The offices are located in the middle and have a shared lab. The labs include a cold room, a sterilized room for the preparation room and a dirty hallway. In addition, the sea labs have dry labs, outdoor and indoor wet labs. It also has a dark room designed to simulate deep-sea conditions and a quarantine facility for insulation and treatment of diseased or stressed organisms, which underwent experimentation. Wet lab facilities are also supported by a special-purpose indoor facility, which includes a food preparation room, two specimen labs, an environmental room, a multipurpose room and two walk-in refrigerator/freezer compartments for high-volume sample storage. The space distribution of the Red Sea research center consists of offices (47 %), a research lab (48 %) and a meeting room (5 %). The space distribution of sea labs is comprised of offices (20%), wet labs (40%) and dry labs (40%).



Figure 2. King Abdullah University for Science and Technology.

NOAA Southwest Fisheries Science Center

NOAA Southwest Fisheries Science Center is located at La Jolla, California (Figure 3). This center was designed by architect Gould Evans. The construction area of this center is 124,000 square feet. The center is comprised of offices, laboratories, conference rooms, parking, a huge 528000 gallon tank, green spaces and terrace. The center includes a development tank, electrical equipment and parking at the basement level. Furthermore, the engineering tank is also situated on the first level, with laboratories and a public lobby. In addition, the second floor has a library and an office where people can do their research. The third floor includes laboratories and research

offices, as well as a conference room for lectures. The space distribution of this center is comprised of offices (34%), laboratory (33%), technology tank (17%), library (8%) and conference room (8%).



Figure 3. NOAA Southwest Fisheries Science Center

PROGRAM ASSUMPTION AND SPACE DETAILS

For the proposed Shark Aqualife Research Complex, the estimated gross floor area is 2954.64 m². Based on Table 1, the research complex is comprised of few zones, such as main entrance, research center, awareness center, diving station, restaurant, and administration and business center.

Table 1. Space details

Zone	Gross floor area (m ²)
Main entrance	406.8
Research center	975.84
Awareness center	722.4
Diving station	325.2
Restaurant	321.6
Administration and business center	202.8
Total	2954.64

PROPOSED SITE

Proposed site: Site 1

For site 1 (Figure 4), this site is located in the Almorjan neighbourhood on the western side of Jeddah, Saudi Arabia. It's close to Corniche Road, which is one of Jeddah's main roads. It can be accessed from the street of Qutam bin Abbas. The site has an area of 10000 m².

Proposed site: Site 2

Site 2 (Figure 5) is located in the Al Ruwais neighbourhood, on the western side of Jeddah, Saudi Arabia. It can be reached from Corniche Road, which is one of the main roads in Jeddah. The site has an area of 19200m².



Figure 4. Site 1



Figure 5. Site 2

SITE EVALUATION AND ANALYSIS

Two sites were proposed for the development of Shark Aqualife Research Complex. Therefore, in order to determine the most suitable site, both sites were evaluated using site evaluation analysis. The analysis was done based on few criteria's, which are location, accessibility, utilities, security and safety, surrounding, and shark intensity. In addition weighting factor (WF) were used in the evaluation analysis for each criteria, where 1 = not very important, 2 = somewhat important, 3 = important, 4= very important and 5= essential. The evaluation results is shown in Table 2. Based on the results in Table 2, site 2 exhibited the highest evaluation score of 61, compared to site 1 with evaluation score of 50. Thus, site 2 is selected as the proposed development site.

Table 2. Site evaluation.

Criteria	Weighting factor (WF)	Site 1	Site 2
Location	5	25	25
Accessibility	3	6	9
Utilities	2	2	2
Security and safety	3	9	9
Surrounding	2	4	4
Shark intensity	4	4	12
Total	-	50	61

The site is accessible by arterial street, which is Al-Andalus Street. The main street is Corniche road. The traffic flow surrounding the site is smooth during off peak hours and slightly congested during peak hours. The site is close to the Saudi flag roundabout and is surrounded by residential and commercial buildings. In terms of climate, the warmest months during the day are June, July and August. The coldest months (with the lowest average low temperature) during the night are January and February (21 ° C). Furthermore, the month with the highest relative humidity is October (65%). The month with the lowest relative humidity is July (53%). Likewise, the month with the highest daily sunshine is May and the month with the highest wind speed is February.

PROJECT DESIGN

The Shark Aqualife Research Complex is comprised of 3 main zone with different functions. The zones are research center (private zone), awareness center (public zone) and diving station (semiprivate zone). Furthermore, the research complex has incorporated shared spaces to allow interaction between users. For the research center, the division is entrance (4%), laboratory (28%), open offices (59%), and services (9%). For the awareness center, the division is entrance (1%), exhibition(47%), lounge (9%), hall (35%) and services (8%). For the diving station, the division is diving area (28%), services(35%), training spaces

(28%), and equipment room (9%). The exterior design of the research complex is designed based on the shape of a shark. The building is designed to have a constant connection with the sea. Furthermore, straight line and edges were used to create narrow paths for cross ventilation. Furthermore, different heights and mass overlapping were incorporated in the building design to create more shaded area. In addition, the walls of the research center were build based on glazing method that utilized rough and smooth materials as shading elements. In terms of facilities, for the awareness center, it is comprised of aquarium, touch pool, interpretive exhibition, digital interaction, and coastal interaction. For the research center, the facilities include research space, auditorium, laboratory, and support systems. For the diving station, the facilities include diving area, equipment storage area, changing area and also service area. Figure 6 to Figure 9 shows the architecture design of the proposed Shark Aqualife Research Complex.

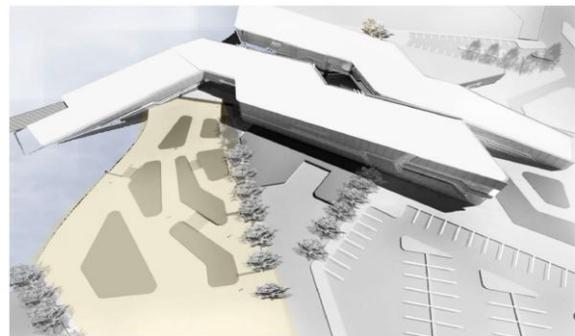


Figure 6. Overview of Shark Aqualife Research Complex.

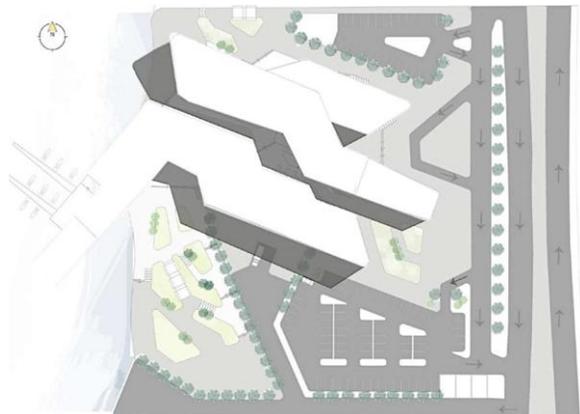


Figure 7. Topview of Shark Aqualife Research Complex.



Figure 8. Floor plan of Shark Aqualife Research Complex.

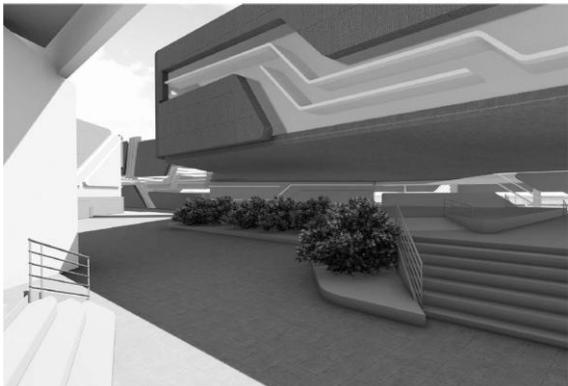


Figure 9. Outdoor of Shark Aqualife Research Complex.

CONCLUSION

This work has presented the development of Shark Aqualife Research Complex at Jeddah, Saudi Arabia. The estimated gross floor area for the research complex is 2954.64 m². Furthermore, the research complex is comprised of few zones, such as main entrance, research center, awareness center, diving station, restaurant, and administration and business center. The development of Shark Aqualife Research Complex is expected to provide a world-class facility that focuses on the preservation of sharks. In addition, this research complex will be a key platform that organizes exhibited that would enhance the conservation awareness among the Saudi Arabia community. Furthermore, this research center will enhance the tourism industry and cultivate the economy of Saudi Arabia by attracting local and international visitors.

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