

AQUATIC RESEARCH AND EDUCATION CENTER

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Received: 12.04.2020

Revised: 11.05.2020

Accepted: 08.06.2020

Abstract

The proposed project is a Red Sea marine research center located in Jeddah, Saudi Arabia. The project will serve three main functions: 1) Scientific; with the research center 2) Educational; with facilities for the already existing College of Marine Sciences in King Abdul-Aziz University in Jeddah 3) Public/Social; with the diving center, exhibition area, restaurant, and open interactive spaces provided for the public. The research center will provide scientists with state-of-the-art labs to help them conduct extensive research, discover new findings, document and protect existing marine life, and raise awareness on impending dangers. Students and faculty from the College of Marine Sciences in KAU would also benefit from the center as it would present them with great facilities and live interactions that would help further their studies. The diving center would act as the element that attracts the public to the project; it will provide the necessary means to discover what's beneath the sea. During public exhibitions, families and children would be able to attend and learn about up-to-date Red Sea issues, all while interacting and having a good time.

Keywords--Aquatic Research, Education Center, Scientific, Educational, Public/Social

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DOI: <http://dx.doi.org/10.31838/jcr.07.08.61>

INTRODUCTION

Oceans cover 71% of the earth's surface, yet it has been estimated that only 5% of the oceans have been explored [1, 2]. In order to enhance and ensure the longevity of sea life and human life, things need to change. Scientists have always had a need to uncover the unknown, from ancient mysteries to outer space discoveries, however, marine and underwater exploration haven't had their fair share of study and research yet. With all the increasingly alarming marine-related concerns that are witnessing nowadays from pollution, coastal development ramifications, and marine life extinction, it has become more important than ever to really build an understanding of the oceans and what needs to be done to protect them [3]. Today's vast advances in technology and science really give researchers and scientists great opportunities to dive into the world of seas, oceans, and anything marine related and opens up boundless doors of knowledge [4, 5].

The Red Sea is one of the richest and most bio-diverse bodies of water on earth. The alarming number of Red Sea dangers today urges the need to raise public awareness on some of the issues, by providing exhibition and public interaction spaces [6, 7]. However, it unfortunately lacks a state of the art marine research center. Jeddah being one of the major cities strategically located on the Red Sea's coast gives it the critical responsibility of protecting the Red Sea's unique marine life and discovering its immense hidden treasures that lie beneath.

CASE STUDIES

Several similar marine related research centers are considered as the case studies in order to examine the design concept and its unique features. The chosen research centers are Bali Marine Research Center and Interconnected Volcanoes Marine Research Center, Bali, Indonesia as well as Jacksonville University Marine Science Research Institute, Jacksonville, Florida

Bali Marine Research Center, Bali, Indonesia

Bali Marine Research Center is designed by Solus4. In response to the 2004 Indian Ocean earthquake and tsunami disaster, the need for tsunami research and preparation was quite eminent. Thus, the Bali Marine Research Center was designed. Inspired by

the structure of tsunami waves it has an imposing fluid structure that seamlessly adapts to its natural aquatic environment and allows visitors and scientists to have a direct visual connection to the exterior (Figure 1). In keeping with the nature of the universal ocean, the project is intended to be wholly energy efficient. Large glass-based panel form the skin, transparent and an opaque as well as embedded PV cell is used. The close in to shore location allows for tidal/current generators to serve the power requirements. Rainwater collection and seawater conversion systems take care of the domestic water requirements. Deeper source seawater is circulated through the skin for radiant cooling and temperature control of the overall anthropomorphic shape [8,9].

Interconnected Volcanoes Marine Research Center, Bali, Indonesia

Interconnected Volcanoes Marine Research Center is designed by AVP_arhitekti. The island of Bali is famous for its beautiful natural landscape especially volcanoes. The designers working on the project really wanted to incorporate the island's natural landscape into the design, therefore they used the integration of solid and void elements as their project concept representing the merging of land and sea (Figure 2). The designers were influenced by traditional Indonesian architecture that had strong geometric qualities, adopting the trapezoidal profile in a lot of their designs. In the project this was represented in the four volcano-like forms emerging from the sea. In addition, they cut voids in the building mass, to create spaces that are filled naturally with water to accomplish different function requirements, and solid volumes were manifested in the above-sea level as tops of volcanoes, connected on the under-sea level [10].

Jacksonville University Marine Science Research Institute, Jacksonville, Florida

Jacksonville University Marine Science Research Institute (MSRI) is designed by Dasher Hurst Architects. The University's goal is to provide a premier biological and marine environmental research and educational facility to provide outstanding teaching and high-quality research opportunities for students, faculty and other researchers on issues related to the St. Johns River and the

aquatic environments (Figure 4). The MSRI has been certified LEED Gold by the U.S. Green Building Council, some sustainable applications include the rain water harvesting for wastewater processing and boat wash down, innovative wetlands for storm water treatment, energy efficient design, and extensive use of recycled building materials [11].



Figure 1. Bali Marine Research Center [8]



Figure 2. Interconnected Volcanoes Marine Research Center [10]



Figure 3. Jacksonville University Marine Science Research Institute [11]

SPACE PROGRAM

The project is categorized into two main areas namely buildable area and unbuildable area. The buildable area includes the research center, education center, social/public spaces, and maintenance. The unbuildable area includes landscape and parking spaces. Figure 4 demonstrates the bubble diagram of the project. The types of users that consider for the project are researchers, students, faculty, admin, public visitors (families/individuals) and employees. Table 1 tabulates the expected user calculations for the project.

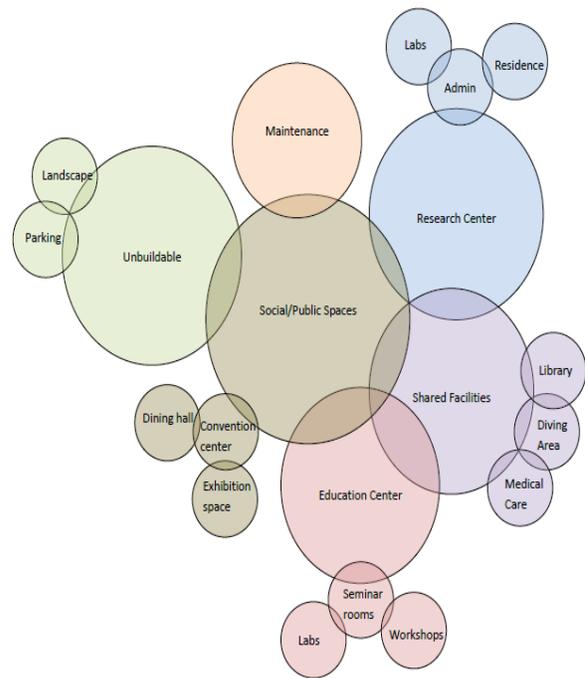


Figure 4. Project's main zones

Table 1. Expected user calculations

Space program	Component	Expected users at the one time
Buildable area	Research center	400
	Education center	100
	Library	50
	Auditorium	1000 max
	Lecture halls	100 each
	Amphitheatre	300
	Services	100
Unbuildable area	Outdoor recreational	
Total max. number of users per day with event/ program running		2000 users
Number of users on regular basis/ 5 days a week		Approx. 600 users/ day

The research center is composed of 4 main departments (conservation, maritime studies, oil spill response, and oceanography). Each department provides interactive labs and facilities that help researchers and scientists conduct further studies in different fields. Private residences will also be provided to some researchers and their families. Education center will provide on-site facilities to the already existing KAU College of Marine Sciences. In response to a conducted questionnaire, several labs, research pools, seminar rooms, and workshops will be provided. Some facilities such as the library and medical care unit are shared between the research and education centers. Users from both centers would be able to access them and use them at the same time. The convention center designed to serve large number of audiences in different events and conferences. It's a facility for both private and public attendees and occasions. This space also includes an outdoor amphitheatre that holds smaller numbers for simple entertaining events, an exhibition area for any public events, and a dining hall. Maintenance space provides maintenance facilities that serve the whole project. The buildable area contains the research center, education center, library, convention center, exhibition spaces, and other services and facilities. The expected area is 16,096 m², 41% of the entire project's area. Table 2 shows the total areas of each space separately.

Table 2. Overall Space Program

Components	Area (m ²)
Research center	5843
Education center	3000
Shared facilities	1256
Social/public area	5754
Maintenance	243
Total	16096
Unbuildable	22969
Total Project Area	39065

Table 3 shows that the unbuildable area contains both parking spaces and outdoor recreational areas, with a total space of 22,969m², 59 % of the entire projects area. Recreational outdoor spaces are used as safe grounds for activities, enhance microclimate within the project, integrates project with the environment and provide a buffer zone between different spaces yet keeping them united.

Table 3. Space Program of Unbuildable area

Facility	Standards	Quantity	Total current area (m ²)
Parking for research center	1/25m ² 2/villa	260	6500
Parking for education center	1/3 students	50	1250
Parking for shared facilities	number of employees	10	250
Parking for social/public spaces	1/ 3.5 of seating area	460	11500
Parking for maintenance	number of employees	10	250
Total		790	19750
Outdoor recreational area	20%		3219
Total unbuildable area			22969

SITE SELECTION AND ANALYSIS

The three site options are located in the city of Jeddah, Saudi Arabia. With two of them located in Sharm Obhur and one in North Cornish. Figure 5 shows site 1 is located in Northern Cornish next to Faqeih Aquarium. Its location next to the aquarium might be useful and complimentary to the project. Figure 6 shows site 2 is part of KAU's College of Marine Sciences Obhur location. It overlooks Sharm Obhur's creek. Figure 7 shows site 3 is located in the area of Sharm Obhur. It overlooks both the open sea and Obhur creek. A comparison between the three sites is conducted to determine which site is more suitable for the project. The comparison will be made based on different weighed criteria, each site will then be rated on a scale from 1 to 10 and scored, and the site with the highest total score will be selected as the project's site. Table 4 tabulates the site evaluation result. The site criteria requirements are:

- (1) Sea accessibility: The more the site is exposed to the sea the better, having access to the open sea and Obhur creek both have different advantages.
- (2) Accessibility: The site should be easily accessed by all users involved, and shouldn't be too far.
- (3) Surrounding land use: Preferable surrounding land use would be residential or educational.

- (4) Context urban development: The site should be located in an up and coming area rather than an old part of the city.
- (5) Expansion capability: The site should have the capability for any future extensions within the project.
- (6) Views: Pleasant views should be present and poor views avoided.
- (7) Noise levels: High noise levels should be avoided in order to create a quiet environment for the researchers and students.
- (8) Parking capacity: The site must be able to hold enough parking spaces for all expected users, and extra space for future extensions.



Figure 5. Site 1 [12]



Figure 6. Site 2 [13]



Figure 7. Site 3 [14]

Table 4. Site Evaluation

Criteria	Weight Factor (%)	Site 1	Site 2	Site 3
Sea Accessibility	25	1.75	2	2.25
Accessibility	20	1.6	1.6	1.4
Surrounding Land Use	10	0.5	0.6	0.8
Context Urban Development	10	0.5	0.8	0.9
Expansion Capability	9	0.27	0.72	0.72
Views	8	0.56	0.48	0.56
Noise Levels	10	0.3	0.7	0.7
Parking Capacity	8	0.24	0.48	0.48
Total	100	5.72	7.38	7.81

Based on the site evaluation result shown in Table 4, site3 appeared to have the highest total score making it the best fit site for the project. The selected site is located in Sharm Obhur with a prime location by the sea. Its total area is 50,000 m². According to Jeddah's Municipality (Amanah), Jeddah's growth plan and future development is heading north towards Obhur with a number of new major projects taking place around that area e.g. Al-Waleed's Kingdom Tower Development, Obhur Bridges, and the King Abdul-Aziz new international airport. The new development of Al-Waleed's Kingdom Tower will take place in Obhur, not too far from the site but also not too close to disturb the work environment. This development will attract visitors to the area and put Obhur on the map as a thriving area in Jeddah, making it a perfect location for the project that aims to become a leading center in Jeddah. The Amanah is working on constructing two new bridges that link Obhur with AlMadinah and AlMalik roads, making the site more accessible from different points (Figure 8).

Figure 9 shows the site's orientations and interesting form allow for maximum benefit from the north western prevailing winds. The sun path determines where shading devices must be used. The site's existing topography is relatively flat with a gradual slope that might help with rain water drainage. Another issue that should be looked at when choosing a site by the sea is water current intensity and movement. After studying the site's water current properties over a 10 year period of time, it is determined the site is stable to build on but some buffer element must be located next to the open sea area.

Figure 8 demonstrates a number of main roads lead to the site including AlMadinah, AlMalik, and AlCornish roads. The site is also accessed from sea from both the open sea and Obhur creek. The two new Obhur bridges will also help make the area more easily accessible. Figure 10 indicates the site is located in a relatively quiet area to serve the project's functions. It is mainly surrounded by residential areas and some parks. KAU's Amrine College is also conveniently located next to the site to benefit from the facilities provided. The site is conveniently also located close to protected marine preserves that will greatly aid the project as researchers, students, and divers can all benefit from them.



Figure 8. Accessibility Analysis

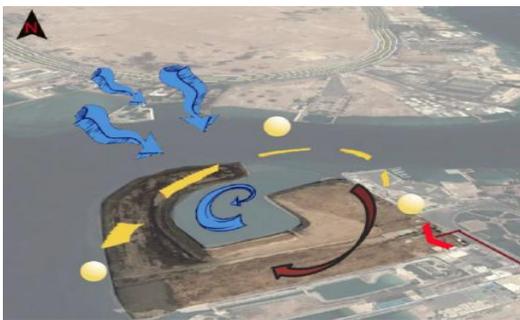


Figure 9. Sun and Wind Analysis



Figure 10. Surrounding Land Use

ZONING AND PROJECT DESIGN

Figure 11 demonstrates the site zoning of the project. The bridge serves as the connection path for diving center and exhibition space. Figure 12 shows site plan of the project. Figure 13 and Figure 14 shows the main perspective of day and night respectively. Figure 15 and Figure 16 demonstrate the labs research pool and exhibition space respectively.

CONCLUSION

This project furthering the research, education, and advocacy by creating a potentially leading center in marine biology research for one of the most bio-diverse seas on earth. The proposed space program consists of research center, education center, shared facilities, social/public area, and maintenance space. The area of Sharm Obhur was selected as the site location based on the evaluation criteria of sea accessibility, accessibility, surrounding land use, context urban development, expansion capability, views, noise levels, and parking capacity. The project providing students and fresh graduates with the means that would help them excel in their field, and hosting several environmental awareness campaigns to prevent red sea dangers.



Figure 11. Site zoning



Figure 12. Site Plan



Figure 13. Main perspective (day)



Figure 14. Main perspective (night)

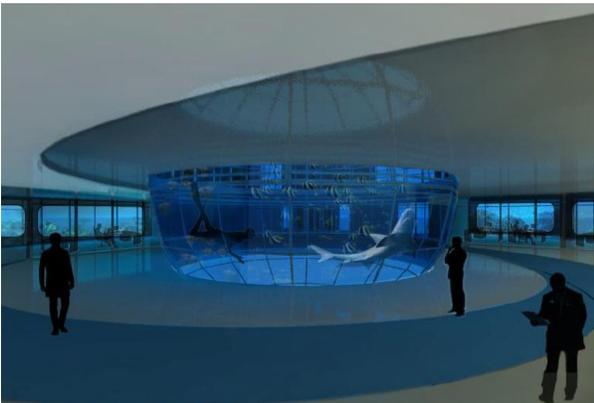


Figure 15. Labs Research Pool



Figure 16. Exhibition Space

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