

JEDDAH EASTERN HILL ECOLOGICAL COMPLEX

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Abstract

With people moving to cities around the world, urban areas need infrastructure to function well. Realizing that green space is also an essential component of a comfortable city. Green infrastructure takes green space planning beyond preserving a few selected sites. Saudi Arabia's 2030 vision looks toward green infrastructure as new approaches to energy production, industry, and natural resource management are needed. Thus, this work proposed the development of an Eastern Hill ecological complex at Jeddah, Saudi Arabia. For this work, two case studies related to ecological complex were analysed. Based on the analysed case studies, for the proposed complex, the estimated overall gross floor area is 25 000 m² and the net floor area is 22350 m². The ecological complex encompasses multiple areas such as public area, education, research, service, basement parking, outdoor activity space and outdoor parking. Three sites were proposed for the construction of the ecological complex and based on site evaluation analysis, site 3 achieved the highest score of 147 and was selected as the proposed site. This complex is expected to enhance the government of Saudi Arabia's ecological preservation effort and will contribute positively to the community.

Keywords-- ecological, complex, architecture, green, building, Jeddah, Saudi Arabia

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INTRODUCTION

In the last decade, many of the developing countries in the Middle East have seen rapid growth of industrialization. This has led to unplanned development of urban areas and has affected adversely on general environment and maintaining ecological balance [1]. Swift migration and population growth in urban areas has also led to extensive spreading of air and water pollution, garbage, impairment of the esthetic value of the area and land, water shortages, and solid waste [2]. Therefore, it is important to revitalize depressed areas in ways that satisfy the community needs. Likewise, resources such as land and materials need to be reused and recycled.

The importance of urban green infrastructure in reducing energy consumption by countering the warming effects of paved surfaces can not be ignored. As such, this greenery provides urban residents with a wealth of environmental, economic and health benefits [3]. By actively cooling the urban landscape, it helps to reduce carbon dioxide emissions. Trees, shrubs, and turf remove airborne smoke, dust, and other pollutants [4]. Furthermore, water is the primary infrastructural framework and life support system in cities. Today, the ways in which cities address their water challenges will be critical to their ability to thrive and grow its urban green infrastructure [5].

Saudi Arabia occupies about four-fifth of the Arab Peninsula, about 40 percent of which are desert lands [6]. Thus, it is important to rethink the greenery impact. More green space within the boundaries of a city can improve the urban environment. Jeddah's past development patterns greatly influence the conditions facing today's city and environment management [7]. Therefore, the demands of water use and environmental protection need to be balanced by providing alternative solutions. Thus, this work proposes the development of an Eastern Hill ecological complex at Jeddah, Saudi Arabia.

CASE STUDIES

In this work, two case studies related to architecture of ecological complex were analysed. The case evaluated case studies are:

- a. CenterGlobal Ecology Research Center
- b. Brock Environmental

Global Ecology Research Center

Global Ecology Research Center is located at California, United States (Figure 1). It was designed by EHDD architects. The building has a gross floor area of 10900 m². The Stanford University Global Ecology Research Center is an exceptionally low-energy laboratory and office building for Washington's Carnegie Institution. The Department of Global Ecology's task is to undertake basic research on the relationships between the earth's ecosystems, soil, environment and water. The development group concentrated on decreasing site water use by collecting storm water. Furthermore, the building was designed to promote adequate care of the landscape over time. The building is designed to decrease carbon effects and solve biodiversity and water problems while offering laboratory and study facilities that fulfill the highest requirements. The structure is designed with good orientation, excellent use of daylight, sun shading, and natural ventilation creates the standard for creative mechanical technologies.



Figure 1. Global Ecology Research Center

Brock Environmental Center

Brock Environmental Center is located at Virginia, United States (Figure 2). This center has an area of 10900 m². The Center offers meeting rooms and an 80-seat conference space, indoor areas, including a prominent indoor school that serves thousands students. The building is designed to provide daylight, views and an operable window for connecting occupants to the outer environment. The building consists of one ground floor plan, which includes a lobby, conference room, meeting room, education pavilion, and services. The main purpose of the building is to protect, preserve and sustain the environment. The building has incorporated natural ventilation and daylight usage in its design. This building has a rooftop water catchment area, pressure tanks, filtration skid, drinking fountains and rainwater infiltration garden. Furthermore, solar panels are used to harvest energy from the sun and use it as the building's electrical power.



Figure 2. Brock Environmental Center

PROGRAM SPACE DETAILS

For the proposed ecological complex at Jeddah, Saudi Arabia, the estimated overall gross floor area is 25 000 m² and the net floor area is 22350 m². The ecological complex includes several zones such as public zone, education, research, service, basement parking, outdoor activity space and outdoor parking. Table 1 presents measurement details for each zone.

Table 1. Space details

Division	Zone	Gross Floor Area (m ²)	Net Floor Area (m ²)
Build up area	Public zone	3200	3000
	Education	2400	2150
	Research	2800	2600
	Service	1600	400
	Basement parking	2500	2200
Outdoor area	Outdoor activity space	10000	10000
	Outdoor parking	2500	2000
Total		25000	22350

PROPOSED SITE

Proposed site: Site 1

For Site 1 (Figure 3), this site is located in the north of Jeddah, near the water treatment station at the airport. This site has an area of 28000 m²

Proposed site: Site 2

For Site 2 (Figure 4), this site is located in the district of Al Khumrah, which is the southern part Jeddah. This site is close to factories and industries. This site has an area of 40000 m².

Proposed site: Site 3

For Site 3 (Figure 5), this site is located in the east of Jeddah, near to the east of Alharamain highway. This site has an area of 40000 m².



Figure 3. Site 1



Figure 4. Site 2



Figure 5. Site 3

SITE EVALUATION AND ANALYSIS

This work has proposed 3 potential sites for the development of the Eastern Hill ecological complex in Jeddah, Saudi Arabia. Therefore, site evaluation was carried out using weighting factors (WF) to select the most suitable site, where WF=1 is less important, WF=2 is important, and WF=3 is very important. The sites were evaluated based on several criteria's, such as transportation accessibility, utility accessibility, topography, existing vegetation, future expansion, proper zoning, adjacent building, site potential use, potential users, security and safety, noise, view, smell, sustainability, and land cost. Table 2 shows the site assessment score for site 1, site 2 and site 3. Based on Table 2, site 3 showed the highest score of 147, whereas site 1 showed a score of 133 and site 2 showed a score of 102. Site 2 was therefore selected as the proposed development site.

Table 2. Site evaluation

Selection criteria	Weighting Factor (WF)	Site 1	Site 2	Site 3
Transportation accessibility	3	15	9	6
Utility accessibility	3	12	12	12

Topography	1	4	4	4
Existing vegetation	1	3	5	5
Future expansion	2	6	10	10
Proper zoning	2	4	10	10
Adjacent building	3	9	6	15
Site potential use	3	15	6	15
Potential users	3	15	9	9
Security and safety	3	9	3	9
Noise	2	4	2	8
View	2	10	4	8
Smell	3	9	3	9
Sustainability	3	15	15	15
Land cost	3	3	9	12
Total	-	133	107	147

The selected site 2 is accessible from three main roads, which are Al Haramain highway, Huda Al Sham, the extension of Palestine Street, and King Abdullahroad. The surrounding land has potential for a futuristic project like the green mountains and other mega pejects that are still under planning. The land is also used for mountain biking. The site has a potential for urban development Murooj Jeddah. Murooj Jeddah is established on the eastern side of Jeddah with a total area of 132 million square meters. It represents a unique and perfect blend of residential compounds and integrated services to provide the best lifestyle society and elevate development standards in the Middle East. The climate is hot through the year.

PROJECT DESIGN

The concept of this Eastern Hill ecological complex is based on the use of architecture as a mechanism for expanding public ecological awareness. This is done by designing a building that provides the user with sensory experience and emotional connection with nature. The complex is developed to compliment site topography by appreciating the significance of the site view. The building masses were separated and connected at the same time to create an extroverted plan and to create a fluid connection with nature. The building massaging is single and multiple volume shifts in design represents fragmentation while the volume is fused at the intersection. The entrance to the building is filled with light, creating a welcoming atmosphere for the visitors. The design concept is based on creating a guided path tour by placing the window opening along the direction of the path, in addition to using oblique lines that encourage movement. Designing with the color theme of the surrounding nature with a clear use of natural material such as rammed earth and natural stone blocks that enrich the sensory experience of the visitor. Likewise, entrance atrium serves an important function of acting as a solar shimmy where excess hot air rises and escapes from the ventilated roof. The sustainability features of this building include orienting between the building blocks to capture the North West wind, as well as designing a wind catcher that works in conjunction with a courtyard to enhance wind movement inside the buildings. Furthermore, elevation of the building's structure was done at the lowest level to allow air circulation and benefit from the valley breeze. In addition, at the south and southwest elevations, a double skin façade was designed to reduce heat gain without blocking natural light. Furthermore, this building is designed to contribute to energy and water preservation practices. This building will redirect the treated water that originates from the treatment station to the east lands, instead of discharging it into the sea. Figure 6 to Figure 9 shows the design of the proposed ecological complex.



Figure 6. Overview of Eastern Hill ecological complex



Figure 7. Master plan of Eastern Hill ecological complex

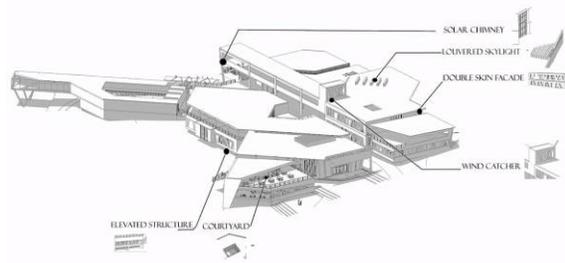


Figure 8. Sustainability features of Eastern Hill ecological complex.



Figure 9. Main entrance lobby

CONCLUSION

This work has presented a proposal on developing an Eastern Hill ecological complex at Jeddah, Saudi Arabia. This complex emphasizes on the pursuit of Saudi Arabia government in realizing their vision 2030 towards the usage of natural resources and ecosystem services. This complex will serve the community of Saudi Arabia and will educate them on the importance of preserving natural resources and environment.

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