THE RESILIENCE HUB
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INTRODUCTION
The word sustainability originated from the idea of sustainable development at the first Earth Summit of the World in 1992 [1]. The first definition of sustainable development is as follows “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [2]. Such development became everyone’s need because of the deteriorating environmental conditions round the globe due to pollution, increasing amounts of greenhouse gases in air, effluents from factories and so on. All of it leads to global warming, which in turn would cause graver consequences of hot places on earth getting hotter and cold places getting colder [3, 4].

Since people spend most of their time indoors and the built environment makes up a large part of the earth’s surface, buildings are considered a media that can affect the environmental conditions and certainly, humans. Thereby, the relationship between buildings and sustainability is also crucial. Sustainability not only needs to be incorporated into the built environment but also need to be advocated for in the society. Sustainability has been a measure for evaluation of active establishments and a goal for achievement [5]. Sustainability has two more dimensions other than environmental sustainability, economic sustainability and social or cultural sustainability [6]. This project shall promote sustainable practices in society via holding exhibitions primarily and providing space for workshops, and conferences about sustainability. Additionally, the project shall highlight the aspect of cultural sustainability with a section of the project dedicated to the issue’s specificity.

CASE STUDIES
There are three sustainable related centers are selected as the case studies, which combination of passive design strategies and latest sustainable technologies. The selected centers are inspiring with the creative use of art and science for achievement of the crucial goal of sustainability and they are:

a. The Crystal, Royal Victoria Docks, London, UK
b. Centre for Interactive Research on Sustainability (CIRS), Vancouver, British Columbia, Canada
c. World Sustainability Center, Alexandria, Egypt

The Crystal, UK
The Crystal located in Royal Victoria Docks, London, United Kingdom is designed by Wilkinson Eyre Architects (Figure 1). The Crystal is one of the most sustainable edifices on the earth. The project is intended as education cum exhibition place for facilitating discussion about sustainability among diverse people like architects, urban planners, municipality officials, students and every common man who visits the edifice. It houses three main functions under one roof, namely, exhibition (about the future of cities), a venue for events like meetings and/or conferences and the office space of Siemens. Siemens (the owner) has rightly termed the project a Sustainable Cities Initiative [7].

The project was named the Crystal, taking inspiration from the Crystal Palace. The Crystal Palace had displayed the then new technologies, emergent of the Industrial Revolution of 1851. The Crystal Palace, in fact, marked the availability of new material for construction. Similarly, the Crystal exhibits the recently developed sustainable technologies. As a matter of fact, the crystalline form too reinforced the choice of the name. The edifice’s design concept has origins in nature’s crystalline geometry and is a way of portraying the multifarious aspect of life in the present urban world. The form of the building is a depiction of the complexity as well as challenges of urban life [7].

Centre for Interactive Research on Sustainability (CIRS)
The Crystal is located in Vancouver, British Columbia, Canada is designed by Perkins and Will (Figure 2). The intention behind the project is to encourage adoption of sustainable approaches in daily life while testing sustainable building approaches at the same time. The edifice is experimental in its essence. The major components of the living laboratory are labs for indoor environmental quality, building simulation software and one for building management system. The center includes a Group Decision Lab, which has employed innovative interactive technologies for visitors to involve in real-time scenario of sustainability. The other components of the project are offices of academic departments, meeting rooms, numerous social spaces, auditorium and a café [8, 9].
The design team considered the prospects of both having a curvy form and a rectilinear form. The rectilinear form was ultimately chosen as the CIRS was meant to be an example for future projects on the University of British Columbia campus to follow. A building without any complex structural requirement is easy to replicate. Other factors that influenced the edifice’s design are needs of building occupants, ecological constraints including the surrounding physiological elements, structural system, building materials as well as the financial limitations. The decision to use wood as the main structural material further affected the design [8,9].

World Sustainability Center, Alexandria, Egypt

World Sustainability Center located in Alexandria, Egypt is designed by Karim Elnabawy (Figure 3). The project was initiated as a response to the hazard of global warming. People need to be informed about the nature forgetting them to love nature and thereby, take care of it. The World Sustainability Center intends to help people feel the nature from another viewpoint, understand the powers of nature and apply it for better living. This goal has been sought for through creation of elaborate display. The chief zones in the project are major entry, auditorium, education and administration in addition to the entertainment part of exhibition [10].

The project form of the five pavilions was developed from the topographic lines on site. Another design influence was the weather. Sun energy was used to its utmost potential. The rays were made to fall normally on some roof parts, while some other rays of the sun were utilized to generate power. The roofs were shaped according to the aerodynamic principles and the pavilions were separated by certain distance to allow passage of wind across the entire site. One end of the pavilion is narrower compared to the other end for facilitating high speed of wind. Such wind is utilized to make electricity and on the facades of carbon shafts, resulting in addition of interest to the façade [10].

### SPACE PROGRAM

There are six primary zones considered for the project namely exhibition, education, assembly, administration, main reception and amenities, and services. The unbuildable zone covered of piezoelectric playground, public relaxation space, parking and greenery. Figure 4 demonstrate the connection between the project’s zones. Table 1 and Table 2 tabulate the space program for buildable space program and unbuildable space program respectively.

![Figure 1. The Crystal [7]](image)

![Figure 2. Centre for Interactive Research on Sustainability [9]](image)

![Figure 3. World Sustainability Center [10]](image)

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**Table 1. Space program buildable zone**

| Zones                  | Use Percentage (%) | Unused Space (m²) | Net Area (m²) | Gross Area (m²) |
|------------------------|--------------------|-------------------|---------------|-----------------|
| Exhibition             | 23                 | 1229              | 3368          | 4596            |
| Education              | 33                 | 983               | 5647          | 6630            |
| Assembly               | 5                  | 221               | 690           | 1097            |
| Administration         | 6                  | 393               | 731           | 1124            |
| Main Reception and Amenities | 20     | 1106              | 2936          | 4042            |
| Services               | 13                 | 983               | 1573          | 2556            |
| **Total**              | **100**            | **4915**          | **14945**     | **20045**       |

**Table 2. Space program if Un-buildable zone**

| Zones                  | Use Percentage (%) | Area (m²) |
|------------------------|--------------------|-----------|
| Piezoelectric Playground | 10                 | 1703      |
| Public Relaxation Space Parking | 22 | 3814      |
| Greenery               | 22                 | 3845.5    |
| **Total**              | **100**            | **17338**  |

There are several design guidelines that considered for this project. The lobby should be designed such that peak load or maximum number of users in a shift can be accommodated. The number of entrances needs to be limited for facilitating security, and control points need to be designed to ensure security, also segregation of secure area is recommended as well. The daylight should be efficiently used to decrease consumption of electricity for lighting, especially when the lobby is at the periphery of edifice. The air lock should be allotted at entry point for preventing loss of heat/cool from within [11]. The reception desk and signage regarding other facilities within project should be visible from the entry point [12,13]. The hard-wearing finishes ought to be applied in lobbies for facilitating long-term use for a large number of pedestrians [11]. In addition, raised flooring is not recommended for non-secure areas.
SITE SELECTION AND ANALYSIS

Figure 5 shows the whole plot of the King Fahd Coastal City is 108,000 sqm, which is much greater than the plot area required for the capstone project. Thus, only 28,897 sqm shall be used for the project and zoning shall be proposed for the rest of the area to be developed as a future sustainable complex. Additionally, the site of the King Fahd Coastal City has been chosen to propose this future development for the now unused area.

The considered evaluation criteria are accessibility, visibility, utilities, image/visual quality, surroundings, and future development opportunity. The weighting factor (WF) refers to the value assigned to each of the criterion as per its significance. The factors are given the numbers 1, 2, 3, 4 or 5 depending on the level of relevance of the factors regarding the site chosen. The numbers 1 and 5 ratings mean very low and very high level of importance respectively. The site evaluation result is tabulated in Table 3.

The site should be easily accessible. The plot should ideally be reachable through more than one route from different parts of the city. The site should facilitate good visibility of the project. The project should not get hidden by massive buildings such as towers. In other words, site should be such that the project would be easily view of passers-by. Since the surroundings of the specific project site are barely buildings, the site would facilitate the visibility of the project for the passers-by. Next, it would just be complementary to situate the project in an area already having a good connection with water supply and other services such as electricity, sewer lines, gas lines etc. Situating the project in an area equipped with these essential services would also help bring about a positive contrast between some of the sustainable measures incorporated into the project.

The surroundings should ideally help achieve the project objectives and not serve as distractions in any manner. The governmental building of the Jeddah Chamber on the north-west, the Bastah Market as well as the view of the flag from the site, all act as reminders of the context and culture of the city and help add to the cultural objective of the project of valuing as well as linking the past cultural practices with the fairly-modern considered notion of sustainability.

It would be ideal to have a large expanse of land around the plot size (around 30,000 sqm) required for this project. The surrounding empty lands would ensure the possibility of building a sustainable community in the future, considering the capstone project just to be an initiation of such large sustainable development. The entire 108,000 sqm of the King Fahd Coastal City adds significant value. Only 28,897 sqm shall be used for the capstone project and a proposal shall be developed to make use of the remaining land. Thus, a simple proposal would be developed to convert the site of the King Fahd Coastal City into a sustainable community in the future.

Based on Table 3, the selected site is Al-Baghdadiyah Al-Gharbiyah District and confirmed to be a good choice as the sums of the weighting factors is about 19.85, while for an ideal case, it’s only about 17%. The accessibility and the site surrounding analysis are shown in Figure 6. Regarding the site climate analysis, the selected site experienced prevailing winds from the direction of northwest and non-prevailing winds from the direction of southeast throughout the year.
Besides that, there are several challenges at the selected site. The site is within an area with very few buildings and thereby, people now go to the locality only during the evening hours for making use of the existing public promenade and enjoying the view. This presents an opportunity that more people shall certainly visit the area after some development. Secondly, the amazing views from the site, namely the waterfront happen to be in the south, which can be a threat to the project if no proper shading is designed to take advantage of the views. Next, some parts of the site are currently low-lying, which can be a threat in case of rain and result in flooding. The varied topographic levels on site need to be tackled appropriately to make maximum use of the available land.

ZONING AND PROJECT DESIGN
Figure 7 demonstrate the site zoning. The zone allocation keeps the central portion of the larger site as white land and incorporates a waterfront plaza, including the existent observation deck. The community research center has been shifted for direct access from the main road of Al Andalus Road, in addition to being waterfront. The commercial center has been relocated to be midst of residences and the community research center considering social prospects. Moreover, utilities have been considered to be embedded within the varied institution complexes for a better and a longer sustainable community. Figure 8 demonstrates design concept of the project, which highlights the three aspects of sustainability by segregating them into three clusters, having a common connector midst the cluster. Figure 9, Figure 10 and Figure 11 demonstrate the site master plan, aerial shot and aerial shot from water-front respectively.
CONCLUSION
The proposed project has become a catalyst for the continued development of KSA by providing practical knowledge to raise public awareness of sustainability. The proposed space program covered exhibition, education, assembly, administration, main reception and amenities, and services for buildable zone. The unbuildable zone consists of piezoelectric playground, public relaxation space, parking, and greenery. The proposed site namely Al-Baghdadiyah Al-Gharbiyah District is evaluated for the criteria of accessibility, visibility, utilities, image/visual quality, surrounding, and future development opportunity. The design concept outlines the three aspects of sustainability by segregating them into three clusters and having a common connector midst the cluster. Also, this project will act as an aid for Vision 2030 namely Vibrant Society - With Fulfilling Lives.

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