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UTOPIAN MEGASTRUCTURE

Marwa Abdou AL-Sobaihi[1], Nader Y. Azab[2], Hossameldin H. Elborombaly[3]

[1,2,3]College of Architecture and Design, Effat University, Qasr Khuzam St., Kilo. 2, Old Mecca Road. P.O.BOX 34689, Jeddah 21478, Saudi Arabia.
E-mail: [1]malsobaihi@effatuniversity.edu.sa, [2]naazab@effatuniversity.edu.sa, [3]helborombaly@effatuniversity.edu.sa

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Abstract
Modern strategic development policies and procedures to coordinate urban growth have resulted in the consolidation of contemporary megastructures in many nations. Thus, in this work, a proposal on the development of utopian megastructure with the sustainability element in Jeddah, Saudi Arabia is presented. Prior to designing the proposed megastructure, 3 case studies were analysed. Based on the case studies analysis, for the current megastructure proposal, the estimated area for development was 46903 m2. In addition, the estimated build area of the proposed megastructure is 24820 m2 and it consisted of several zone which were office tower, hotel and facilities, entertainment facilities, residential department and service department. For this work, three site were proposed as the area of development. Based on the site evaluation analysis, site 1 attained the highest score of 181, compared to site 2 which attained evaluation score of 160 and site 3 attained evaluation score of 161. Thus, site 1, which is located north of Jeddah in AL-Corniche was chosen as the proposed site. The proposed utopian megastructure has been designed with smart features and a sustainability element that will benefit the Jeddah society.

Keywords--mega structure, design, building, concept, city, Saudi Arabia

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INTRODUCTION

Megastructure is one of the most fundamental concepts in architecture [1]. Architectural movements used the idea of megastructure in the 1950s and 1960s and has become an imperative architecture and design topic across the globe [2]. Megastructure corresponds to the gigantic-scale of the development plan that incorporates most the features, structures and constructions needed for a town [3].In addition, megastructure may be seen as a unique organizational structure with countless modular components that can be extended and changed when each system requires to be renovated [4].The concept of megastructure was and remains fundamental to the concept of contemporary architecture and is associated with the development of the potential utopian town. Generally, megastructures consist of building a ' base ' (primary frame), combined units, and community structures [5]. Furthermore, architects were genuinely convinced that the unique qualities of daily life could be greatly improved by the development of building technology in terms of utopianism [6].By contrast, utopian architectural megastructures were originally created as an option for consumerist values and state-led schemes, and these concepts also influenced leading countries and real estate investors willing to cash in on the revolution [7,8].Thus, this concept of the development of utopian architectural megastructures has gained momentum around the globe, and Saudi Arabia is no exception.

Saudi Arabia's urbanization pace is one of the biggest in the globe. Riyadh, Jeddah, Madinah (Medina), Dhahran, and Makkah's current main metropolitan centers have undergone rapid development since 1973 [9].As a result, towns were extended through high-rise public housing, land subdivision for fresh residential areas, and fresh road networks. Although urban growth remains a major domestic goal, several metropolitan experts and cultural critics are talking about harm and increasing the environmental, cultural and financial problems that restrict its efficiency. Thus, a proposal on the development of utopian megastructure with the element of sustainability at Jeddah is presented in this work.

CASE STUDIES

Three case studies have been referred in this work. The case studies chosen are:

a. GwangGyu Power Centre
b. Peruri 88
c. POTO Vinculum

GwangGyu Power Centre

GwangGyu Power Centre is located 35km from Seoul, South Korea (Figure 1). This structure was designed by MVRDV architects. The plan consists of a series of overgrown hill-shaped buildings with great programmatic diversity and sustainable credentials, aimed at high urban density to encourage further development around this New Town's so-called ' Power Center'. According to the architects, this is a self-sufficient city, and the number inhabitants who will be able to occupy its space is around 77,000. The towers of this mega-structure complex appear as stacks of rings. The successively larger diameter of the rings towards the bottom of the towers allows each part of the complex to have a terrace. The resulting series of "hills" are carefully positioned: the housing around the reservoir, the shop along the road, the museum next to the lake and the offices next to the main street. This expansion of the lower floors generates, as a counter-effect, hollow cores that form impressively large atriums within each tower. These are used as lobbies for housing and offices, shopping center places and museum and leisure areas halls.The functional spaces are connected by a network of streets, which form an attractive series of walks at ground floor level. The rooftops of these "hills" and the terraces can be planted with box hedges, which would filter the air, improve ventilation. The city also focuses on the conservation of energy and water. The commercial part of this structure consists of an area of 48,000 m^2. In addition, the allocated area for the residential part is 200,000 m^2.On the other hand, the recreational part consists of various parks and lakes around the site, walkable areas, a museum, various shopping areas and plazas, and a variety of public spaces. Furthermore, the sustainable features include: use of terrace for outdoor living, use of rainwater on the terrace and landscaping flow from top to bottom, climate improvement

parks, energy and water use, plantations around the terraces with a floor-to-floor circulation system to store water that irrigates the plants, usage of sunlight and building slopes to capture as much water as possible for later reuse.

Peruri 88

Peruri 88 is located at Indonesia (Figure 2). This structure was designed by MVRDV architects. Peruri 88 combines Jakarta's need for higher density with its need for green spaces, though drawing on typologies from the current urban fabric, according to the architects. Its total area is 360,000m2 and functions as a vertical city with a high quality of life and high sustainability criteria. It includes a wide range of housing, offices and commercial spaces. In addition to all this, we have internal and external. In addition, this structure offers a wide variety of types of office and housing, from large office surfaces to living / working units and studios, from lofts to townhouses, from terraced houses to patio living. In addition, each of these stacked urban blocks has a semi-public roof park, small gardens, playgrounds, spas, gymnasiums, swimming pools available to residents and office staff, and last but not least outdoor restaurants.

Figure 1. GwangGyu Power Center

Furthermore, the structure of the Peruri 88 building stands on five core principles and is not as complicated as it appears to be. Basically, we have four traditional high-rise towers built between which bridge floors will be built. Arup will continue to develop and rationalize the structure to remain within the regulations and budget. The commercial part is located from level B2 to 7th floor. It has a central plaza, sheltered by the mid-rise stacked volumes, and it provides multiple restaurant outdoor layers and, most importantly, shadow and natural ventilation. In this area, escalators work to connect the shopping and retail center to the mid-rise parks. On another note, the commercial podium of Peruri 88 reflects the historic islands of the city with reflective bodies of water and landscape crossing the public street levels, while integrating a sunken garden plaza. According to the designers, the residential or housing part in this vertical city is luxurious like fancy multi-star hotels. It includes hotels (commercial part) and housing facilities. On the other hand, in terms of sustainable features, it combines the need for green space in Jakarta with its need for higher densities, providing shadow and natural ventilation in open spaces, use of water features in every corner to cool the temperature naturally and usage of the sun as a source of daylight energy. In addition, this structure houses a luxury hotel from the 44th floor to the 86th floor, rising from a platform with park, swimming pool and marriage house. A panoramic restaurant and viewing platform on top of the hotel completes the 88th floor structure.

Figure 2. Peruri 88

POTO Vinculum

Poto Vinculum is at United States of America (USA) (Figure 3). This structure has been designed by architects Ting Ho Cheung and Lee Yiju. The total area of this structure is 73579m^2. This is a concept design for a vertical city on a small scale. Basically, the project or the building is set up as a series of towers that are placed on a podium, which automatically makes the podium function as a connection between all the towers and host commercial uses. The towers are occupied by apartments and hotels connected horizontally by bridges with additional commercial spaces and amenities. Last but not least, all of the roofs are green outdoor Vertical Park. Poto Vinculum is a connection between towers and podiums. The vertical elements sit on one horizontal base and are interconnected through several elevated podium bridges from tower to tower. The buildings operate as one unit made up of several pieces. The building has green roofs that create communal parks everywhere. In addition, for the commercial part, it consists of public spaces such as malls located in the podium area and office located on the left side of the building from the front elevation. On the other hand, the residential part of this vertical city takes up a lot of space. It has variety of different apartments. Moreover, the residential area offers good views from all sides and these good views are provided by the public gardens. There are many public gardens in this building and it is supposed to work as social areas where people interact with each other. The sustainability features of this building includes natural ventilation and usage of daylight as natural lighting and energy source. Also, the trees and plants in the public gardens cool down the temperature and provide shade for people.

Figure 3. POTO Vinculum

PROGRAM ASSUMPTION AND SPACE DETAILS

For the proposed utopian megastructure, the estimated site area is 46903 m²Based on Table 1, the total estimated build area is 24820 m², which comprises of office tower, hotel and facilities, entertainment facilities , residential department and service department.

Table 1. Build area estimation

Zone	Total Area (m²)
Office tower	2410
Hotel and facilities	2570
Entertainment facilities	14990
Residential department	3200
Service department	1650
Total estimated build area	24820

PROPOSED SITE

For the development of proposed utopian megastructure, the site should be located in North Jeddah, a financially rich area where futuristic and smart projects are appreciated and could be afforded. Also since Jeddah is a coastal town and here the sea is a landmark. Furthermore, the site is considered an environmental attraction and should have good sea views from approximately all sides. In addition, the site should have good accessibility. Thus, based on this the following sites were analyzed.

Proposed site: Site 1

For Site 1 (Figure 4), the site is located north of Jeddah in AL-Corniche and is accessible by AL-Corniche road. The site's topography is relatively flat land.

Proposed site: Site 2

For Site 2 (Figure 5), this site is also located in the north of Jeddah and 2 km from the sea. This site is huge with vast areas and is surrounded by residential areas. It is accessible by the road of King Abdul Aziz. The site's topography is relatively flat land.

Proposed site: Site 3

For Site 3 (Figure 6), this site is located on the AL-Corniche street, it looks directly at the sea and takes a linear shape.

Figure 4. Site 1

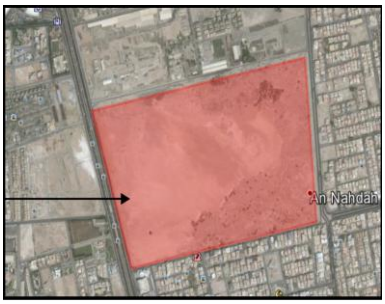

Figure 5. Site 2

Figure 6. Site 3

SITE EVALUATION AND ANALYSIS

Based on the three proposed sites, site evaluation was performed. The site evaluation was done based on several criteria, which were location, accessibility, shape/proportional, views, utilities, visibility, size, and environmental aspects. For this evaluation. weighting factors were used where 1 = not very important, 2 = slightly more important, and 3 = important. This weighting factors was used on all the site criteria. Table 2 shows the site evaluation for site 1, site 2 and site 3. Based on Table 2, site 1 has attained the highest evaluation score of 181, compared to site 2, which attained score of 160 and site 3 attained evaluation score of 161.

Table 2. Site evaluation

Site criteria	Site 1	Site 2	Site 3
Location (WF= 3)	26	17	30
Accessibility (WF= 3)	30	30	30
Shape / Proportional (WF= 1)	10	8	4
Views (WF= 3)	20	15	30
Utilities (WF= 2)	20	20	20
Visibility (WF= 3)	30	25	30
Size (WF= 3)	30	30	10
Environment aspects (WF= 2)	15	15	15
Total	181	160	161

Site 1 was selected as the proposed development site. This site is located north of Jeddah, at AL-Corniche, and it is accessible by AL- Corniche road. The topography of the site is relatively flat land. This site has an area of 46903 m². The surroundings of this site include buildings that vary in height from 3 to 5 floors max. The area where the site is located has warm temperatures in winter and in summer the temperature is very hot. The rainfall there is sparse in general. Natural lighting is efficient and will not be blocked by any surrounded structures.

PROJECT DESIGN

Figure 7 shows the proposed design of the utopian megastructure. The zoning of this structure includes office towers, residential , service and education, power center, and entertainment. For the office tower, it will include smart features such as smart projectors that use minimum of energy, smart gadgets and boards will be used when needed (to reduce usage of papers). In addition, at night the entire building is in night-time mode, power consumption is reduced to a minimum and all unnecessary electricity charges are deactivated. At the beginning of the work at 9 am, the functions are automatically activated depending on whether any one is in the room. The presence of people is detected by the access controller. The room temperature controller ensures an optimal indoor climate through proper heating and ventilation. The sun protection collector opens the window blinds and allows day light into the room without heating or dazzling. Furthermore, this structure has gardens and shaded footpaths. It will have some water

feature to complete the serenity of the picture. theses gardens will be a product of renewable energy. The footpaths will be naturally ventilated and shaded, it will be 300 m to 500 m away to encourage people to take comfortable walks. In addition, this structure will have Aqua Forest, where it will be a youth relaxing park and entertainment facility. Its buildings are translucent, magical, and thick greenery grows all around. The daytime and weather in Aqua Forest will be controlled. The area's seasons will change according to the desire of people. This will be done by using stuff like fake snow, fake trees that look realistic and temperature control. On the other hand, the residential department will include Islamic design features and smart features. The walls are comprised of sensitive breathing exterior and interior walls . A membrane, between the exterior and interior of walls, will absorb all the vital elements like air, water and light from the outside and feed the interiors as energy. This will supply the habitat with all necessary sources to be able to live off the grid. The active skin of a building is designed to harness the energy of the sun as it automatically moves into the most efficient position to make the best possible lighting. In addition, This active skin of the building also reacts to the rain, collecting and channelling rainwater into the habitat. On the other hand, the residential departments are small in space on purpose as an attempt to achieve maximum efficiency in energy and space.

Figure 7. Proposed utopian mega structure

CONCLUSION

This work has proposed the development of utopian megastructure with the element of sustainability at Jeddah, Saudi Arabia.The site is located in AL-Corniche, north of Jeddah. The proposed utopian megastructure requires an estimated area of 46903 m^2. Furthermore, the total estimated build area of this structure is 24820 m^2. This megastructure will be a main point of attraction at Jeddah. In addition, this megastructure is designed with sustainable and futuristic features that will benefit the Jeddah community. It will thus help to have a negative impact on the environment through the design itself and to relate people to the environment.

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