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Research Article

HYDROTHERAPY CENTERS: APPROACH OF INDUSTRIAL AND LIGHT STRUCTURES

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ABSTRACT
Various roof systems despite good strength used in the building are followed by some problems such as high weight, increase of wastage and high cost price which are mentioned as the problems in traditional construction methods. This research discusses on approach of industrial and light structures in hydrotherapy centers and represents the results and suggestions.

Keywords: *Light Structures, Industrial Structures, Aquatic Sports, Hydrotherapy*

INTRODUCTION
Architecture is a science which seeks to improve life conditions for the individuals in the community with an emphasis on scientific themes and movement towards artistic creativity. Building is constructed via traditional and industrial method, and based on the definition, all or a part of building components are produced under industrial system in the factory and different aspects of building components in sake of quality and experiment reduce and then production increases. The definition for Industrialization of building especially industrial production of housing is different in different countries. For instance, in America the prefabricated house is defined with integrated steel structure, yet in Canada a prefabricated house is called to a house with 85% or more operations and construction of its components fulfilled in the factory. In this regards, industrialization at any scale due to mass production of components in factory and qualitative supervision on process of production causes reduction of cost, improvement of quality and increase of speed. Yet, experts have mentioned the advantages and disadvantages for industrial productions, thus many countries have welcomed industrial production and few countries have rejected it. The major cause for this rejection has lied on this fact that the industrial method due to rapid and mass production has neglected some personal tastes. Apparent uniformity of such buildings has influenced freedom of choice among different groups of people and influenced the advantages from applying the industrial method. Increasing speed of construction and the necessity to attention to modern technologies and saving in construction industry to keep distance from traditional methods and attention to productivity at economic areas, energy consumption and manpower and so forth have caused invoking to modern executive methods. Reducing weight of building with improvement of the quality of used materials and development of a structure adjusted with environment as well as development of a system with minimum wastes indicates the necessity for considering the modern construction method as an alternative for traditional methods. Hydrotherapy center or Aquatic Park refers to a recreational park which has been developed from funny tools and Aquatic games such as Aquatic slides, lazy river, recreation rooms, swimming pool and sauna. Surfing has been started in some Aquatic parks through development of artificial waves. Popularity of Aquatic centers dates back to the late of 1940. There are the highest number of Aquatic centers with more than thousands of Aquatic centers and tens of new parks per year in United States of America. The most common organizations include International Association of Amusement Parks and Attractions (IAAPA) and WWA (World Aquatic Park Association). If Aquatic parks are fed with natural hot, mineral, and geothermal springs, they will have health benefits, whereby the need for use of disinfectants for biohazardous materials such as Chlorine diminishes. The advantages of Aquatic Park include bathing and swimming which cause euphoria of the soul and body. Much equipment in Aquatic Park raises excitement and safety for individuals. Under these conditions, excitement causes secretion of adrenaline from the adrenal glands and secretion of Endorphin from mucous gland and hypothalamus. Therefore, it can say that construction of hydrotherapy centers help for

euphoria of the soul of individuals and their health, yet construction of these centers is much more important.

As a result, with regard to what mentioned above, development of a space for improvement of level of quality, health and spirit of individuals is of great importance. Increasing vitality and morale can be linked with increasing Adrenaline in body.

In normal state, a small amount of adrenaline is secreted helping for maintaining normal blood pressure; when stressed, a large amount of adrenaline is secreted in a few minutes, under which effects of Adrenaline on body refer to raising blood sugar levels by stimulating the liver to change glycogen into glucose, release of fat from fat tissue into the blood, increase of heart rate, increase of blood flow to the muscles, reduction of blood flow in the face and intestines, widening of bronchioles, pupil dilation; all these factors indicate the body' readiness for activity. In addition, architects' view on Aquatic centers being established throughout the city increases and the standards used in Aquatic centers keep growing drawn into attention as much as possible, under which it can develop a better view together with better facilities for the individuals in the city.

Further, Qeshm Island has been centered at one of the pillars of tourism, industry and the economy, and this has transformed this island to a place for saving capital and has caused authorities' attention to architectural and recreational dimensions of city decreases, yet this weakness if severely felt by residents. Since establishment of Aquatic and hydrotherapy centers plays a potential role in development of tourism and recreation within city, attention to these centers and investment in them are more likely drawn into attention. Use of light materials and structures in Aquatic and hydrotherapy centers will be economically effective. Flexibility in architecture plan and reduction in dead load of building and saving in energy consumption have been mentioned as the most important features of these structures than rest of traditional structures. In this research, an attempt has been made to investigate technical and executive aspects of these structures in Aquatic and hydrotherapy centers. Therefore, in this research, the most important aims include:

-an overview on effect of establishment of Aquatic and hydrotherapy centers on morale and health

-a study on effect of approach of industrial and light structures on establishment of Aquatic and hydrotherapy centers

-overview of related works at this area and evaluation of them

-detection of suitable approaches to build Aquatic and hydrotherapy centers

-overview of adverse effects of use of industrial structures in construction of Aquatic and hydrotherapy centers

Research Hypotheses

The hypotheses used in this research include:

1-use of light structures causes reduction of cost and increase of speed in construction

2-it seems that light structures with flexible design result in new forms

3-it seems that light structures can be potential in new forms

Research Method

Since the research method depends on type and nature of research, in this research firstly infrastructure architecture studies have been conducted and then an attempt based on researcher's movement in line with scientific studies and practical results has been made to pursue the research via descriptive method, library studies and field method, i.e. at the first stage the library studies including historical studies in the past have been considered, at the second stage the practical part of research is proposed and a form and space at the area of early studies at the selected place is represented and then different stages of design based on theoretical background at library section are examined and numerous parameters are examined including industrialization of buildings, review of reduction of costs, increase of speed, optimal use of materials, overview of increase in safety and durability, quality of materials in sake of safety, manpower, equipment and facilities, economic costs, environmental issues, efficiency, accuracy and performance culture.

Variety of Construction Methods

Conventional Construction

In this method, over 18 expertises are required and all the construction operations are fulfilled via the early equipment including plaster, carpenter, blacksmith, plumbing, tile work, asphalt work, glazier, and painter. The required time for construction via conventional method is about thirty-one hours per square meter infrastructure (Jalali, 2009).

Figure 1: Doing tasks in manual in conventional construction (Jalali, 2009)

Advanced or Semi-Industrial Conventional Construction

This method which is called improved construction implies engaging in task by competent individuals and using the machineries and mechanical construction equipment to increase speed and size of task.

Figure 2: Semi-industrial construction (Jalali, 2009)

Industrial Construction

In this method, in addition to use prefabricated components such as blocks, beams, and prefabricated panels made of light wood, metal, plaster and concrete, most of construction affairs are fulfilled via workshop equipment and tools in a mechanical way and a variety of opening forms for concreting.

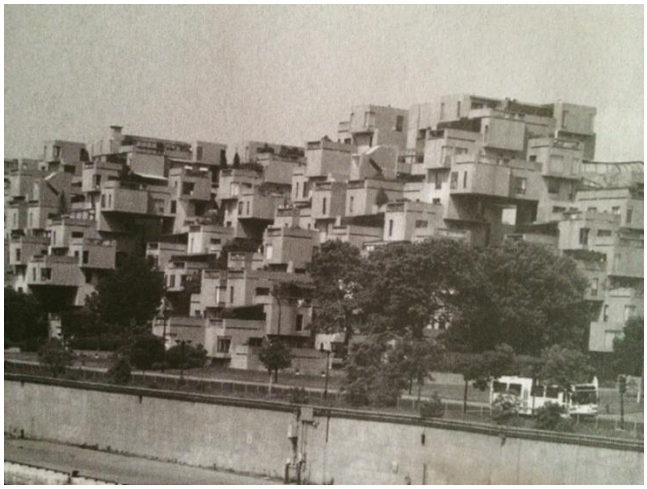

Figure 3: Industrial construction and use of prefabrication (Jalali, 2009)

Manufacturing building components in workshops and factories paves the way to use the most advanced existing techniques to construct components of building and take a step towards industrialization of construction technique. Modular system will allow the managers, practitioners and supervisors in construction workshops for a better planning and management so as to pursue the construction operations with more speed and better quality. Experience has shown that traditional construction method does not meet the individuals' needs within community in sake of management construction and organization of construction operations, thus attention to more industrialization and invention of industrial modular systems have necessitated. With regard to high population growth, household growth, increasing urbanization, needing to housing especially in urban areas and large cities, industrial construction is required, whereby advantages and disadvantages of industrial construction will be as follows:

- Centralization of a large part of the construction stages in the factory and reduction of workshop costs

-Improvement of quality of components as the result of accuracy in control of industrial production

-increasing performance of manpower due to the possibility for suitable planning in production line and suitable job conditions at the factory and as a result reduction of useless workshop activities

-increasing productivity of equipment due to reuse of them

-diminishing the construction duration

- Reducing impact of seasonal and climatic conditions in construction

- Reducing the consumption of wood in formatting

- Transformation of construction methods to a series of production activities

-reducing operations

-the possibility for planning and organizing technology production methods in a proper way (Taghi, 2003)

Under prefabrication, several problems might raise to which a particular attention must be paid, including:

- Low precision in size of prefabricated components prevents building proper seams between them. Thus, during production, the allowed range of error at dimensions will be certain, for which metal formats and suitable control must be applied.

-the effect due to contraction of different sizes and combination of different components of structure must be limited through steeling

-unknown points that are in this way: mutual reaction of prefabricated components must be fabricated in joints

-the materials which are used for sealing the seams must be satisfactory during the lifetime of structure
-freedom of action is limited in architecture of construction
-finding economic methods and suitable implementation for connection of prefabricated components and pieces is a major issue in the plan for the prefabricated concrete buildings resistant against earthquake (Rahaei, 2003).

The Necessity for Centralized Management and Planning and the Early Macro Investment

-Heavy components and dependant of loading, transport, unloading and implementation to heavy machineries and tools
-lack of necessary efficiency at modular buildings
-dependence on fixed executive factors and lack of possibility for use of manpower and local materials
-Doubt on sustainability against the forces due to earthquake
-lack of capability to bring about changes during construction
-necessary facilities must be predicted for joints in components and transport of components

There are also barriers as follows:

-high cost than old buildings
-A lack of diversity in the industrial methods
- Lack of organization in the stages of industrial production of building
-Lack of expertise
-Imbalance in manpower
-The absence of a successful pattern
-People's unfamiliarity with industrial production methods (weakness in public notification)
-Lack of industrial methods in construction of public projects
-Limited materials in industrial methods
-Faster payment for the construction cost than conventional method
-Economic problems in industrialization
-Undesirable quantity and quality of education in industrial production of building
-Lack of adequate projects in industrialization of building
-Lack of standards and regulations for industrialization of building
-weakness in transport system
-problems in arrival of the required machineries
-Difficulty in access to production centers of industrial components of building and their limitation which cause sustaining away from industrialization

Table 1 represents the differences in industrial construction and conventional construction.

Table 1: Differences in industrial construction and conventional construction

industrial construction	conventional construction
All the activities are fulfilled in a permanent place.	Activity is fulfilled at different temporary places
Low to average lifetime of a product	Long lifetime of a special product
A high degree of standardization	low Standardization of each project has distinctive aspects
Limited number of simple tasks for a certain product is required	Many tasks require a lot of manual skills to complete certain projects
All the tasks are fulfilled in a fixed job station	Any activity at a wide work place is fulfilled by the workers who are coming and going from a place to another place
The work place has been organized based on man's needs	harsh work environment
In comparison with fixed work force	Changing workers
Authority by decision making unit for design, production and marketing	Authority for decision making has been divided among advocator, local government, contractor

Overview of Several Samples of Aquatic Centers via Approach of Light Structures

Aquatic Sports in *London*

Aquatic sports center in London is a stadium in London which has been established for Aquatic sports considered as a part of Queen Elizabeth Olympic Park. This stadium which has been established for Olympic Games in summer (2012) has been developed from two swimming pools (50 meter swimming pool for swimming and 25 meter swimming pool for diving). Table 2 represents the entire characteristics of this Aquatic stadium (Begley, 2012).

Table 2: The entire characteristics of this Aquatic stadium (Begley, 2012)

Place	**Aquatic sports in London**
Area	Stratford, London
Construction cost	269 million pounds
Design	Zaha Hadid
Capacity	۱۷۵۰۰

Wavy roof with the length of 160 meter at Aquatic center has been transformed to one of the structures with the most complicated engineering and construction challenge in Olympic park for games in London during 2012.

Ceiling is designed in a tensile, torsional and rotational form, found as a response to effects of snow, wind and other climate changes. This Aquatic center will start working with aluminum roof coating for several months.

After aluminum, the roof at the area of 12000 m^2 is designed with timbers made of Red Lauro, becoming a sustainable source that combines a required level of durability and visual effects. Figure 4 displays a general view of Aquatic sports in London. Figure 5 displays use of light structures in construction of this Aquatic sport in London (Begley, 2012).

Figure 4: A general view of Aquatic sports in London (Begley, 2012)

Figure 5: Use of light structures in construction of this Aquatic sport in London (Begley, 2012)

Beijing National Aquatics Center

Beijing National Aquatics Center, also known as the Aquatic Cube, is an aquatics center that was built alongside Beijing National Stadium in the Olympic Green for the swimming competitions of the 2008 Summer Olympics. This aquatic stadium has the capacity for over 17,000 spectators. This center was built in north of China by prominent architects from Europe group and another group from Australia that their idea and theory under minimization of energy consumption as well as a suitable idea regarding the use of center were found superior to other views to which the highest priority was given. Table below represents general features of Beijing National Aquatics Center.

Table 3: General features of Beijing National Aquatics Center (Lara, 2010)

Name	**Beijing National Aquatics Center**
Location	Beijing
Construction cost	200 million dollar
Designer	China Construction Design International
Capacity	١٧0٠٠

Most of people believed that Aquatic Cube is the fastest Olympic pool throughout the world, because this pool is deeper than most of Olympic pools for about 314 meters. The coating used at exterior surface of cube and how it works, fire and how to cope with it, using solar energy and recycling Aquatic consumption in pool regarding shortage of rain and Aquatic in Beijing are the creative and unique features of this project. Beijing National Aquatics Center has been designed by China Construction Design International and constructed over 3 years. This center was prepared in 28 January 2008 for Beijing 2008 Summer Olympic Games. Aquatic cube is one of 37 facilities in which Summer Olympic Games are held. This salon next to Beijing National Stadium has been known with Bird's Nest stadium (Lara, 2010).

Land Use

Needing to a suitable concept and idea in Swimming and Aquatic Games center including Swimming, Open Aquatic Swimming, Diving, Aquatic Polo, Synchronised Swimming regarding the type of land use can help use in role of center. The figure below displays a view of Beijing National Aquatics Center.

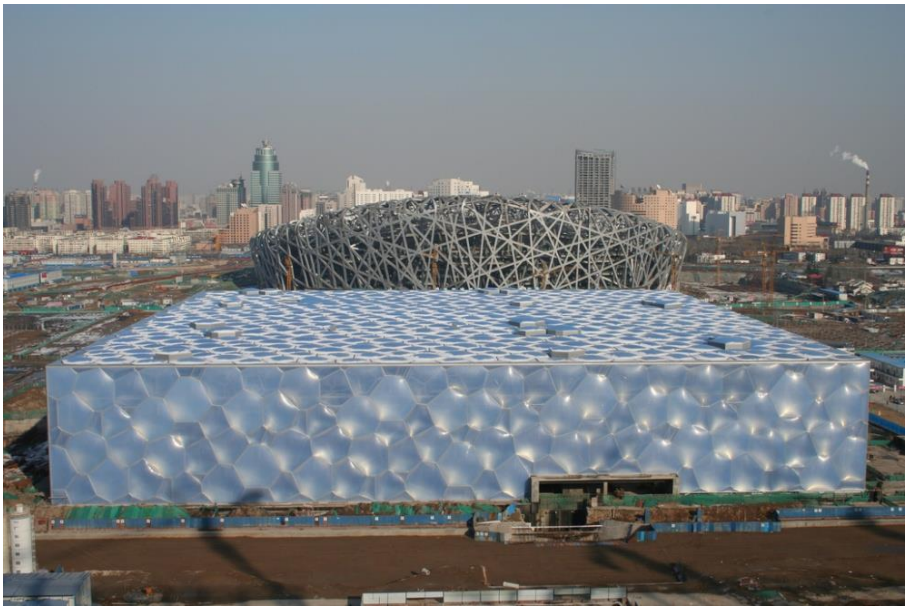

Figure 6: A view of Beijing National Aquatics Center

The project appears as a simple and transparent cube with the dimensions to the length of 177 meter, width of 177 meters and height of 31 meters. Structure of this building has been made of steel coated with over 100000 m^2 bubble pads with a coverage made of ETFE, accounted as the largest coverage made of ETFE throughout the world, mentioned that 65 tons steel has been consumed in this building.

Figure 7: Light industrial structures in Beijing National Aquatics Center (Lara, 2010)

***Les Bains Des Docks* Aquatic Center**

Les Bains Des Docks (The Bath by the docks) is an Aquatic Center in Le Havre city in France designed by a famous french architect, Jean Nouvel. The total area of this center is 5000 m^2 including 12 swimming pools, an outdoor swimming pool to the dimension of 21×50 meter, a big sauna, oriental bathrooms, a hot spring pool, mssage rooms. Table 4 represents features of this aquatic stadium. Figure 8 represents one of the outdoor swimming pools in this center in Le Havre city.

Table 4: Features of Les Bains Des Docks aquatic center (Douglas, 2010)

Name	Les Bains Des Docks aquatic center
Location	Le Havre
Construction cost	16 million euros
Designer	Jean Nouvel
Capacity	1000

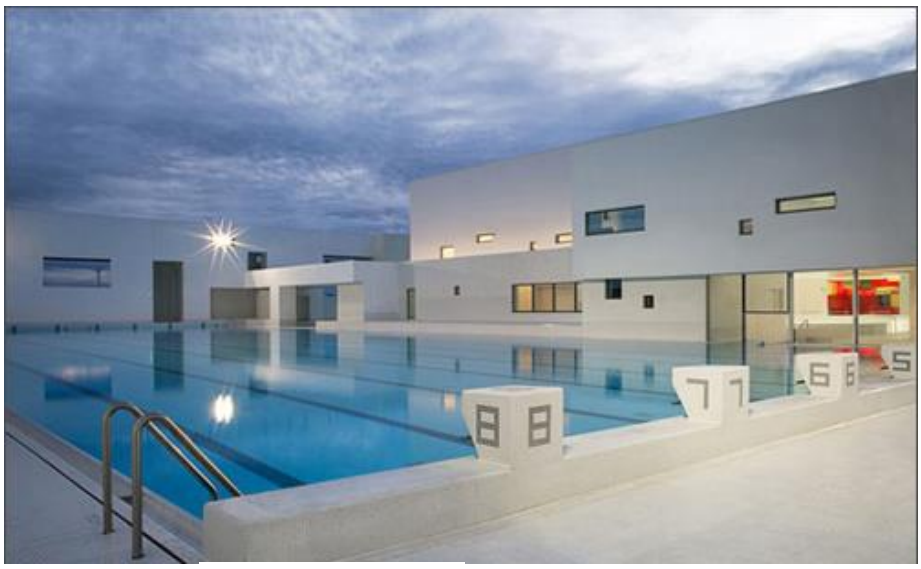

Figure 8: Les Bains Des Docks aquatic center (Douglas, 2010)

The interior spaces especially the space in the outdoor swimming pool mention surrealist paintings, so that suspension of environment to the spectator. Further, intelligent use of mass of sharp colors among neutral colors at environment has developed an interesting contrast for the children. Figure 9 represents plant of building in Les Bains Des Docks aquatic center (Douglas, 2010).

Figure 9: Interior space of Les Bains Des Docks aquatic center (Douglas, 2010)

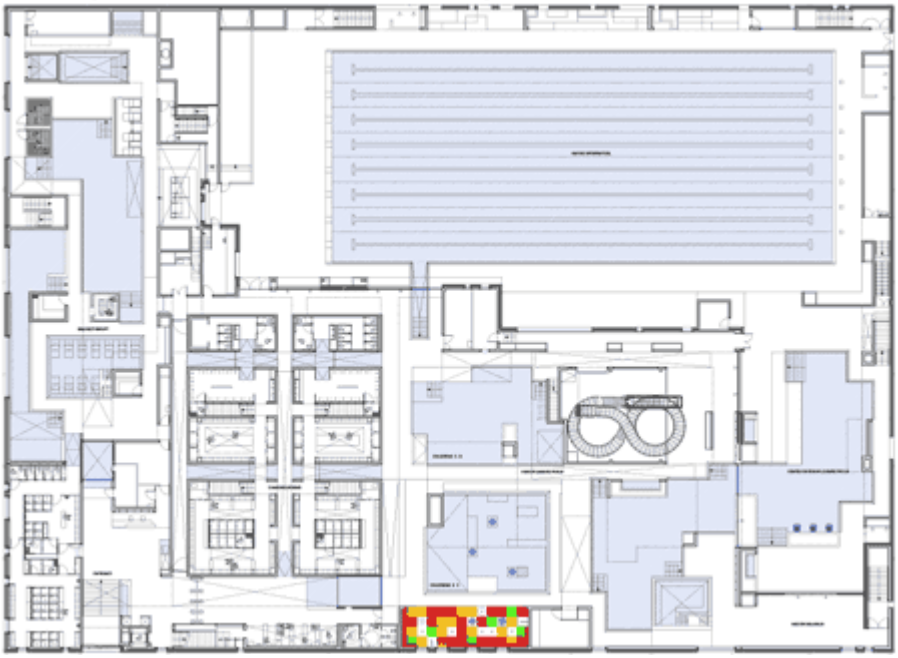

Figure 10: Plan of Les Bains Des Docks aquatic center (Douglas, 2010)

History and Appellation

Hormozgan Province is one of the provinces of Iran. This province has been located in south of Iran and north of Strait of Hormuz. Coasts of this province have been located in Oman in the East and the Persian Gulf in the West. Some of the most important islands in Hormozgan include Kish, Lavan, Hormuz, Larak, Sirri, Qeshm and Abumusa. Hormozgan Province has 13 cities, 23 towns, 33 districts and 71 rural districts and 2,170 villages, which the population of this province has been reported about 1062155 individuals regarding the census in 1996. This province has been located between the geographical coordinates of 25 degrees and 24 minutes to 28 degrees and 57 minutes north latitude and 41 minutes and 59 degrees to 59 degrees 15 minutes longitude from Greenwich Meridian. The province spans an area of over 68,000 square kilometers, found as the eighth province in the country. It neighbors Kerman Province from the north and northeast; Fars and Bushehr Provinces from the northwest and west; Sistan-Baluchestan Province from the east, and the Persian Gulf and Sea of Oman waters from the south. Figure 11 represents Hormozgan province for each city.

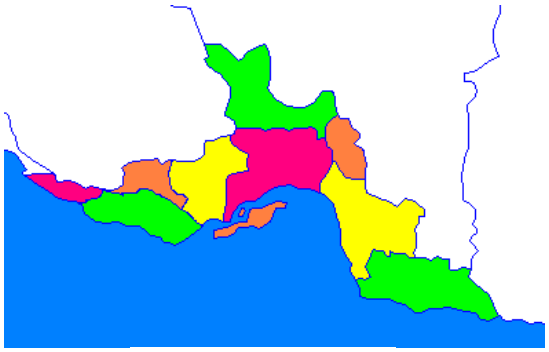

Figure 11: Hormozgan province for each city

Qeshm is the biggest island in Hormozgan and Persian Gulf. A particular attention has been paid to this island due to big and cheap markets. In addition, a large number of tourists visit this island due to prevalence of several ancient and natural works such as Jangal-e-Hara, Enjir Maaber, Kheris cave, Salt

cave and so on. The route between Bandar Abbas and Qeshm Island is passed using speed boats. Speed boats pass this distance for about half an hour. There is the possibility to use speed boats during the day before getting dark. Figure 12 represents the aerial map of the island.

Figure 12: Aerial map of Qeshm Island

Geographical location of the Qeshm has limited to Bandar Abbas and Bandar Khamir from north, to Hormoz Island from northeast, to Larak Island from east, to Hengam Island from south, to the islands of Greater and Lesser Tunb and Abu Musa from South West. Distance of Qeshm Island from Bandar Abbas, Hormoz Island, Larak Island, Abu Musa Island and islands of Greater Tunb is about 20, 18, 9, 163 and 114 kilometer. Figure 13 represents Chahkooh Valley in Qeshm.

Figure 13: Chahkooh Valley in Qeshm

Seismicity of Qeshm

On 2006, at 12:34 pm an earthquake magnitude 6.4 MW struck off Hormozgan, felt at the regions of Qeshm Island. The earthquake epicenter was reproted at 27.7 degrees north latitude and 91/55 degrees east longitude coordinates around west of Bandar Abbas in 19 kilometer to Dargahan port. The only aftershock recorded at this earthquake has occurred at 16: 11 pm at that day with magnitude of 8.2.

Climate of Qeshm is categorized in the climate of arid territories, yet humitidy rate is high in Qeshm. Air pressure ranges from 1015 to 1018 mbar mercury in Qeshm that reaches to less than 1000 mbar in summer due to high heat. Average temperature in Qeshm Island is about 26°C with average maximum and minimum temperature of 33°C and 18°C. Seasonal temperature difference is very high in this island. The hottest periods are in summer and the coldes periods are in winter. Maximum and minimum temperature has recorded about 46°C and 16°C in Qeshm Island.

The Reason for Selection of Site

Qeshm Island as the biggest island in Persian Gulf has natural and cultural potentials and a valuable anthropology, of which it can refer to Hara forests, unique animal species, beautiful coastal visions and valuable historical works such as Portuguese Castle, Naderi castle, Khorbas Cave and the remaining works from Safavid and Sassanid periods and special culture of local people, their language, customs and traditions and architecture of houses. Concering climate, Qeshm Island as a part of big climate of Iran has been under influence of atmospheric flow especially Siberian flows, the Mediterranean flows, the Atlantic flows, the Indian Ocean monsoon currents, that air temperature of this island is greater than zero reported about 26 degree of centigrade due to low latitude and adjacency with hot waters in Persian Gulf. A long, hot and moderate season and a short and moderate season are considered as the major features of climate at this Island. The highest point of island is in Kish koh which has height of 350 meter from sea surface. The rainfall in Qeshm Island is under influence of meditaraneian conditions, subjected to seasonal rains, that is, rain has been seen in colder seasons. Nonthless, due to influence of seasonal flows in Indian Ocean, there is a poor rain in august which is mentioned as the climax of the activity of this flow. Qeshm Island among free regions of Iran has a unique status from different aspects, that is, it represents the status of the entire country, thus it cannot be compared with any port of territory which encompasses just a legal attribution. Qeshm Island is a wide island with a little distance from land, having social and cultural history similar to other population regions of country, that the human, natural and mineral capabilities are prevailed in this Island. These capabilities are not limited to geographical position of this island or tourism sector, industry sector and so on. With regard to the beauty in parts of Qeshm Island and attraction potentials which have been developed via custom exemption facilities, facilities such as hotel, restaurant, sports centers and other recreational instruments can be developed for developed of tourism in Qeshm. Tourism can be an important source for earnings and job opportunities in Island especially in a short and midterm.

Criteria, Standards and Physical Planning for the Case

Function of any space is a function of human, that is, this space can be an acquatic sports center or a recreational center or tomb, but it requires detecting the human needs in the space considered to be designed. To determine human needs, the factors such as culture, climate, economy and so on should be examined. To examine function of spaces in hydrotherapy and aquatic centers, firstly a general classification is required so as to examine simple via this classification.

In this context, the most important points include:

1-all the individuals who refer to swimming pool must have the possibility to use all the sectors without others' help.

2-suitable health services and bathroom must be considered for all of them.

3-besides use of all the facilities in swimming pool, safety considerations must be also considered.

4-the building must be designed in a way not to jeapordizes the individuals with poor sight.

General conclusion for the project

Nature refers to a distinctive design and engineering that selects the best items in selection of forms of an object and employs the simplest and most effective form in selection of skeleton and mechanism which stabilizes that object. It is interesting that form of an object and the elements developing the object define each other in nature.

The Pattern for Development of Region

Concerning principles of the pattern for development of region, three factors including function, form and space have been considered as the major pillars for design of region that have been elaborated regarding

the existing status, environmental capabilities and compliance with the principles pertaining to sustainable development.

Function

The major function of region in the project is a recreational and sport function, so that the national and transnational services have been developed due to proper networks and settlement of terminals and services have been developed at these regions since the past. Other service spaces have been suggested in domestic regions to provide services at the region, settled besides the collector and distributor networks.

Space

Space and form of region and the surrounding environment have raised special visions and facilities that conduct the plan to a special orientation, so that the plan has extended to eastern and southern edges.

Form

Design of form of region has been fulfilled based on meeting needs and upcoming functions in compliance with the natural environment, so that an attempt has been made to protect the natural form with the least damage.

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