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Design of Music house Inspired by Splashing Raindrops to approach Environmental Protection

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Abstract

Comprehending the functions o f natural processes and threads can be an initiative for human societies to imitate and produce not only form, but also proper process and functioning. In this paper, the sound and shape of raindrops falling on a surface was used as a source of inspiration along with musical features such as rhythm, harmony, space and repetition to design a multi-purpose auditorium complex. This complex which was designed using the 3D MAX software is meant to serve as a place for holding conferences, lectures, galleries and concerts as well as a movie theater. The Post production software was also utilized to make some modifications on the design and the AUTOCAD software was used to generate 2-D plans. In addition to its bionic feature, this design acts as a reminder of the importance of Iran's water scarcity issue the necessity of efficient use of rainwater. This issue can be further emphasized by building a musical fountain on the complex's open grounds. The design of complex's interior and exterior façades, structural form, and materials is based on combination of modern technology with innovative use of bionic design. The site envisioned for the design is located at the intersection of two busy streets in central Tehran where the absence of local artistic-cultural complexes highlights the design's future influence on promoting social interactions in the area.

Keywords: raindrops, bionic, architectural design

Introduction:

Today, the rapid growth of industry and accelerated loss of connection with natural environment highlight the importance of more effective use of modern architectural, urban and landscape designs that are based on natural forms and way of creation. Integration of objects of bio architecture, bio urban planning, and landscape design can contribute to creation of a harmonious environment (KAZANTSEVA T 2014). People have always been fascinated by biology and have tried to simulate the miraculous capacities of biology which are endowed by the nature and incorporate the functional principle of nature

into the engineering technology so as to create new technologies and invent new instruments and devises with superior features (Taheri and Orangi 2010) (Tian et al. 2010) (Wang et al. 2010). The direct effects of architecture on human life has led to an entangled association between architecture and industrial design (Abbasi Nima 2014); In fact, many important technological and engineering problems have been effectively resolved by the inspiration drawn from biological systems, so people have learned to look for answers through bionic methods. (Zhang, Zhang, and Hapeshi 2010) The term "bionic" was first coined in the mid-twentieth century, and refers to the act of applying biological studies to technical aspects such as architecture, industrial design, and material science. The formation of bionics was an attempt to create a reasonable and realistic balance between man and nature; a balance, which through inspiration from nature, fulfills human needs without harming natural and ecological systems (Ghiabakloo Z, 2014). The concept of design discussed in this paper is the sound of rain (the sense of purity created by this sound), so the shape of raindrops and the way they fall on the ground have been incorporated into the design (Figure 4). In previous researches, Mortazavi Natanzi (in a master's thesis) designed an office tower through a bionic approach (the design of building's exterior shell was inspired by plant life) (Mortazavi Natanzi H, 2015). In another study, Gharouni et al. used the abalone as a source of inspiration for the design of exterior shape of the structure (Gharouni F, Omranipour.A., Yazdi M, 2013) In a study by Ghiabakluo, a multi-purpose hall was designed by using seashell as the source of inspiration (Ghiabakloo Z, 2014). Other notable works with similar subjects include the design of LuQuan and XiuJuan, who took inspiration from the wings of dragonfly (Ren, L. and X. Li, 2013) and the study of Ashadi et al. on the Demak Great Mosque (Ashadi, A.,2015).

This study designs and simulates a multi-purpose auditorium envisioned to act as place for holding conferences, lectures, and concerts, as well as a movie theater for citizens of Hijab Street, Tehran. The design aims to enhance social interactions among citizens by taking inspiration from the sound of rain and the sound and shape of raindrops falling on the ground. Moreover, the innovations that are used in the exterior and interior forms of structure and the method of taking inspiration from nature make sure that the resulting complex will be unique of its kind.

2- Study area

Tehran is the capital of Iran and Tehran Province and has a population of around 9 million in the city and 16 million in the wider metropolitan area (Iran 2012). Tehran is the largest city and urban area of Iran, the 2nd-largest city in Western Asia, and the 3rd-largest in the Middle East. Tehran is located on the southern foothills of the Alborz Mountains and at the northern edge of Iran's central desert, on a relatively flat plain with a slope from north to south. Geographically, Tehran is located at 51 degrees 33 minutes west longitude and 35 degrees 36 minutes to 35 degrees 44 minutes north latitude and has an altitude of 1100 meters in the south, 1200 meters in central regions, and 1700 meters in the north. Tehran generally has a hot and dry climate, but the northern parts, which are located in the Alborz mountain range, are slightly more temperate and humid in climate. The city's weather is hot and dry in summers and mild and sometimes cold in winters (Masoodian S.A, 2009). Tehran's average rainfall is 218 mm, most of which occurs during the months of December, January, February, March and April. Tehran's average annual humidity is 39.5% with the maximum of 64% in January and February and minimum of 23%, in August and September.



Figure 1- Tehran and the site of design in the city center

3. Profile of the simulated model

The auditorium complex is going to be located at the intersection of Hijab Street and Keshavarz Boulevard in the 6th district of Tehran. This district is bounded on the West, East and North by three main Tehran highways, namely Chamran, Modares, and Hemmat Highways and on the south by the longest east-west arterial road of the city, i.e. the Enqelab Street. Furthermore, one of the oldest and longest north-south arterial roads of Tehran, the Valiasr Street, passes through the center of this district.


Figure 2- the future location of the auditorium complex and its accessibility

The auditorium complex has been designed and simulated on three floors and according to the principles and criteria of design of artistic cultural spaces. The ground floor consists of a meeting hall, a restaurant and coffee shop, a music library, an auditorium hall, a theater hall and office sections. The first floor includes audio-visual halls, a control room, a foyer, conference halls, a book storehouse and a warehouse. The second floor includes a lobby, a gallery and a permanent exhibition and a multipurpose hall (See Figure 3).

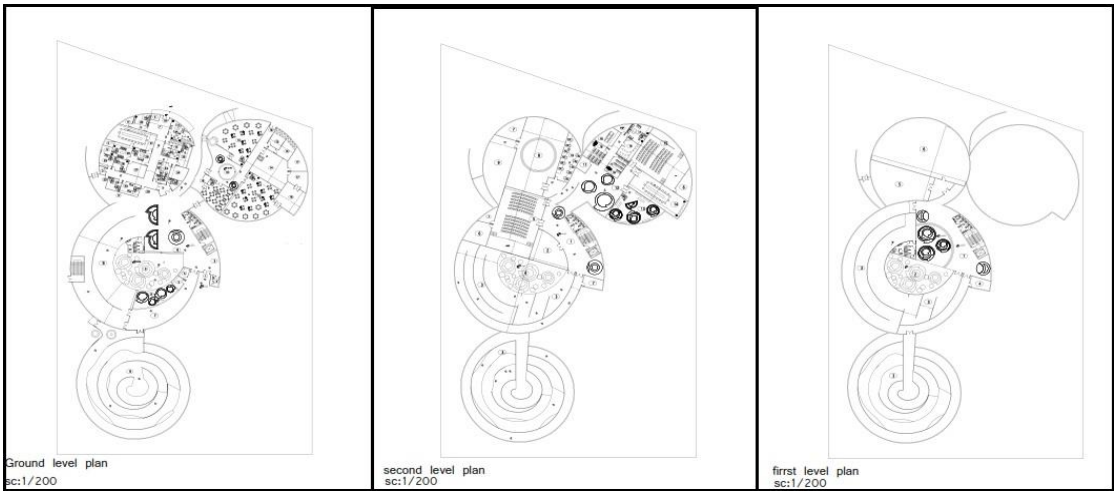


Figure 3- Plan of the auditorium complex

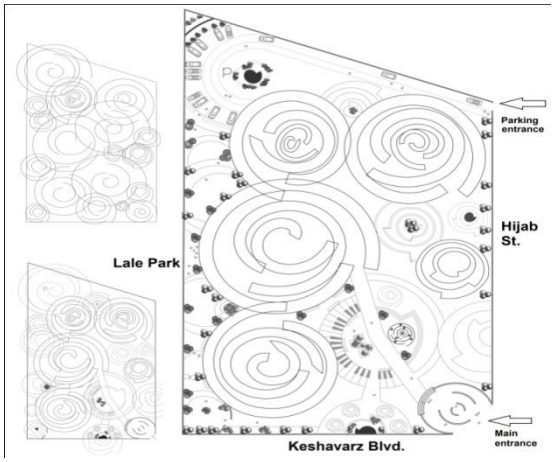


Figure 4- Site plan of the auditorium complex and the method of taking inspiration from the shape of raindrops falling on the ground surface

Considering the location of the site at the intersection of two busy streets and the land use of the surrounding urban zones (Figure 5), it can be predicted that after construction this complex will act as an artistic cultural site for enthusiasts and will play a major role in promoting social interactions.
The complex entrance, dominant wind direction, angle and direction of sunlight, and sidewalks and buildings surrounding the site can be observed in Figures 6 and 7.

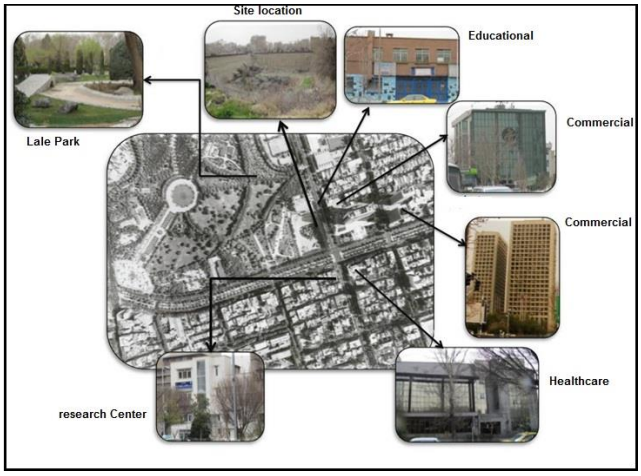


Figure 5- The land use of surrounding urban zones

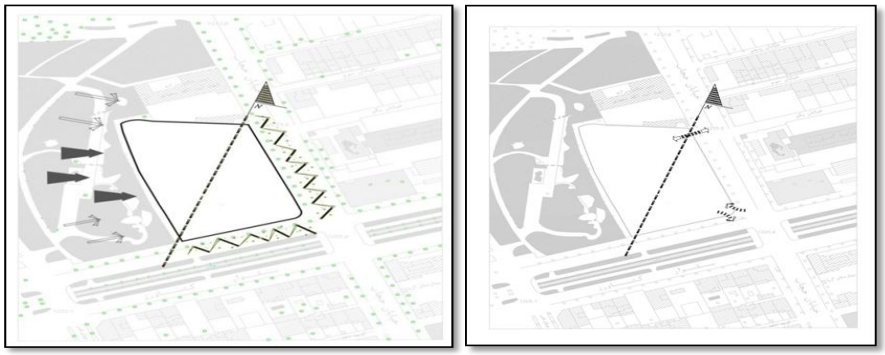


Figure 6- the entrance and exit of the complex and parking (on the right); noise pollution and wind direction (on the left)

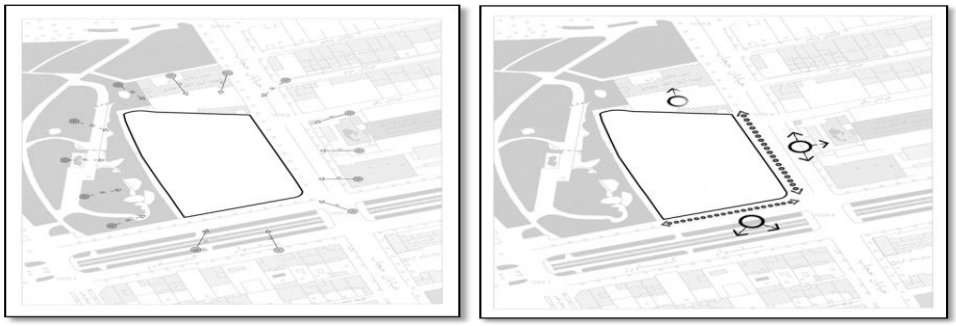


Figure 7- surrounding sidewalks and buildings (location of green belt) (on the right) and the angle of sunlight (on the left)

4. Design and Simulation Results

Being one of the essential and necessary elements of urban everyday life, spaces and public areas of the cities are the most important places that provide a position and base for the pursuit of social relationships and civil life (Mojgan Hasani Koochaki 2015). Due to placement of the site in the vicinity of a green spot (Laleh Park) and the recent years' growing attention toward the importance of efficient use of water, raindrops were selected as the design's formal concept. It is worth noting that unlike other art centers, this design does not impose any limit on the hours of visit, and people can attend the complex even in times when the main halls and are closed or hold no particular event. In this regard, the complex can be compared to the successful Vahdat Hall, whose surrounding area acts as a gathering and recreation spot for artists and art lovers, and where the periodical street theaters held in front of the hall encourage passing pedestrians to stop for a while and attend in events, which both can have significant and wide-ranging positive effects on the quality of urban environment. The entrance and the inside furniture are designed in form of raindrops and the concept of water is incorporated in different parts of the design. A number of raindrop-shaped gazebos are also placed in front of the cafeteria in the southern part of the site. Furthermore, a space in the northern part of the site is predicted to act as employees' rest and recreation area. The entrance is designed boldly so that people can feel the concept of raindrops when first entering the complex (Figure 9). Moreover, the entrance is located at the intersection of two very busy streets, so to filter noise pollution a green belt is used in both sections of the complex that are adjacent to sidewalks (Figure 7) . Upon entering the complex, visitors walk into a space that engulfs them with the sound of soothing music and the sight of statues of outstanding musicians while leading them to the entrance the main building. Considering the structure's angle of exposure to sunlight (Figure 7), photovoltaic panels can be installed on the roof to supply a portion of energy needs with clean solar energy (Kabir, M.H.,2010).

In accordance with design concept, the mass of the structure is designed in the form of ripple effect with some parts being higher than others, as a rough imitation of a raindrop falling on a surface; so the inside circles are more prominent and taller than the outer ones (Figs. 9 and 10). In addition, given the primary use of the complex as an auditorium, prominent musical features such as rhythm, harmony, space and repetition are incorporated into design.

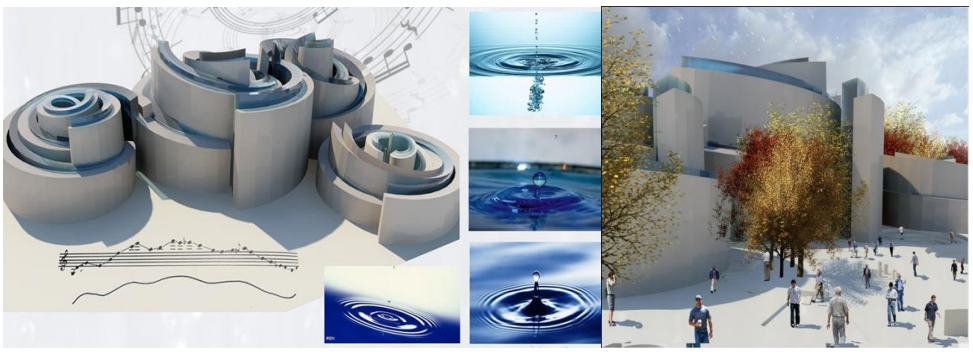


Figure 9- an overview of the structure of the auditorium complex (on the right), and its entrance (on the left)

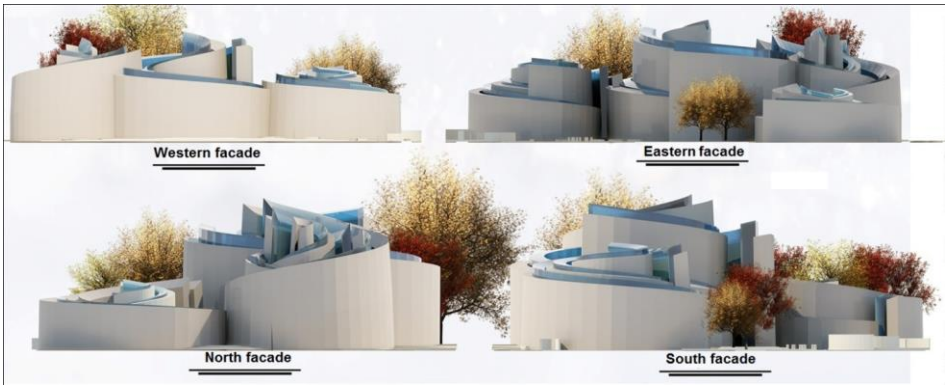


Figure 10- view of the structure of the auditorium complex from four perspectives

Materials selected for the façade are made of transparent plastic with a thickness of 10 mm which gives the mass an opaque appearance during the day and a transparent appearance at night (Figure 11). The envelope is equipped with an electromatic foil which allows the structure to be converted from opaque to transparent. Moreover, the needed light is provided through the ceiling.

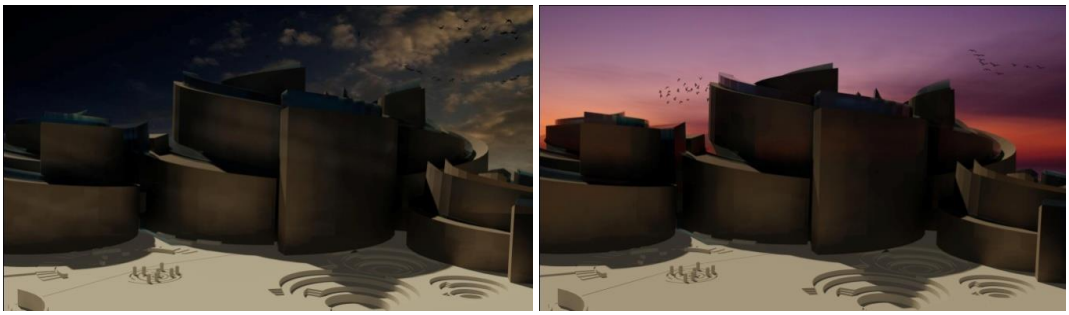


Figure 11- Building façade during day and night

5. Conclusion

this design and simulation of the auditorium complex is inspired by raindrops falling on the ground surface. In addition to acting as a reference to nature, this design can be a reminder to attendants and visitors of the importance of water scarcity in the country and the necessity of efficient use of rainwater. This issue can be further stressed by building a musical fountain on the complex's open grounds or by running street theatres with the theme of water consumption. Considering the structure's full exposure to sunlight and the empirical coefficients of the Angstrom equation, the sun radiation received in the project site have a right angle suitable for harvesting clean solar energy to supply a portion of energy needs of the complex. The design of complex's interior and exterior façades, structural form, and materials is based on combination of modern technology with innovative use of bionic design.

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