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Investigation of Strategies to Improve the Quality of International Exhibitions with Smart Technology Approach

Case Study: Designing Tehran International Exhibition

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Abstract

The study seeks to do a pathological process for Tehran exhibition spaces and provide a solution for responsive space design to meet the needs of international exhibition by looking at the phenomenon of smart building. In this study, after examining the problems associated with existing and potential obstacles, it has been tried to design an appropriate space by using smart technology through explaining the available criteria and standards for exhibition space and also reviewing and analyzing successful examples of internal and external contexts and putting together the important indicators in an suitable and at the same time an economic attractive and ideal environment for users and comparison with the current situations and defects, which seems that besides preserving and conserving energy at high-traffic public places, provides a good physical condition for visitors.

Localization and solving defects and possible barriers to hold exhibitions in order to attract more domestic and foreign audiences and promoting areas of mass communication are other objectives of this research. In order to perform the various stages of the thesis, we firstly describe, analyze and understand the current situation and then determine an outlook of ideal conditions and finally employ the result to design the space according to the exhibition space standards based on smart technology.

Keywords: Exhibition, Intelligent buildings, Good physical conditions, Visitors.

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Introduction

In modern times, place and space was redefined and its relation with the environment, people and technologies were focused. The exhibition, which was a phenomenon, originated from the ancient times, and emerged according to the necessity of mass production and supply of goods took a symbolic aspect. An exhibition was institutionalized in the modern era and became a place of dialogue and product; it is the space for constructive talks between the leaders of the host country's economic and other countries participating in the joint venture to explore the possibilities and conditions of exchanges and contracts of sale provided. In addition, an international exhibition can be a gate for identifying various global markets, and internal market producers and industrialists of other countries come together to perform marketing based on a wide scale. At the present time, the exhibition is not only the place to supply and find the audience, but also is a communicative action in various fields of human life (Moslehi, 2011). Existing problems, lack of a comprehensive and long-term look at the exhibition spaces, problems related to the localization of existing exhibition and visitors, caused numerous grievances and reduced productivity and efficiency, resulting in the failed communication among its global markets and decreased growth and commercial development. The aim of this study is to do a pathology process for exhibition spaces in metropolis of Tehran and provide a solution for designing a space responsive to the needs of an international exhibition by looking at the smart buildings phenomenon. Using smart technology in exhibitions makes an optimum use of existing facilities and energy, which in addition to the comfort of visitors, returns the initial capital used to implement an intelligent building with savings in energy consumption. Intelligent management system of building together with the use of smart materials, control different parts of the building and creates the environmental appropriate (Shengwei, 2009). So in order to perform various stages of the research, we initially study and describe theoretical principles and knowledge about the current situation and then determine the ideal conditions and finally design a space to suit the standards of exhibition space by using smart technology.

Description and Analysis

Smart buildings

The concept of intelligent building represents a strong tradeoff and sharing of complete information among different parts of the building. The term covers parts of the building, all the components that play a role in managing buildings, such as HVAC (heating, ventilation and air conditioning), mechanical sectors, construction, access control, security, management,

lighting, maintenance, local network and energy management. Smart building refers to control and management of the components of the a building used by computer users to meet their needs including efficiency, productivity and save energy, entertainment, creating joy and happiness, comfort, return on investment and low cost of life. Therefore, it is necessary to define smart building based on the success and relevance of very specific objectives and ideals, because they vary from situation to situation has been defined differently by people. An intelligent building must have the same function have to be able to respond to the different needs. Scientists have defined “smart building" as: The structure with the latest technology used. International Symposium on architecture in 1985 in Toronto stated “A smart building is a combination of innovations (whether technological or beneficiary) with complete management, these two features largely return the capital invested.” This definition, in addition to the need for innovation and use of technology, also reminds that one of the objectives of building smart is that smart buildings should return the more capital that is spent on the construction (Abdoli, 2013).

New materials and products

We have a wide range of products and materials made available or are marketable. Some of them are produced specifically for use in the field of architecture or have been considered for other applications such as industry, textiles, automotive. However, the main point is how these new materials available to recommend architects and designers. If there is an opportunity for architects to apply all the materials and products modified directly or in the form of projects, then we will be faced with the great flood of new and interesting possibilities for building design and construction methods. New creative architects can develop new materials and products for specific architectural applications and enable to bring about new industry the architecture based on new materials and as a result, architects are considered entrepreneur, producer and manufacturer other than building designer (Marco, 2016). Smart materials are materials that make sense environmental events as well as process data and respond appropriately to the environment and conditions, in other words; it has an innate ability to respond quickly to their environment. This material has some features and characteristics that distinguish them from more traditional materials in architecture. These properties and features include: adaptability, urgency and emergency, selection, self-operation, clearness and directness. These materials can be divided into several groups regarding the features and properties of these materials and thus understanding the direct focus of this material on the actuating events as well as their predictability and at the same time being able to react promptly and quickly towards the environmental conditions (Marco, 2016).

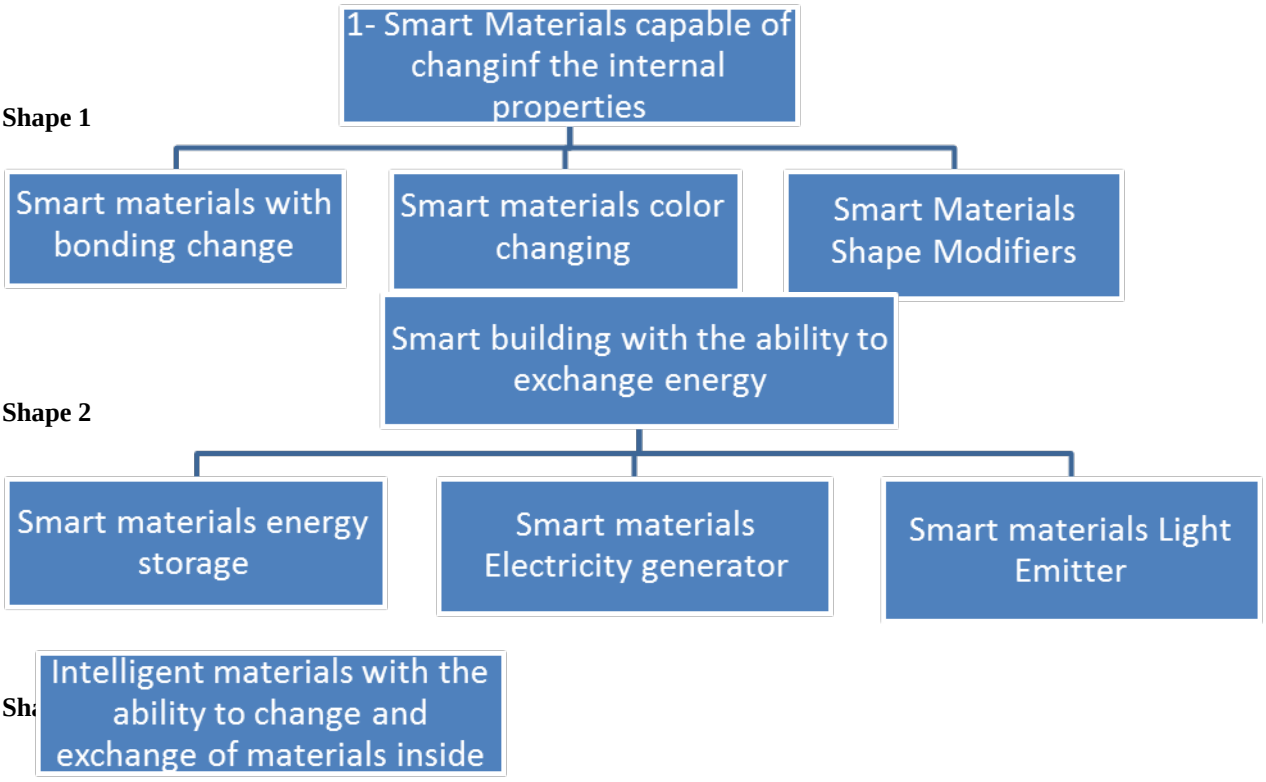
Smart materials have been termed for products with the ability to understand and process environmental events and respond favorably to it. In other words, these materials show flexibility and

are able to reversibly change their shape, form, color and inner energy in response to physical or chemical impacts in the environment.

Materials are classified into three groups: non-smart, semi-smart and smart materials. The first group lacks high specificity, semi-smart materials are able to change in response to the environmental impact of their form for short time; however, the third materials are reproducible and reversible. Smart materials are also known as the "flexible" and "versatile" materials and this is because of their special property for adaptation with environmental conditions. The following chemical and physical variables have been introduced as motives that smart materials react against them (Marco, 2016).

Classification of smart materials

Generally, available materials ranging from traditional, natural and artificial are classified according to their characteristics, including: appearance, texture, chemical composition, mechanical and physical properties, environmental impact, etc. However, in classification of smart materials, in addition to the considering the above-mentioned parameters, other properties are specifically distinguished from traditional materials. Indeed, the proposed classification for smart materials was provided based on the following three properties (Chart 1 to 3) (Marco, 2016). But what is important in the classification of smart materials is that with respect to issues in the sustainable development in the twenty-century are their interaction with the environment, sustainability, possibility of recycling, beauty and desirability (Marco, 2016).



Smart materials changing the shape

These smart materials can change their internal properties and create some changes their shape and dimensions in response to external stimuli that these changes depend on the type and distribution of their internal changeability. These features are now available in many materials, but the most commonly are thermostrictive, piezoelectric, electroactive and chemostrictive smart buildings that are currently drawn the most attention in the field of architecture (Marco, 2016).

Thermostrictive smart building

All sorts of different materials are included; their numbers are limited in architecture. Thermal smart materials consisting of the subset of smart materials involve an intrinsic feature that enables them to reversibly withstand against temperature changes in the surrounding environment. Temperature changes may have an inactive impact, so that they are continuously regulating their internal temperature with its natural setting through the outer shell. On the other hand, in active impacts, an active warming is caused via contact by applying an electric field. Thermostrictive materials include expanded materials abbreviated as (TEM) are reactive materials with a coefficient of thermal expansion which considered as the first systems made with applying these materials (Eugeny, 2015), But their most important applications are in architecture and building services for heating thermostat as well as special incentives in the greenhouse and on building facades to control and manage energy. Their other applicability is in the ventilation system of rooms. Although in recent decades, expanded materials (TEM) have been used as components of thermostats, they are used for building automatic ventilation of building in the last few years. The system works well at specified temperatures such that it is opened or closed to provide space ventilation conditions. By automatically raising or lowering section of roofing, they are designed as components of the ventilation system in the building (Kasmaee, 2012).

Smart materials changing color

As the name implies, they are able to change their visual characteristic in response to one or several external stimulus in the form of reversible change. These types of materials involve various types according to their motivating stimulus, but many of them are highly regarded in architectural applications, including photochromic, electrochromic, and thermoteromic materials (Akhtarkavan and Sadiq, 2012), Photochromic materials abbreviated by PC are now highly regarded in architecture. These materials react with their color change by exposure to

light (visible radiation (Ultraviolet) UV light (Infrared) IR or electromagnetic radiation. Now photochromic materials or PC are available as pigments, photochromic glasses, and photochromic plastic or polymers. Figure 1 is an example of color-materials (Kasmaee, 2012).

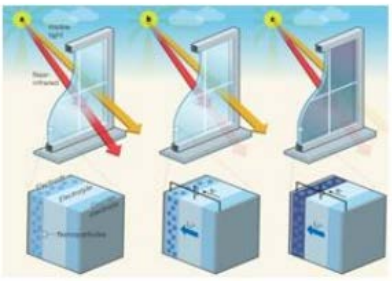


Figure 1. Performance Smart glass

Although initially the adoption of materials was because of their beauty, (due to the color spectrum of light); however, researchers did a lot of research on these materials to make use these products for other functions, such as reducing energy consumption or temperature changes of these coatings. Electrochromic materials are used in electro-optical glass architecture. Electro materials alter their transparency with exposure to the sun's visual characteristic rays (Kasmaee, 2012).

Smart materials for energy storage

The materials and products are able to store energy either visible or unseen in the form light, heat, hydrogen, or electricity; it is noteworthy that these materials are reversible as well. Therefore, they are able to store materials in different ways. However, in the meantime, smart materials for storing heat have mostly drawn attention to their intrinsic property of a material that enables them to store energy as heat or cold in the form of potential energy (Akbari, 2008).

Tehran International Exhibition

Tehran International Fair is now the most important international trade fair in Iran which has been established in 1964 and has been a member of International Exhibition Union (UFI) since 1976. It is the oldest and most active trade for nearly 34 years in Iran. Tehran International Fair as one of the most important commercial and economic centers established an appropriate context to specialized and international exhibitions by utilization of space, facilities and unique exhibition facilities in the country and provided an opportunity for meeting domestic and foreign merchants so that in addition to supply and display capabilities,

trade, technical cooperation and international joint ventures or projects might be started and developed (Ritter and Valerie, 2007).

Fair position towards urban networks

Fair was located in the northern Tehran between the neighborhoods of Saadat Abad in the West, Evin Darakeh and Velenjak and Mahmudiya in the south and Vanak in the South and Amanollah in the East. Amusement park, Enghelab club, Esteghlal hotel, Evin hotel, Azadie hotel, Broadcasting, International Trade and Shahid Beheshti University, which provide services in the ultra-city scale, are gathered together in the exhibition area and raise the congestion zone (Casini, 2016).

Problems for operators and visitors

Due to the lack of convenient parking for amusement parks and its opening in the limited hours of day, local congestion has been very high and heavy traffic occurs.

Exits and entrances of northern parking of the fair was located in the Tabnak streets which itself is considered as one of the main access to Shahid Beheshti University and has relatively high traffic. Therefore, there are many problems in the bright street traffic while in holding exhibition (Zeeshan and Mujtaba, 2011). Due to the inappropriate access and height variations in the halls, stairs and ramp, useful area for the fair has been reduced and severe confusion for visitors is created (Casini, 2016). The absence of correct markup and necessary signs for orientation causes visitors to be diverted and waste a lot of time. Special entrances in large fair are not enough for the population and in many cases, not only slowdowns enter and exit the fair but also influences on the network of main routes around the city and creates very high traffic around the exhibition. Traffic problems not only influence on the efficiency of fair, but also seriously harm in the functioning of the surrounding areas and land uses that are placed around the exhibition (Casini, 2016). Fair operators are faced with the chaos caused by the lack of service network and an inappropriate and non-formation of service in the original plan (Casini, 2016).

Climates in Tehran Province

In terms of climates, Tehran is slightly moist and mild, except for the northern mountainous areas, which is generally hot and dry. The maximum temperature recorded in Tehran is 39/4 degrees, and minimum -7/4 °C and maximum and minimum monthly degrees are 29 and 0.1

respectively. In Tehran, cold season usually begins in December and the highest temperatures of the year occur in mid-summer (July). Tehran's surrounding mountains are an effective strong barrier in the penetration of different air masses. That is why Tehran's air is calmer and quieter than its neighboring regions; in other words, the mountains of the north and the plains of the desert areas of the south and southeast create a mild current and air from the plains to the mountains during the day and night.

Studying local and geographical characteristics

The use of natural forces to improve living conditions in different places has been common for a long time in Iran contributed to the saved energy and, more importantly, to improve the quality of health, comfort, constructions and instruments and an healthy environment. To harmonize the building with climatic conditions, an accurate and correct recognition of micro and macro climatic conditions in the ranging plan is necessary.

Winds status and features

The wind blowing in the region is an important factor in determining the direction of the building; therefore, in the different stages of building design, particularly for its establishment, it is necessary not only identify an area of climate and radiation of sun's rays but also consider the direction and speed of winds in the area (Shengwei, 2009).

Wind blowing in Tehran

Due to the exposure to special situation in Tehran in the Alborz mountain range in northern and eastern highlands and south-east of the city, wind blowing is mostly observed during the year in Tehran. However, the degree of the wind intensity is an appropriate and not troublesome, but mostly resembles the surface and gentle breezes. However, there are some severe storms during the years (Shengwei, 2009).

Rainfall and humidity and its variations

Rainfall statistics in southern areas of Tehran during five years shows that rainfall in this area for its position on isolite lines of 250 to 300 mm in different years and seasons change. The maximum number of rainy days has been in December and from July to October has been reported without a rainy day.

Solar energy shined on surfaces

The intensity of sunlight and heat from it depend on the earth to the weather condition, weather, sun position and height in question. This means that at one point, and at the given time, the amount of solar energy radiated to the levels of the different angles varies. External surfaces of buildings can be divided into vertical, horizontal and inclined horizontal surfaces and roofs are flat. Inclined surfaces toward the direction of East and West receive the lowest amount of energy in the summer (Michelle and schodek, 2005).

Sunlight on the wall and reflected rays of surfaces around

The effect of sunlight on interior heat of a building depends on the characteristics of the materials used in exterior walls. When the air inside a building is not controlled by mechanical systems, the type of materials used in a building has a great impact on the welfare of its residents. Even when the air inside a building is controlled by mechanical systems, quality of building materials used in the amount of lost or gained heat in the building is an effective and therefore in the comfort and economic efficiency. Therefore, in any case, the choice of building materials appropriate to the type of building and climatic conditions is very significant. In hot summer days, the amount of solar energy that falls on the horizontal surfaces is nearly twice as much solar energy is applied to vertical surfaces. The horizontal surfaces around a building may be a significant amount of solar energy reflected into it which the value depends on the potential reflection in the desired levels. The following table shows the percentage reflection of sunlight at different levels. If we want to reduce the rate of this type of radiation on the structure, it is necessary to cover adjacent surface in the building with surfaces that reflect little percent. Table 1 shows the percentage reflection of some materials.

Table 1. Percent of reflecting some materials

Materials	The reflection of the sun's rays
Dry sand	18-30
Wet Sand	9-18
Black, dried, soft sand	14
Wet, dried , soft sand	8

Stone	12-15
Dry grass	32
Field covered by plants	3-15
Green leaves	25-32
Forest surfaces	5
Desert	24-28
Salt marsh	42
Brick by paint	23-48
Asphalt	15
City area	10

Orientation of Building to the sun

For the building orientation to the sun and calculating the energy radiated by the sun and levels of different vertical and daily energy intake at different times of the day for hot and cold times of the year at latitude 31 degrees, the following procedure was used: For the best location of the building in terms of solar energy, rectangular building is intended. High-rise buildings are along the east - west sides. The building along its axis relative to the axis north and south is 45 degrees south to 45 degrees of east-west. For each time rotation about 11 degrees (deployment diagrams) and the amount of energy that falls on vertical surfaces at different hours, its position at the time of its establishment in summer and in winter times were calculated (Michelle and schodek, 2005).

Conclusion

According to the material presented and the scale of the project, the results of these analyses are required to update the type of project implementation. Also, by adding the results of the advantages of new technologies in building either in the field of smart materials or intelligent management of building, we will address the proper energy and sustainability in this section.

Architecture premises resulting from climatic factors:

Two general principles for climatic design in hot and dry areas

Preventing the impact of hot air in the interior sets

Design of semi-protected areas outside the building
The use of vegetation to cool the enclosure
The use of plants in the exterior walls of the building
The use of double-glazed roof and wall for ventilation within the building
The use double shell for heat transfer

Building protection against the sun during the hottest years

Landscaping design
Shading for windows in sunny summer
Shaping and orienting to the building to reduce the impact of summer's sun
The reduced reflection of the Earth and outer surfaces of the windows to reduce summer sun
Providing shade for the walls facing the summer's sun

Planning and Design

Calculations of indoors

Tables 2 and 3 show areas of constituent spaces in each components of Tehran fair

Table 2. An approximate area of land needed in the fair

Row	Spaces	Capacity (person)	Area (m^2)	Total (m^2)
1	Fair's halls	**50000**	**90000**	

2	Administrative section		**17000**	
3	Conference hall	**4000**	**20700**	
4	Grand Central Mosque	**19000**	**3500**	
5	Customs warehouses		**16000**	**417950**
6	Preventive offices		**8000**	
7	Toilets	**1500**	**6000**	
8	Restaurants	**3000**	**12000**	

Table 3. An approximate area of land needed in the fair

Row	Spaces	Capacity (person)	Area (m^2)	Total (m^2)
1	Green space		**300000**	
2	Development areas		**30000**	865800
3	Outdoor amphitheater	**1000**	**1700**	
4	Main entrance	**7500**	**7500**	
5	Outdoor parking	**2400**	**60600 (Vehicle and Helipad)**	
6	Travel space	**50000**	**65000**	
7	Common passwords spaces	**200000**	**260000**	

According to architecture computing and percent of various distributed indoor spaces (main, dependent, welfare and support), we will find that the distribution of area in spaces has been very desirable and has definitely the required efficiency and performance.

Shape and design trends

a. Figure 2 shows the location of the main entrance of fair according to the shape of the earth and adjacency to the original access

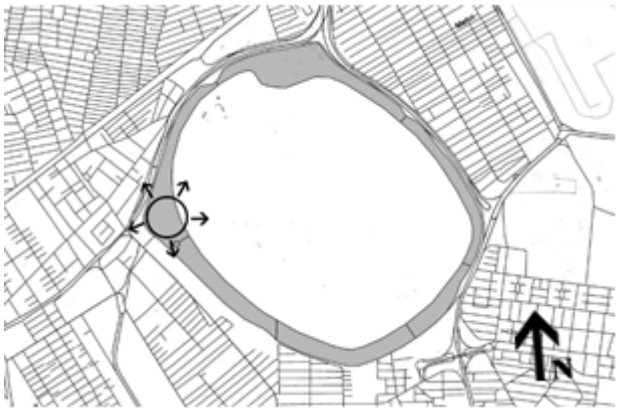


Figure 2. Entrance

b. Figure 3. The basic idea is to apply the plan (growth) based on a central circle input

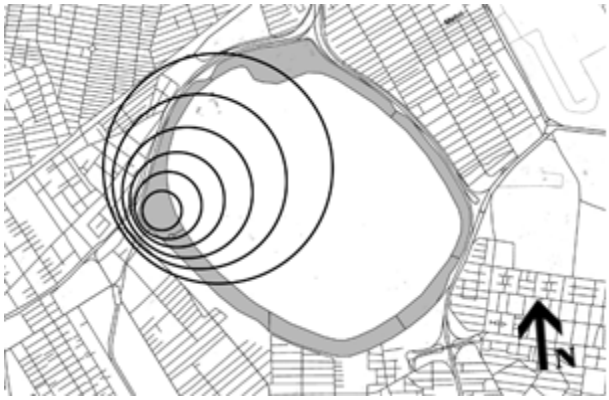


Figure 3. illustrates the basic idea

c. Organized plaid selection for design due to the extensive capabilities which is the most important factors of Exhibition Design

Figure 4. Plaid organization

d. Figure 5. The integration of design idea with plaid organization

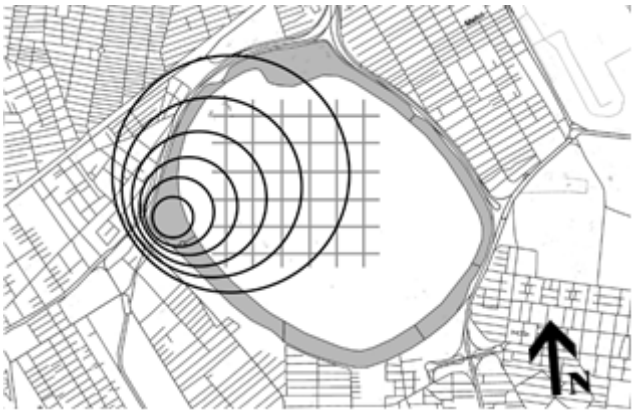


Figure 5. Integration

e.. Figure 6. The general fair organization

Figure 6. Proposed organization

f. Figure 7. Use the confluence of the venues for placement volumes

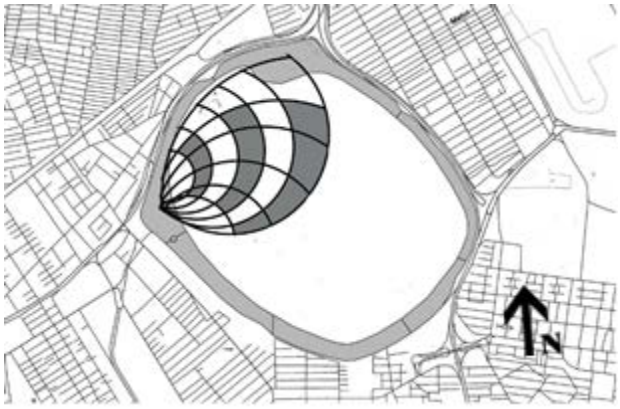


Figure 7. Initial formation

Project documents

Complex plan Site

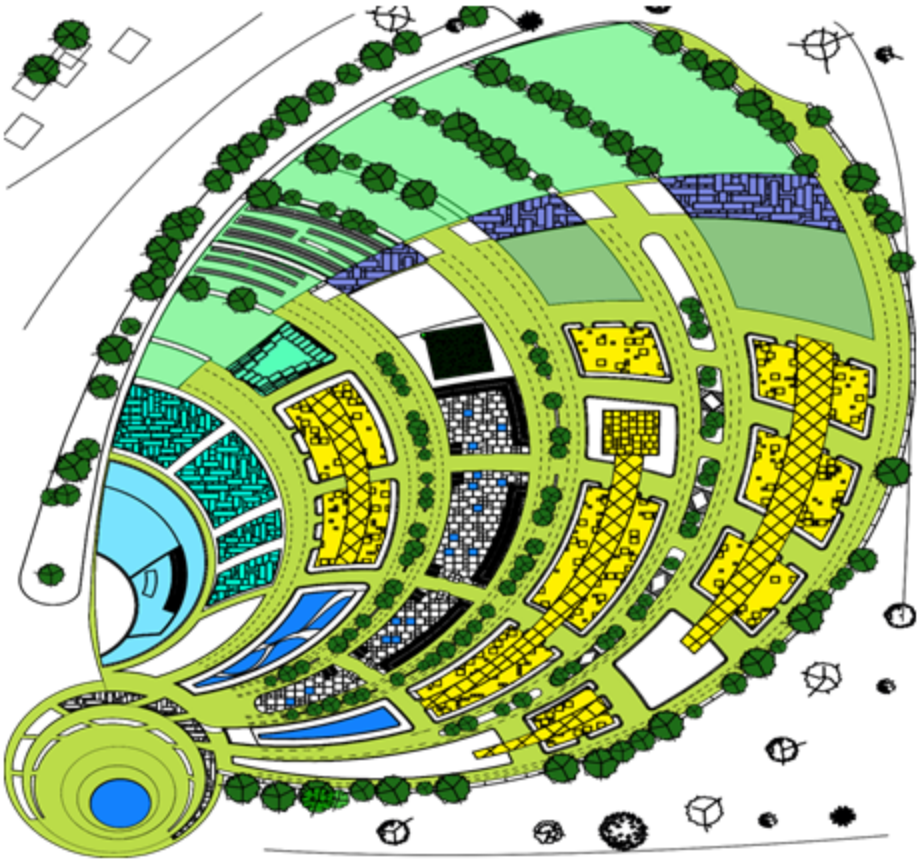


Figure 8. Proposed plan Site

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