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Climatology Center Design in Relation with Understanding Different Climates and Its Performance in Research, Cultural and Educational Fields

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Abstract

Since about 50 percent of fuel reserves are consumed in buildings, it is necessary to pay attention to constructions. Thus, sustainable architecture as a systematic and logical way for solving energy-related problems in buildings seems necessary. In this type of attitude to architecture, minimizing use of non-renewable resources through designing buildings based on the climate in which they are located, and also the natural environment surrounding the construction site are considered at all stages of construction. In addition, necessity for using renewable energy sources such as solar, wind, biomass and etc. is emphasized. Use of this type of energy has become possible today through the use of new technologies such as photovoltaic panels, solar collectors, wind turbines and etc. designing climatology center based on sustainable architecture can be justified in two aspects. First, considering type of the subject, which is related to understanding different climates and potential environmental capacities, should be identified at each region so that all potentials can be used for climate-based designs. Thus, physical plan of the building in this center has been designed according to the type of the climate and various factors such as solar radiation, wind direction and etc.

Keywords: Energy crisis, sustainable development, renewable energy, photovoltaic, wind turbines, smart systems, green roofs, solar collector.

Introduction

Human and nature relationship: since the beginning of human civilization, attractive natural world has been a rich resource for innovation and inspiration for the greatest painters, sculptors, musicians, philosophers, poets, designers and engineers. Nature evidently intends to teach order and obedience to the laws of creation and evolution to the human being. To this end, the principles, based on which the human relationships with the environment are formed and are involved in its creativity, include:

Law of nature: that is, use of facilities that nature provides us with its own law. Taking model from the nature by human being: that is, taking advantage of the situation.

Change in Nature: that is, adapting meanings from the manifestations. For example, deconstructivists disturb formal causes by disassembling their geometric structure and they want to have deconstruction so that it obviously influences the audience (Zare, 2004). In fact, a climatology center deals with specific research works and accurate studies on different climates in Iran. Considering there are many sub-climates in Iran, this center can identify climates well based on its accurate studies and analyze them. Thus, it would be able to provide architecture and urbanism solutions for more adaptation between designs and regional climates for particular users who are often architects, urban planners and designers. Data collection section includes different research groups such as applied climatology, climatology of climatic disasters, climate change, and etc. this section is directly associated to National Bureau of Meteorology. Also, it is in ongoing relation with meteorological stations worldwide. In recent years, theory of construction and locating administrative complexes has been considered in executive policies of many provinces in the

country. Locating urban offices within a single complex in a specific location of the city considers economic issues and reduces transportations helping traffic, energy, etc. problems (MoshaverzadehMehrabi and Sabri, 2008). Thus, with defining an administrative site in Tehran, which is accessible for clients with minimum traffic difficulties and it can be accessed through public transportations such as subway, objectives in terms of sustainability and administrative parks can be achieved. It should be noted that sustainable architecture originates from Iranian architecture history. As it is known, Iranian architecture has been in pace and consistent with its surrounding nature in most cases and it has been often adapted to the nature. For example, the houses in desert areas are made of clay brick and are most consistent with the climate and their environment with their courtyard and pool and garden. Although sustainable architecture originates from Iran's architecture history, unfortunately such attitude to architecture is being forgotten in our contemporary architecture especially in large cities such as Tehran, where citizens need to have the nature in the urban space, while excessive and unsystematic construction in Tehran daily destructs considerable parts of the environment and resources rich of natural energies. Given dangerous conditions of environment in Iran and destruction of many environmental species in the country, the architects should pay special attention to this type of architecture and take steps for initiating this type of architecture in the country by providing scientific ideas and strategies.

Utilizing Solar Energy

Location of building: suitable sunlight, surrounding landscape and the site are important in locating the building. The building should be able to receive sunlight from 9 am to 3 pm. solar energy is 90 percent during these hours of the day. The building should be located in the north of ground and the obstacles which hinder sunlight radiation should be avoided.

Building shape and direction: the building shape should so that it is able to absorb and penetrate sunlight. Solar radiation facilitation into the building should be considered in designing the building and it is better to consider eastern to western direction for it.

Some factors are important in investigating climates of the regions. Compressed forms are more suitable for cold or arid climates, since they reduce contact surface with the rough environment. Moderate climates provide more freedom of action. Eastern to western direction is more suitable for hot and humid climates.

Color of external surfaces influences the heat received from the sun. Light colors and reflective materials are preferred for hot climates and dark colors and absorbing materials are preferred for cold climates.

Higher thermal mass for the walls and roofs cause increasing time of heat transfer between internal and external space. Using two- and three-walled covers may help obtaining maximum sun heat in day and consuming it at night (Sayadi and Madahi, 2011).

The solutions provided by the architectures of this style include: Photovoltaic Solar Cells, smart windows for ventilation, smart ventilation systems, storing excessive heat in various parts of the building, storing water in underground layers for supplying summer cooling (Zare, 2004).

Sustainable Architecture Definition

Sustainability is the adjective describing something which leads to peace, nutrition and supplying the life and thus to survival and continuation of the life. Hence, it can be concluded sustainability is a collection of statuses which continue over the time and aim of sustainable architecture is a sustainable development.

Theoretical Principles of Sustainable Architecture

Theoretical principles of sustainable architecture are more similar to those of such topics as "eco-tech architecture", "architecture and energy", and "green architecture". These principles include three stages: saving resources, designing for return to the life cycle and designing for the human (Zare, 2004).

Sustainable Architecture Principles

The principles which should be observed so that the building is regarded as sustainable buildings include:

Principle 1 – Saving energy: every building should be designed and constructed in such a way that need for fossil fuel is minimized.

Principle 2 – compatibility with climate: The buildings should be designed so that they are able to use the local climate and energy resources. The shape and placement of the building as well as placement of its internal spaces may be in such a way that promotes welfare in the building and appropriate insulation of the structure helps fossil fuel consumption reduction.

Principle 3 –Reduction of using new resources: every building should be designed in such a way that minimizes use of new resources and creates a resource for developing other structures at the end of its useful life.

Principle 4 – Fulfilling needs of residents: sustainable architecture respects all people using the building. Respecting human and labor force needs may be justified in two ways. For a professional constructer, it is necessary to take into account that health and safety of the material and construction processes is important for workers or users as well as for the whole human community.

Principe 5 – compatibility with site: the building should not disturb its surrounding ecosystem.

Principle 6 – holism: all principles of sustainability require participation in holistic process for constructing built environment. Sustainable architecture should include more than one single building and it should cover a sustained form of urban environment. The city is an entity beyond the collection of buildings. In fact, it can be regarded as a collection of interacting systems.

Sustainable Architecture and Culture

Every society has some goals and ideals and the society's culture reflects subjective ideals through its form, and thus it is a manifestation for measuring the culture. The culture influences the design, which represents governing value system and shapes it. The design is influenced by the ideology governing the society and hence architecture style reflects these changes and influence. Undoubtedly, sustainable architecture responses are shaped under influence of the culture for meeting needs of its residents, since although these needs are innate and common in all the earth residents, the way of responding and expressing sustainable architecture varies by different communities and cultures and these different responses in different communities and cultures may take unique form (Mehri, 2011).

Dimensions of contexts can be classified to several groups:

Skeletal, historical, cultural – historical and climatic contexts

Sustainability Status in Iranian Architecture

Great land of Iran is among the few countries of the world which has been able to create varied architecture over the history with its own cultural and geographical characteristics. Goals of sustainable environmental designing and key indexes include:

1. Maximizing human welfare through light absorption, pleasant landscape, air quality, sound insulation, proper control of temperature, humidity control, quality of care and safety provisions, adequate human control ...
2. Efficient planning for suitable consumer mobility in space, realizable security, ease of adaptation and flexibility, the ability to meet the demands of consumers, blending structure with facilities ...
3. Designing for change through simple and modular design which can adapt with development and increasing needs, creating ease for changing the map and functions in the building.
4. Minimizing current expenses for energy using maximum renewable and free energies such as daylight, solar energy, wind energy, temperature change control, appropriate heat insulation, controlling effective methods and efficient construction systems and utilizing plants.
5. Maximizing usable spaces through reduction of garden areas inside the building, minimizing the air canal space, maximizing structural and infrastructural elements mixture, eliminating the need for suspended ceilings in buildings.
6. Minimizing construction cost through reduction of installations and engine room spaces, reduction of the complexity in space and service elements, synchronization of structural elements and services, using efficient structure.
7. Reduction of building maintenance through using durable materials, high-life equipment, simple and reliable environmental control systems, adequate access for maintenance and repairs.
8. Preserving and respecting natural values through integration with the wild life and animals and paying attention to sustainability of all microorganisms considering green conditions, rainwater harvesting and fresh water recycling, recycling wastewaters and using them effectively (Sayadi and Madahi, 2011).

Followings are strategies to achieve sustainable architecture: use of nanotechnology in construction materials technology to eliminate the adverse impact on the urban environment, green roof and walls to prevent energy waste in buildings, two-façade system to prevent energy waste in buildings, using photovoltaic system for generating consumption energy in municipal buildings using sunlight, paying attention to the stability and strength of buildings in terms of improving the quality of construction and the longevity of buildings, using sustainable and recycled materials in construction, and maximum use of local materials, good thermal insulation, rainwater collection and use, designing for maximum use of daylight, using simple control structures, minimizing water consumption, waste water treatment and re-use, use of the two-walled drop downs (windows and doors), proper sealing for all vents, proper orientation of building and generally observing cases for environment conditions regulation such as: western and eastern light control, locating windows and proper ventilation in the southern and western fronts, building orientation, surface-to-volume ratio of the building, distance tothe cold in winter and cooling in summer, two-walled covers for roof and wall for the delay in heat transfer, desired climate color, appropriate shading, proper layout of the interior spaces to take advantage of ventilation and radiation (Majdi, 2011).

Use of advanced two-walled walls and insulated glass for optimum use of the sunlight, using central atrium, use of natural light at all hours of the day, natural ventilation with regard to environmental aspects, use of solar systems in buildings and using solar water heaters, vacuum tubes and flat panel solar collectors (Maxwell, 2011).

Renewable energies are those which there is no need for long time to access them and they are generated or accessible within short time. Solar, wind, water energy and energy obtained from

tide are among renewable energies. The main benefit of these energies is that they are available usually in various points of the world and they are accessible for all.

Advantages of photovoltaic systems include no need for grid electricity, no need for fuel, compatibility with the environment, no noise pollution, noneed for water for electricity production.

Disadvantages of these systems include: high initial investment cost, dependence on the variation of solar radiation during the day and different months (Hynteh, 2012).

Designing empty intermediary space in systems with natural ventilation is classified into four groups based on ventilation functioning (Moore, 2003):

Multi Story Façade: internal space is integrated in this type of façade and top and down is open in this space.

Corridor Façade: intermediary space is closed horizontally in this type of façade. Its advantage is better natural ventilation; but sound transfer from internal spaces (rooms) to each other is possible (Mehri, 2011b).

Box-Window Façade: internal space around the window is closed horizontally and vertically in these facades. Main advantage of it is preventing from sound and smell transfer in internal space (rooms). However, natural ventilation does not occur well (Moshaverzade, 2007).

Shaft-Box Window: Internal space is divided vertically. This division improves heat and sound insulation performance and few numbers of openings are needed in external façade.

In eco-tech architecture, architects attempt to use natural factors such as sunlight, wind, underground waters and plants maximally using technology for adjusting environmental conditions of the building (Mehri, (2011).

Central office in Jin Jo is one of the successful examples of sustainable designs (Mehri, (2011).

The other goal of the project is designing a building for systematic understanding of the country's climate which is applicable at national level. Also, placement and locating a specific site in Tehran for constructing administrative park is the other goal of the project, so that other offices are extended to this location in the future. This building and the way of designing and application of its technologies can be a good pattern for other designs in this climate.

Results and Discussion

Figure 1 shows plan site of complex and Figure 2 shows ground floor plan of the complex.

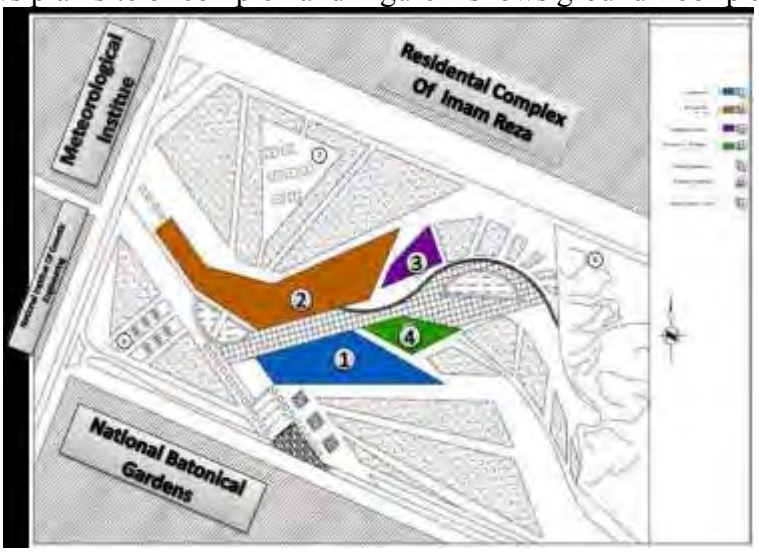

Figure 1. Plan site of complex

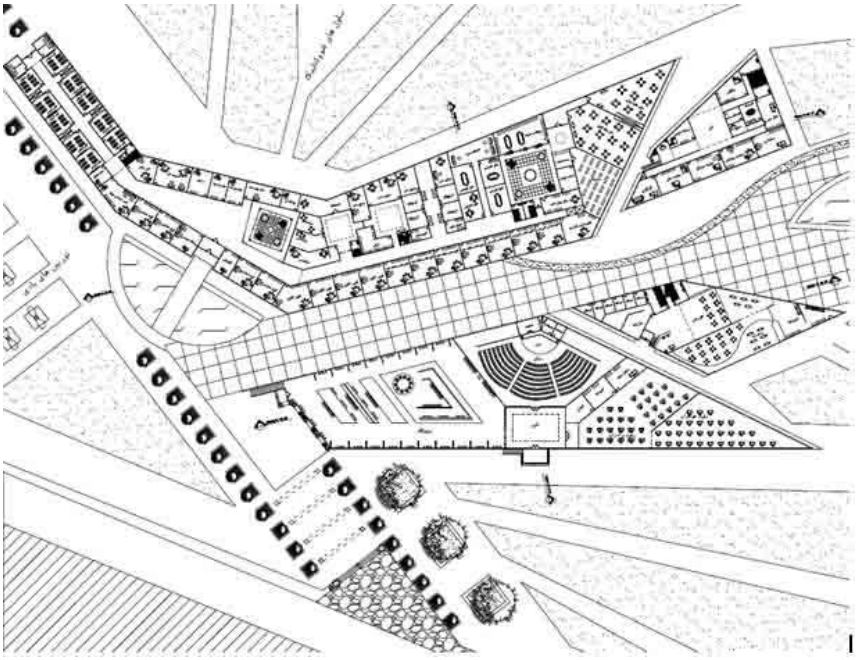

Figure 2. Ground floor plan of complex

The main concept in sustainable architecture is that the building wants to represents its protest to hardships affecting the plants. That is, the bundling considers itself as a living creature (here it is plant) which wants to show effect of air pollution on its body and express its protest. This building, which has been created in a sub-climate by the site plan, crawls like a plant and reaches to its surrounding so that it can find a refuge or shelter for a moment resting in clean air. It does not ascend high, since it wants to enjoy pleasant weather in its surrounding green environment. It does not want to reach to pollutions in upper parts. Even sometimes it places green surrounding environment on its body so that it alleviates its pains (such as green roof, atrium, etc.). This effect is manifested both in the plan and volume and form of the building. Of course, as it is known, the main concern of designer in sustainable architecture is mostly on use of natural potentials of the site and using permanent renewable energies. Hence, extension of the plan is so that maximum use of solar energy is provided in southern façade. On the other hand, maximum use of daylight is obtained using atriums. Western and eastern fronts of the building should be minimized so that heat loss is prevented. Simple and modular architecture is the other principle in designing which originates from thoughts of sustainable architecture. The main goal of designing is achieving interaction between human, nature and technology; that is, achieving sustainable smart architecture. Landscape is designed in such a way that an optimal sub-climate is developed within area of the site. This sub-climate causes that building needs less energy for its cooling and heating and sustainability in the building is justified. On the other hand, the building can play considerable role in generating needed energy; for example, using photovoltaic panels in areas to the south.

Table 1 gives research areas of the Centre.

This area, as the main area of the center, includes two sections. Data collection section, which collects data regarding climates of Iran and regional characteristics and includes various research groups such as applied climatology, climatology of climatic disasters, climate change, and study of natural sciences including botany and zoology, and etc. in order to receive more accurate data, this section includes a meteorology part which is directly associated to National Bureau of

Meteorology. Also, it is in ongoing relation with meteorological stations worldwide. There are also educational courses for educational promotion of experts and staffs working in different sections. A specialized journal is published in quarterly form.

The second section deals with analysis of data received from previous section. It includes climatic modeling laboratories which analyze and provide region specific solutions based on research sector's data and information. This section directly cooperates with architectsand urbanism experts. Also, it holds various conferences and seminars for providing its scientific achievements.

Table 1: Research area

Research Area						
Title	Total area (m^2)	Description	Useful Area (m^2)	Capacity (person)	Number of space	Spaces
Climatology department	**800**					
		Per capita 5 m^2	200	10 per room	4	Applied climatology
		Per capita	200	10 per room	4	climatology of climatic disasters
		5 m^2	200	10 per room	4	Climatic change
		Per capita	200	10 per room	4	Botany
Meteorology	**100**	Per capita 4 m^2	96	6 per room	4	
Weather Forecast	**90**	-	30	5 per room	3	
Data analysis	**80**		80	20 per room	4	
Modeling laboratory	**200**					
		Per capita 4 m^2	80	4 per room	5	Labor room
		-	40	-	2	Dressing room
		-	50	-	2	Resting room
		-	30	-	1	Archive
Confrecne room	**180**	Per capita 1.5 m^2	-	30	4	
Study room	**200**	-	20	-	10	-
Journal	**120**					
			30		1	Editor
			60		3	News staff Writer
			30		1	Print Affairs
Educational class	**430**					
			36	18	10	Classes
			50	-	2	Professor resting room

Table 2 shows cultural – educational area of this center. This area includes such spaces as exhibition, library, educational workshops, internet site and multi-purpose salon.

Table 2: Cultural – educational area

Space	Number of space	Capacity (person)	Useful Area (m^2)	Description	Total area (m^2)	Title
					120	Exhibition
Exhibition design	2			-		
Display sector	2			-		
					400	Hall
Seating place	1	200	220	Per capita 1.1 m^2		
Scene	1	-	60	-		
Scene warehouse	4	-	80	-		
Sound room	1	2	15			
Projector room	1	2	15	-		
Electrical room	1	-	15	-		
					250	Computer site
Ladies Site	1	50	75	Per capita 1.5 m^2		
Gentlemen Site	1	50	75	Per capita 1.5 m^2		
Site Management	2	2	40			
Warehouse	1	-	30			
Repairs	1	-	30			
					480	Library
Entrance and Control	1	-	20			
Book Search	1		20			
Study Hall	2	100	022	Per capita 2 m^2		
Book Repository	1	-	120			
Journals and publications	1	-	60			
Head of Library	1	2	20			
Staff resting room	2	-	40			

Conclusion

Design and various aspects of the Climatology Center of Tehran were investigated. As mentioned, this center is in optimal condition in terms of design and energy and etc. investigation of research, cultural and educational aspects also shows optimal design for this center.

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