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Standardizing the Education Environment Based on Optimization of Energy Consumption with Regard to Climate Change in Sanandaj

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Abstract

Standardizing the education environment with the approach for optimization of energy consumption with regard to the change in climate in Sanandaj is the goal we have set for this study as, on the one hand, in today's schools, technical standards, environment necessities and architectural identity are applied at their lowest level, on the other hand, climate change is a very serious issue that human beings face and it challenges human life more and more. Thus, the attention to this matter in education environment is of very high significance. This research is of descriptive and analytic nature and the data collection method was mainly through libraries and documents. The results of the study makes it clear that with regard to the increase in temperature and the reduction of raining in the city of Sanandaj, new measures must be taken in skeletal planning and designing of new spaces. The designing of educational buildings must first be subject to study, analysis and matching with climate conditions and with a design that is in coordination with the climactic conditions of the region and by considering the climactic changes in recent years. Also, optimizing the consumption of energy, free or cheaper and reproducable sources can be used. All of these items can be used as a standard in designing educational buildings.

Keywords: standard, optimization, energy, education centers, climate change

Introduction

In the past, because of the respect and the value that knowledge and learning had among the thoughtful Iranians, and considering the reinforcement and encouragement of this desirable characteristic based on the teachings of Islam, schools and scientific and education centers, found a position worthy of their value. It is with this approach that we see a notable number of Iran's historical buildings and also some of their best and most prominent ones are attributed to education centers and schools. This is an indication of the important position education and school building has in Iran's Islamic culture.

In Iran, schools are heirs to and inspired by mosques and have borrowed a major portion of their function during history from these places. Although today and with the expansion and lightning-quick leap of the modernization of knowledge and the borders of science and technology, this historical relation and bond have noticeably become weaker. However, designing, constructing and executing new schools with inspiration from past architecture which have given special attention to sustainable architecture and regional designing, added to giving identity to these education centers, can be helpful and work in the direction of reinforcing the historical and cultural bonds between these kinds of spaces (Kleiner, 2009).

Those who succeed in entering college and continue their education in sciences and arts in universities and high education centers, spend approximately one fifth of their lifetime, from primary school till they finish college, in educational environments. Therefore, the proper design of these spaces and observing the functional standards and factors, principles and foundations of aesthetics in designing educational skeletal spaces, aside from responding to the physical and mental needs of the students, result in the training of talents and the flourishment of their creativity. The identification and optimized consumption of energy in education environments will be a great help

for designers and programmers of these spaces to improve them and standardizing in this field, aside from improving the education environment, will lead to economize the consumption of nonrenewable energies. There are several schools that are constructed in our country in which technical standards, environmental necessities and architectural identity are applied in their lowest level. It is significant now to understand that a better environment will lead to a better education. Therefore, in parallel with the expansion of the school's education system and curriculum, the environmental pattern of schools also needs to evolve, something that has never been done in Iran's contemporary schools history.

On the one hand, climate changes today are a very serious matter facing human beings and challenging human lives more and more everyday. In the beginning of the industrial revolution, meaning the eighteenth century, the density of carbon dioxide in the earth's atmosphere was 270 particles per million, today this density has reached the amount of 377 particles per million. This amount, not only surpasses the record of the past 740 thousand years, but also that of the past 55 million years. 55 million years ago, planet earth was a tropical planet, there were neither a north pole nor a south pole and sea levels were 80 meters above their current levels. This situation was not proper to cradle human life and only through its elapse was human life able to take form on planet earth (Qin et al, 2013). But today, human beings are recreating that very same condition by their own hands and this is one of the most important issues facing them.

Today, the climate change phenomenon is one of the most critical subjects that has kept the minds of the programmers and politicians busy. The first step for the prevention of the continuing of this trend, is to understand the climate change phenomenon and accept its destructive effects. In the next step, its decreasing and increasing factors must be analyzed and definitive results should be reached; then, the culture in this matter must be worked on and public awareness regarding the climate change issue, must be increased (Engels et al, 2013). The most important way for the prevention of the on-going process of climate change is to give more attention to the subject of energy. In this subject, politicians must establish motivating or deterrent programs for the reduction of fossil fuels consumption or investing in the field of efficient technologies of energy and propagate the culture of consuming perdurable energies (Li et al, 2012). Therefore, in this study we are trying to analyze the climate changes in the city of Sanandaj and the effects these characteristics have on the design of the education centers in this city and standardizing them from the energy consumption optimization point of view.

Method

This study is of descriptive and analytic nature and the data collection is mainly based on inquiries in libraries and documents. To achieve this goal, the needed information were gathered through books, articles and all the other national and international documents related to the subject.

Theoretical Framework of the Study

Standardizing in Education Environments

Standard is a concept that can be an indication of the execution and discipline of intellectual, scientific, technical and cultural activities of the society and in general it is synonymous with order (Thomson, 2012). Standard, is a system that is based on the results of human sciences, techniques and experiences; standard means the law, rule, basis, criterion and in general anything that is done in coordination with a set of orderly and regulated principles. Standard is the crystallization of knowledge and experience of the past. Standard (criterion) is the desirable level of indicatives of the fact that quality determines the pattern (Bazargan, 2001).

Standardizing is a process that can be utilized in the long term and gradually make the access to better educational and cultural qualities possible. In order to reach such a quality, this

process must take its evolutional flow. It can be stated that all the aspects of the education system, including educational facilities and tools, education environment, teaching methods, evaluation methods, learning rate, staff and teacher's evaluation method, their welfare, the amount of their income, the way those who apply for a job in the education system are used, etc. are all in the domain of the standardizing activities of the education system (Yegane, 2000).

According to the expansiveness of the standardization in the education system, the present study is trying to standardize in the field of educational environments and the skeletal design in the direction of the research's desired goals.

Renewable and Nonrenewable Energy

Access to nonrenewable energy on earth is limited. Oil, coal, natural gas, propane and uranium are examples of these sources that in some texts are referred to as "finite sources". And renewable energy sources include solar energy, wind energy, hydropower, biomass (biomass energy), geothermal energy, wave energy and tidal energy. The sun shines everyday, winds blow and rivers flow. Renewable energy sources are often used for generating electricity (UNEP, 2011).

Now the utilization of new energies is getting some attention in different countries all over the world. This is caused by different reasons and these are the most important ones among them:

- The undeteriorability and renewability of these types of energies (in contrast with energies generated from fossil fuels)
- Reduction of environmental pollutions (Apergis and Payne, 2010)

Considering the potentials in the utilization of differnt types of renewable energies in our country and the share their utilization will have in the country's economic development, discussing the skeletal features of the buildings in a way that could result in the least amount of energy consumption with regard to the climate changes that have taken place, is of a very high importance.

Energy Management State in Education Environments

The optimization of energy consumption is a subject that not only reduces the expenses, but also can improve the quality of the school's educational environment and facilities and help keep the nonrenewable sources of energy and reduce the generation of environment pollutants such as carbon dioxide gas which is one of the most important reasons for global warming and climate changes.

With the proper management and the practice of the right methods, like turning off the supplemental lights, closing the windows and analyzing the rounds of the heating system, will lead to a minimum of 10 percent decrease in energy expenses. The amount of the money resulted from the economizing varies from hundreds of thousands of Rials to millions of rials per year, depending on the size of the school (Javanbakht, 2011).

Among the effective factors in energy consumption in schools, the following can be mentioned:

- Space Occupation Surfaces: Generally, one of the most important factors in the work of the facilities in the environment of a school, is the low amount of energy expenses per every student. For instance, in conditions where the number of students is low, the average heated space for each student increases and as a result, there will be an inevitable increase in the energy expenses per each student. It is possible that the class or the school's door cannot be closed at all times, but if it happens, there will be a noticeable amount of economization in energy consumption.
- Lateral Facilities: Lateral facilities such as swimming pools or gymnasiums cause a notable increase in the expenses of energy. In average, 20 percent increase in the total energy expenses is predictable.
- School Building Construction Date: The effect of this matter is less emphasized upon. In newly constructed schools the energy revenue is above the average level.

• Utilization Hours: Adding hours to the school's curriculum will increase the amount of the energy consumption. For instance, two hours of overtime work for a makeup class or a PTA meeting will cause up to 10 percent increase in the energy consumption expenses.

• School Size: Studies have shown that bigger schools are more efficient in terms of energy consumption. This may be because of the higher number of students. In schools where there are kitchen facilities, due to energy consumption in cooking, they have about 7 to 10 percent higher rates of energy consumption in comparison with similar schools (McIlvaine, 2000).

Optimization of Energy Consumption Through Sustainable Architecture

Effective utilization of natural resources and following the ecological principles with the goal to design sustainable buildings and reduce damages on energy resources and nature, is one of the most important characteristics in sustainable construction including the following rules:

• Reducing the consumption of nonrenewable sources

• Expanding the natural environment

• Elimination or reduction of the consumption of toxic or damaging the nature in the construction industry (Perez, 2009).

Therefore, buildings that have the least amount of incoordination and contrast with the natural environment surrounding them and on a larger scale, with the region and earth and also their construction techniques, on a large scale, are in the direction of providing a unified quality in economic, social and environmental terms, are considered sustainable buildings. Therefore, the rational use of natural resources and the proper management in construction will help keep the limited natural resources, reduce energy consumption and cause improvement in environment quality.

Designing sustainable buildings will lead to a special attention to the climate. Some of its characteristics are:

• Proper and coordinated understanding of the environment and climate with regard to the function of the intended building

• Coordination with the surrounding environment in constructing buildings, especially educational centers

• Proper use of regional materials in construction

• Building form in coordination with the climate

To achieve this goal, the form of the building can have a considerable impact in coordinating the climate and also moderating the transformation of the critical conditions of the outside air to the inside of the building. To find out the role that each region's heat conditions (temperature and sunshine severity) in the form of that region's buildings, the relation of importance of each of these factors needs to be determined. But. in general, it can be said that the high intensity of sunshine will lead to the building's elongation in the direction of the east and west axis. In determining the most proper form of the building, this must be kept in mind that the best form of the building is one that loses the least amount of heat (calories) in winter and in summer, advocates the least amount of heat and sunshine from its surrounding environment. Regarding this matter, buildings with square plans have been known as the best forms. This belief is based on the fact that this form gives the minimum amount of exterior surface against the highest amount of volume. Of course, this idea resonates with the old buildings which often had small windows and because of that let a trifle amount of sunshine in them (Rezaei, 2005).

Climate Change

Climate change may be one of the biggest problems of human race today. Because it is happening to all people and they can see it in events like famine, fires, etc. The climate of the earth during the twentieth century and especially in the past two decades have lost its balance and shows more tendency to an increase in the temperature. In this change of climate, the role of human and his activities in different fields is very obvious and it continues the process whose next results are completely clear for climatologists. Therefore, the subject of climate change and the earth's tendency to increase in temperature and its ecological, economic, social and political consequences that have not only attracted the attention of scientists, but also have busied the minds of government authorities and politicians all over the world (Azizi et al, 2008:14).

The rise in the sea levels and change in temperature and rain thresholds are among the consequences of climate change. Change in the raining distribution pattern and change in the water resources of an area are also other matters that are caused by climate change. Long term prediction of climatic variables to know the amount of changes and consequently consider the needed preparations for reducing the negative effects of climate change, is in the attention of different experts such as climatologists, agricultural experts (watering, farming and gardening) and even experts in social and economic fields (Schaeffer et al, 2012).

The UNFCCC convention, in defining "climate change", have stated that climate change is a phenomenon that takes place as a result of factors such as the earth's dynamic processes or effective exterior factors like changes in the intensity of sunshine or human activities. Significant exterior factors in the climate are often called climactic forces and they include processes like radiations in the sunlight intensity, deviation in the earth's movement pattern and the increase in greenhouse gases. The feedbacks from climate change vary and may cause the increase or decrease in these internal factors. Many of the internal factors in climactic systems take place with a delay because the climactic system of planet earth is very big and moves slowly and responds to the inputs with delay. For instance, a year of famine will only lead to the slow drop of a river surface or withering of the margins of flat lands. In the next years, these conditions may lead to a reduction in raining that on its turn, lead to another more famine year (Santamouris, 2013).

Several researchers in the world have tried to identify the process of climate change from which the research of Krishna Kumar et al that studied the rainings process of Kerala, India in the past two centuries (Kumar et al, 2009) and the study of changes in the rainings of the Palakkad area in southern India by Raaj et al can be mentioned (Raj et al, 2010:75).

In Iran, also in the field of climate change, there have been excellent studies by the researchers from which the study by Sabzipour et al (2013) can be mentioned that analyzed the temperature process in arid and semiarid areas of the country and showed that the maximum temperature in 70 percent of the stations and minimum and average temperature in about 90 percent of the studied stations indicated a meaningful increasing annual trend. Also Alijani et al (2011) analyzed the annual minimum and maximum temperatures of the country using the Mann-Kendall Test.

Climactic design with the goal of optimizing energy consumption in cold climates

To control the climate of a building, it is needed that the thermal transaction from the outside to the inside and from inside to outside be controlled. We know that thermal transaction can happen in three ways: radiation, syndrome and conductivity. In the subject of climate and creating the conditions for the welfare, the surface evaporation factor also plays an important role in reducing the temperature. Table 1 shows that in warm and cold seasons, which natural factors must be cared for to decrease or increase the temperature. Therefore, methods for the utilization of natural energies

and resources to create the welfare conditions inside the building can be categorized into a number of groups:

- The utilization of sunlight or avoiding the intense sunlight
- Radiative cooling or the building's radiation at night
- Avoiding the wind
- Utilizing the wind and mild air flows
- Reduction of the building's thermal conduction (Watson, 1937)

Table 1: Natural factors for reducing or increasing the temperature in hot and cold seasons (Watson, 1937)

Evaporation	Radiation	Syndrome	Conductivity		
	Utilization of solar heat			Increase in heat absorption	Winter
		Reduction of air flow outside the building, reduction of air penetration	Reduction of thermal conductivity flow (insulation)	Preventing heat waste	
	Reduction of heat absorption from the sun	Reduction of air penetration	Reduction of thermal conductivity flow (insulation)	Preventing heat absorption	Summer
Utilization of evaporating coolness	Utilization of radiative coolness	Utilization of air ventilation	Utilization of the Earth's coldness	Increase in heat absorption	

The sun is the only important source of natural energy for heating the building without the utilization of electric of fossil fuels. The intensity of sun's radiative energy in most of the areas of the globe, is a notable amount. But, this amount is accurately dependent on geographical latitude of that area and the clarity of the sky. Also, the intensity of this radiation varies in different seasons of the year and different hours of the day. The surface angle is also another significant factor. If the surface was perpendicular to the sun rays, the maximum absorption takes place and as the surface is more inclined to the direction of the rays, the percentage of absorption will decrease.

Optimized utilization of energy in Sanandaj with regard to the climate

Sanandaj is located in 35 degrees and 17 minutes of the north latitude and 47 degrees and 18 minutes of the east latitude from the Greenwich meridian and is 1570 meters above sea level. The city of Sanandaj, in terms of nature, is surrounded by hills in a spatial cup, in a way that the mountains and hills (Abidar, Kouchke Resh and Toush Nozar) that are the continuum of Zagros mountains, are all around this city and have limited the growth and expansion of the city in the south western and north eastern sides. This city is generally affected by two main currents of hot and cold air and cradles different climates. The amount of atmospheric precipitations in the city of Sanandaj is 500 millimeters per year. Sanandaj enjoys a cool and mild weather in Spring and Summer. The coldest month in this city is Bahman (January-Feburary) and the minimum temperature is about 1 degree below zero. The ice cold days of the city of Sanandaj have reportedly been counted as 92 days per year (Shaaterian, 2008). The topographical conditions of the city and its surrounding mountains have caused the city to be enclosed naturally in a relatively flat valley. Certainly the formation have expanded in other directions and this formation of the network of passages and main and subsidiary routs, alleys and neighborhoods is based on the earth's slopes and even most parts of

the city (buildings) are placed in a step rated form and terraces and except for new neighborhoods, most alleys are narrow, maze-like and in steps.

The city of Sanandaj, in terms of climate, is located in a cold area and its architecture is based on the climactic situation of cold regions. The analysis of the form and the orientation of the buildings and the functional elements of this city indicates that its residents, through the utilization of the radiations' positions and angles to use solar energy in the buildings' walls and rooftops, have acted carefully and have used the formation of the buildings to optimize their energy consumption. But today, the changes in this city's climate have caused the relative humidity and maximum temperature to increase and also the amount of atmospheric precipitations to have a decreasing trend. The rise in the temperature will lead to human and other creatures' increasing need of water which in its place, causes several problems in the future.

Conclusion and Suggestions

The increase in the temperature of the world is a great challenge that later generations will face because every year, the amount of the generated greenhouse gases in the world rises by 2 percent. With regard to the fact that more than 60 percent of the greenhouse gases are generated by the utilization of heating, cooling and lighting facilities in buildings, the prediction of preparations for the reduction of its negative effects on the world climate is necessary. To reach this goal, the collaboration of all the experts, especially architects, urban planners and people is a necessity so that future generations will be able to satisfy their needs. This is the same concept of sustainable development including futurism, environmentalism, justice activism and oriented partnership. Therefore, following this development is an inevitable necessity that helps us reach methods for preventing the climate change phenomenon. However, the new architecture is propagated without the study, analysis and coordination with climate conditions of each city or area and Sanandaj is not an exception. Because of providing energy, in ways other than the natural energies of wind and sun, attention to the orientation of the buildings, types of the materials, thickness of the walls, the dimensions of the windows and the shades are not heeded. The wastage of a great amount of this nonrenewable energy could be avoided by a proper architecture in coordination with the climactic conditions of the region that would lead to the optimization of energy consumption or the use of energy from free or cheaper and renewable sources. And, all of these items can be utilized as a standard in designing buildings.

For designing educational buildings and optimizing the energy consumption in them, the following items are suggested:

- Proper insulation of the buildings' rooftops, walls, floors, doors and windows
- Utilization of double glazing windows with high quality or PVC windows
- Utilization of efficient equipment (especially in the facilities category, equipment like pumps, fans, etc.)
- Utilization of daylight and natural ventilation
- Keeping the building's skeleton in both the hot and the arid ways
- Utilization of attracting and storing masses of solar heat
- Utilization of solar energy in the form of stable solar systems (solar window, Trombe wall, greenhouse, thermos iPhone, etc.), Photo Voltaic system, dynamic solar system and natural lighting
- Designing education environments with compressed plans
- The formation of buildings for creating shades in the summer and receiving enough heat in the winter
- Utilization of materials such as bricks and a mosaic or stone floor can keep the temperature stable, this state is very desirable for buildings that have south oriented windows

- Avoiding the utilization of big windows, especially in northern exteriors
- Utilization of double or triple glazed windows and the injection of argon gas between the glazes

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