

Explanation of Sustainable Architectural Design Motivators with Respect to the Concepts of Sustainability

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ABSTRACT: For more than half a century, the concepts of sustainability has appeared in developed countries with holding several meetings and conferences and also publishing various articles and book. In the last conclusions of these researches, sustainability pyramid is introduced with three elements of ecological, society and economy; considering these elements is necessary to reach a comprehensive and general insight in this area. With growth of these themes, various academic fields are impressed from the discussion of these concepts. In this regard, in architecture, motivators such as energy efficiency in building, low energy building and green buildings spread in international level. These motivators just cover a part of concepts of sustainability and each of the themes has potentials and defeats. Of The sudden introduction of these concepts to the Iranian literature and architecture without recognizing its potentials and defeats led to detouring from its moderate way. Due to what was mentioned, this paper tries to introduce architectural design motivators in sustainability and then uses these concepts to explain potentials and defeats. This is done through historical-commentary research method and with reference to official and unofficial documents. In this case, motivators of sustainable architectural design that are handled in the contemporary world are explained and their potentials and defeats are analyzed in order to use its advantage and avoid its defeats.

Keywords: Sustainability, Sustainable Architectural Design Motivators, Energy Efficiency in Building, Low Energy Building, Green Building.

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INTRODUCTION

Concept of sustainability is rooted in six independent and yet interrelated streams of thought which emerged in 1590. Each of the streams of thought explain some concepts in clarifying past, commenting on the future of the human and continuing life on earth and the relationship between human and future. During more than half a century, these concepts have been developed and finally reached this result that they cannot be discussed individually about ecological, society and economy; there are three mentioned elements in sustainability meetings, conferences and articles and their simultaneous consideration is necessary to reach a comprehensive and general insight.

With emergence of the term sustainability from 1972 and its developmental themes from 1981, various academic fields were influenced from an international idea and tried to transfer concepts of sustainability to relative field. Like other fields, architecture is also influenced by these concepts; in this field, motivators of architecture design such as energy efficiency in building and their Building Codes and Standards are related to it; structuring low energy building and green building will also be explained.

The mentioned motivators just cover a part of concepts of this area. As mentioned, sustainability pyramid is constructed from three elements of ecological, society, economy while these motivators

emphasis on ecological aspect and take less attention on society and economy aspects. Evident defeats in this area are caused from it. In the following parts, potentials and defeats of these motivators are discussed briefly. The sudden introduction of these concepts to the Iranian literature and architecture without recognizing its potentials and defeats led to detouring from its moderate way. Also this issue caused indifference or even negative feeling to concepts of sustainability that in the contemporary world is of great significance. In this research, it is tried to explain the sustainable architecture design motivators with historical-commentary research method and with respect to concepts of sustainability, it describes its potentials and defeats. It should be mentioned that this way with the official documents and library will take a particular attention to the concept emerged on informal sources. It is hope that some effective steps be taken to correctly transfer these concepts to Iranian literature and architecture.

Motivators of contemporary sustainable architectural design

With development of sustainability, various academic fields are influenced, and they try to transfer its concepts to relative field. The energy efficiency in building, low energy building and green building are some examples of these motives. Therefore, each of them is described briefly.

Energy efficiency in building: Energy consumption in building account for the building itself and in some cases like regulate the climate inside the building, the lighting and electrical equipment and other equipment located in the building. The residential and commercial buildings, as can be seen in figure1; accounts for more than 39% of total energy consumption. However, in other cases such as industry, energy is used for a particular purpose, not in relation to building. Moreover, , energy is used in building in many cases, such as heating, cooling, conditioning, lighting, hot water supply and installation of equipment. As shown in figure 2, energy consumption for heating, cooling and hot water supply accounts for more than 75% of total energy consumption.

On the other hand, buildings have life span over decades or even more than a hundred years. Other equipment in the building has a maximum life of about a decade. With regard to the importance of energy efficiency for electrical and non-electric equipment, how can a person be indifferent to energy efficiency in buildings?

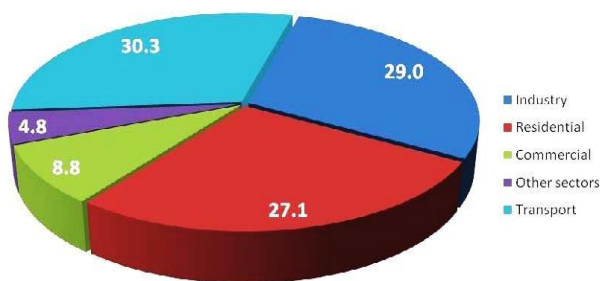


Figure 1. Energy consumption in different sectors (IEA, 2007)

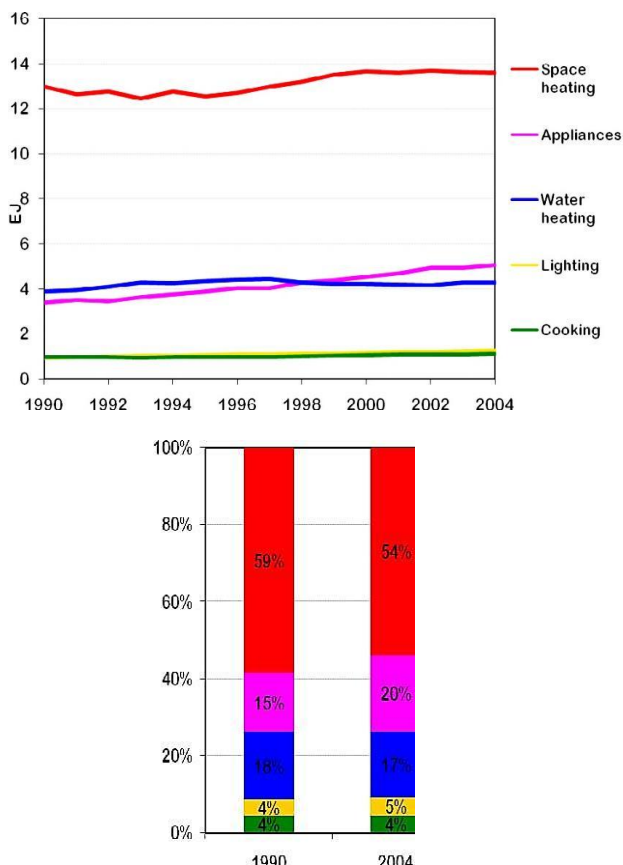


Figure 2. Energy use in residential buildings

It should be noted that due to the energy efficiency requirement in step of architectural design, it is more practical to determine the orientation of the building and appropriate window orientation and quality of shades.

If these items are not considered at this stage and after completion of the building, the construction is trying to raise its energy efficiency, then there will be problems, such as changing the structure system. All the mentioned cases which lead to that energy efficiency in building are entered in low energy building.

Building Codes and Standards: Building Codes and Standards are not new phenomena but it is for a long time that the regulations for construction's safety, fire protection, providing the residents' health and preventing disaster are laid down. It should be noted that codes are rules that specify the minimum acceptable standards for a construction. In this context, the codes will be issued by independent agencies as legal reference, is valid. The standards are documents that imposes a series of minimum for certain aspects of the building design. The codes which are related to energy efficiency are often general and standards are more detailed. Most of the codes refer to standards. It should be noted that the Building Codes and Standards can be set at the local or national level.

Building Codes and Standards related to energy efficiency compared to other Building Codes and Standards are new phenomena. The regulations between the First and Second World Wars, the Cold Regions located in countries such as Scandinavia, were passed. The Building Codes and Standards to improve building energy efficiency and achieve comfort conditions were applied. Nowadays most countries use the Building Codes and Standards, which have been greatly expanded for designers because of the issues of energy efficiency and the potential risk during construction.

In this context, for example, we can refer to America's energy efficiency standards like International Energy Conservation Code for residential buildings and the American Committee for heating, cooling and air condition engineering used in America and Canada. Energy Agency provides financial and technical assistance to improve the situation, force and implement Energy Codes and it also provides information to run this code in certain situations. It should be noted that to support these programs, the Europeans established Union for Europe Program of energy efficiency applications. Of course Europeans emphasize available guides that "the biggest help for energy efficiency is to price the energy efficiency of buildings", (European Union, Directive, 2002).

Building Codes and Standards in different countries are used with five different modes, which are given below.

- Prescriptive: This method specifies the energy efficiency regulations separately for each building or any part of its equipment.

- Trade-off: In this way, the values that have been set for each part of the building will be weigh and determine which values are better or worse.

- Model Building: In this way the values in the replacement Method are calculated with the same shape

and the same values. Calculations must show actual building as well as fashion construction.

- Energy Frame: The general framework is established to determine the maximum amount of energy loss and calculations must show that these thresholds were met.

- Performance: Regulations is based on energy use or the use of fossil fuels or the amount of greenhouse gas emissions.

It is noteworthy that none of these methods is superior to the other and in some cases it can be used in combination. Also, to implement the regulations in different countries mandatory and incentive methods are used. "In some countries, strict supervision and in some others, encouragement, such as tax-exempt, is desired", (Laustsen, 2008).

Low energy buildings: Besides the role of low energy building to construct buildings with high energy efficiency, there are other architectural design motivators in this field considering which is necessary. In this regard, some options can be pointed such as passive houses, buildings with zero energy consumption, building with zero carbon emissions, buildings with surplus production, smart buildings, integrated structures, and buildings with ecological implications. Then try to explain some of the most important motivators. In general, the buildings with low energy consumption phrase is constructed to show better energy efficiency building rather than new buildings or than applied building regulations. In these buildings, energy consumption is lower compared to the building observing Building Codes and Standards. In some countries, buildings with low energy consumption are defined by building codes and in others, by relevant standards. These buildings can be defined by having half or a certain percentage of its energy compared with construction which is built in accordance with Building Codes and Standards. Determine this percentage in different countries can create different definitions for such buildings. A building in the country may be placed in this category but in other countries the same building is not accepted. In some countries, the definition of these structures is discussed and in some cases, the entire building with the energy consumption less than the minimum defined by the Building Codes and Standards falls into this category. Also, consecutive years may improve Building Codes and Standards and building with energy consumption lower than the minimum stated in the Building Codes and Standards, can today be considered in accordance with them.

Passive houses: Passive houses are buildings without the use of conventional heating and cooling systems that can provide comfort for its residents. It is claimed that these buildings uses less energy compared to traditional buildings. These buildings often use 70 to 90 percent less energy than energy efficiency regulations in cases such as heating and cooling. To define this building some conditions have been raised, which is given below.

- "Heating energy consumption in these buildings should not be 15 kilowatt-hours per square meter or more.

- Specific heating load for the heating source must be less than 10 watts per square meter.

- With pressure building blower with pressures to 50 psi, building should not leak more than 0.6 volumes per hour.

- The total energy consumption for heating, whether to provide hot water or electricity should not be more than 120 kilowatt hours per square meter."(Feist,2001)

Passive house standard was defined in 1988 by Wolfgang Fays and the first passive house in Germany was built in 1990. To achieve the required standards, some building regulations must be adhered. In this context, we can refer to high levels of insulation, in the absence of thermal bridges in building, the comfortable three-layer glass windows with two sides lined and filled with gas; high permeability, ventilation with adequate and innovative heating technology utilization.

In passive houses, building shell and heating and cooling systems are made with high emphasis on energy efficiency. Implementation details in the buildings with traditional homes are different especially in maintaining the building joints, using the equipment against water vapor and changes in some aspects of construction such as windows. It should be noted that there is no engine house in this building and residents will have more living space.

Zero Energy Buildings: Such buildings are defined in various ways some of the most important cases of which will be presented below.

- Network buildings with zero energy consumption: Buildings that acts as a neutral within one year. This means that these buildings will deliver additional power to support network and the time required feed from that network. These buildings do not use fossil fuels for heating, cooling, lighting and other applications, though, sometimes it gets energy from network.

- Autonomous buildings with zero energy consumption: The building is not connected to the power network and could provide the necessary energy for itself. This is because of its capacity to store energy for using at night or in winter.

- Buildings with surplus production: These buildings deliver more power than its consumption to support systems.

- Building with zero carbon emissions: These buildings do not use the energy that leads to Carbon dioxide emissions. These buildings act as a neutral or positive from Carbon production during the year. However, because of the differences in building with zero energy consumption, this will be more explained separately.

Compared with passive house standards, there is not a definition for the construction of buildings with zero energy consumption. In fact, according to this traditional building can be considered with solar collectors and photovoltaic systems. If these buildings generate energy to the amount of energy consumption or more, they fall into this category.

Zero carbon buildings: Climate change and the warming of the planet have created concerns in the

community of designers that can refer to positive reaction of most professional organizations to the challenge in 2030, published by Architecture 2030.

Carbon dioxide and methane are the main greenhouse gases. Greenhouse gases in the atmosphere trap the heat in the same way that the glass holds heat from the sun in the greenhouse. "By imprisonment of heat, the temperature increases and climate change." (ASES, 2007) Buildings have important contribution to carbon dioxide emissions and therefore it is essential to consider it in order to take some actions to reduce global warming.

Buildings produce carbon dioxide in three ways. These three paths consist of the following: one is the result of the transport for construction activities and standing building in site; the other is the result of the consumption of energy for heating, cooling and the last one supports the operation of the building, and other waste materials in organic matter of construction while decomposing.

"Reducing carbon emissions in the construction of buildings can refer to options such as improving the energy efficiency of the building shell and heating and cooling systems, the use of renewable energy sources and filtration the carbon emissions." (Grondzik et al., 2010) It should be noted that there is no standard or guideline so far in this area code.

Green buildings: Green buildings regard more than what about energy efficiency is existed in the Building Codes and Standards. Both locally and globally, in addition to energy, water consumption and use of resources to provide materials are also taken special attention. Although there is no concise and consensual definition for green buildings, this term is usually used to express concerns about the health of the residents, respect to the global environment and adhere to the right to its future production. Green building attempts to maximize positive factors affecting at different levels on the site, local, regional, or whether national and global level and minimize the negative factors.

Some systems of green buildings have been accepted as architectural design criteria. In this context, we can refer to Energy and Environmental Design Management System related to Green Building Association of America, Green Environmental Evaluation System related to the green building innovations, and International evaluation method as GBtool. Energy and Environmental Design Management System, which is used in America and Canada, states options for architectural design to adopt appropriate strategies of the building and its grounds. Some of these are mentioned below.

- "Appropriate choice of building site
- Efficient use of water in the core and shell building systems
- Energy efficiency of the building shell and core systems and provide the necessary equipment for users for efficient use of energy
- The materials and resources for the construction of the building shell and core
- Providing the necessary equipment for users to make optimal use of environmental quality such as

natural light, landscapes and preventing indoor pollution."(U.S. Green Building Council, 2003)

In summary, it can be stated that energy efficiency is an attempt to minimize energy consumption in the building. Green building tries to maximize the positive effects and minimize negative impacts on the environment by respecting energy, water and material resources. It can be stated that energy efficiency is a subset of green buildings. It should be mentioned that some researches have considered revitalizing design motivator which aims to develop a better understanding of the positive effects of environment and respect to energy, water and materials.

Explanation of sustainable architectural design motivators with respect to concepts of sustainability

Concepts of sustainability is rooted in six independent and yet interrelated streams of thought. These streams of thought have different opinions in clarifying past, commenting on the future of the human and continuation of life on earth planet and relationship between human and future. Each of these streams of thought has given some particular interest to some concepts. Some referred to more ecological factors and others to society and economic factors.

The term sustainability appeared in 1592 and it developed from 1591. In these years, sometimes the ecological element is emphasized, sometime the social element and sometimes economic element. Finally, in the United Nations Conference in 1992 it was emphasized that to achieve sustainability, this cannot be viewed individually in three areas. Simultaneous consideration of them is necessary to reach a comprehensive and general insight.

Under the influence of sustainability, every fields especially architecture try to transfer the contents to the field. Architecture is in direct contact with human life and is considered as an interdisciplinary note to three elements of sustainability. Architectural design motivators that have emerged in the field of sustainability take less attention to the social and economic elements since it is an obstacle to its development. Then, it is tried to explain potential and defeats of motivators according to the concepts of sustainability.

1. Potentials of sustainable architectural design motivators

The factors identified above are useful for the community. When energy consumption in buildings is reduced, the total energy consumption will be reduced, too. This causes the country to need to import less energy and can operate independently in this context. It is very important for European countries to import energy, however, this matter is equally important for the Islamic Republic of Iran.

By reducing energy consumption, greenhouse gases such as carbon dioxide will be reduced. It should be noted that greenhouse gases get hooked heat in the atmosphere like glass in a greenhouse and cause to rise global temperatures and climate change. Reducing greenhouse gas emissions will have benefits both at the local and global level.

This action also reduces energy poverty at the community level. When energy is low, the cost of energy

risers and families may not be able to suit their budget to pay these costs. This drastically reduces the amount of energy and the situation is below the level of comfort.

In addition to what mentioned above, considering the mentioned factors makes additional costs spent on the field is returned within the specified time. It should be noted that this period can last up to 30 years. This not only brings many benefits for homeowners and decrease energy costs of course, but will also be beneficial to the community.

Defeats of sustainable architectural design motivators: With regard to the factors discussed in the context of sustainability, they have many benefits for individuals and society but they are also of some defects. One reason is employers due to the initial cost of construction, rather than spending a lifetime building. Many people who are attempting to build a construction have provided the initial capital with various loans. Therefore, to minimizing the cost of construction is emphasized by them. Additional costs, such as costs related to energy efficiency of buildings are considered a major obstacle to the attention of the public. Moreover, the main decision makers in construction building are not interested to spend money for the life of the building. As mentioned before, it takes about 30 years to pay back the costs and however, later, the major builders want to sell buildings or to rent to others. This makes them not to benefit from a cost structure that is returned in a lifetime. Hence, they do not show any interest in such investment. On the other hand, "the users and developers that are pursuing energy efficiency in construction are given loan reward" (IEA, 2007).

Another issue is the calculation of lifetime costs. The lifetime cost analysis is difficult due to its binding to changing conditions in the future. It is also an obstacle to expansion of community-level factors. In addition, the expensive energy efficiency of equipment or other measures thought and it is rare in the market which is considered another drawback of this method.

Another case which should be mentioned is the lack of awareness by people, corporations and banks in this regard. This makes some to be indifferent due to these strategies or even they have negative feelings about it and consider it inconsistent with the character of their family. This sense causes families to consume more energy than the sufficient amount. In this case, "homeowner or consumers just want to improve economic conditions" (Jensen, 2004).

On the other hand, Building Codes and Standards are specified by the maximum and minimum amount. This makes designers so happy to have accepted amounts. In fact, the designers will only try to license from related organization and do not try for most of that to achieve higher performance buildings.

It should be noted that even elements of ecological sustainability are not well covered in this motivators. For example, the Building Codes and Standards include the building shell, heating and cooling equipment, renewable energy sources and equipment installed in the building. Building Codes and Standards in the first place pay attention to the shell of the building, including walls, ceilings, floors, windows and doors. In this context, the thermal resistance and thermal capacity

will be given specific attention. Secondly, because these laws insists on constant climate conditions inside the building, it is paid attention to the device efficiency heating, cooling, ventilation and air regulator, moisture removal and supplying hot water. Renewable energy sources such as solar energy are in the next place. This regulation has been given less attention to, while these resources play a role in increasing the efficiency of buildings. At the end, the indoor equipment and some like lighting are given attention to. The first two areas increase the use of more renewable energy sources. In addition, local conditions are considered less. In this context, it can be stated that weather conditions which include the local temperature, moisture and its lots of natural light, are considerations that are more important than the low energy building.

Thus, it can briefly state that lack of attention to social and economic factors prevent developing such approaches. The sustainable architectural design motivators partly focus on concepts of sustainability in such a way that "they cannot even find a building in contemporary construction that is considered a sustainable architecture". (Grondzik et al., 2010)

CONCLUSION

For more than half a century, the concepts of sustainability has appeared in developed countries with holding several meetings and conferences and also publishing various articles and book. In the last conclusions of these researches, sustainability pyramid is introduced with three elements of ecological, society and economy; considering these elements is necessary to reach a comprehensive and general insight in this area.

These concepts must be transferred into architecture since it directly deals with human life more than any other field; some motivators for architectural design are emerging. These motivators emphasize more ecological aspects and give less attention to society and economy aspects. Energy efficiency of buildings and observing the low energy building, buildings with low energy consumption such as passive houses and buildings with zero energy consumption pay more attention to energy issues and even the concept of ecological sustainability. Perhaps the most comprehensive ecological approach can be seen in green buildings that in addition to energy, it also considers water and material resources.

Lack of attention to social and economic elements of the motivators is preventing it from spreading in the community. Factors such as additional costs is not acceptable for people who are taking loans to construct a building, rare and expensive equipment on the market, the negative feeling of family and its contrast with the characters of their family are among cases.

In this case, it is stated that sustainable architecture is the same as Green architecture. Indeed, currently there are no theoretical foundations for sustainable architecture. It should be noted that architects of Iranian traditional buildings not only interest to three elements, ecological, economic and social, it is also used as an unbroken one. It seems that particular attention must be given in this context to the potentials of Iranian

traditional architecture; this is a necessary condition in order to achieve sustainable architecture.

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