

# Designing Residential Complex with an Energy Efficiency in Iran (Tehran)

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**Abstract:** At the present time, energy is an essential issue for many countries. The reason stems from fast energy consumption and it assumes that after certain time, human being is not able to exploit fuel fossils. Therefore, it is necessary to preserve energy and natural facilities and make them efficient. Then, most countries were paying attention to solutions leading to fewer problems for environment. In the meantime, architectural spaces can be presented as a vast area that human beings' activities are taken place and it can play an important role to protect environment, reduce environmental pollutions and save energy. Therefore, sustainable architecture is an important approach for designing and making spaces. In other words, sustainable architecture is trying to represent a model, which is based on climate, local material and existed energy.

**Keywords:** Residential complex, Energy efficiency, the optimization of energy consumption, Energy crisis, hot and arid climate

## 1. INTRODUCTION

With emerging of high rising building, building design and its equipment have experienced new areas. In recent years, there are so many discussions about energy consumption in high rising buildings. New researches prove that high rising residential places in comparison with energy consumptions' standards use energy triple per unit in single houses. The limitation of energy sources and fast energy consumptions endanger the future of human being (Haj Saghati, 2002) In recent years, new insight toward renewable energies has been noticed considerably and as a result Bio Mass is being presented as a renewable energy source and it is a proper replacement for producing energy (Minouei and Derakhshan, 2011). The shortage of fossil fuels and environmental pollutions caused by burning has opened new discussions in environment and energy field. At the beginning of 1970, energy crisis, depletion of ozone layer and global warming were the main reasons to set rules for controlling energy consumption. Since then, development and sustainable architecture have been introduced as important subjects in the field of architecture. Undoubtedly, energy is one of the main reasons for creating limitation in human being daily life. Although fossil fuels may end fast, demand for energy is increasing day by day. New theories existing around the world depicts that the best and influential solutions for coping with this worldwide issue is to optimize energy consumption and applying new sources of energy to replace fossil fuels.

Controlling and optimization of fossil energies which have great values in human being societies, not only is vital economically, but it is also environmentally important. Fossil fuels as energy sources, in addition to producing energy, can cause improper consequences as well. In some cases, in order to control the conditions

which are made by using energy, it is necessary to use the same or more amount of energy. In other words, the optimization of energy consumption in building not only reduces the expenses, but it also creates less damage in the environment. As a result, it can improve the level of users' satisfaction. Therefore, even if when accessing to fossils fuels is possible and it does not need to spend costly budget, it is not easy to fix the environmentally unfavorable consequences resulting from using such fuels (Farahani, 2011). Therefore, the proper use of energy and other natural phenomenon, avoids misusing natural sources such as wind and sun for developing facilities and improving environmental conditions. Regarding this issue, architectural spaces are considerable for designing and making spaces (Izadyari, 2011).

## 2. Discussion and result

### Energy consumption in Iran's construction

In Iran, it has been some years that Optimization of fuel consumption [affiliated to the Ministry] has set rules for saving energy in all economic area, especially in construction (Bahari Nejad and Safarzade, 2002). Construction and housing are the biggest energy consumers (40%). Not only do residential and commercial buildings have high portion in energy consumption, but energy consumption in comparison with other countries and international standards is highly noticeable. The average energy consumption of buildings in the 58/2 times the average world consumption (Nasrolahi, 2010).



Fig 1. Residential complex [URL:1](#)



Fig 2. Zeytoon residential complex [URL:1](#)



Since Tehran as a major metropolitan area is dealing with increasing population, buildings with low energy consumption can reduce the energy consumption significantly. Also 98% of energy consumption in Iran is supplies with gas and petroleum products. Nowadays, world is facing with major issues such as the shortage of fossils energies, increasing price of energy, depending on macroeconomics in exchanging energy products and in lower rate, the high expenses of improper use of energy in families.

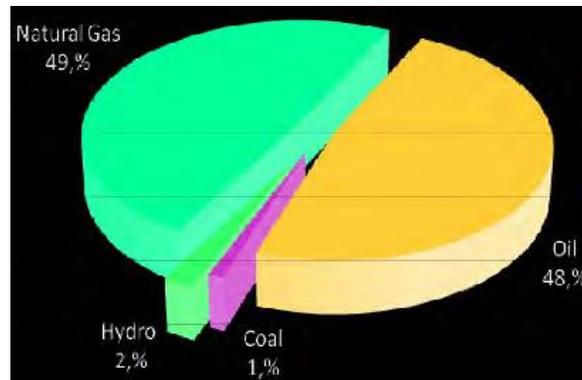


Fig 3. Energy consumption (Nasrolahi, 2011)

### Sustainable architecture

Sustainable architecture is a method in designing and dealing with reduction of nonrenewable sources and optimizing of renewable energy consumption and claims that whatever we need to survive is achieved in environment. Sustainable architecture is a method that intends to respond human being demands without damaging future’s resources. In sustainable architecture, we should pay attention to social and economic sustainability as energy consumption and environmental influences of building and cities (Hosseinmardi, 2004). Then, proper and decent house for social coherence and personal welfare and independence are essential and if housing does not follow the sustainability, societies can never achieve sustainable development.

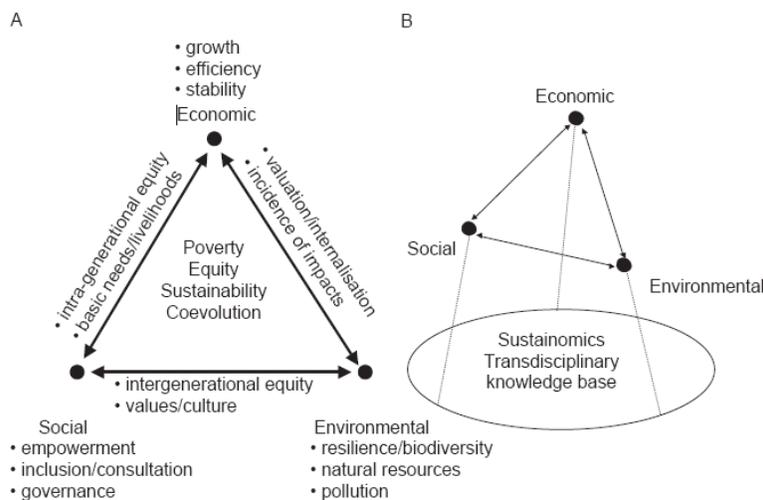


Fig 4. Component of sustainable architecture (Maleki, 2011)

### ***General principles for designing buildings***

Architectural designing should be climatic in order to benefit from natural advantages and protect the building against unfavorable climatic condition. This approach in architectural designing leads to a decrease in the amount of energy for responding demands and those parts supplied by passive systems.

### ***Building orientation***

Building orientation to south is influential in benefiting from solar energy. Orientation means that openings are benefitting from sun in the shortest day of the year from 9 to 3 pm. Additionally, the building is arranged in such a way that preserves them from unfavorable winds and also in the heat benefits from favorable wind for natural ventilation and maintaining thermal comfort.

### ***Arrangement of interior spaces***

Interior spaces of the building are divided into main and middle spaces. Main spaces are used during days and nights and individuals are dwelling there while middle spaces are not used constantly.

### ***Openings***

Openings are included in windows, voids. These spaces must be seamless and the minimum air leakage. More importantly, the opening should meet the defined expectations such as resistance against wind and safety in fire. Applying usual windows or proper thermal specification is recommended. The amounts of opening surfaces are very influential in transmitting heat. Due to little thermal resistance of openings surface respective to other outer surface, it will reduce heat loss from buildings, no matter how much opening surface is less than the surface of the outer shell,. As a result, considering sufficient and proper amount of opening surfaces, not only it supplies lighting for interior spaces, it also reduces transmitting heat outside the building.

### ***Parasols***

Parasols are used to control the amount of sun ratios to openings; in all climatic areas, parasols are not necessarily needed. To clarify that, the climate of the region should be taken into account carefully, and the parasol's angle vertical or horizontal should be determined according to hot weather around the year and sun ratio's angle.

### ***inertia***

Some elements such as floor and walls having thermal inertia are capable of saving heat. Due to thermal capacity, heat or coolness existing in the air can be transferred to the elements and reused in environment when it is needed. It is concluded that thermal capacity of building elements can contribute to reducing temperature fluctuation in interior space. Dependence on thermal elements with high thermal capacity depends on the sort of usage of space. Thermal inertia is favorable for those spaces which are used during the day and thermal insulation in outer shell is recommended.

### ***Natural ventilation***

Providing natural ventilation in buildings can supply thermal comfort and reduction of energy consumption of mechanic systems. In hot arid climate, natural ventilation can make the mass material colder. During the day, ventilation of interior spaces by cold air through evaporation system supply the great amount of cooling demand in the building.(Topic handbook, 19th National Building Regulations,2013)

### ***Principles for designing sustainable architecture***

Green design and sustainability are characters that determine compatibility with environment and durability with building. Regarding this hypothesis that sustainability of the earth with the sustainability of its component is possible, designing and building should be done according to the newest technology and intelligent compatibility with environment

Not only it is not a sustainable and green building against the nature, but also it is along the nature and parallel exploits environmental facilities and provide human welfare. A sustainable building applies advanced systems and is controlled coordinately by natural circumstances. An architectural design respects aesthetic and function and additionally utilizes spaces to benefit from natural resources such as renewable energy (sun, wind and geothermal energy) and plants to adjust environmental circumstances for users' comfort(Mahmoudi Kohne and Roudposht, 2009).

### ***Conservation of energy***

Each building should be designed in such a way that minimizes demand for fossil fuel. Undoubtedly, The necessity for accepting this rule in the past -regarding with construction styles - was inevitable and perhaps the variety of materials and new technology are unjustified excuses to ignore this rule. Regarding the users'

demands, the usage of different materials or combination of them can change the environment. Buildings which are following interaction of local climate and trying to reduce their dependence on fossil fuel, respectively, are tolerating different and individual experiences and as a result, they can be presented as beginning steps toward green architecture. Many of these experiments are resulted by individual efforts and it is clear that they are counted as sustainable principles in designing.

### ***Climate***

Building should be designed based on using climate and local energy resources. Due to encourage users' welfare inside the building, shape, arrangement, and site planning and interior design are essential items in building and moreover properly insulated structure can reduce using fossils fuel.

Before vast usage of fossil fuels, wood was the main source of energy and it provides 15% of energy now. When the wood sources became rare, it was common for many people to use sun for producing heat. Ancient Greece such as Prine change the city's location in order to prevent flooding and building a rectangular frame with east-west streets that can help buildings benefiting from sun.

Designing based on climate for creating comfort does not limit in warming rules but in different climates, architects have to create a cool space for producing favorable condition. The common solution in present century is to use ventilation system which is not efficient against climate and it is spending too much energy. This solution even if the energy is cheap or abundant is a big error.

### ***Reduction of using new resources***

Every building must be designed to minimize the use of resources and at the end of its useful life, it should create another resource for other structures. Although this trend is aiming new buildings, it is worth mentioning that the majority of existed resources in the world are applied in artificially-built environment and the importance of restoration and upgrading of present buildings for reducing environmental impacts is equal to building new structures. It is worth remembering that there are not sufficient resources for creating artificially built environment that can help constructors with renovating every generation of buildings. Reusing material can be done on the path of using recycled material or recycled spaces. Recycled buildings and its elements are important part of architectural history.

***Respecting users***

Green architecture respects all users. It seems that this principle does not relate to pollution caused by world climate changes and depletion of ozone layer. But green architecture having respect for common resources in making a building does not ignore human being. All buildings are built by human being but in some structures the real presence of human being is respected while in others it seems that human beings are not evaluated well in the process of building.

More respects for human beings' demands and workforce can be experienced in two different ways. It is necessary for professional constructors to note that the materials and processes that shape the health and safety of building are important for workers or users to the extent that it is important for the whole society. Architects gradually notice dangerous materials in building and recently are using insulated material contained CFC or harmful



Fig 5. Green Roof [URL:2](#)



Fig 6. Green Facade [URL:3](#)

**Facade URL:3**

***Respecting site***

According to Australian architecture Glen Murcutt, every building should touch the site gently. This saying contains one important characteristic between building and site which is necessary for green process and of course it has expanded characteristic. A building which is spending energy greedily produces pollution and does not feel close with users and as a result it cannot touch the site gently.

To prove more, it is not possible to remove a building from inside the site and revive the previous circumstances. This relation with site in traditional habitat of Arabs can be seen. The existed weightless and calmness is not included fast moving portable house, also material was considerable. Arab's tent is made by animals' wools such as sheep, goats and camels. When Arabs set tents, the sections were aerodynamically strong and were resistant against windy weather. Tent is kept with long ropes and used few woods because wood was rare in desert.

### ***Holistic theory***

All green principles need to participate in holistic process for making artificial environment. Looking for buildings which have all green principles is not simple and easy because green architecture is not known completely. A green architecture should have more than one building and it should contain a sustainable shape of a city. City is a creature above all buildings and in fact it should be seen as an interactive system. These systems are for life and enjoyment and they have framework that precisely form the future appearance of the city.

Therefore, a proper architectural designing can reduce energy consumption. It is important to consider energy consumption at the very beginning of designing and projects

## **5. Conclusion**

The sustainable architecture is an interdisciplinary field that is trying to combine developing concepts such as environmental subjects with social and economic matters. Sustainable architecture makes a big change in understanding of relationship between human being and nature. Two centuries ago, this important issue was against the common attitude which was based on separation between environmental, social and economic subjects. At that time, environment was a major external subject and human being could not assume that it could play an important role in making a healthy environment and help us with saving non renewable energy sources.

Therefore, sustainability in architecture and construction which spend large amount of

energy can be very useful. It has been so many discussions for setting certain rules that can result in saving energy and reduction of energy consumption in building but totally, principles that should be respected in sustainable architecture are listed below:

- Energy conservation: to minimize demands for fossil fuels
- Compatibility with climate
- Reduction of using new resources: the material of old building at the end of its useful life is used for making other building

- Respecting users' demands
- Compatibility with site
- Holistic: all sustainable principles should end up building a healthy environment.

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