Journal of History Culture and Art Research (ISSN: 2147-0626)

Tarih Kültür ve Sanat Araştırmaları Dergisi
Revue des Recherches en Histoire Culture et Art
مجلة البحوث التاريخية والثقافية والفنية

Vol. 6, No. 3, June 2017

http://kutaksam.karabuk.edu.tr

DOI: 10.7596/taksad.v6i3.991

Citation: Mirpadyab, S., Fatahi Darbid, Z., Khalili Ardali, A., & Malek Poor, A. (2017). Solutions of Making the Smart Energy Consumption in the Buildings. *Journal of History Culture and Art Research*, *6*(3), 1208-1232. doi:http://dx.doi.org/10.7596/taksad.v6i3.991

Solutions of Making the Smart Energy Consumption in the Buildings

Seyed Kasra Mirpadyab[1], Zahra Fatahi Darbid[2]
Atefeh Khalili Ardali[3], Amin Malek Poor[4]

Abstract

Energy sources in the world have diminished rapidly during the last few decades. The projections suggest that the world would suffer energy shortage in near future. This problem leads states, governments, non-governmental organizations as well as engineers and architects to increase ways of using energy efficiently. Building energy-friend structures would be a substantial contribution to saving energy. In order to identify these factors that will help us in this regard, in this study, we tried to identify the solutions and methods that would increase energy saving. For this purpose, this study benefits from the current literature and identifies the smart materials which can be applied in the architectural design.

Keywords: Sustainable architecture, Smart buildings, Smart materials, Building smart management (BMS).

[1] Architecture, Islamic Azad University of Qazvin, a member of Young Researchers and Elite Club, a member of landscape architecture Iranian, lecturer and university teacher. E-mail: k.Mirpadyab@qiau.ac.ir
[2] Master of Architecture in Islamic Azad University, Arak Branch.
[3]Master of Architecture Islamic Azad University, Shahre-Kord Branch.
[4] Architecture graduate student in the University, Shahre-Kord Branch.

1- Introduction

Undoubtedly, with considering the increasing the population and industrial development, reducing the energy consumption is an ideal target that is very difficult to achieve. On one hand, in different sections of the society, especially in the building, the methods and the measures must be applied that can reduce the energy consumption, on the other hand, these methods must be compatible with the nature. In the building section, the use of the new technologies such as the solar panel building, green roofs, and the use of the waste to produce the energy can be very efficient to reduce the energy demand and help energy saving. One of the very important ways in the establishment of the building construction is to consider the direction of the building which is closely related to the motion of the sun and its radiation in different seasons. On the other hand, the existing of the destructive winds in some areas, the importance of the direction of the building can be doubled (Ziabakhsh, Barzegar, 2011). One of the most important issues in the recent decades that have attracted the attention of the developed industrial countries is the preservation of the wasting energy and the environmentally friendly methods. The new researches show that there is a direct relationship between the level of development of a country and its energy consumption. The buildings that use the new technology, compared to the buildings that are far from this advantage are able to adapt itself to the condition properly by the smart use of the materials. New buildings should be applicable to any possible changes. With designing the different smart systems, the energy consumption in the buildings can be controlled and minimized.

This paper will outline to the strategy of the architects related to the future smart buildings and also investigation of the factors that contribute to the sustainability of the buildings. Therefore, it is necessary to identify and introduce the strategies of the design in the new buildings. Due to the abundance of the fossil energy resources in Iran, only a few measures have been taken place in this regard. Attention to the architecture in constructing the buildings is one of the principles that should be examined in our country. The proper design of the building with considering the climate and gaining the energy are the guarantee of the building residents' comfort. Given the limited reserves of fossil fuels, the available resources cannot be relied any longer. We are now on the verge of the next generation of buildings, and it is the consequence of creating the smart buildings in a variety of the different ways. The smart systems of the building refer to a system with unified management that seeks to create the ideal conditions in the building using the latest technologies and optimizing the consumption energy. The purpose of the smart building, is to match the different components according to the environmental conditions and building requirements at that time. Making smart building can save the time and manpower cost.

2- Research questions

1. What factors do involve achieving the goals of the sustainable architecture?

2. What measures will lead us to sustainable architecture?

3. Does the intelligent building design bring us closer to the approach sustainable architecture?

3. Research Methodology

The present paper attempts to identify and introduce the new technologies to achieve the sustainability and intelligence by searching the current literature.

4. Definitions

4.1. Sustainable Development

The most important definition that was presented about the sustainable development in Rio was as follows: "Development which meets the current needs of the human without endangering the future generation’s needs and this development must consider the environment and the future generations” (Zandiye, Parvardy Nejad, 2010). This term is a concept that requires defining words such as the sustainability, ecology and implementation. Although there is a strong correlation between the words, but each category is independent and exclusive as the mutually manner. For example, a building can be sustainable but not compatible with the green or the environment. A compatible building with the environment must be practicable with a combination of environmental sustainability and compatibility. Green level of a building is determined based on the interaction between these three categories. A green architectural work must be relatively sustainable, ecological and practicable (Ghorbani, Saremi).

4.2. Smart Building

It can be said with a simple definition that a smart building refers to a building which is equipped with the infrastructures of the modern information and communication system, in a way that the building can use a smart central system and records the changes moment-to-moment and adapts and coordinates itself to the new circumstances and its surrounding.

According to a more comprehensive definition, an intelligent building is known as a combination of some innovations based on the technology in the form of a smart management and in order to return the investment quickly (Rezai, Nahavandi, Zendeh Shahvar, 2013). According to the definition of “Smart Building Institute” a smart building is one that with optimal use of some basic elements, including the structure, systems, services and management and the internal relations creates a suitable and economic environment. In such buildings in addition to the minimizing of the energy requirements and losses, the builders also attempt to maximize the building utilization scale of the natural energy with the passive method and the design of the proper directions.

4.3. Smart Materials

The smart materials are ones that with the smart application against the changes of the environment can adapt itself to the environmental conditions such as the living creatures. Some of these materials can predict any damage and destruction in their structure and remove its defects. One or more characteristics of these materials such as shape, hardness, frequency and color of them change significantly in a controlled manner or under the influence of the electrical power or the magnetic fields (Mustafa Baghllani, 2014).

5. Identify the factors that will lead us towards the sustainable architecture

5-1 Water resources and the use of them

The availability of the clean water should be the characteristics of the green buildings. Buildings should avoid from the overused of the underground water for its uses, other than for cleaning and cooking. Architects must install the water storage equipment that are environment-friendly and use the water used for the sanitary, agriculture and the green space consumption or utilize the rainwater again. Landscaping for the water supplying should be constructed such a way that the supplier of the water can be self-sufficient a landscaping with local plants can have a better coexistence with the environment. Green buildings should not use more than 50% of drinking water, which is used in a certain commercial building with the same size and in the same area. Green buildings must use less than 30% of the traditional buildings (it does not include the irrigation).

Figure 1: Introduce of the collecting rainwater method for irrigation

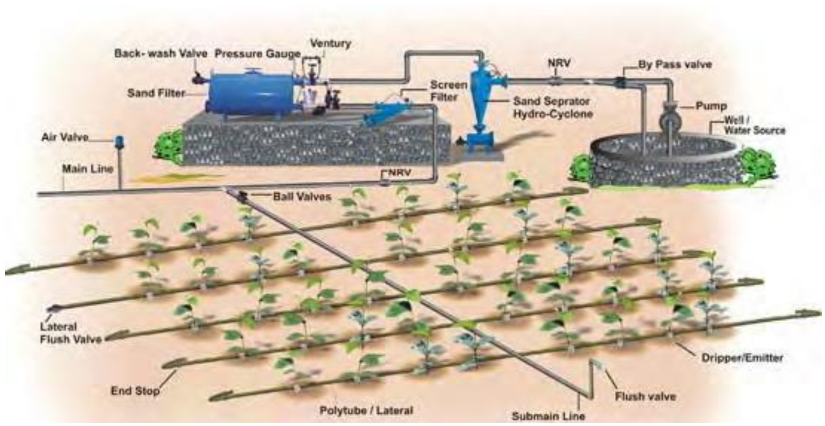


Figure 2: Introduce of the application of the irrigation system with the rainwater

Solutions for the recycled water use:

1- Installation and adding the low pressure plumbing for reduction of the water consumption up to 40%,

2. Installation of the plumbing system of the rainwater on the building site to control the flooding,

3. Rainwater and flooding management to prevent the soil erosion and damage to the building,

4. Use the collected water for washing and so on as well as the efficient reuse of the gray water in the building cycle..

How can we control the available rainwater on the site?

1- Rainwater piping around the building

2- Planting the vegetative species

3- By impermeable paving (Hoseiniyan, Mady, 2014)

Solutions and advantages of using the high-rise buildings for reduction and efficient consumption of the renewable energy for the environment and economic saving:

1. Use the wide surface of the body as the heat sink

2. Use the transparent photovoltaic window

3. Correct orientation of the building in the path of the prevailing wind and installation of the wind turbines

4. Wastewater treatment, rainwater collecting, biogas or replacing thermal-electric energy instead of the use of the gas

5. Use of the materials to prevent the loss of energy

6. Practical use of the dense waves, such as mobile phones, radio and so on to create usable energy (Gharemaifar, AmirShaghaghi, 2014).

5.2. Wind resources and the application of them

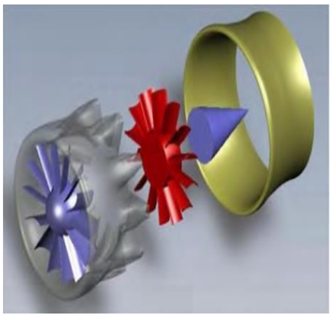
5.2.1. Wind Turbines

The single wind turbines are used to supply the electrical loads to the residential, commercial, industrial or agricultural use. The consumable load is placed next to the turbine and is connected to the grid. Most of these turbines are placed near to farms or a group of houses. Generally, the power of these turbines is 10-100 KW. Nowadays, the activity domain and the use of the wind turbines cover a wide range of the industries, for example, they are used for the water pumping or battery charge. These turbines change the kinetic energy into the mechanical energy and then into the electrical energy (Hosseini, Mohammediyan, 2014).

5. 2. 2. Windcatcher

Windcatcher is an Iranian innovative method to create a cool space in the indoor of the houses in the hot desert region. This air conditioner could help the Iranian people for tolerating the hot regions in the desert for a long time in the past. Wind catchers are small tower like a quadrilateral or regular polygon that they have not the triangle structure at all. The main work of the windcatcher includes two applications; first, it guides pleasant and delightful air in the bottom part of the windcatcher, such a way as soon as the air blows towards the spans of the windcatcher, the wind is quickly drawn into the bottom of the windcatcher due to the special position in the spans of the windcatcher. The second application of this kind of the windcatcher is to escape the pollutant and warm air from the other side of the wind catcher, meaning it works as a sucker (Mohammediyan, Hoseiniyan, 2014).

Table 2: Explain the use of natural resources and man-made tool in the building energy supply

Energy Resources	Facilities	Application Method	Image & Introduction
Water	Electricity Generation	Some blades are placed inside the water pipes and by flowing the water inside the pipes; these blades are driven and create the magnetic field for electricity Generation.	
	Recycling the water to the consumption cycle:	Waters that could bring them again to the consumption cycle can be used for watering plants and washing. This kind of water is stored in a water reservoir and it will be used in time of need, but the reservoir has a limited capacity	

		and in the case of filling it, the overflow water is guided to the municipal wastewater.	
Wind	Electricity generation	Use the turbines that are able to move with the wind for electricity generation and the electricity can be used in the housing applications	
Sun	Use the solar plates	The light and heat of the sun are used in the setting segment of the heat, electricity generation and so on. By the solar plates can be supplied some household electricity.	
	Use the solar water heater	The capability of changing the cold water into hot water for housing consumption with the solar water heater	

6. Use the solar energy and man-made tools in the building energy supply

6.1. Smart glass

The capabilities of the smart glass is the possibility of the change the brightness degree and color of the glass that can play an important role to control the light intensity and reduce the energy losses, and thus lead to reduce the ultraviolet rays in the environment. So the windows play the major role in the control of the entering light intensity in the building and the amount of the energy required. These conditions can provide the possibility of the retaining the proper environmental heat or cold and the reasonable storage of the energy along with providing the desired amount of the light. In addition to the energy storing capacity reduce up to 40%, it allows also to change the glass state from the full transparent to 100% opaque to be able to darken the glass for reducing the entry of the hot weather in the building in the warm sunny days and the sunlight is allowed to enter in the building with the transparency of the glass on the cold days. The controllable glass with the different mechanisms includes three types; the electronic (ES), liquid crystal (LC) and the PSD (Other types of the Electrochromic glass include the Self-regulation glass on 24 ° C., Holographic- Optic glass, the configurable glass with the turning on-off capability) (Beygum Taghavi, 2013).

The advantages of using the smart glass:

Thermal comfort in the winter and summer, annual energy cost reduction, lower costs for heating and cooling installations, preventing the harmful rays of solar radiation, providing the proper lighting of the building, reducing the costs required for lighting, reducing the noise pollution, high strength, and etc.

The disadvantages of using the smart glass

The available smart windows, from the electro-chromic windows to windows with suspended particles have also disadvantages, including the high prices, rapid decline of the efficiency, use of hazardous materials in the producing process (Mustafa Baghllani, 2014).

Nano glass for energy controlling

In this respect, the use of nano-coatings on the glass of windows lead to insulate them and the heat exchange is optimized and increased. Their role in reducing the energy consumption is undeniable. This kind of glass is known as the low-emissivity glass. The nano-coating in the low-emissivity glass filters and reflects the thermal spectrum (infrared rays) and the harmful rays (ultraviolet rays) but they allow passing the visible part of the sunlight spectrum through them. The glass reduces greatly the heat transmission arising from the temperature difference that is a combination of the guidance, displacement and radiation phenomena, reduced and also they control the radiative heat transfer (gaining the solar power) and also under control. According to the mentioned specifications, using the kind of glass has some advantages such as thermal comfort in the winter and summer, reducing the annual energy cost, prevents the harmful solar rays with providing the appropriate lighting for the building, then, to reduce the costs required for lighting. This type of glass in addition of having a variety of colors and other characteristics, they also are capable to prevent the energy waste in the building with an intense reduction of the passing ultraviolet and infra-red rays and adjusting the visible light transmission in the winter up to 85% and in the summer up to 80%. Actually, they have a significant role in saving the energy consumption (Hussainy, Mohamadian, Hosseini, 2014).

Table 3: Definition of the types of smart glass

	Types of the glass	Advantaged
Smart Glass	Photochromic glass	When the sunlight is radiated on the glass, it becomes dark, In other words, its control is automatic and we cannot control it
	Gaschromic glass	Multi-walled (at least two walls) that is coated by some certain covers and different gases are used between its layers
	Thermochromic glass	It is used without the electric current and the user command. It contains certain special polymeric materials which merged at low temperature to merge as well as expanded and scattered at the high temperatures that it

		lead to scatter the light.
	Polymer dispersed liquid crystal – Smart glass	By controlling the light passing through its various layers and the refractive index of the different light in the layers it causes a positive disrupt in passing the sunlight.
	Electrochromic glass	The glass color is changed by the electric current. It has the ON - OFF and mid status state and memory. For example, when the glass becomes the blue and suddenly the power goes out, It takes about two days for changing its color. The smart electrochromic glass can control the light as well as the temperature. For example, in the environmental hot weather, the transparency of the glass is reduced automatically and leads to enter a small amount of light into the indoor environment and prevents the excessive heating of the air in the room. It can adjust the amount of the light and heat entering in the room, so the cost related to the air conditioning systems is severely reduced.

	Nanowire/polyaniline - Smart glass	
	Nano Crystal - Smart glass	With passing capability of the visible light and rejecting the Infrared Ray
	Low-Emissivity glass	The nano-coating in the low-emissivity glass filters and reflects the thermal spectrum (infrared rays) and the harmful rays (ultraviolet rays) but they allow passing the visible part of the sunlight spectrum through them. The glass reduces greatly the heat transmission arising from the temperature difference that is a combination of the guidance, displacement and radiation phenomena, reduced and also they control the radiative heat transfer (gaining the solar power) and also under control.

Electrochromic glass: The internal structure of this type of the glass contains the two layers of transparent tin as the electrode and a layer of liquid crystal is sandwiched between them. By passing the electric current from the crystal film, the liquid becomes transparent. By cutting off the crystals flow and the accidental orientation in the space, it spreads the light and therefore, the glass becomes opaque.

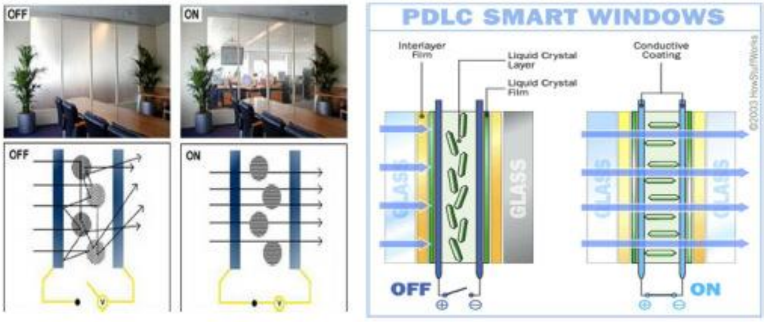


Figure 3: The simulated image of the Electrochromic glass

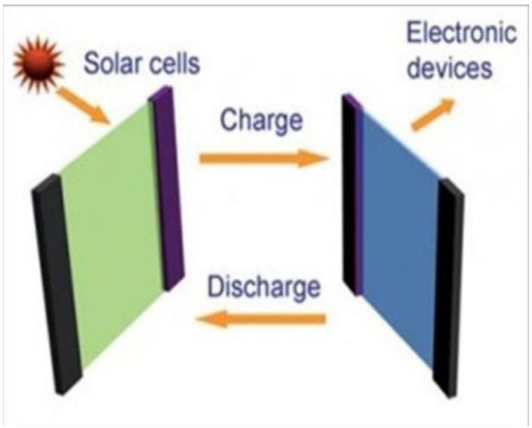


Figure 4: The glass that can convert the sunlight into electricity

Supercapacitors are placed in the electric windows and they are able to change the color. When the sunlight is intense, these windows absorb and store the light, and when the capacity of the windows was completed, it can be used in the other electronic devices such as TV. When the stored energy in the smart windows is used by the electrical devices, the capacitors are discharged and re-charged by absorbing the sunlight again.

6.2. Solar canopies with smart and continuous photovoltaic cells

The external solar canopy is one that is fixed or adjustable, in which the blades of the glass (opaque or transparent) have integrated with the photovoltaic cells (polycrystalline and monocrystalline which are placed between two sheets of glass). Thus, both the shade and electricity is provided (Beygum Taghavi, 2014).

6-3 Facades

The facades are implemented as dry manner, thus the facade materials (stone, ceramic, composite sheets and cement board) are installed on a steel structure that have anchored to the building structure. The steel structure consists of vertical and horizontal members that can provide the facade stability. In the light facade, a layer of air is considered between the insulated external wall and the facade layer. The air layer can be completely seamed and closed, so that, the traffic of the air becomes impossible in it. Or the joints between parts of the facade become open. These small open joints can provide the possibility of expansion OJVF of the air layer. In this case, it is called the open-joint ventilated facades (OJVF). The existing of the air layer has some advantages as follows: evaporating the remaining water in the materials during the construction, cooling the outer shell of the building and reducing the flow of heat from outdoor to indoor of the building during the summer, to prevent the heat dispersion from inside to outside due to the lack of thermal bridges. Forming layers of the ventilated facades include: indoor elaborate (finished) work (the layer of plaster), clay or brick walls, thermal insulation, air layer, aluminum or steel under structuring, and facade panels. Figure 1 shows a simplified model of ventilated facades or open joint. The main difference between OJVF and other similar facades is that in the other facades, the air layer is closed or only is open the above and below, while in OJVF, the joints are open between the parts throughout the facade. Improvement of the thermal performance of OJVF under the radiation of the sun relies on the flotation impact. Thus, by warming the parts of facades (due to the solar radiation), airflow is created. This flow eliminates some of the heat load and reduces the heat transfer to the internal environment. This phenomenon can occur if the openings are placed only at the top and bottom of the facades, but its efficacy is not the same due to the reducing flow and the higher temperatures in the upper of the air layer. In the facades with the closed air layer, the warm airflow rises along the wall and the cold airflow comes down along the wall. Thus, a convective loop is created which it has a reversed effect and by transferring the heat into the building, the convection is added to the radiation to guidance. Figure 2 shows a sample of the cross-section of the seamed facades and OJVF (Tavasoli, 2014).

6.4. Facades response of the climatic conditions

The facades that are responsive to climatic and atmospheric have developed, because there was the need of its compatibility with the weather elements and heating elements between the man and his thermal environment. So these facades became a priority to be used in the researches and many researchers, including Fanger who has developed the new aspects of the building facades. Fanger (2001) used the controlled tests as a main method to create a single scale by the combination of the full environmental effects of the temperature, humidity, radiation and the air replacement for their effects on the human skin in terms of the thermal losses. Because the body shell of the building is very similar to the human skin in terms of application. With the advancement of science and technology, the role of the facades has changed to protect against the outside environment (weather condition). It is expected that they become waterproof and vapor proof for providing the suitable temperature and the good weather conditions for indoor spaces due to the necessary resistance. These facades can control the amount of the surrounding sound transmission in the sensitive and fragile indoor environment of humans. From this perspective, the new facade application is considered as a filter (Houghton, 1998).

6.5. Double-skin facades

Double-skin facades are not a new approach for the sustainable building. In fact, this approach has passed the different stages from the beginning. The facades as the engineering solutions were also considered during the World War II. In the 1970s, and with occurring the energy crisis, the main thinking of the designers was on this issue that how to reduce the energy consumption in the buildings (Lars H. Ringvold, 2004). This fact creates a possibility to generate a curtain wall (the partition state) and it became common. Using the polished and enamel glass cannot prevent the solar energy losses. At the same time, the double-skin facades begun to develop, until in the 1990s, the idea of the double-skin facade was widely used in the world and they were used for the commercial buildings. These facades were considered to prevent many of the environmental concerns. The functions related to the partitions of buildings can be divided into two categories: 1- they are related to the energy, 2- they are not related to the energy. One of the new styles of the facades is the sensitive facade to the energy that its partition must have some features such as strength, power, sustainability and durability. They must also control the temperature, humidity and vapor as well as the flow of the water motion and fire (Wigginton & Harris 2002). With the influx of the various technologies in the architecture, the various aspects have been outlined about the building facade's response to the environmental conditions. For this purpose several complex approaches have been provided for the facade designing in which the enamels and polish are greatly used to perform them as well as the solar and shade-making control systems have developed and more controls are done automatically. These technologies are known as the interactive facade. It means, they are reactive and must meet perfectly and intelligently the outside weather conditions and the inside needs of the building. These facades optimize also the natural energy such as light, heat and insulation and use them with the best way and they keep the optimum and required temperature at the same time. Since, the costs of the lightening can be declined in the future, such facades should be common and local, and use for the buildings (Stephen Selkowitz, 2004).

6.6. Smart shell (two shells facade)

In different climates, the full glass buildings need a device (blind) for shading. External shading devices are much more effective than the internal shading device, the idea of the climatic windows developed in the 1970s. The BIS control's system adjusts the temperature and lighting and the brightness level of the sun in the external facade of the building. This thermal process depends on the different combination of the types of the two-shell facade structure aerodynamic and the temperature of the inside space, environment temperature, wind speed, wind direction, absorption and passing of the solar radiation and its angle. In the intelligent facade design can be used the intelligent horizontal or vertical sunshades that adjust automatically the indoor lighting. Generally, the smart shell acts as an anti-heat in front of the building. In recent years, the architects consider and review the building shells like the living organisms. These shells breathe and transform as well as they are consistent with the weather.

This issue has three heat effects in the building:

Most of the time of the day, the air temperature inside the smart shell is higher than the ambient temperature and the additional glass layer of the smart shell lead to reduce the sunlight to the inner shell. The smart shell causes the reduction of the radiation ray load of the window by the possibility of placing the blind inside the shell. The smart materials with the changeable color can change their color or visual characteristics in response to one or several external stimuli in a reversible manner. These materials according to their stimulus include the Photochromic, Electrochromic and Thermochromic. The photochromic materials with the abbreviated name of the PC react when are placed against the light (visible rays, ultraviolet, electromagnetic radiation) by changing its color (Beygum, Z., Taghavi, 2014).

6.7. Smart wall

The most important application of the smart walls in the architecture is the thermostats of the heating system in the building and its facade to control and manage energy. These walls are designed in such a way that its color turn to white when the temperature is 20 ° C for reducing the solar energy and heat in the summer and when the ambient temperature is less than 20 ° C, they adjust themselves automatically. Another application of them is in the ventilation systems of the rooms in the building, so that, the system will be open or close at the specified temperatures to provide the appropriate ventilation conditions of the space.

6.8. Atrium

The possibility of constructing an atrium in a place can reduce the consumption energy, especially with the public and mixed applications. Atrium as a buffer space, in the form of a thermal interface is typically 10 to 13 °C for the indoor temperature. While the Atrium temperature is changing by the fluctuations of the ambient temperature with a time lag. Atrium adjacent spaces protect the drastic changes from the environment and reduce their heat loss due to the transparent surfaces. The amount of the saving depends on the following items:

1. Internal temperature of the atrium
2. Status of the atrium's airtight and ventilation
3. Conductivities of the thermal
4. The amount of the insulation levels

In terms of skeletal, the atrium is a combination of the transparent, semi-transparent and opaque surfaces that surround the openings, hallways and exterior walls, of the interior spaces of the atrium (Sharifi et al., 2014). In fact, atrium is referred to the open courtyard or rooms with the orifice within the Roman houses which had a pond to collect the rainwater that besides the interior spaces are used for supplying the fresh air and light. The courtyards of the medieval basilica churches are called the Atrium and these courtyards were used for gatherings of religious groups. In the eighteenth century, after the awareness of the glass properties, these spaces with ceilings and walls of the glass and wooden frames were used by Dutch botanists. During the nineteenth century, following the production of the steel pieces and create the large gates, the large glass spaces were designed and constructed for exhibitions and industrial agricultural products stores. The oldest and most famous of them is the Royal Pavilion in Brighton All power, Crystal Palace and Milan Gallery. Atrium refers generally to the central four different categories; connected, linear, junctional and environmental (Ibid).

6.9. Sunken Courtyard

The Sunken Courtyard was built in the middle of the central courtyard and was under the ground as a floor. Some examples of it are seen in Kashan, Yazd and Nain. The sunken courtyard in addition to providing the soil in need of the used bricks in the building, it provided also to access the aqueduct water. Therefore, there was usually the running water in the sunken courtyard that could fill the middle pond and its overflow went to the other houses. On the sidelines of the courtyard, some rooms were built in the form of semi-open and the trees such as pomegranate, pistachio and fig were planted in them. The courtyard was small and it is built into the lower part of the building, then, they used the moisture and cool on the ground, as well as the moisture and coolness of the plants. In fact the space of the courtyard was climatic more. The sunken courtyard of the Pirnia house in Nain and the mosque of the Agha Bozorg School in Kashan (a city of Iran) are examples for the sunken courtyards (Hussaini, Mohamadian, Hosseini, 2014).

6.10. Trombe wall

This system is an indirect productivity system which includes the thermal mass of storing heat that is placed between the glass surface in the south-facing and it must be heated with at least 25 mm empty spaces in the air. Moreover, the surface of the wall that is placed in front of the sun causes to absorb the solar radiation greatly by the wall, because the wall has been painted with the dark color or covered by the optional covers or black sheet. The extent of the heat which is transferred through the wall depends on the type of the material and thickness of the wall. The masonry material or water-wall can be used and can form a big part of the southern facade which is not the glass. They can be conducted like the full height of the wall or as a part of the wall that has been placed bottom of the window. The optimal thickness of Trombe with the masonry materials and gate is between 322 to 422 mm and without the gate is between 252 to 352 mm depending on the density of wall materials. For example, this thickness in the raw brick walls is 152 to 252 mm and for water-wall is 222 mm or more without the gate. The diameter of the water tubes must be at least 252 mm and an insulation layer is required to heat reduction at the night and can be placed in the air space between the mass and glass (Fazli and Madi, 2013).

6.11. Green roof

The green roof or living roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. The green roof is a new approach of the architecture and urbanism and is derived from the concepts of the sustainable development that can be used to increase the per capita green space provision ranges, the improvement of the quality of the environment and urban sustainable development. The practical use of the roof can be considered as the possibility of utilization of the urban land. Green roofs are known by the titles such as the rooftop garden, planting technology on the roof, living roof or biological roof. In fact, the green roof if a living ecosystem that provide the ability of a desirable living in urban environments and leads to make a more productive and sustainable city. In other words, the urban green roof is a positive step to improve the quality of the urban environment by improving the air quality, reducing the volume of surface sewage and the urban heat island effects, creating the thermal balance for the indoor and outdoor of the building environment, generating the natural habitats and biodiversity and increasing the operational life of the roof insulation. In the urban residences can be seen an abundance of surfaces covered with the concrete, or asphalt that do not allow the water penetration into the soil. The black or stone surfaces absorb the energy from the sunlight and store and reflect it on the night. In this regard, the green roofs can reduce the negative effects of buildings in the local ecosystem and consequently reduce the energy consumption in buildings and have a certain role in changing the energy flow in the buildings.

6.11.1. Necessity of the green roofs

Global warming, ozone depletion due to the use of a variety of pollutants, increasing environmental pollution and loss of the biological species, all of these problems lead to predict the necessity of the ecological and environmental matters for the future.

6.11.2. Advantages of the green roof

Ecology, preservation of biodiversity and habitat creation, improving the quality of urban ecological biology, adjusting the urban heat island effect, the cooling effect, reduce the effects of cold wind and thermal insulation, the quality of the urban environment, improving the air quality (filtration of the suspended particulate in the air). Exchanging of the oxygen and carbon dioxide, noise reduction (sound insulation), reducing the volume of rainfall (sewage retention, increasing the water quality and preventing the pollution of it, reducing the effects of electromagnetic radiation up to 99 %. Economic-cultural advantage: Reducing the cost of artificial ventilation (cooling in summer, increasing the operational life of the roof insulation, recreation and health, increasing the sense of belonging to the place, saving energy (insulated cover in the winter), additional green space (Litkohi, 2013).

Smart Building Management System (BMS):

Intelligent or automation management system in the building not only is expending in its application and its term, but many theoreticians have outlined to it from their point of view that by collecting many of them can be achieved the definitions and views ahead. Smart Building Management System refers to a set of hardware and software that were installed for integrated monitoring and control of the critical and vital parts into the building. The task of the system is the continual monitoring of the various parts of the building and to apply the commands to them in a way that the application of the different components of the building can interact with each other at the optimum condition with the purpose of reducing the unwanted consumption and allocation of energy resources for only the spaces during operation (Industrial designer, 2010). Artificial Intelligence in the construction industry that in Iran is known as the intelligent management, comprehensive system of the building is a system which is used for intelligent control and management of the mechanical, electrical and electronic facilities and equipment in every building. In fact, by using a set of electronic components in every building to whatever size and volume can be manage the indicators of the consumption, energy costs, maintenance and repair, passive defense and crisis, remote control, safety and security and the environmental effects (Sarmady, 2013-1). It can be said by a simple definition that a smart building refers to a building which has been equipped by the infrastructures of the modern information and communication system in a way that this system can enable a building to use a smart central system (Smart Home Hub) for registering any changes moment-to-moment and coordinate and adapt itself with the new conditions and its surroundings. According to a broader definition, a smart building is known as the combination of the innovations based on the technology in a smart managerial form and in order to return the investment quickly (Behzadi, 2004). Using a variety of indoor and outdoor sensors the building and using a single system and network can be obtained the temperature information, pressure, humidity, air flow, oxygen and carbon dioxide amount in order to achieve the ideal conditions permanently and immediately (Kamarposhti et al., 2011: 1). One of the optimization of the energy consumption is the use of the building management system (BMS) (Rezaei et al., 2013: 10). Many actions can be carried out by the BSM that the residents of a building do it habitually which lead to save the time and reduction of the manpower cost as well as reducing the energy consumption and energy costs, decreasing the errors and increasing the effectiveness of the system. Employing a variety of inside and outside sensors or with the use of a single system, you can control all welfare and security services at any moment and use them in order to achieve ideal situations. For this purpose, it is required to the specific hardware and software for collecting the environmental data and transferring them to the central system for building control and management process (Hariri, 2009). The environmental conditions can be evaluated with this type of system and by the installation of the temperature measurement, windows opening and closing, detecting the presence and movement of people and the amount of ambient lighting sensors and the necessary commands will be issued to the air conditioning and the lighting systems to reduce the consumption and increase environmental quality (Rezai et al., 2013: 10).

The Building Management System (BMS) or Building Automation System (BAS) refers to a system that has been installed and through its components can control the different parts of the building and display the appropriate output for the user. Different parts which are under control include usually the mechanical facilities and heating, ventilation and air-conditioning (HVAC) and lighting equipment which can be extended to the security and fire systems, access setting, emergency power supply and etc. (Morovati et al., 2014: 3). Generally, the building automation is the use of the information technology in order to manage the building which its result is the dynamic, safe and useful system that helps the integrated and unit management of the building. In order to reduce the cost of the building industry and the optimal use of the technology and the use of the communications and the computer technology, the performance of the management and automation systems of the building becomes impressive that generally it leads to save the consumption energy, so that the saving from using these systems leads to compensating the concerned cost in a short time (Kamarposhti et al., 2011: 428). Generally, the purpose of using the BMS systems in a building, is to adjust the output condition of the different components due to the environmental conditions and the building need at that time (Morovati et al., 2013: 3). The intelligent control systems have a highly flexible that can be adapted easily to different needs. Also during the operation can do easily the change and optimization operation for better guidance and reducing the costs of the energy and repairs. The building automation in addition to the providing control and planning possibility of the household devices and facilities, it also can aware you about the building from anywhere and anytime and from the indoor and outdoor of the house. Also by home automation, your intelligent building is responsible for energy management, HVAC, lighting, traffic and safety control, fire and many parts of the house components which you have had never any idea about their automation (Kamarposhti et al. 2011: 428). The BMS or Building Smart Management, which is in charge of the central processor refers to the system that through of it can manage and control automatically the items in need of a building with minimal interference of the people. According to the use of intelligent and non-intelligent systems in the buildings in Iran that often operate in isolation from each other, it is suggested that first, the automation is used in the mechanical facilities and equipment, including the HVAC systems. As a result, in addition of the main beneficiary as well as the government and the entire people of the country can use its benefits and even the future generations. Its disadvantages include as follows:

1. Reducing negative environmental impacts during operation of the building

2. Reducing the consumption and the cost of energy

3. Optimized maintenance and repair the facilities and mechanical, electrical and electronic equipment

4. Effective in the civil defense and crisis management

5. Creating the capabilities remotely

6. Security and comfort of the residents (Sarmady, 2013).

Generally, the energy management of the building involves some general management: 1. The HVAC control 2. Lighting control 3. Power quality control 4. Control of the level of carbon dioxide in the building (Rezai, Nahavandi, Live Regal, 2013). The concept of intelligent building and the smart facades have been formed during the last two decades as well as the term of the smart building has been used since the early 1980s and from the beginning different definitions have been provided about the smart building. For example, Wigginton, M. and Harris, J. (2002), have been provided thirty-four definitions about the smart building and thirteen definitions about the smart body and cover of facades. These definitions can be integrated together and provide a simple definition of Wigginton and Harris: The facade is a technology of the combination of the variable which changes and improves itself to provide comfortable conditions inside the building and whatever is related to the external environment (Wigginton and Harris, 2002). From other different perspective, this concept can be stated as: "energy + information = less energy" (2012 Lawrence). The concept of building management system (BMS) or building automation system (BAS) belongs in the early 1980s (Sinopoli, 2010).

8. The role of human beings in achieving the sustainable architecture.

The sustainability requires a continuous and progressive effort. Without the participation of people, there is no possibility of improving and reforming the built environment. Sustainability is not something, that people agree simply its rules and regulations, therefore it must be done by participation of the associations in an efficient management of the resources and with considering the equality of the rights which is the basis for the sustainability levels (Georgi Mahlabani, 2010: 93).

9. Conclusion

This study has attempted to show what methods and measures can help the mankind to achieve the sustainable architecture and facilitate the path to achieve this objective. With the conducted surveys and the previous papers, we find that our ancestors taught us indirectly the best solutions including Windcatcher, Atrium, Sunken courtyard. As Professor Iraj Etesam stated: "The human must recognize completely his past architecture and then refers to the new technologies and solutions." This paper shows that the use of the ancestors solutions and integrating them with the technology can help greatly the architects and the human can achieve to the sustainable architectural indicators that one example of it is the energy saving. And in the part of the research has been tried by the introduction of the modern technologies helps the mankind in producing other energies from an energy source. For example, from the solar radiation can be generated and stored the electricity or heat, and from the water pressure or the pressure of the gas pipes can be generated the electricity according to the driving blades embedded in them. Consequently, the final result of this study can be this result: The architects can create a sustainable architecture with the intelligent use of the ancestors' solutions in the energy conservation and combining it with the modern technology as well as using the smart-make tools of the building.

References

Abdullah Zadeh, S. & Litkohi, S. (2013). *Green Roof, New Approach in Architecture in Sync with Nature in Order to Reduce Energy Consumption and Fight Climate Change.* Third National Conference of energy and the environment.

Ahmadi Kamarposhti, Ali; Gholami, P. & Ahmadi Kamarposhti, M. (2011). *Study of the Use of New Technologies and Automation in Intelligent Buildings.* The First Regional Conference on Civil Engineering.

Baqillani, Mustafa (2014). *New Implementation of Smart Buildings Using the Smart Glass.* Fifteenth Student Conference on Civil, 11, 12, 13 August, 2014. Urmia University.

Behzadi, B. (2004). The intelligent control systems in buildings. *Journal of Urban Development and Architecture-Abadi*, Issue. 42, pp. 68.

Beygum Taghavi, Z. (2014). *Habitat City, Sustainable City Model, Ventilation Systems (Cooling and Heating) and Lighting in Ghazvin.* National Seminar on modern theories in architecture and urbanism.

Fanger, P. O. (2001) "*Human requirements in future air-conditioned environments"*, International Journal of Refrigeration, 24 (2), 148-153.

Fazli, M. & Madi, Hussein (2013). To investigate the role of architecture in energy consumption and climate change. T*he International Conference on Civil.* Architecture, Urban sustainable development.

Georgian Mahlabani, Joseph (2010). Sustainable architecture and its critique in the field of environment. *Journal of Urban Research Association of architect Yu*, Issue 1, and P. 9-100, Fall.

Ghahremanifar, H.; Amir Shqaqy; Shaheen, A. (2014). *Critique of Contemporary Architecture in Iran in Non-Compliance with Energy Consumption of Renewable Energy Patterns and Sustainable (Case Study of Tehran International Tower).* The National Conference of modern theories in architecture and urbanism.

Ghorbani, Vida & Saremi, Hamid Reza (n.d.). The study of affecting indices and factors of the green architecture in residential areas.

Hariri, R. (2009). Principles of energy efficiency in the industrial buildings, energy management period. *The International Energy Research Institute of the Ministry of Oil.*

Hoseiniyan, K. & Madi, H. (2014). *How Old Buildings Are Upgraded to the Green?* National Seminar on modern theories in architecture and Urbanism.

Hosseini, Laden; Mohamadian D.; Hosseini, M. & Seyed Sepehr (2014). *Stability in the Past, Present and Future Architecture.* New theories in architecture and Urbanism Conference.

Houghton, P. D. (1998). *Building Comfort with Less HVAC.* Architectural Record, 12, 131-136.

Lars, H. Ringvold (2004). *Innovative Facade Concepts.* Aluminum pp.17.

Lawrence. T. et al. (2012). *A New Paradigm for the Design and Management of Building Systems.* Elsevier, 51, 56-63.

Morovati, A.; Bahari, T. & Firozfar, S. (2014). *Examine to Optimize of Energy Consumption Solutions in Smart Buildings.* The Third International Conference of new approaches on Energy Conservation.

Rezaei, D.; Nahavandi, Marzieh; Zendeh Shahvar & Mohammad Amin (2013). *Providing the Solutions to Energy Conservation in Residential Architecture and Study of the Smart Performance.* The first national conference on sustainable architecture and urban space.

Sanati Tarah, M. (2010). The intelligent management systems of the building. *The Technical Journal of Executive Director's,* pp. 2.

Sarmadi, M. (2013). *Providing a Model for Entry Artificial Intelligence to the Construction Industry, Using Multi-Criteria Decision Techniques.* The International Conference of Civil Engineering, Architecture and Urban Sustainable Development.

Sharif, M.; Habibi, Hussein & Movahedi Rad, F. (2014). *Sustainable Architectural Elements (Atrium), Second Congress of Architecture.* Restoration, Urbanism and sustainable environment, 12 September.

Sinopoli. J. (2010). *Smart Building Systems for Architects, Owners, and Builders.* Butterworth-Heinemann: USA.

Stephen Selkowitz; Yvind Aschehoug & Eleanor S. Lee (2004). *Advanced Interactive Facades-Critical Elements of Future Green Buildings*. Presented at Green Build, The Annual USGBC International conference and EXPO.

Tavasoli, N. (2014). Study of the Thermal Behavior of Ventilated Facades BCM Conference of Modern Theories in Architecture and Urbanism.

Wigginton, M. & Harris, J. (2002) Intelligent Skins, Oxford: Architectural Press.

Zandi, M. & Parvardinejad, S. (2010). *The Sustainable Development and its Implications in Iran Housing Construction.* Housing and rural environment: Summer 2010, Volume 29, Issue 130; from page 2 to page 21.

Zia Baksh, N. & Barzegar, M. (2011). *To Investigate of the Influencing Factors in Formation of Sustainable Architecture Based on the Form of the Building (A Case Study of Shiraz).* Second national conference on sustainable architecture.