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New Strategies to Optimize Energy Consumption in the Hotels: A Step to Sustainable Design in Iranian Hotels

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Abstract

Incorrect methods of construction lead to a diseased environment and create an unhealthy biological system. To create a correct construction and maintain environment, materials and technologies used in buildings play an important role. To select sustainable materials and to use appropriate technology in design and construction of hotels provide more health for environment. Since these materials lead to decrease in fuel consumption to heat buildings and decrease in infusion of air pollutants and greenhouse gases. As a result, using natural resources decreases and the society approaches to the criteria of sustainability. In the other hand, by permanent increase of the inflation over the energy price, hotel officials try to provide strategies to decrease energy expenses without guess satisfying, Such as to control extra heating and to use it for supplying the needed heat in the hotel. But modern methods actualize to optimize the energy consumption. Thus, identifying and examining new methods and patterns of optimizing energy consumption is the main subject of present study in the area of sustainable architecture; these methods include using nanotechnology in constructing materials to remove destructive effects on urban environment, green roof system and double skin facade to prevent energy loss in hotels, using new smart glasses to generate urban buildings consuming energy by sun light.

Keywords: Hotel, sustainable architecture, green roof, nanotechnology, double skin facades, photovoltaic system.

Introduction

At present, saving and optimizing energy consumption and using sustainable energies play no role in the construction culture of Iran. In the area of architecture and construction, optimizing energy consumption is the main standard. Thus research is worth considering on the principles of sustainable architecture and green architecture which is a part of echotech style in architecture[1].

'Sustainable architecture, as other architectural classes, involves its especial standards and includes three steps: to save resources, to design for return to life cycle and to design for human, each including its particular strategies and to identify and study these considerations lead the architect to further understand the environment which is to be designed. While Iran is one of the oil-rich countries possessing great resources of natural gas, fortunately because of sun radiation in most parts of Iran as well as wind blowing in some parts and existing water resources, execution of solar and wind plans is necessary and using these energies in cities and villages can results in saving oil and gas and other fossil fuels; another advantage of this type of energies is simple technology, no air and environment pollution and most importantly saving fossil fuels for the future'[2].

Meeting this goal is possible by interacting architecture and sustainable energies; that is, to use new energies instead of non-renewable energies and to find new appropriate solutions and technologies to use new renewable energies.

Sustainable Development

Sustainable development means movement based on human-environment and considers development of economic facilities regarding environmental considerations and social justice. Sustainable development arose from problems created of exclusively economic development following World War where irregular development resulted in class differences and numerous environmental problems and development direction valued environmental and social dimensions less than economic one[3].

The idea of sustainability has its roots in distant past of thoughts about environmental movements. Traces of sustainability concept can also be found in the geographic literature. In fact, sustainability and its discussion is outcome of ideas about geographic determinism and feasibility. Environmental laws and restrictions regarding human thought and prudence can help sustainability of human life and made spatial and natural forms.

Although the term sustainable development has been used at Cocoyok Declaration on Environment and Development of in the early 1970s and this term refers to the roots of ecological development approach which is considered in World Conservation Strategy[4], its formation depends on establishment

of a World Independent Commission on environment and development and reporting on principles of sustainable development. The report is called Brundtland report which has been taken from its Norwegian chairman and includes a series of recommendations and legal principles to achieve sustainable development for developing countries; it defines sustainable development as follows: 'meet the needs of present generation without infringing upon abilities of future generations to meet their needs'. This simple definition is the basis of Agenda 21 as a Sustainable Development framework for 21st century[5]. But as a part of sustainable development, urban sustainable development is based on the rational use of natural resources and in this type of development, the three environmental, economic and social considerations will be considered together. Thus, sustainable city is the result of developmental process which provides subjectivity and possibility of permanently improving ecologically social - economic health of the city and the region and converts subjectivity and possibility to objectivity and action.

Therefore, the following guidelines are suggested as strategies for sustainable urban development: i. Minimization of environmental impacts, ii. Minimization of consuming non-renewable resources, iii. Exploitation of renewable resources[6].

Sustainable Architecture

Sustainable architecture dates back to 19th century. John Ruskin, William Morris and Richard Lethaby are among pioneers of sustainable architecture. Ruskin believes that to achieve growth, harmonic discipline found in nature can be modeled. Morris his 'Seven Torches of Architecture' recommended return to the suburban landscape, self-sufficiency and restoration of local industries. Sustainable buildings are designed to reduce damage on the environment in terms of energy and exploitation of natural resources which includes following rules: i. Reduce the consumption of non-renewable resources, ii. develop natural environment, iii. Eliminate or reduce the consumption of toxic or harmful materials for nature in construction industry. iv. In summary, sustainable architecture can be defined as follows: 'a building by minimum inconsistency and conflict with its surrounding natural environment and in broader sense with the region and the world'[7].

Thought and attitudes towards sustainability in architectural design is an attempt to adapt architectural design with environment. In other words, sustainable architecture is to use design tools and construction methods, negative effects and properly communication between environment and building to minimize construction in environment and to achieve goals of sustainable development meeting the social, emotional and spiritual needs. Emphasis on sustainable architecture is indeed the basic definition and a basis for choosing the best option to protect environment. Investigating the subject with this approach results in those constructions being considered which have less impact on the environment[8].

The Interaction between Architecture and New Energies

Due to an energy crisis in the world and finite resources of non-renewable energies as well as increasing environmental pollution due to indiscriminate use of fossil energy, need for sustainable energy use is considered specifically in construction industry which accounts for 40 percent of energy consumption in Iran. According to growth of technology and the introduction of sustainable energy discussions and a continuous reduction of non-renewable energies as well as adequate sources of sustainable energies (solar, water, wind, biogas, etc.) in our country, architects can take advantage of appropriate methods to use sustainable energies in architectural design and create suitable environment and provide desirable thermal welfare considering new technology and science[9].

Nanotechnology and Energy in Building

Nanotechnology results in dramatic changes in using natural resources, energy and water and will reduce wastewater and pollution. New technologies also will allow recycling and reuse of materials, energy and water. In terms of energy, nanotechnology can significantly influence efficiency, energy production and storage and reduce energy consumption. Future buildings should be able to increase yield and security and to avoid wasting energy using new technologies, and creating a healthier environment. Despite the problems in the field of architecture and urban development (increased cost of construction, urban pollution) and its direct influence on the buildings, greater attention is required to new technologies and their role in optimization of energy consumption in buildings. Nanotechnology promises significant advances in the field of very efficient solar energy conversion and storage, thermoelectric converters, batteries, fuel cells. Control of nanostructures and composition and manufacturing new materials to achieve modern techniques used in building promises hope for energy management in buildings, particularly for future buildings and cities. Nanotechnological activities are dramatically growing across the world. Nanotechnology has important interdisciplinary aspects, coordination of which is difficult without a strategic plan of research and development[10].

Ability to prepare appropriate materials is made possible in order to control energy in the building by this technology. According to the characteristics provided by these technologies, the following expectations can be meet by manufacturing new materials: i. Limitation of thermal transfer in allowed amounts. ii. Required sealing, iii. More strength against the effects of environmental and climatic factors, iv. Adequate fire resistance (thermal insulation and endothermic different parts of outer shell) with stability and stress resistance. v. In the case of thermal insulation (endothermic) of building elements, thermal comfort conditions in controlled environments are easily provided and maintained along with energy savings. vi. Reducing the thickness of layers that form thermal resistance of a shell[10].

Green Roof

Development and equitable distribution of urban green space in neighborhoods, especially in urban centers, is considered as one of the main challenges of contemporary metropolises in a way which is appropriate for urban construction. Since urban green and open areas seem often lacking direct economic values, development of constructions by greater benefit in short-term on local investments and public sector resulted in increased use of land in favor of short-term economic interests and development of urban green environments is financially supported less than other investments. Green Roof is a new approach of architecture and urban planning derived from concepts of sustainable development which can be used to increase per capita green environment, improve environmental quality and urban sustainable development[11,12].

The roofs have many benefits, such as absorbing rainwater, creating a layer of insulation on the roof, providing new habitat for various species as well as helping reduce urban air temperatures and fighting the effect of thermal islands which occurs in cities, especially populated big cities[13].

Functional use of the roofs can be considered as allowing optimum utilization of urban lands. Many people who are interested in and enjoy plant nurturing, need large open parasol places. The best possible places for this are terraces, courtyards and roof of the building. Terraces are the most private possible places for this and courtyards and roofs can be used jointly. The only option to nurture plants on terraces and roofs for these people was to use vases and flower boxes in small and large sizes; inconsistency of their color, material, size and shape resulted in turbulent atmosphere and occupying large amount of the place by pots. Creating a garden on the roof creates a uniformly designed surface for desired plants. The advantage of creating a garden on the roof is the larger surface, brighter and a broader landscape. Thus the unused area on roofs which is permanently exposed to sunlight can be used to create a low cost garden. These gardens can be used by residents at different hours of the day[14].

Use of these elements in the hotels, especially recreational hotels, has especial importance in perspective and aesthetic, can have outstanding role to attract tourists and costumer for hotels. In this regard, one can to use roof of hotels by low expense to make spaces can be used by hotel residents in daytime different hours.

Double skin facades for Energy Optimization

Double skin facade is an architectural phenomenon in response to aesthetics for a fully glass frontage. Transparency is often the main architectural reason to choose double skin facades, because results in close contact of internal space with surrounding environment and reduced energy consumption. Reducing energy consumption in double skin facades depends on many factors, such as: type and usage of buildings, building orientation, insulation levels, ratio of transparent and non-transparent surfaces of inner shell, operational procedures of double skin facades, type and position of shading equipment, the quality and size of openings to inside and outside of the building, control system of equipments in fronts such as opening windows or using shading equipment. Glassy front technology is often designed for buildings with energy optimization, sustainability and green architecture purposes, thus number of these buildings is increasing and the success of these fronts is due to optimal use of daylight and an integrated and beautiful view[15].

Double skin facades can be defined as follows: a pair of glass shell separated by an air corridor. 'The main glass layer is typically insulated. This air space between glass layers acts as insulation against the maximum and minimum temperatures, winds, and voice. Bright devices are often placed between two shells. All elements can be differently organized by several permutations and combinations of solid and transparent membranes'[16].

Application of New Glasses in Architecture and Energy Generation

Light is the source of all existence. Lightening up the surface of objects, light presents them surrounding and a visible environment. Accumulation of shadows behind them gives depth to objects. Objects make sense only in boundaries of light and darkness, gained and show their shape, their internal relationships are discovered, and as loops of chains are connected to infinite. Light gives objects independence and autonomy, and simultaneously limits their dependencies. Light enough promotes any object in its surroundings that the object is completely specified and is different from other objects. For Neanderthals, light was considered as a means for calculating the time. High-energy beams of light reflected from a distance to Earth were pulled by openings inside constructed areas, and allowed the one living inside to understand his existence in relation to surroundings. Today, technical and technology advances have facilitated the artificial lighting. However, the artificial lighting make human lose his relationship with nature. The natural light can be directed in such a way that deepens and defines the place and very exciting spaces can be created. The light cannot pleasantly appear alone. Light must be next to darkness to create its own existence. Darkness reveals the brightness of light its power[17].

New Smart Glasses

Application of smart windows has been blindingly developed in recent years. Imagine gigantic towers with windows equipped with glasses that turn on and off according to severity the sun light. But high expenses spent to manufacture each of these windows are a significant problem. Recently a group of researchers from the University of Sungsil and South Electric Technology Institute offered an interesting and of course cheaper idea to build these types of windows. They have offered

this solution while current windows which turn on and off as intensity of sun light changes, not only steeply cost to manufacture, but also in long-term they do not well performed. Moreover, toxic materials are used to produce these windows posing considerable risks on nature even human. Now young researchers claimed in new windows there is no a trace of these problems. The structural formula applied for new windows is not complicated. However, the results have been surprising to experts. They have used a poly electrolyte already well known and has been used by researchers. Polyelectrolyte is a kind of polymer, dissolving in water, creates several ionized groups and makes water conductive. Ion reactions of this substance with solvents such as methanol have the desired result followed by Korean researchers. Using this method, they found glasses which respond to changes in light severity and turn on and off, but with some significant differences compared to the previous ones; such that not only the costs of production are much less but also there is no toxic and dangerous materials. Also these glasses have a good performance in the long term and as the current ones do not lose their quality after a short time. According to Korean researchers one of the main advantages of glasses produced in this manner is their apparent color change in very limited time[18].

Smart Glasses to Increase Energy Efficiency

Several experiments has been done on these glasses in different environments all of which shows new glasses will change from dark and opaque to transparent mode just within a few seconds and according to the severity of sunlight. While in current glasses which benefit this technology apparent color change occurs in more time period. New glasses are produced based on long-term plans of Korean researchers in the field of sun-blocking glasses. They are looking for glasses which can block sunlight when it is shining vertically while they are relatively transparent. Thus significant savings takes place in energy consumption for cooling and ventilation systems and indoor air conditioning. New approach specifies at times of the year, such as summer when energy consumption peaks in the cooling systems. But this technology is also working in winters when solar radiations is less severe due to the angle which this star always have with earth. Glasses play a significant role in reducing energy consumption in heating systems during cold seasons like winter, while passing through sunlight and relative heat of weak solar radiations into closed spaces[18].

A Bright Future with New Smart Windows

Recently, using electrochromic smart glasses as the next generation of glass is not limited only to reduce energy loss. But rather with these glasses, in addition to energy storage properties, one can customize the intensity of light, glare and heat passing through window to control it. So these glasses have been highly regarded throughout the world and now are used in many advanced industrial countries in automobile and construction industry. Electrochromic smart windows in addition to effect of energy storage will prevent energy loss in buildings and make it possible to change from completely transparent glass to full opaque with one hundred percent privacy. Among application of these glasses can point out to glass windows, walls and ceilings in commercial buildings, universities, offices, show rooms, shops, hospitals, restaurants, laboratories, waiting rooms, conference halls, meeting rooms, offices, operating rooms, windows, glass greenhouses, stairs and glass stairs and ... As a result these glasses are ideal for implementation of architectural new designs and ideas and are highly regarded throughout the world. These glasses are considered a positive solution to use modern technology and provide comfort and peace for sustainable development and sustainability of buildings for residents. It is worth mentioning, key requirement to accomplish these tasks is acceptance by people and their belief in the truth of these matters; because despite all the regulations and laws, people as consumers of fuel, if do not believe in reducing power consumption, they would never respect for these principles[19].

One of the most attractive technologies listed in Exhibit C. A. S, is Samsung's smart window. Instead of a simple glass window, imagine a transparent screen on which weather report, Twitter and Facebook posts, video playback and other exciting things like this are displayed and every time you wish all these items are removed from the screen and scenic behind the window is visible. This smart window is 46 inches with a resolution of 1368 × 768 pixels. What is displayed in this window will be visible only to owner; that is, people looking out of the window will not see anything. This technology seems to be very romantic and charming and reminiscent of films such as Mission Impossible[19].

Conclusion

Considering nature is an important matter to help environmental problems; because, healthier environmental conditions are created while maintaining valuable resources. Sun energy with high and intact potential can make the important role for suitable consumption of the fossil fuels for hotels.

Recently the relevance of quantity and quality of the architecture, especially in hotels, has become a primary concern of architects which is assessed in environmental approach as sustainable architecture and green architecture such. Sustainability and principles of sustainable design emphasize on the importance of designing with nature; this philosophy underlines the undeniable interaction between nature and design. Principles of sustainability and ecological design particularly consider effects of either positive or negative aspects. Thus they consider interaction and effectiveness of design and environment as a particular indicator of a good plan. Principles of this type of design offer a broader view to design hotels and cultural, spiritual factors and historical traditions effectively and obviously participate in its process. In contemporary architecture, changes occurred due to bioclimatic

and sustainable criteria become more important every day. Speaking of sustainability in hotels architecture can be interpreted to image and design of future constructions. Thus it seems that sustainability can be imagined based on a model where available materials are applied with more and better functionality rather than wasting or neglecting.

Planning for energy management and optimal using of them in hotels can be successful for hotel making in view of financial and the applied aim. Hotels try to find suitable equivalence between expenses and income rate. Then it seems that sustainable architecture can provide possibility that hotels provide necessary attractiveness to attract customer satisfying in addition to decrease energy expenses and it can perform important role to take suitable profit for hotels.

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