Zero-Energy Architectural Patterns Applied in Hotels

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Abstract

Tourism can play a major role in developing economy around the globe. In Iran, however, one of the main challenges facing tourism is the absence of needed infrastructures especially suitable residences. Therefore, building modern and well-equipped residential spaces and hotels for tourists is an undeniable obligation in this respect. In connection with this, the idea of Net-Zero Energy Buildings have come to the fore in recent years. In such buildings, the common technologies have been replaced with considerably more effective, energy-saving technologies which take advantage of renewable energies. Net-Zero Energy Buildings are designed and constructed in such way that they are able to generate their annual energy independently. In these buildings, no energy load remains unused. At the same time, surplus generated energy can be saved. The presence of abundant oil sources and public ignorance about new energy sources are the most important reasons why renewable sources of energy have not been exploited in Iran. In this study, a descriptive-analytic methodology was adopted. First, the characteristics of Net-Zero Energy Buildings were described and the feasibility of using such buildings in hot and humid climate was examined. The study aimed to approach sustainable tourism.

Keywords: Net-Zero Energy Buildings, hotel, tourism, hot and humid climate

Introduction

Sustainable development is a process by which the needs of a nation can be met and the quality of life can be improved without exploiting recourses belonging to future generations. Therefore, development can be considered sustainable when it does not cause destructive effects and it does save natural resources for future generations as well. Tourism is one of the basic industries in worldwide thriving especially in coastal regions. Environmental sustainability is one of the issues which should be kept in mind in coastal tourism. Disregard of this may result in upsetting the ecological imbalance from one hand, and in unbalancing socio-economic conditions of the region from the other hand. In this regard, booming economies and growing demand for consuming non renewable fossil fuels which generate huge amounts of pollutants have encouraged man to take into account renewable energy sources and especially solar energy as an unavoidable solution. Attractive features of solar energy like generating no pollution, being free of charge and easy availability have given it a special place. Given the geographical location of Iran, the potential of taking advantage of solar energy is available during four seasons of the year. The study aimed to provide approaches to design environment-friendly buildings in order to be used by tourists. Considering the abundance of solar energy in Iran, this end is not out of reach.

Methodology

The general methodology of the present article is descriptive-analytic. Data were gathered based on library sources and field studies on tourism, sustainable development and architecture. The concepts of hotel management, sustainable architecture and Zero Energy Buildings were described. Then, approaches were suggested on how to design hotels to have all integrated features mentioned.
The General concept of Zero-Energy buildings

According to the U.S. Department of Energy, zero-energy buildings may be defined as buildings where there is equilibrium between energy generation and consumption through applying renewable-based technologies. In such buildings, energy demands of the residence are met through integrating artistic expression and principles of designing renewable energy equipment. Zero-energy buildings are nearly self-sufficient in terms of energy generation; they are able to generate their annual energy source (Hernandez, 2010). In other words, the objective of designing ZEBs is not only minimizing energy consumption (which is at high level in buildings designed by passive methods) but also generating amounts of energy needed in a building. This can be done through making use of active renewable-based technologies including solar photo, photovoltaic panels, solar light collectors, solar or wind turbines, etc. The British Government suggested the idea of sustainable housing in a guideline entitled Building a Greener Future: Towards Zero Carbon Development in December, 2006. The prospect of the document is that by 2016 all newly-built houses in Britain will be Zero Carbon Houses (T.Mousavi Shabizade, 2013).

Table 1. Priority in sources of renewable energy in ZEB Buildings (Laleparvar, 2009).

<table>
<thead>
<tr>
<th>NO</th>
<th>Mechanism</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Decreasing consumed energy through using modern technology (low-energy buildings)</td>
<td>Natural light, high efficient air conditioners and heating systems, wind-catchers, evaporation cooling</td>
</tr>
<tr>
<td>1</td>
<td>Exploiting renewable energy sources by installing relevant systems on the roofs</td>
<td>Photovoltaic (PV) panels, solar heated energy and installation of wind turbines over the roofs</td>
</tr>
<tr>
<td>2</td>
<td>Exploiting renewable energy sources by installing relevant systems around the building</td>
<td>Photovoltaic (PV) panels, solar heated energy, low-pressure water system and installation of wind turbines around the building</td>
</tr>
<tr>
<td>3</td>
<td>Exploiting off-site renewable energy sources</td>
<td>Exploiting off-site biomass, wood, ethanol, etc</td>
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Classification of Zero-Energy Buildings

Generally speaking, the highest rank of energy consumption in worldwide goes to construction activities. In recent years, new investigations have been done to define new generation of buildings in terms of energy consumption that the outcome of which has been Zero-Energy Buildings. International efforts to decrease universal pollution, admission of shrinking energy sources in worldwide as well as the fact that construction activities consumes an enormous amounts of energy were, among others, the major stimulus for doing such investigations. A Zero-Energy Building refers to a building which the amount of its energy consumption is reduced to a minimum through taking advantage of renewable and clean sources of energy. One of the sub-classes of ZEBs is Net Zero Energy buildings in which the sum of generated energy and consumed energy is equal to Zero. In NZEBs, the amount of consumed energy is kept to a minimum as much as possible by taking into account such factors as architectural considerations and using wind-catchers and green-houses. Also, a major part of energy needed in building is generated by solar energy.

Zero Energy Building

A ZEB has no connection to national or regional electricity grid and generates its energy demands through renewable energy sources.
Net Zero Energy Building
An NZE building has energy give-and-take with electricity grid which means that sometimes it takes power from the power supply network and sometimes it sells its surplus energy to it. In sum, in such a building the amount of energy received from the network is less than that of it sells.

Net Zero Site Energy
In an NZSE building, through calculating the amount of energy consumed in the site, the energy consumption approaches to zero. In other words, the amount of energy consumed in the site also includes the energy carriers consumed irrespective of converting the energy carriers into the primary forms of energy.

Net Zero Cost Energy
In an NZCE building the cost of energy consumed is balanced by that of different consumed energy carriers. In other words, in an NZCE building the money which the grid of electricity pays to the house owner for the electricity generated on-site is balanced by the money which the owner pays the grid of electricity in return for the annual power service.

Net Zero Source Energy
In an NZSE building the amount of energy consumed in generation point is balanced by that of different consumed energy carriers. In other words, the amount of energy consumed in the building has been calculated by considering the equivalence of primary energy of consumed energy carriers as well as the amount of lost in refinement process, production and transition of energy carriers.

The advantages of Zero-Energy Buildings
The advantages of ZEBs include the possibility of heating by inactive systems, considerable increase of environmental destruction, keeping a balance between consumption and demand of energy, removal of surplus energy consuming systems, optimum use of wood waste as bio-fuel and saving drinking water as much as 50% (Jalalian, 2009).

Hoteling industry and consideration of sustainable architecture as an obligation
Climate and tourism, as the main parts of a system, interact closely. The outcome of this interaction is the newly emerged field: climatology of tourism. As an industry, tourism, with an outcome of one trillion in a year, can be considered as one of the clean industries well competing with other industries such as oil, car making, etc. The countries enjoying tourist attractions are privileged to earn billions of dollars a year from this environment-friendly industry.

In order to make optimum use of natural sources of a region, vernacular climate and the available natural potentials should be taken into consideration. Unpleasant climate conditions may cause adverse effects on tourism in terms of economic considerations.

Bio-climatic comfort of residents of a building/hotel depends on the thermal balance between the body temperature of residents and that of surrounding atmosphere. The balance depends to large extent on such factors as physical activity, temperature, relative humidity, sunlight and wind. The state of bio-climatic comfort is established when there is balance between the emitted heat from the body and the heat attracted by the body from the ambience and as a result, the body's temperatures is kept at 37 °C.

Basically, a building should be designed in a way that the residents can feel and experience the quality of indoor comfort. In order to a building can function satisfactorily, there should be a true understanding of the residents' needs and wants, arrangements of appliances and the way of interaction of the residents indoor and outdoor. Well-arranged spaces and organized interaction of persons indoor creates the sense of team-work. Also, indoor flexibility is an important factor in
sustainable buildings which means that they should be flexible enough to meet the unpredictable needs (Valadkhan, 2014).

Hote ling industry is a major part of tourism. However, in cases of poor management it can cause serious environmental problems. It has been estimated that 75% of environmental destructive consequences caused by hotels is related directly to over-consumption of energy. Annually, the amount of energy consumed in hotels around the globe is as much as one trillion dollars. The rate of energy consumption in hotels surged in 2005. The trend still kept on in subsequent years. Today, one of the serious challenges in hotel management in worldwide is to decrease energy consumption (and its related costs) without giving poor service, whether in quality or quantity, to the resident tourists. Meeting heating and cooling needs as well as satisfying the comfort of residents, from one hand, and considering environmental issues as well as concerns for energy consumption, from the other hand, has made the hotel managers to focus on sustainable architecture and taking advantage of renewable-energy-based technology.

The fact is that based on renewable energies such as wind and solar energies it is feasible to cut off the energy costs of a hotel considerably. It is expected that such clean technology is used extensively in construction activities, especially in hotels in Iran.

Conclusion

In this article, it was tried to propose an approach to control the increasing rate of energy consumption based on the principles of sustainable design as well as of Zero Energy architecture to find solutions against diminishing fossil fuel sources. In this regard, making use of renewable sources of energy has focused on international programs and policies concerning sustainable development. According to the U.S. Energy Information Administration (EIA), oil will be still as one of the main fossil fuels during a few decades in constituting 40% of energy source in worldwide. Given that such non-renewable sources will not last forever and that they cause a huge amount of air pollution, finding alternative energy sources seems inevitable. Fortunately, making use of renewable sources of energy are becoming common in developing countries for certain advantages including being environment-friendly, producing no pollutant, renewability and easy universal availability. That is why making use of renewable energy programs with an aim of reaching sustainable development has been on focus in international policies including UN programs. In this connection, if the houses to be designed and built based on the principles of vernacular architecture, taking advantage of climatic potentials will be made possible. In other words, through exploiting renewable energies in construction activities, consumption of fossil fuels can be saved considerably and as a result, environment can be preserved more effectively. In sum, the architecture of the third millennium enjoys certain features such as high efficiency, low-energy consumption, low-cost maintenance and low emission of carbon dioxide.

References


Openly accessible at http://www.european-science.com