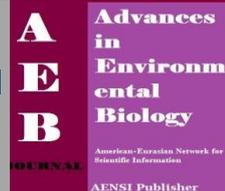




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Investigating the Methods for Using Solar Energy in Residential and Recreational Complex Design of the Quru Gol (Tabriz)

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ABSTRACT

Since now different countries and societies around the world are facing two major crises; environmental pollution and the completion fossil fuels; so the quest for new technologies to use renewable energy such as solar, wind, geothermal energy, are rising in many parts of the world. Iran's activities in this context in the past few decades have begun. Because Iran is geographically located on the yellow belt of the earth which has the maximum amount of sunlight throughout the day in different months of the year; thus the best option for supplying energy requirements is solar energy. Azerbaijan region as the selected site for this complex has a cold and dry climate. This region of the Iranian plateau has long, cold winters and short, warm summers, therefore, a large amount of energy for heating and cooling different places with a variety of usage including residential, educational, recreational and... is required, while using clean solar energy, results to saving a lot of fuel costs and preventing air and environmental pollution. This study surveys the different ways of using solar energy as an alternative for fossil fuels in the design of residential- recreational set in Quru Gol (Azerbaijan). The design and use of this energy leads to supply various needs such as water heating, power supply, space heating and cooling and many other issues to extent that possible and to achieve a sustainable and green architecture in this collection.

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INTRODUCTION

Iran's geographical position and its particular climate, causes high environmental and cultural diversity and this variety of conditions has provided suitable situation for the development of tourism in different regions of the country, but unfortunately, due to lack of proper planning and attention to this issue, the tourism has not made a significant progress in this country.

This selected site in this research is appropriate for residential- recreational usage with sustainable designing because of these 3 reasons:

1. Presence of Quru-Gol pond causes humidity and reduces dryness of air on the site of the complex. Also water has high thermal storage capability, due to a high specific heat capacity, so the water causes temperature moderation, and decreases the temperature difference between day and night in this area and the presence of water leads movement and liveliness in set.
2. Being outside the metropolitan area, the place is away from environmental, noise pollution and heavy traffic.
3. Due to city limits, it can be designed with the low height and extensive for maximum sunlight receipt on the roof to be used.

According to the features mentioned, this site's design is completely aligned with the characteristics of sustainable architecture. One of the most important issues in this complex is energy supply which is needed for different purposes. Some of them include: Producing electricity consumption, providing energy for space heating, hot water, swimming pool's water, laundry and air ventilation.

Nowadays mankind is confronting problems such as: environmental pollution, acid rain and high speed declining fossil fuels, so it is better to use renewed and environmentally friendly energies. Therefore, in this study the different and usable ways in Iran and the Azerbaijan region will be investigated for using of solar energy for power generation.

This was tested in the world and developed countries and many cases have been implemented and in Iran some activities in this direction have been done in the last two decades and in some residential or industrial

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projects have been used, but in the case of non-residential buildings such as hospitals, schools, hotels and offices, any project is not feasible.

Currently hotel sector is one of potential thermal energy demander that could incorporate solar assisted heated systems with the advantage not only of reducing fossil energy dependence but also improving their touristic image in the way of getting Green Labels that makes attractive to the tourism this type of buildings [10].

2. Search Method:

Study method is descriptive - analytical and research type is theoretical- usable. Data and documents collection methods are field and library studies, websites, articles and documents. In this way, the appropriate methods and strategies are analyzed and then matched with the ecological condition of the studied site and after the evaluation results, the data will be used for the design of this residential - recreational complex with energy approach.

3. Discussion:

One of the most promising renewable energy technologies is photovoltaic systems . Photovoltaic (PV) is a truly elegant means of producing electricity on site, directly from the sun, without concern for energy supply or environmental harm. These solid-state devices simply make electricity out of sunlight, silently with no maintenance, no pollution, and no depletion of materials [15].

3.1. Introduction of solar systems:

3.1.1. Active solar systems (dynamic:)

In the Active solar energy systems for achieve and transmit energy, the electrical and mechanical systems are used. Such as photovoltaic systems (solar electric collectors), solar thermal collectors (such as solar water heater).

3.1.2. Photovoltaic system or PV:

One of the types of systems that generates electricity from solar energy. In these systems by using solar cells, the energy of sunlight directly converts into electricity. Solar cells are semiconductors that are made of silicon material the second most abundant element in the Earth's crust. The sun exposure on photovoltaic cells causes the potential difference between the positive and negative electrodes that is the current flow between them.

Efficiency of solar cells includes the ratio of energy radiated to electrical energy generated, which can be varied according to the type and design of the cell ,which there are different methods for increasing energy efficiency. Since the energy source of these cells is sunlight, so the cells positions are parts of the building that has suitable area to achieve direct sunlight [8].

3.2. Passive Solar Systems (Static):

Unlike active systems, static systems no longer need other interface system and structural elements acts as receiving components, absorb and distribute energy. Such as sunny windows, tromp walls, greenhouse, solar roof, wind towers, basements.

3.3. Component Systems:

In this system, both static and dynamic systems can be used simultaneously. That is, except the main part of the building as a static system, the necessary electrical and mechanical components and systems are added to the building.

3.4. Selection of appropriate system and a method to design it for the complex:

The suitable system for residential– recreational complex, due to cold and mountainous climate and a great amount of energy needed, is a hybrid system.

The best position for building is locating in the west – east direction of the sun. Scilicet, the length of the building to be erected in this direction and the width of the building to be erected in the south –north direction due to southern walls gain the maximum energy in the winter and this wall can be protected by a canopy in the summer.

West- east walls in the summer are located on the sun exposure, should possibly have lower levels. It is better to rotate the building to the East till the summer sun to shine lower directly upon the West level [5].

After proper placement of the building in the site, according to the physical application of this complex, various types of static systems may be used. For example, for heating and cooling of residential rooms, they can be placed in a part of the building to fully take advantage of the southern light. Also consider basement for this set and place applications such as swimming pools in the area to utilize geothermal energy and insulating

properties of the earth because temperature in these spaces must always be balanced and also to prevent the waste of energy as well as basement acts as an insulation for upstairs.

In addition by creating green space for cooling and heating of different parts such as the lobby, the restaurants, the required energy can be provided.

The cases which were mentioned on the static systems only provide a small part of the complex energy requirements. Therefore to complete the system, active solar systems should be used.

Thus, the photovoltaic cells are used for generating electricity and providing energy. Photovoltaic cells can be used in different forms in the complex. They can be designed as integrated with the building or separate them as a form of small-scale solar farm in the vicinity of this set.

Photovoltaics may be integrated into many different assemblies within a building envelope:

-Solar cells can be incorporated into the façade of a building, complementing or replacing traditional view or spandrel glass. Often, these installations are vertical, reducing access to available solar resources, but the large surface area of buildings can help compensate for the reduced power.

-Photovoltaics may be incorporated into awnings and saw-tooth designs on a building façade. These increase access to direct sunlight while providing additional architectural benefits such as passive shading.

-The use of PV in roofing systems can provide a direct replacement for batten and seam metal roofing and traditional 3-tab asphalt shingles.

-Using PV for skylight systems can be both an economical use of PV and an exciting design feature.

To design the system with integrated method, It can be designed integrated with roof, walls or awning but in cold climates because the roof is flat and also due to the synchronic design of passive solar systems, the best method is to integrate designing with the roof to receive both the best form of sunlight and prevents the penetration of sunlight into the building which acts like roof insulation and. The best performance is achieved when the static and dynamic solar systems are designed in perfect harmony with each other. The placement direction and method of adjusting the angle and inclination of the solar panels is different for each city and region because the amount of received solar energy at different locations are not the same and the amount of solar radiation in different parts of the region depends on the latitude and thus it is possible to account the inclination angle of the solar panels on the latitude of the location and evaluation of the received radiation and the amount of rainfall of that place.

For example, for Tabriz with geographical coordinates (18, 46) east longitude degrees and (04, 38) north latitude degrees from the Greenwich meridian and the approximate height (1348) to (1561) meters above sea level and also the average amount of solar radiation (3.8 to 4.5) KWh per square meter per day, Favorable orientation of the panels can be identified that this orientation is to the south of Tabriz and also appropriate slope for panels approximately is equal to location latitude with a degree of ± 10 tolerance.

This arrangement provides the best kind of energy exchange during the year and can achieve about 95% of maximum output power [6]. Photovoltaic systems can be run in both isolated and connected to the network. The individual systems are not connected to the city power network and cannot use the city power in the cloud weather or at night, so on sunny days and during those days, the excess energy must be stored to use it on times during the night and needed times. Energy is stored in the accumulator that the development and maintenance costs are consuming. While the systems which are connected to the network, needs no storage because they get their energy during the day and consume the needed amount of electricity and sell the rest to the power company and buy the required energy from the company during the night and when needed. In this system, there is no additional cost for the preparation and maintenance of storage. Therefore, according to the conditions and calculation of costs, it can be identified the type of connected or isolated.

3.5. Survey the level of efficiency of photovoltaic systems in cold climates and mountainous regions of Azerbaijan:

Designers should understand the impacts of the climate and environment on the array output. Cold, clear days will increase power production, while hot, overcast days will reduce array output;

- Surfaces reflecting light onto the array (e.g., snow) will increase the array output;

- Arrays must be designed for potential snow- and wind-loading conditions;

- Properly angled arrays will shed snow loads relatively quickly; and,

- Arrays in dry, dusty environments or environments with heavy industrial or traffic (auto, airline) pollution will require washing to limit efficiency losses [15].

Because solar panels work very useful it does not require direct sunlight. They even work as well as when they only receive daylight.

This is a misconception that the solar panels have the best performance in the quite warm and sunny summer days while they lose their efficiency at a temperature above 30 degrees. So the cooler temperature is more favorable for performance of the panels.

The panels are designed to maintain their ability in the coldest temperature so snowing, cold temperature and wind would not damage the panels. Sitting the snow on the panel during snowfall and the cloudiness

decreases the panels efficiency, but as long as the snow on the panels are clean and the sun shines on them, the reflection of sunlight by snow sitting on the ground, can caused the amount of light that reaches the panels to multiply and therefore the efficiency of the panels becomes very high and energy will be compensated.

Snow accumulation on the panels will not harm them and sunlight can pass through the thin layer of snow sitting on the panel and also the snow accumulates on them melt quickly because of hot plates which cleans them. Even in the event of heavy snowfall and high accumulation on the panels, it can be cleaned by a hand on them. Thus the efficiency of solar panels in cold weather is more favorable because the hot weather reduces electricity and in hot weather to enhance the quality of panels they have to provide a cooling device on the back of the plates.

Also for cold regions like Azerbaijan, this point must be considered that the total energy received from the panels is related to the whole year, therefore, in the days when panels receive a lot of energy from sun, is saved and is used later on days with less received energy.

In recent years, special panels are designed for cold climates as vacuum tube panels which are more expensive than conventional panels but respond better to cold regions and have a better performance up to about 50%. There are new kind of panels that have magnifying glasses which increases light and leads to absorption of more energy.

To avoid lowering high efficiency of panels in the summer and high temperatures, the panels are not completely attached to the ceiling and they are adjusted with a distance of several inches from the ceiling till the air flows on the back of it and cause the coolness of pages and prevents from transferring heat from the roof to the panels.

One of the important issues and requirements in designing of the photovoltaic systems, is that no shadow should be created on the panels, in particular, during the day (noon) that complete light should reach on panels on 3 hours of Noon, because in these hours the sunlight is full so the panels must be avoided from creating artificial shadow, such as: tall buildings and trees, on the building and the surfaces which are covered with panels, and also panels that are created by horizontal lines absorb light as much as 50 -70% more than vertical lines .

3.6. The history of the hotel industry trend toward being green:

Tourism is one of the largest and most important known industries in the world which is developing very fast and this industry makes an important role in the economy. The hotel industry is one largest sector of the tourism industry and if not properly managed, it can bring great harm to society and the environment. Therefore in the trend toward being green for tourism and hotel industry, the desired goals in the short term can be achieved.

Hotels trend toward Green Architecture accelerated in 2007 and in this time, the number of green hotels in the United States increased from day to day, for example, Bulter hotel in 2008, and Wiegler hotel was formed in 2008. Ted Saunders was one of the pioneers in hotels trend towards being green that in 1989 began using the principles and practices of green architecture in the hotel industry.

Hotels had reasonable grounds for trending towards being green, such as a sense of social responsibility, state laws, and the economic benefits [19].

3.7. The benefits of using solar systems in the complex:

The use of solar energy and adaptation plan with climate in addition to supply clean energy and no air pollution and prevent from full consume of fossil fuels will lead to welfare clients and also the decrease of energy costs of complex for its owner and therefore will decrease residential costs for the guests. This is another advantage that over 10 years investing and applying solar panels for hotels can be traced back to its owner.

Also doing this design for the owner of the complex and the area in which it is located, has a great value of Advertising because the topic of clean energy is more proposed in the world today and has many fans; so these types of complexes are very important in terms of tourism.

Conclusions:

According to studies carried out in this research, it can be considered using of renewable energy such as solar energy in various methods and forms, in the desired residential- recreation complex located in the cool and mountain climate as a suitable way for following issues:

- Deal with environmental pollution crisis
- Prevent from the decline of fossil fuels.
- A way to produce energy with a low-cost for the owner
- A factor to promote and advertise of green architecture in the region and the country.
- Creating a new way for the development and growth of tourism and ecotourism industry in Iran

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