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Solar energy in contemporary Iranian constructions

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Abstract

Sun is not only an enormous energy source, but also is the source for life and all other energies. According to the scientific estimations this fireball has existed for about 6000 million years and about 4.2 million tons of the sun mass is converted to energy each second and this glamorous star can be counted as a huge energy resource for the next 5 billion years. All the fossil, wind, waterfall, and sea wave energies depend on the energy received from the sun. The primitive humans used nature to shelter themselves from the nature, and due to the need to be permanent, different climate-based architectural methods were developed. The sun, water and wind were the three main elements utilized to bring about comfort and ease in constructions. After the industrial revolution utilizing the climate situations to provide comfort were replaced with artificial methods to do so. Ignoring the nature, problems caused by fossil fuels, and their short life in comparison with the sun, has made architects and designers to use natural factors and especially solar energy as the head factor in their designs. And nowadays we can see structures which are aimed to make the most of the solar energy. The items studied in this research are: the specifications of utilizing solar energy and its uses, Active and inactive systems, the importance of utilizing renewable energies in Iran, and studying cotemporary examples which have benefited from solar energy such as Supreme Audit Court Building, solar building of Science and Technology University and energy Museum Park in Neka city.

Keywords: Active Systems, Climatic Architecture, Natural Factors, Solar Building

1. Introduction

Characteristics of using solar energy and its application:

- Omission of green house gases dispersion mainly CO2
- Free and availability
- Reduction in consumption of fossil fuels
- Safety
- Endlessness
- Providing consumed hot water by using active solar systems
- Providing required cold by using high performance flat collectors
- Providing required heat by using tromp wall, green house and solar pools
- Providing luminance by using photovoltaic cells.

Fig 1: solar absorption panel.

Providing building thermal needs by utilization of sun:
- Passive system
- Active system

Passive system:
In passive solar system, the building is heated naturally by using natural elements like sun.
- A standard and well- designed building in direction of the sun can be a passive solar house.

Direct entering sun light into rooms by windows:
Day light is entered by windows and heated internal spaces. During sun exposure hours the day light heat is preserved in thermal masses of ceilings or internal walls from water, stone and concrete or adobe then preserved heat is transferred into internal spares during sunset, if one of the main walls and most of the windows are in south direction and the windows are insulated accurately (using double layers windows).
In hot areas, west and east windows should have curtains.

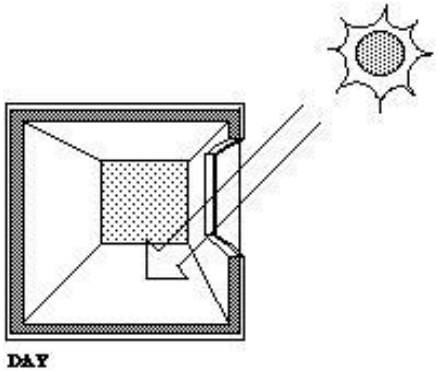

Fig 2: Direct entering sun light into room.

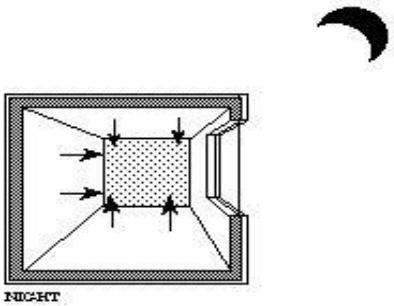

Fig 3: Transfer of stored energy at night.

Passive indirect systems:

In a passive indirect system, the thermal mass is placed between house and sun and it absorbs sun rays the transfers it into house space by conductance. This system consumes 30-45 percent of sun energy transmitted in glass as thermal mass.

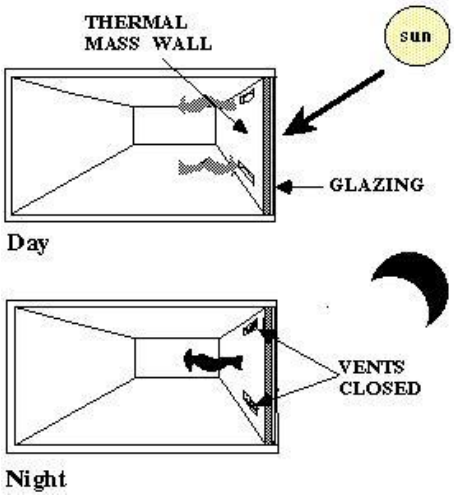

Fig 4: Thermal mass wall.

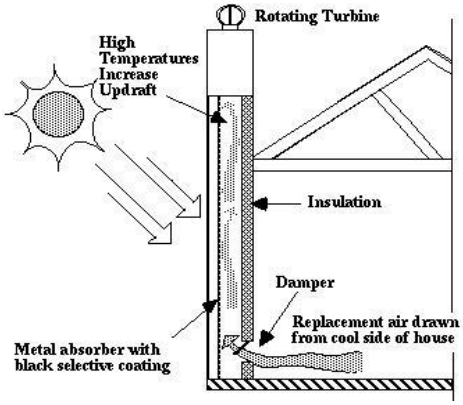

Fig 5: Passive solar wall.

Indirect sun rays absorbing systems:

- Thermal collection walls (tromp walls)
- Roof basin system
- Hydraulic wall (water wall)

Active system
Active solar systems involve water heater and photo voltaic solar energy collectors.

Photovoltaic system
• Photovoltaic system converts solar energy into electricity. These systems provide clean environment.
• Photovoltaic system can work in every climate.
• Electricity is reduced in cloudy and rainy weather; this amount never reduces from 25 percent of maximum production capacity.
• In normal condition 80 percent electricity is produced.
• Easy maintained without need to parts replacement
• Beautiful photovoltaic cells are manufactured in different colors glasses.
• Architects can use photovoltaic systems for aesthetics aspect in building in addition to main application
• In case of using solar cells in windows, the installed cell out performances glass, so building materials are saved. Thus the windows produce electricity.
• Floor heating photovoltaic system uses solar energy for heating water.

2. Research Methodology
The importance of renewable energies in Iran:
Availability of new energy resources is important in developing countries from economic development view point. Recent research shows that there is a direct relationship between level of development in a country and energy consumption. According to limited fossil energy reservoirs and increase in energy consumption, it can not be relied on current energy resources. Because of ever- increasing need to energy resources and reduction fossil energy resources and considering healthy environment, decreasing air pollution, limitation of electricity and providing fuel in remote areas, utilization of solar, wind and other energies in important in our country. Exploitation of solar energy is most of the countries and a sunny region is common. Iran is located between north latitude 24-40◦ in high solar energy absorption area. The level of sun shine is estimated between 1800-2200 kw.h/m^2 in a year that is higher than universal average. Averagely more than 280 sunny days in a year have been reported in Iran.

3. Results and Analysis
Investigation of contemporary Iranian buildings' employing solar energy.
Supreme Audit Court Building
• Area: 22000
• Period of implementation: 1371-1384
• Employer: dwelling and urban building administration
• Designer: Rahrou consulting engineers

Fig 5: Supreme Audit Court Building.

Based on solar energy
Double layers buildings with solar energy specifications.
Double layers- eighteen floors building
Plan 30*30
Designing module 75cm
Vacant space skin 75 cm
Structural distance 6= 0*75*3m
Crossing all installation ducts between layers
Class external skin (layer)
Low transmission coefficient light wall internal skin (layer)
Limited and insulated opening internal skin (layer)
External skin (layer) without opening
Horizontal 3cm split between two floors

Fig 6: Building two-shelled samples made using solar energy.

Characteristics of the project

- Efficient utilization of double- layers technique for building climatic designing
- Segregation of stairs lift and installation public access from main parts with open plan
- observing sustainable architecture principles and respecting users by regulation of voice, light and thermal elements
- building safety by observing styles and other techniques and regulation
- Building similar establishment in north- south and west- east directions from climatic designing perspective.
- Problems in building west side in the summer
- Simplicity of building in plan and functionality

Fig 6: two-shelled external wall of Supreme Audit Court Building.

Solar building of Science and Technology University
Client: research and investigational assistance of science and Industry University
Area: 200m3
Year: 1368
Period: 1373-1377

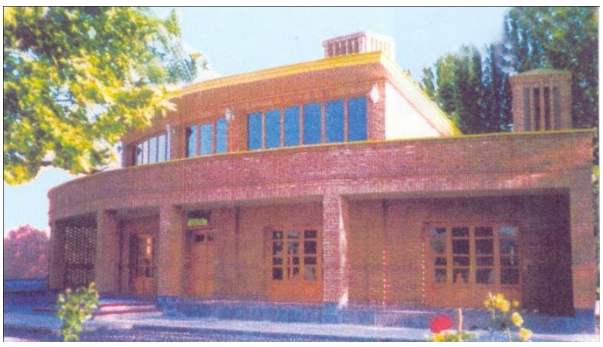

Fig 6: Solar building of Science and Technology University.

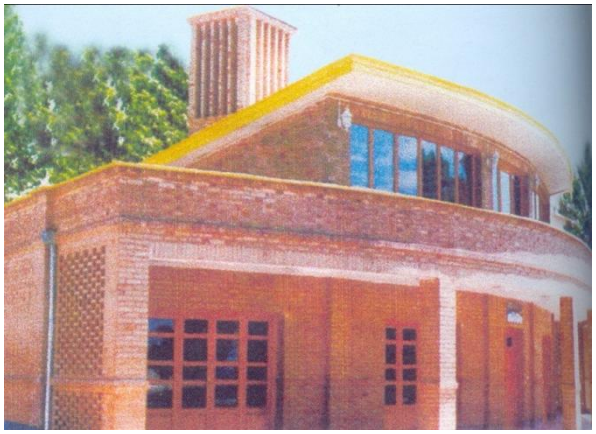

Fig 7: Solar building of Science and Technology University.

- This two floors building was awarded 20000 prize of UNISCO because of considerable values in architecture
- In this building, it was tried to offer creative elements without imitation of the solar buildings use vernacular and available products
- The structure of the building was designed by word beams changed to concrete during implementation
- from three utilizations of sanders solar building in the U.S (1- water containers heating chamber-2- south facade cover green house 3- under building stone pile as a heat reservoir) only the heating chamber or hot chamber was employed and its glass section was designed statically (its life equals to building life) without need to "focal heat" meaning central radiators and etc that can absorb required vernacular louver and glass were used for cooling of the building. The cold weather is flow underground by a channel in height of 40m and opening of 80*80 cm without need to cooler.
It is necessary to note that water- solar dynamics method was added that damaged building heating chamber and its designing motivation.

Neka energy Museum Park

This complex is located in Nek in Mazandaran province in coastal area of Caspian Sea. The aim of designing and selection of this site was to show superiority of solar energy relative fossil energy based on placing this site near fossil fuel power plant and combined cycle and oil terminal. The park site is located in 19 hectare from coastal area with low slope by soft sandy soil. This site is important from economic and industrial viewpoint. This complex consists of power plant and other area. The aim is to identify and receive electricity from sun wind, earth, thermal and wave resources. In places other than power plant area the manner of using energy in active and passive modes is presented and also training workshops are established for authors, engineers and interested individuals. In this complex the pools are circulated by active system. The mentioned complex is a center for receiving clean energies.

4. Conclusions

One of the considerable points in saving energy consumption related to modern strategies for providing optimal life in recent century is preservation of future resources and their effects on (plant and animal) ecosystems. Preservation of nonrenewable energies, reduction of earth resources utilization and effect of low destruction of building on environment are important in architectural designing new methods of designing and making environmental compatible spaces for present and future generations are considered with minimum pollution.

Based on ever increasing need to energy resources, reducing fossil energy resources, considering healthy environment, reduction in air pollution, limitation of providing electricity and fuel in remote places, using energies like solar, mind energies is important. It is interested to note that heating water and space consumes more than 80% of energy in the building so more than one – third of universal energy is consumed for heating water heating consumes averagely 20-30% of total consumed energy in a house.

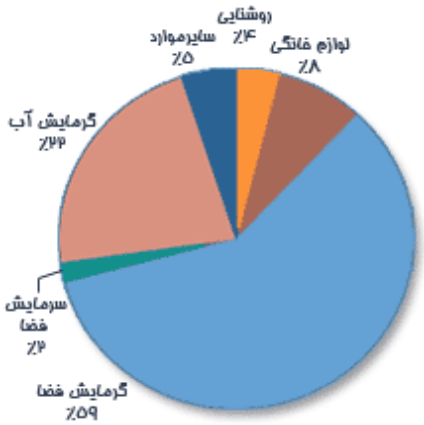

Fig 7: Evaluation of energy consumption.

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