ISSN 2349-4506
Impact Factor: 2.265

Global Journal of Engineering Science and Research Management

DESIGN IMPROVEMENTS IN INCREASING THE EFFICIENCY OF HYBRID SOLAR ENERGY BUILDING

Amana Ayoob*, Devika Venugopal, Bismiya Sunny, Nimmy Johnny, Vikram J
* Under Graduate Students, Civil Engineering, METS School of Engg. Mala, Kerala, India
Associate Professor, Civil Engineering, METS School of Engg. Mala, Kerala, India

DOI: 10.5281/zenodo.53751

KEYWORDS: Energy; Efficiency; solar position.

ABSTRACT
The electrical energy used for the living comfort, by the present society mainly comes from burning fossil fuels. These fuels are decreasing in a dramatic rate and it also contributes to pollution. Hybrid solar design for buildings helps to reduce the consumption of electrical energy and maximize the use of solar energy. A good thermal comfort is maintained during the whole cycle of the sun. This paper deals with maximum utilization of sun's energy according to the various positions of sun during a day. It also includes the positioning of solar cells and better orientation, thus helping us to capture maximum solar energy. Based on the prevailing conditions of Thrissur a prototype is also being prepared.

INTRODUCTION
In the present scenario, the electrical energy that is being used is obtained by burning the fossil fuels. These fossil fuels is getting exhausted. An alternative for this is the solar energy. This article deals with the methods of utilization of sun's energy to the maximum extend according to the various position occupied by the sun in a single day. According to the temperature variation present outside the building the interior is cooled and warmed by this energy. The sun's energy received is either reflected back or scattered or absorbed in the atmosphere. Maximum solar intensity is at noontime when the sun is in south

There are three ways in which sun's energy reaches the earth's surface – Direct, Reflected and Diffuse radiation. The most usable heat is provided when a surface is perpendicular to the sun's rays (angle of incidence is equal to 0 degrees) and this occurs in direct radiation. The dust, clouds, pollution etc. scatters the energy that comes from the sun and also becomes non-directional within the atmosphere. This is called diffuse radiation. 100 percent of the diffuse radiation takes place on a cloudy day whereas only 20 percent of the diffuse radiation takes place on a sunny day. The cloud cover, air pollution, location and time of the year are the some of the factors which affect the amount of sun's energy reaching the earth's surface.
Upon reading this article, the reader will understand:

1. The advantages of using solar energy while designing a building.
2. A comparison between passive, active and hybrid solar technologies.
3. Maximum utilization of sun's energy.
4. Developing a Temperature control inside a building using heat exchanger.

METHDOLOGY
Solar buildings work on three principles: collection, storage and distribution of the sun's energy.

Passive Solar Building
When the solar radiation is used for heating and cooling of building by reducing the energy use, such a system is the passive solar building. The natural energy flow through air and radiation, conduction, absorption and natural convection is made use in this. This system emphasizes in maintaining use of passive energy which flows for heating and cooling. The optimization of heat gain in passive is direct which is by the windows collecting the heat and the interior materials storing them. The natural movement of heat and air, passive solar gain and cooling in order to maintain a good internal comfort are the regards of a Passive Design. By the application of passive solar

ISSN 2349-4506
Impact Factor: 2.265
Global Journal of Engineering Science and Research Management

building, there is reduction in the use of mechanical system and energy demand and also CO2 emissions. The 5 basic principles for planning of a passive solar building are:

- Orientation
- Overhangs and shadings
- Insulation
- Double or triple glazing
- Thermal mass

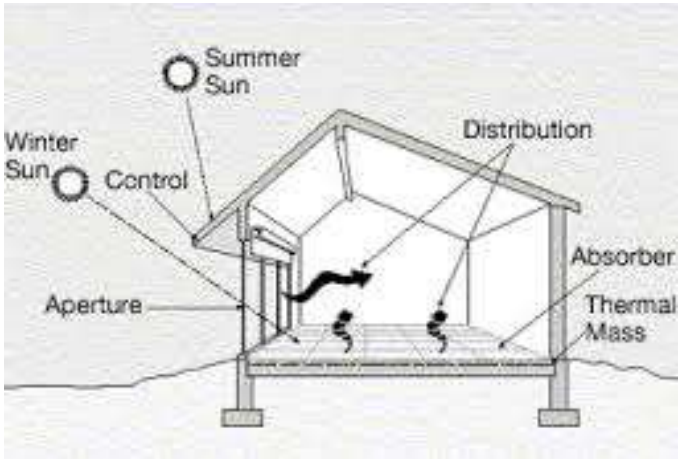

Fig.1: Sources of external energy in a building

Active Solar Building

When collection, storage and distribution of sun's heat is done with the help of a mechanical equipment, such a system is called an Active solar system. This system comprises of solar collectors, a storage medium and a distribution system to distribute it. This Active solar systems are commonly used for multiple purposes such as:

- Heating of water;
- Air conditioning;
- Electricity production;
- Heat processing;
- Solar mechanical energy etc.

Hybrid Solar Building

The passive as well as the active has their own limitations, so as to overcome these limitations both of them can be combined. The word Hybrid indicates the combination of two or more things. Here a hybrid of the active and passive systems are made so that the limitations of either system can be overcome. This can be done by placing photovoltaic panels to supplement electricity. Hybrid systems are the most common, except for the direct gain system, which is passive.

WORKING OF A TEMPERATURE CONTROL SYSTEM

The exhaust air from the interiors of a building is extracted in and provided to a heat exchanger. The principle of the heat exchanger is that it transfers the heat without transferring the fluid that carries the heat. The exchanged air is transferred back to the interior of the building. Thus, cooling or heating is done respectively. The energy for the heat exchanger has to be supplied externally.

ISSN 2349-4506
Impact Factor: 2.265

Global Journal of Engineering Science and Research Management

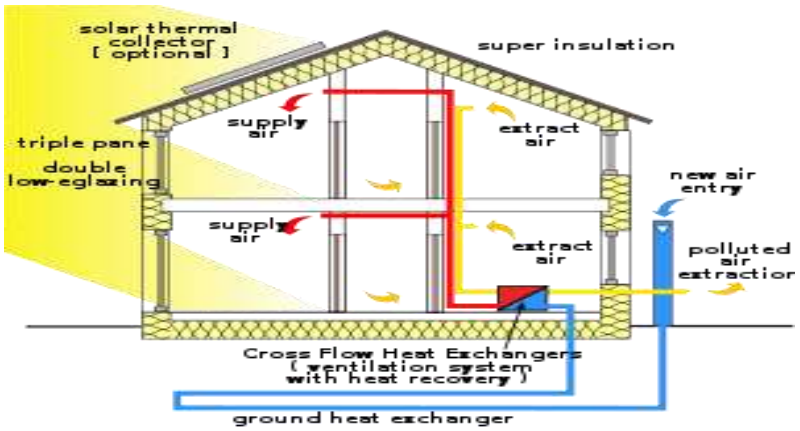

Fig.2: Passive energy building concept

SUGGESTION TO IMPROVE THE EFFICIENCY OF SOLAR BUILDING

The passive and active system as discussed above are combined so as to get maximum utilisation of sun's energy. The solar panels when kept in a single position cannot capture the entire solar energy available all through a day. Hence, the solar panels used for storing and supplying energy can be replaced by individual solar cells positioned at different positions over the roof. By this arrangement, the solar energy is utilised to a maximum extent over the entire lighting hours.

.

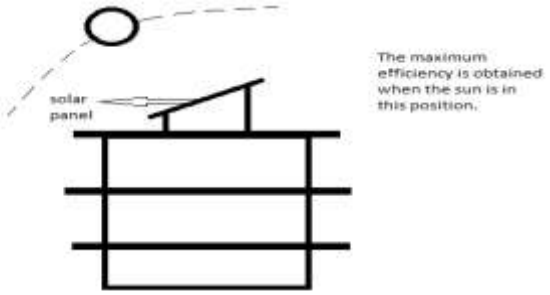

Fig 4: Energy efficiency based on position of sun

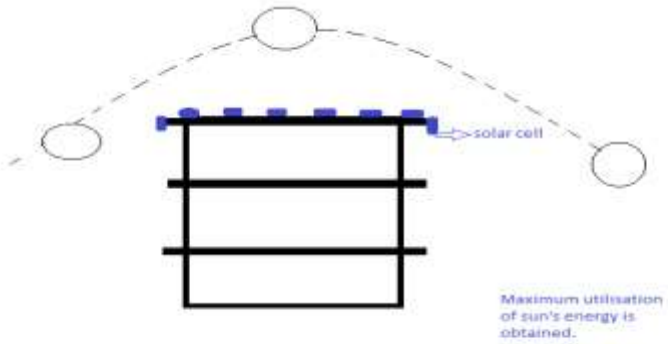

Fig 5: Maximum Energy utilization based on solar cell location.

ISSN 2349-4506
Impact Factor: 2.265

Global Journal of Engineering Science and Research Management

This strategy can be improved if we can use robotics so that position of solar panel changes with respect to the position of the sun.

CONCLUSION

Conclusion from the above illustration is that the practised method of implementing a solar cell is not according to the movement of sun and hence there might be a reduction in the energy efficiency. The proposed method of location of solar cells in different part of the building based on its exposure to the sun can be made such that the efficiency can be increased. The solar panel can be robotically operated or sensor operated to orient with the motion of the sun thereby increasing its efficiency.

REFERENCE

1. "Zero Energy Buildings". Fsec.ucf.edu. Retrieved 2010-03-16.
2. "Two Small Delta Ts Are Better Than One Large Delta T". Zero Energy Design. Retrieved 2007-12-23.
3. William A. Thermal Shutters & Shades - Over 100 Schemes for Reducing Heat Loss through Windows 1980. ISBN 0-931790-14-X.
4. "Florida Solar Energy Center - Skylights". Retrieved 2011-03-29.
5. "U.S. Department of Energy - Energy Efficiency and Renewable Energy - Sunspace Orientation and Glazing Angles". Retrieved 2011-03-28.
6. "Solar Heat Gain through Glass". Irc.nrc-cnrc.gc.ca. 2010-03-08. Archived from the original on 2009-03-21. Retrieved 2010-03-16.
7. "[ARCHIVED CONTENT] Insulating and heating your home efficiently: Direct gov - Environment and greener living". Direct.gov.uk. Retrieved 2010-03-16.
8. "Reduce Your Heating Bills This Winter - Overlooked Sources of Heat Loss in the Home". Allwoodwork.com. 2003-02-14. Archived from the original on 2010-09-17. Retrieved 2010-03-16.
9. Brian Norton (2011) Solar Water Heaters: A Review of Systems Research and Design Innovation, Green. 1, 189–206, ISSN (Online) 1869-8778
10. "Industrial Technologies Program: Industrial Distributed Energy". Eere.energy.gov. Retrieved 2010-03-16.
11. "Cold-Climate Case Study for Affordable Zero Energy Homes: Preprint". Retrieved 2010-03-16.