International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 06, June-2018

Acquiecent Design from Solar Energy

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***Abstract* - This work shows the effectiveness of passive solar house over a conventional house. The concept of passive house where the energy losses are reduced to the minimum by using different technologies is one of the key features of designing aspect. These have two fundamental principles: optimizing the basis conditions (making the basic house's components more performing) and minimizing the losses (keeping the house's warmness), therefore solar path study is an essential. In passive solar systems the solar energy is highly involved in maintaining the comfortable environment inside the house. It has few moving parts, requires minimal maintenance, and requires no mechanical and electrical devices to operate. In passive solar building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. The key to design a passive solar building is to best take advantage of the local climate, performing an accurate site analysis; landscaping and orientation are also to be considered. Elements considered here include window placement and size, thermal insulation via extensive green roofs and winter gardens, and shading. Passive solar design techniques can be applied easily to new buildings in urban, semi-urban and rural areas, but existing buildings can be retrofitted.**

Keywords— Passive Solar House, Extensive Green Roof, Winter Garden, Orientation, Solar Path Study.

I. INTRODUCTION

Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces. In this approach, the building itself or some element of it takes advantage of natural energy characteristics in materials and air created by exposure to the sun. Passive systems are simple, have few moving parts, and require minimal maintenance and require no mechanical systems.

The present society utilizes the electrical energy for their comfort. This electrical energy is majorly obtained by burning the fossil fuels. These fuels are decreasing in a dramatic rate and it also contributes to the pollution.

Passive solar design for home helps to reduce the consumption of electrical energy by utilizing the solar energy. Passive solar design is a green concept which is aimed to utilize the maximum solar energy in the form of heat to maintain interior thermal comfort throughout the sun's daily and annual cycles, thereby reducing the dependence of energy consuming mechanical and electrical systems of heating and cooling. The windows, walls and floors of the homes can be designed to collect the solar heat from the sun in winter and reject it in the summer. The houses are designed in such a way that they repel heat in the summer but retain heat in the winters. And all this happens in the background, without any active human or machine influence.

II. OBJECTIVE OF THE PROJECT

To design a Passive Solar House. To provide affordable housing to the people living in urban, rural or semi-urban areas with minimum additional costs. To check the outcome of Passive Solar techniques implemented in this project. To check the feasibility of the project. To check the time required to recover the additional input costs through reduction of energy bills.

III. LITERATURE REVIEW

Javad Sadeghsaberi, Sana Zarei, Shahab-o-din Hemmati and Mohsen Kameli focused on designing a passive solar building by taking advantage of the local climate. In their analysis, they studied the various methods available to gain heat by applying passive solar techniques. They studied the varying sun path throughout the year and planned the orientation of the structure accordingly. Taking under consideration the site location and specifications, they noted the guidelines to be followed while planning a structure. Special emphasis was given on the various equipment and methods used to retain or repel heat. Elements to be considered include window placement and glazing type, thermal insulation, thermal mass, and shading. They concluded that Passive Solar Houses are highly efficient and very effective in reducing the heating costs up to 50%.

Piyush Sharma studied Passive Solar Systems in an overall view. He clarified the difference between Active Solar Systems and Passive Solar Systems. Ways of Passive Solar Heating by direct, indirect and isolated gain systems, and ways of Passive Solar Cooling by convective cooling, shading, ventilation, etc were studied by him. He concluded that these houses are very cost effective and require minimal maintenance as they have no moving parts. Also, Passive Solar Houses are rarely constructed in the Indian Subcontinent and there is a wide scope and a great potential for developing them.

Dr Jayeshkumar Pitroda, Lalakiya Biraj, Naghera Dhiraj, Narodiya Jay and Patel Harsh reviewed published papers on Passive Solar Energy Systems. They concluded that Implementation of such systems will save three types of energy need for the space conditioning and visual comfort (i.e., heating, cooling and lighting), 61% energy use reduction in heating is the maximum energy saving, lighting energy use is also decreased by 40%.These houses turn cost effective within a period of 5-10 years. Additional costs of only up to 9% is required. Advantages due to passive solar design like Energy performances, investment, attractive living environment, comfort, low maintenance, environmental concern were noted.

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Rufai Mohammed Ahmed and Asst. Prof. Dr Halil Z Alibaba explained the concept of green roof. They clarified the types of green roofs, i.e. extensive green roofs and intensive green roofs and stated the differences between them. Advantages and disadvantages of both over each other were noted. Further, the studied the implementation of this concept in various places in the USA and Mexico. They concluded that green roof systems need to be installed by professionals because a lot of considerations needs to be taken place for it to survive and thrive. At last green roofing is an important factor that cannot be neglected when trying to achieve sustainable environments because of its numerous importance to urban areas and the world at large.

Nicholas S.G. Williams, John P. Rayner and Kirsten J. Raynor studied the installed green roofs in Australia. They noted that most of the roofs installed were Intensive Green Roofs. They observed that there is a limited range of suitable plants and the growing systems required to propagate commercial quantities are not in place. There are also very few experienced green roof installers or maintenance contractors. These factors can increase the difficulty and expense of constructing green roofs. They studied the substrate, plants and water resources available locally in Australia. They concluded that although green roofs are a proven technology in temperate northern hemisphere countries, there are many barriers to the implementation of extensive green roofs in Australia and other areas with year-round or seasonal hot, dry climates.

Piyush Sharma, Sakshi Gupta presented a detailed investigation on Trombe Walls. They stated the technical aspects of a trombe wall and its working. They also stated the areas where it can be implemented and gave a detailed application in Ladakh and Gwalior regions. They concluded that trombe walls are effective in reducing heating bills by 10-15% and that it is completely passive requiring minimum or no maintenance.

IV. METHODOLOGY

The main purpose of this project was to find the cost effectiveness of passive solar techniques applied to a house. To study this, a purpose structure was planned in Akurdi, Pune region and all the estimation and calculation were based on the implementation of these techniques on that structure. For this purpose, extensive research was carried out by studying many published national and international papers. Some of which are given in the literature review above. Data was also accumulated from various websites concerning the topic. Information regarding the electricity bill was based on the local MSEB rates. Detailed information about the various aspects implemented in this project such as winter gardens (base on green house), extensive green roofs, orientation of structure, landscaping etc. were initially stated. The cost of installing winter garden and extensive green roof was then calculated. Then, the power consumption of similar structure in the same locality was studied. 40% reduction in electricity due to implementation of passive solar techniques was assumed after referring various papers and websites. The annual saving were calculated, and the time required in years to recover the initial additional costs of installing extensive green roof and winter garden was computed.

V. CONCLUSION

The main objectives of this project have been realized. After understanding the functioning of a Passive Solar House, those techniques were implemented in a case study. Recommendations and suggestions were taken from the various research papers and websites studied for this project. Optimum orientation of the building, use of winter gardens and extensive green roofs were some of the methods implemented. After doing the cost analysis of the case study, it was found out that Passive Solar Houses indeed provide a return on investment in monetary terms. The reduction in electricity bills cover up the initial additional costs within 14 years. Also, these houses significantly reduce the carbon footprint and are highly sustainable and environment friendly.
Active use of solar energy is present in India in the form of solar panels, solar water heaters, etc. Passive Solar Housing, although an established concept is relatively new in India. There is a wide scope for its implementation in the future. Various incentives and tax credits should be provided by the government to encourage the people to use these systems.

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