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DESIGN OF PASSIVE SOLAR BUILDING

Vaishali L. Chandane[1] Wrushali D. Chopade[2] Shalini S. Manwar[3]

1. UG *Student, Department of Civil Engineering, J.C.O.E.T, Yavatmal, SGBAU University Maharashtra, INDIA*
vaishuchandane12@gmail.com

2. UG *Student, Department of Civil Engineering, J.C.O.E.T, Yavatmal, SGBAU University Maharashtra, INDIA*
wrushlidchopade@gmail.com

3. UG *Student, Department of Civil Engineering, J.C.O.E.T, Yavatmal, SGBAU University Maharashtra, INDIA*

Abstract

One of the important issue's today's scientific worlds is the topic of sustainable development and sustainable architecture which is followed. Without doubt, unsustainable consumption of non-renewable natural resources like fossil fuels, the Environment will be at risk in the near future. While, the building sector accounts more than a third of energy. Therefore reduce the amount of energy in Buildings causes toward sustainable development which consistent with the needs of today's generation which put future generation at risk. One of the painters of sustainability in architecture is the use of natural energy and fossil energy consumption and minimum natural environmental conditions and climate so solar building designs which is a step towards its achieving. Based on the analysis of data collection 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 by designing windows, walls and floors of the homes to collect the solar heat from the sun in winter and reject it in the summer.

Index Terms:*Solar Energy - Architecture - Optimization – Building*

INTRODUCTION

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 is 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 the reducing the dependence of energy consuming mechanical and electrical systems of heating and cooling. The windows, walls and floors of the homes are designed to collect the solar heat from the sun in winter and reject it in the summer.

Withdrawal from traditional architecture and increased consumption of fossil fuels pollute the environment has been increasing waste of energy resources, Due to the flexible nature of the resource is necessary to pay attention to the scientific use of natural renewable energy and Looking for new projects, especially in our building. Given that one of the goals of sustainable architecture heating and cooling needs by renewable energy With the move to solar building design are taking an important step towards sustainable development and take away from dependence on fossil fuels In this paper, we examine the cognitive energy and solar energy in buildings.

Solar energy is a radiant heat source that causes natural processes upon which all life depends. Some of the natural processes can be managed through building design in a manner that helps heat and cool the building. The basic natural processes that are used in passive solar energy are the thermal energy flows associated with radiation,conduction and natural convection. Then sunlight strikes a building, the building materials can reflect, transmit or absorb the solar radiation.

Additionally, the heat produced by the sun causes air movement that can be predictable in designed spaces. These basic responses to solar heat lead to design elements, material choices and placements that can provide heating and cooling effects in a home solar energy is a radiant heat source that cause natural processes upon which all life depends. Some of them natural processes can be managed through building design in a manner that helps heat and cool the building.

MATERIALS AND METHODS:

In this paper is a descriptive and analytical method. Tools for data collection is library research, internet and field research and General pattern of the research process is based on material extracted from the literature and experience. After study predicted, Results will be analyzed and tried to use the processing and analysis of data and findings in the field of Library Studies, to achieve results in terms of proposals for better use of solar energy in buildings.

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. This is called passive solar design or climatic design because, unlike active solar heating systems, it doesn't involve the use of mechanical and electrical devices.

The key to designing a passive solar building is to best take advantage of the local climate. Elements to be considered include window placement and glazing type, thermal insulation, thermal mass, and shading. Passive solar design techniques can be applied most easily to new buildings, but existing buildings can be adapted or "retrofitted".

PASSIVE ENERGY GAIN:

Passive solar technologies use sunlight without active mechanical systems (as contrasted to active solar). Such technologies convert sunlight into usable heat (water, air, thermal mass), cause air-movement for ventilating, or future use, with little use of other energy sources. A common example is a solarium on the equator-side of a building. Passive cooling is the use of the same design principles to reduce summer cooling requirements.

Some passive systems use a small amount of conventional energy to control dampers, shutters, night insulation, and other devices that enhance solar energy collection, storage, and use, and reduce undesirable heat transfer.

Passive solar technologies include direct and indirect solar gain for space heating, solar water heating systems based on the thermo siphon or geyser pump, use of thermal mass and phase-change materials for slowing indoor air temperature swings, solar cookers, the solar chimney for enhancing natural ventilation, and earth sheltering.

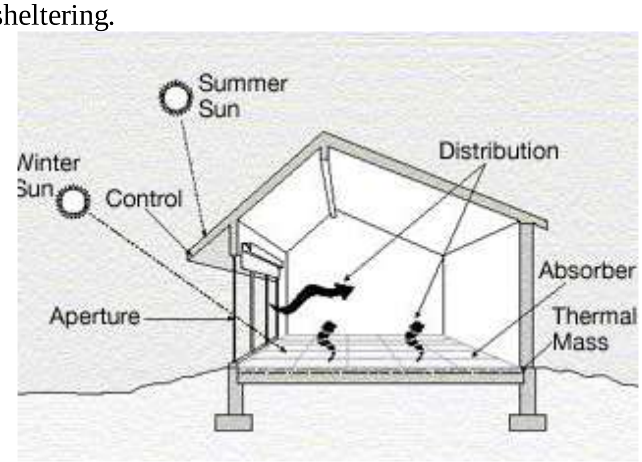

Fig.1 ***Elements of passive solar design, shown in a direct gain application***

More widely, passive solar technologies include the solar furnace and solar forge, but these typically require some external energy for aligning their concentrating mirrors or receivers, and historically have not proven to be practical or cost effective for widespread use. 'Low-grade' energy needs, such as space and water heating, have proven, over time, to be better applications for passive use of solar energy As a science

The scientific basis for Passive Solar Building Design has been developed from a combination of climatology, thermodynamics (particularly heat transfer: conduction (heat), convection, and electromagnetic radiation), fluid mechanics / natural convection (passive movement of air and water without the use of electricity, fans or pumps), and human thermal comfort based on heat index, psychometrics and enthalpy control for buildings to be inhabited by humans or animals, sunrooms, solariums, and greenhouses for raising plants.

Specific attention is divided into: the site, location and solar orientation of the building, local sun path, the prevailing level of insulation (latitude / sunshine / clouds / precipitation (meteorology)), design and construction quality / materials, placement / size / type of windows and walls, and incorporation of solar-energy-storing thermal mass with heat capacity.

While these considerations may be directed toward any building, achieving an ideal optimized cost / performance solution requires careful, holistic, system integration engineering of these scientific principles. Modern refinements through computer modelling (such as the comprehensive U.S. Department of Energy "Energy Plus" energy simulation software), and application of decades of lessons learned (since the 1970s energy crisis) can achieve significant energy savings and reduction of environmental damage, without sacrificing functionality or aesthetics. In fact, passive-solar design features such as a greenhouse / sunroom / solarium can greatly enhance the liveability, daylight, views, and value of a home, at a low cost per unit of space.

Much has been learned about passive solar building design since the 1970s energy crisis. Many unscientific, intuition-based expensive construction experiments have attempted and failed to achieve zero energy - the total elimination of heating-and-cooling energy bills.

Passive solar building construction may not be difficult or expensive (using off-the-shelf existing materials and technology), but the scientific passive solar building design is a non-trivial engineering effort that requires significant study of previous counter-intuitive lessons learned, and time to enter, evaluate, and iteratively refine the computer simulation input and output

One of the most useful post-construction evaluation tools has been the use of thermograph using digital thermal imaging cameras for a formal quantitative scientific energy audit. Thermal imaging can be used to document areas of poor thermal performance such as the negative thermal impact of roof-angled glass or a skylight on a cold winter night or hot summer day.

DESIGN ELEMENTS FOR RESIDENTIAL BUILDINGS IN TEMPERATE CLIMATE

1.Orienting the building to face the equator (or a few degrees to the East to capture the morning sun)
2. Extending the building dimension along the east/west axis
3. Adequately sizing windows to face the midday sun in the winter, and be shaded in the summer.
4. Minimizing windows on other sides, especially western windows
5. Erecting correctly sized, latitude-specific roof overhangs, or shading elements (shrubbery, trees, trellises, fences, shutters, etc.)
6. Using the appropriate amount and type of insulation including radiant barriers and bulk insulation to minimize seasonal excessive heat gain or loss
7. Using thermal mass to store excess solar energy during the winter day (which is then re-radiated during the night)

The precise amount of equator-facing glass and thermal mass should be based on careful consideration of latitude, altitude, climatic conditions, and heating/cooling degree day requirements.

Factors that can degrade thermal performance:

8. Deviation from ideal orientation and north/south/east/west aspect ratio
9. Excessive glass area ('over-glazing') resulting in overheating (also resulting in glare and fading of soft furnishings) and heat loss when ambient air temperatures fall
10. Installing glazing where solar gain during the day and thermal losses during the night cannot be controlled easily e.g. West-facing, angled glazing, skylights
11. Thermal losses through non-insulated or unprotected glazing
12. Lack of adequate shading during seasonal periods of high solar gain (especially on the West wall)
13. Incorrect application of thermal mass to modulate daily temperature variations
14. Open staircases leading to unequal distribution of warm air between upper and lower floors as warm air rises
15. High building surface area to volume - Too many corners
16. Inadequate weatherization leading to high air infiltration
17. Lack of, or incorrectly installed, radiant barriers during the hot season. (See also cool roof and green roof)
18. Insulation materials that are not matched to the main mode of heat transfer (e.g. undesirable convective/conductive/radiant heat transfer)

Key passive solar building design concepts

There are six primary passive solar energy configurations:

1. Direct solar gain
2. Indirect solar gain
3. Isolated solar gain
4. Heat storage
5. Insulation and glazing
6. Passive cooling

CONCLUSIONS:

After completion of its review, Following are the various major finding of the reviews.

1. Based on the design of the houses, it is expected that homes with low and near net-zero energy consumption can be designed in a cost effective manner within a period of about 5 years, provided a heat pump-based system is used for heating and heat is recovered from the PV system and efficiently utilized in the house.

2. We may add passive solar elements like shading devices. Additional elements would keep the interior space at a more comfortable and stable temperature. Similarly, the indoor humidity can be controlled.

3. Heat energy obtained from solar energy is stored by thermal mass floor which is used to maintain comfortable higher temperature inside the room in day time as well as in the night. The low cost materials used for the study in order to focus on low cost construction with comfortable result

4. The energy-efficiency design strategies by passive solar components having the additional cost of about 9% of the total building cost, it is possible to save the total annual energy used in this specific residential building by 18%. 5. Advantages due to passive solar design like Energy performances, investment, attractive living environment, comfort, low maintenance, environmental concern.

6. He compares the different method which we can use in passive solar energy building like direct gain, indirect gain, and isolated gain.

7. It is assumed that the buildings are in the northern hemisphere with most of the solar radiation coming from the south.

8. The orientation, shading device, vegetation, concrete vent blocks, natural ventilation, and material act as effective passive design that plays an important role in achieving thermal comfort. The garden plaza and trees planted around the building acts as filtration to cool the heated air. The uses of concrete vent blocks on parts of the building improve the space quality and enhance the ventilation for user's comfort. The concrete vent block

also act as shading device that allows air to flow in thus making the building naturally ventilated.

9. The present study looks at the relationship between the traditional buildings and sustainable development as well as the climatic conditions and construction patterns in Shiraz, Iran**.**

10. Concept of documenting solar energy distribution through the use of a sun path diagram and the multiple ways in which this can be used for energy efficient buildings and also for evolving passive solutions possible in buildings and also provides an overview of the sun based passive solutions and design approaches possible in the case of buildings especially with reference to tropical countries**.**

11. The height to width ratio of the built mass with each other and other physical features like trees, streets etc. can help not only in desirable thermal indoor conditions but, can also reduce the use of valuable land for other purposes**.**

12. A small set of renewable energy technologies is considered—solar photovoltaic (PV), solar-thermal electric generation, and wind electric power—with the results compared to the standard single-building assumption that PV is used to provide the on-site renewable generation.

13. Solar design days as a useful method for understanding passive solar buildings' dynamic behavior for the purpose of increasing energy performance and gives a background on recent advances in passive solar design, a methodology for selecting and applying solar design days, and a modelling approach for passive solar houses in Energy**.**

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