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# Comparative Study on Passive Solar Building

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**Abstract:** Passive solar design, an idea within the growing trend of green building, is a creative way to use the sun to our advantage, both for heating and cooling, based on the design of buildings. Attempt has been made by engineers by increasing the thickness, changing the geometry of the outer wall and also tried several building materials to reduce temperature fluctuations for indoor environment in both summer and winter. The installation of heating and air conditioning to seek comfort in homes, offices and public places has created high energy consumption and consequently, increased the environmental pollution. 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. In this paper, has been expressed the important factors in solar buildings design. These factors are included external factors and internal factors.

**Keywords:** Solar Energy, Architecture, Optimization, Building.

## I. INTRODUCTION

A solar energy system is a group of interacting pieces designed to collect, store and distribute the solar radiation energy as needed for some specific purpose. The performance of solar energy systems is dependent upon weather.

In a solar heating/ cooling system, for example both the energy collected and the energy demand are functions of solar radiation, the ambient temperature, and meteorological variables. There has been a constant rise in the intensity of energy use reflected in annual per capita energy consumption mainly in the form of electricity.

It is estimated that the residential and service sector, most of which are buildings contribute to more than 40% of energy consumption. Part of the major energy consumption in buildings is the heating, ventilating and air-conditioning (HVAC) system. In order to lessen the burden on the active systems transforming renewable energy into the thermal or electrical energy, a necessary first step is to apply the optimal combination of passive design strategies, foremost among them passive solar design strategies.

## II. AIM OF THIS STUDY

Passive solar design strategies aim to use the solar energy to help to establish the thermal comfort in buildings, without the use of electrical or mechanical equipment. 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. In general, heat storage is avery interesting technique to decrease energy use in the buildings and to reduce the cost of operation of buildings.

## III. LITERATURE REVIEW

### A. Passive Solar Heating or Cooling for Residential Building Using PCM

**(** R.Velraj , G. Daniel)

Man has tried to improve comfort within buildings by improving the thermal inertia and minimize the equivalent thermal conductivity of the envelope of building from time immemorial. Attempt has been made by engineers by increasing the thickness, changing the geometry of the outer wall and also tried several building materials to reduce temperature fluctuations for indoor environment in both summer and winter.

The installation of heating and air conditioning to seek comfort in homes, offices and public places has created high energy consumption and consequently, increased the environmental pollution. The use of passive solar architectural techniques can reduce not only the temperature fluctuations but also can solve the environmental pollution. The use of phase change materials (PCM) in the building along with passive solar techniques is one of the solutions. The integration of a PCM layer into an external building wall diminished the amplitude of the instantaneous heat flux through the wall. In this paper a three-dimensional transient heat transfer model has been developed and solved numerically using the commercial Thermal analysis package ANSYS.

### B. Passive solar building design

(Javad Sadeghsaberi1, Sana Zarei2, Shahab-o-din Hemmati3, Mohsen.Kameli4*)

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

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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 .In this article , has been expressed the important factors in solar buildings design. These factors are included external factors and internal factors. More owner implementation strategies in the design to same energy in buildings also will be presented.

**C.THE FUTURE OF PASSIVE SOLAR DESIGN: (**P. Fisk III)

This paper is organized into two general categories: One, the potentials in physical form of generating relevant climatic solutions by combining passive solar form envelopes; and two, the important overall resource saving features when passive solar is regionally incorporated into other form determinants that derive from regionally understood technologies. The latter has not only lower cost implications, but lower overall embodied energy use, more local job potentials, and potentially higher acceptability by a far wider range of disciplines by virtue of its rich regional derivation.

## IV. CONCLUSIONS LITERATURE REVIEW

1. This paper concentrates on the thermal analysis of walls with and without PCM. The ANSYS analysis of the two wall configurations has been carried out. The simulation results showed that the PCM introduced in rectangular holes can improve considerably the thermal inertia of the building which is very important for improving the heat penetration into the indoor space. Further it is concluded from the numerical analysis that the incorporation of PCM in building elements will reduce the temperature swings.

2. Considerable air ventilation can be generated by solar induced temperature difference if the system is properly designed. The use of solar chimneys in buildings is one way to increment natural ventilation and, as a consequence, to improve indoor air quality. A thermal chimney employs convective currents to draw air out of a building. By creating a warm or hot zone with an exterior exhaust outlet, air can be drawn into the house ventilating the structure. Thermal chimneys can be constructed in a narrow configuration (like a chimney) with an easily heated black metal absorber on the inside behind a glazed front that can reach high temperatures and be insulated from the house. The system may be applied to more than one storey building.

**3.** The five strategies used for passive solar energy, direct gain, thermal storage, solar greenhouses, roof ponds, and convection loops, all have their own advantages and disadvantages as well. The main drawback to implementing these strategies into a building is a need for further planning and specific materials. However, this increased initial cost only increases the long-term savings for a building using passive solar energy. The use of these approaches to passive solar energy requires an evaluation for each building in regards to feasibility and usefulness. They can certainly be useful in many applications, and are worth considering in the planning process. Passive solar energy will continue to grow and change, providing inexpensive, sustainable alternatives for common heating and cooling systems. As technology improves and awareness increases, passive solar energy will become more widely used throughout the country and around the world. It is certainly a viable option for new construction, and will continue to assist in saving energy for many.

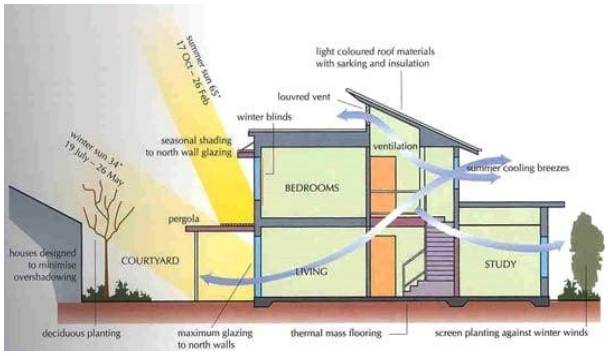
## V. DESCRIPTION

**PASSIVE SOLAR BUILDING:**

Passive solar design refers to the use of 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.

**Concept of Passive Solar Buildings**

The main concept of passive solar buildings is that its building elements i.e. the windows, walls and the floors are made able to collect solar energy and store them. This energy is then used in the winter for warmth and used to reject the heat during the summer seasons.




The buildings convert the solar energy into useful energy without the help of any other mechanical system.

**The passive solar buildings work based on the following principles:**

- The first principle is based on the route of the sun in different seasons. The sun in winter will be traveling in a lower route compared to summer.
- In winter, the south direction faced glass will help in energy absorption and storage in the building.
- The location of thermal mass in a position enabling easy absorption of solar energy later would help in the easy release of the same during evening time.

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- The direct sun can be resisted by overhanging elements as shown in the figure below. These are also called control elements.
- Proper insulation enables warmth in winter and coolness in summer.

**Elements Considered for Passive Solar Building Construction**

**The main elements considered are:**

- Room types, internal doors, walls and furniture in buildings and their placement.
- The Equator faced orientation for the building
- Building dimension extension in east-west direction
- Window size fixed to get adequate solar in winter and shade in summer.
- Windows in the west are avoided.
- Use of thermal mass like floors or walls

**Performance of Passive Solar Building**

The efficiency of passive solar buildings depends upon the following factors:

- The site climatic conditions
- The passive solar building system adopted
- The passive solar building design criteria
- The building size

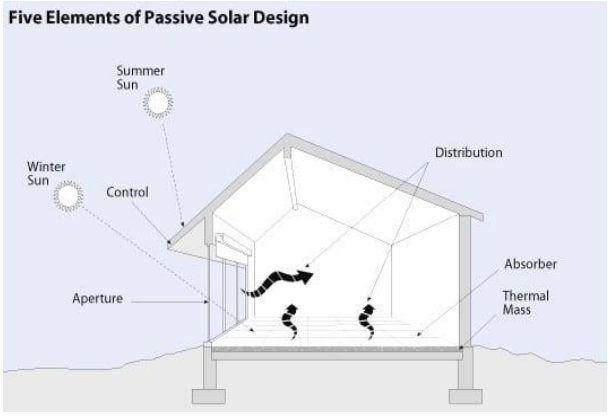


**Fig. Passive Solar Building Elements**

It is found out from the studies that when the passive system and the concept of energy conservation come together appropriately to sink with the climate, the net benefit is tremendous. The net benefit is defined in terms of backup heat reduction compared to a conventional building system.

| Manufacturer | Model | Wattage [Wp] | Efficiency [%] | Price |
|---|---|---|---|---|
| Solar Universe | SUI-250P-60 | 250 | 15.00 | 9,514.00 |
| Solar Universe | SUI-300P-72 | 300 | 15.00 | 10,238.00 |
| Shan Solar | Ruby 60 250 | 250 | 15.00 | 8,790.00 |
| Solar Universe | SUI-250P-60 | 250 | 15.00 | 8,844.00 |
| Solar Universe | SUI-300P-72 | 300 | 15.00 | 10,608.00 |
| Navitas Green Solutions | NS300 | 300 | 16.00 | 10,837.00 |
| Navitas Green Solutions | NS240 | 240 | 15.00 | 8,698.00 |
| PV Power Tech. | ECO 250 | 250 | 15.00 | 9,031.00 |
| Shan Solar | 3PSS60245 | 245 | 15.00 | 8,718.00 |
| Universal Solar Group | USP P6-40/36-G | 40 | | 1,452.00 |

**ADVANTAGES OF PASSIVE SOLAR BUILDING**

The ultraviolet energy is blocked – The direct ultraviolet rays are harmful. The passive solar building system has the advantage of blocking almost 99.9% of the ultraviolet radiation energy. Preventing this would save the interior fabrics as well as decor and make them long lasting. Summer is Made cooler and comfortable – It keeps the interior cool during the hot season. This would obviously reduce cooling energy costs. This would give a low solar gain coefficient value (SHGC). Winter made warmer.

**DISADVANTAGES OF PASSIVE SOLAR BUILDING:**

The result of improper design causes overheating by the sun. This can occur either in summer or in winters.

If the glazing provided in the south is oversized or insufficient or insufficient thermal storage mass for direct gain are the reasons of overheating in winters. A storage size that would limit the temperature within the building to $22^0$C must be adopted.

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## VI. FUTURE TRENDS

The design of passive solar buildings, based on the materials and technologies available today, will remain consistent for the next several decades. The strategies and techniques being used today will be replicated in various ways depending on location and availability to maximize the benefits of passive solar energy. One can assume that when new technologies arrive, the design of passive solar buildings will adapt to incorporate them to maximize their efficiency. However, the specific design for buildings regarding passive solar energy has climaxed for the present time.

The further development of passive solar energy is reliant on new technologies and the development of more appropriate, efficient resources. One of the newest developments that will continue to grow and improve passive solar use involves window glazing. Low-emittance coatings, known as low-E coatings, are metallic oxide films that are installed on windows to reduce from within the building while still allowing solar heat gain. These coatings do not affect the visual aesthetics of the window, yet provide valuable benefits. There are also double-glazed windows filled with argon gas, which provide the same benefits as the coatings on the windows and can be used together to increase efficiency. As these technologies continue to improve, passive solar energy will become more beneficial and effective. It is also important, however, to recognize the role that green building programs will serve in the continuation and expansion of passive solar practices. Certifications and recognition within these programs are available for the buildings being constructed, the professionals who design, build, and remodel those buildings, and the products used for the buildings as well.

## VII. CONCLUSIONS

They can perform effortlessly and quietly without mechanical or electrical assistance. Reductions can be made to heating bills by as much as40% annually, and also improve the comfort of living spaces, Simple techniques can make a huge difference in the comfort and energy consumption through the years, The economical solution to a warmer house in the winter and a cooler house in the summer is to insulate it well, while understanding the movement of heat.it is the better solution.

## REFERENCES

[1] M. Faruqi and P. Ghavami, “SIMULATION ANALYSIS OF PASSIVE SOLAR STRUCTURES USING HEAT TRANSFER EQUATIONS”.
[2] Javad Sadeghsaberi1, “Passive solar building design”.
[3] P. Fisk III Center for Maximum Potential Building Systems, Inc.Austin, Texas 78724, U.S.A.“THE FUTURE OF PASSIVE SOLAR DESIGN”
[4] R. Velraj1 , G. Daniel2“Passive Solar Heating or Cooling for Residential Building Using PCM”.
[5] Bansal N. K., Thomas P. C., “A Simple Procedure for Selection and Sizing of Indirect Passive Solar Heating Systems” Building and Environment Vol. 26, pg. 381-387,1991.