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A REVIEW OF PASSIVE SOLAR ENERGY BUILDING

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Abstract

In India, power generate by many non-renewable and renewable sources. But now days the non-renewable sources are depleting very fast. So in all the other non-renewable sources like hydro, wind, solar the solar is most effective and economical. In this topic we have shown that how the solar energy is useful and economic.Any house hold requirement of power consumption per year-3147.80KWh,per day-8.62 and per hour-0.359KW. We get power 1.78KW per hour using solar panel. Our main aim is to save non-renewable sources and save earth.

***Keywords** – solar water heater, Tank temperature sensor, collector temperature sensor, Heat exchanger, collector and tank pumps.*

I. INTRODUCTION

Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces, and heating of water. Passive solar in ancient history

Socrates noted “In houses that look toward the south, the sun penetrates the portico in winter.”

Greek playwright Aeschylus stated only primitives and barbarians "lacked knowledge of houses turned to face the winter sun”.

In passive building designs, the passive system is integrated into the building elements and materials. It should be understood that passive architectural design does not necessarily mean the elimination of standard mechanical systems. In recent designs however, passive systems coupled with high efficiency back-up systems greatly reduce the size of the traditional heating or cooling systems and reduce the amount of non-renewable fuels needed to maintain comfortable indoor temperatures.

There are mainly two types of solar energy:

1. Active Solar Energy
2. Passive Solar Energy

We are discuss about the passive solar energy further topics.

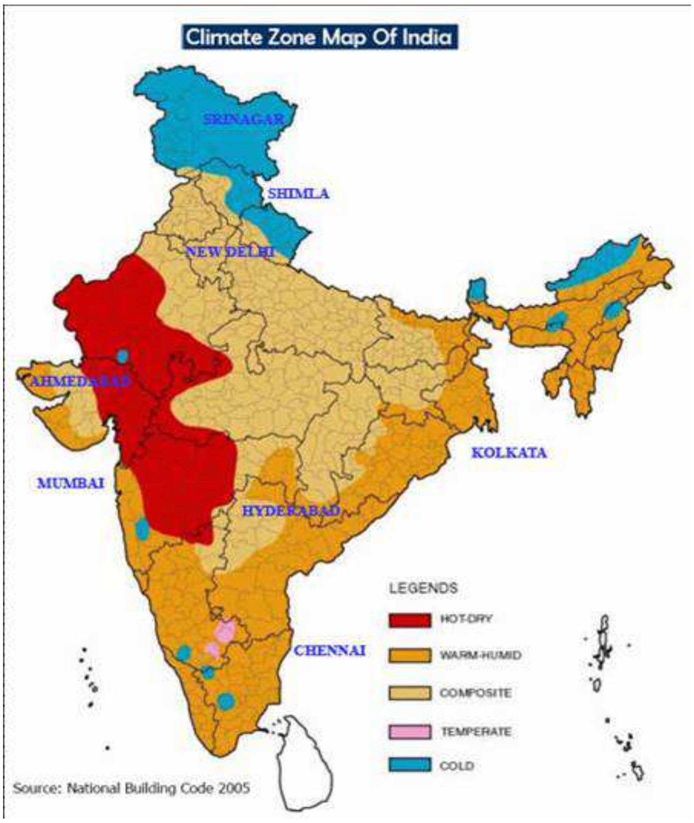
II. CLIMATIC CONDITIONS

2.1 Climate Zones in India

Passive designs need to be considered in the context of five distinct climatic zones that are identified and used as reference by the National Building Code (NBC) and the Energy. Conservation Building Code (ECBC 2007).These are as below –

1. Hot and Dry – e.g. Ahmedabad, Jaipur
2. Warm and Humid – e.g. Mumbai, Chennai
3. Cold (Including Cold and sunny and Cold and Dry) – e.g. Shimla, Leh
4. Composite – e.g. Delhi
5. Moderate/Temperate – e.g. Bangalore

“Figure 1 CLIMATIC CONDITION IN INDIA”



2.2 Positioning of Panels

The direction and angle that the panel faces can have a big impact on its performance by affecting the amount of light that hits the panel each day through the year. Some solar panels move continuously to track the sun but most will not go to the expense and difficulty of implementing that. To get it right we have to make sure that the panels get hit by the maximum amount of light. This happens when the sun is directly above the panel. As you can see from above, the angle that the sun hits a panel changes the amount of exposure.

At 30 degrees from the panel, the panel is only exposed to 50% of the light of the sun, at 60 degrees, 87% and at 90 degrees, 100%. This happens because the sun emits the same number of photons in a square cm, but once we put our

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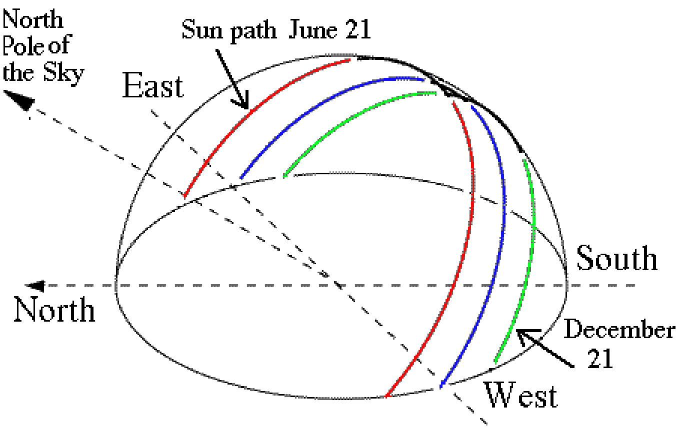
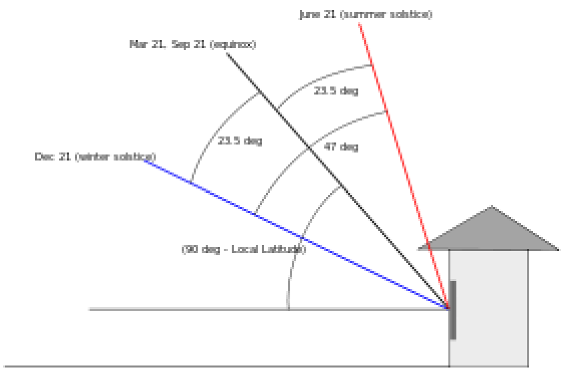
panels on an angle, those photons are spread across a larger area.

FIGURE 2: "DETERMINING SUN ANGLES"

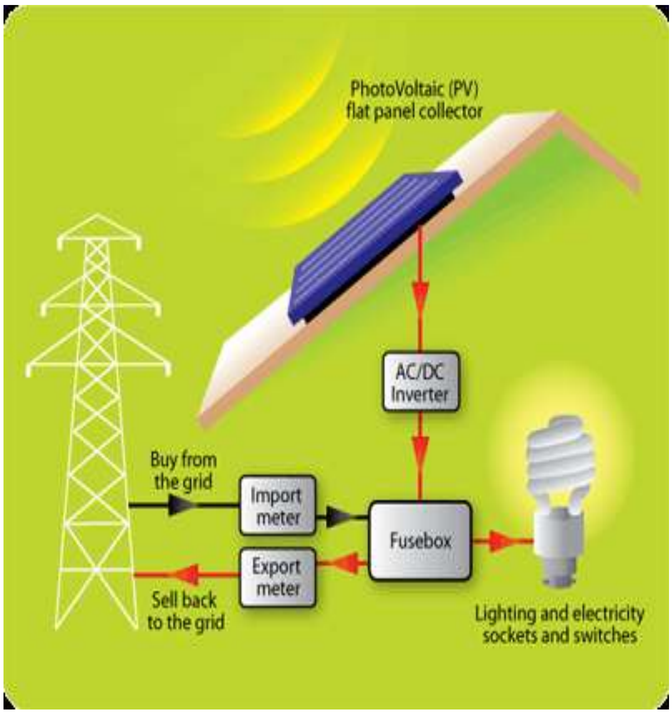


"Figure 3 POSITIONS OF SUN"



III. An Introduction to Passive Solar Energy

"Figure 4 Passive Solar Energy Diagram"



This is an introduction to the passive solar technology that may be used to heat buildings. It is not about active technologies. Usually an optimal solution for a specific building and locale involves passive technology supplemented by active technologies. Active technologies are not part of this course. Utilization of passive solar energy to heat buildings is fundamentally an exercise requiring an understanding of (a) the fact that heat is transferred from outside to inside a building by conduction, convection and radiation, and (b) the concept of heat sinks as a reservoir for heat storage.

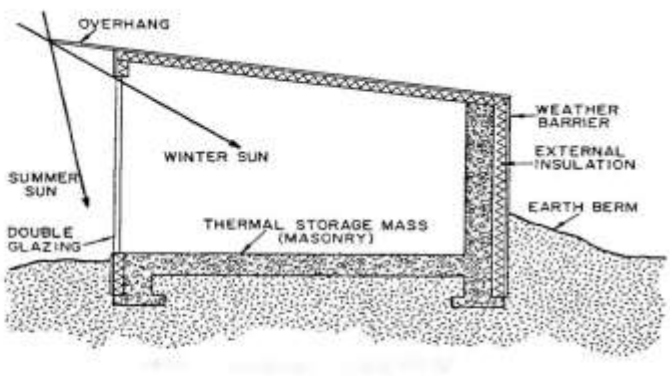
Procedures for design of buildings to passively use solar energy for heating buildings may typically involve (a) use of shading devices to reduce heating by radiant (solar) energy in the summer and allow it in winter, (b) utilize thermal convection (i.e. hot air rises) to maximize heating by convection in winter, and (c) utilize thermal storage (mass-effect) to transfer excess heating capacity from daylight to nighttime hours. This is an introductory course intended to tell you about basic systems and climate considerations underlying the passive utilization of solar energy to heat buildings. It is not intended to be a definitive design manual that can be used for feasibility studies, design analyses and building design.

3.1 Types of Passive System

3.1.1 Direct Gain Heating

Direct gain buildings are passive solar heating systems in which sunlight is introduced directly to the living space through windows or other glazed apertures as indicated schematically in Figure 1. As with all passive solar systems, it is important that the apertures face south or near south in order to achieve high solar gains during the winter heating season and low solar gains during the summer cooling season. In climates having particularly warm and sunny summers, an overhang may not be sufficient to prevent significant aggravation of the summer cooling load. Sky diffuse and ground reflected radiation enter the living space despite the presence of an overhang and must be blocked by external covers or internal shades. Using movable insulation on direct gain apertures has the advantage of reducing night time heat losses during the winter-as well as eliminating unwanted solar gains during the summer.

"FIGURE 5 DIRECT GAIN HEATING SYSTEM"



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Direct gain buildings involve less departure from conventional construction than other types of passive solar systems and are therefore cheaper and more readily accepted by most occupants. However, they are subject to overheating, glare, and fabric degradation if not carefully designed; these problems can be minimized by distributing the sunlight admitted to the building as uniformly as possible through appropriate window placement and the use of diffusive blinds or glazing materials. When properly designed for their location, direct gain buildings provide an effective means of reducing energy consumption for space heating without sacrifice of comfort or aesthetic values.

3.1.2 Daylighting

The daylight delivered to the interior of direct gain buildings is an additional resource that is available year-round. Pleasing uniform illumination can be achieved by using blinds that reflect sunlight toward white diffusive ceilings. The artificial lighting system in many buildings imposes a significant load on the cooling system that may be reduced by daylighting because the fraction of visible light in the solar spectrum is greater than the visible fraction of incandescent or fluorescent lighting.

3.1.3 Radiant Panels

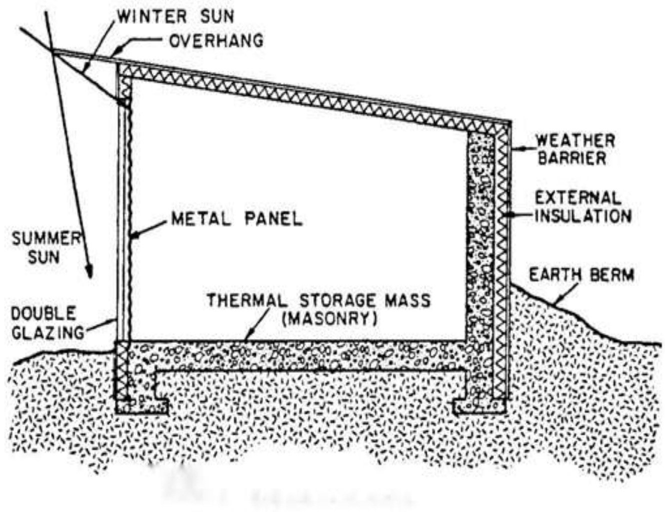

FIGURE 6: RADIANT PANEL SYSTEM

Radiant panels are simple passive solar systems that are inexpensive and well suited as retrofits to metal buildings. A sketch of a radiant panel system is presented in Figure 2. Note that the solar aperture consists of one or more layers of glazing material placed over an un insulated metal panel. The metal panel would ordinarily be a part of the building shell so that a retrofit is constructed by simply glazing an appropriate area on the south side of the structure.

Solar radiation is absorbed on the outer surface of the metal panel after passing through the glazing. The panel becomes hot and gives up heat to the interior by radiation and convection. Thermal mass must be included inside the building shell as with direct gain systems. Usually, only a concrete slab will be available before retrofitting a metal building and it may sometimes be necessary to add water containers to achieve the desired thermal capacitance. Radiant panels perform on a par with direct gain buildings and are likely to be less expensive when used as retrofits to metal buildings.

3.1.4 Trombe Wall

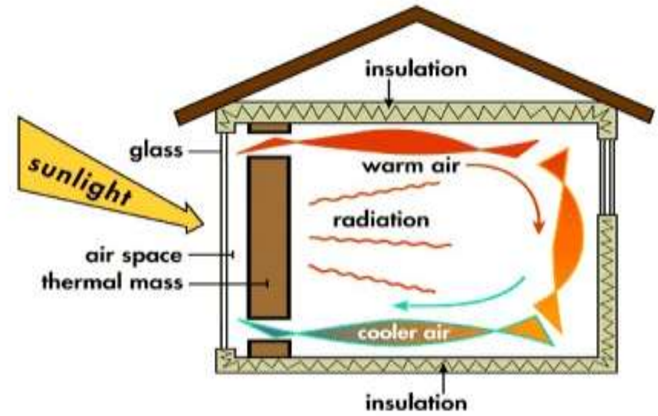

FIGURE 7: TROMBE WALL

A Trombe wall is a thermal storage wall that employs solid, high density masonry as the primary thermal storage medium. Appropriate thicknesses range from 6 to 18 inches depending on the solar availability at the building site. Sunny climates require relatively thicker walls due to the increased thermal storage requirements. The wall may be vented or unvented. A vented wall is slightly more efficient and provides a quicker warm up in the morning but may overheat buildings containing little secondary thermal storage mass in the living space.

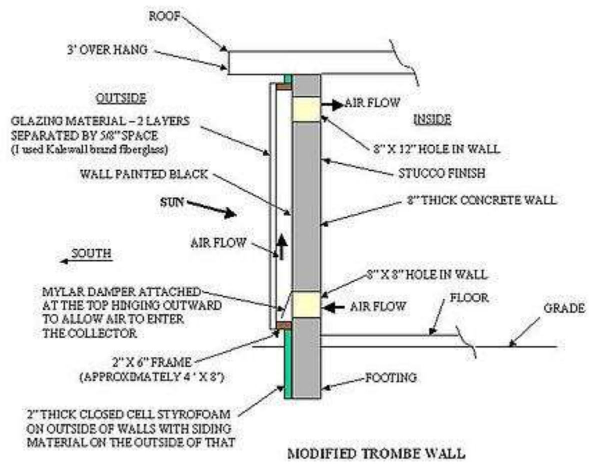

FIGURE 8 MODIFIED TROMBE WALL

3.1.5 Concrete Block Wall:

Ordinarily, a thermal storage wall would not be constructed of concrete building blocks, because solid masonry walls have a higher heat capacity and yield better performance. However, where concrete block buildings are very common they may offer opportunities for passive solar retrofits. Concrete block thermal storage walls may also be introduced during the construction of new buildings. For new construction, however, it is advisable to take advantage of the superior performance of solid masonry walls by filling the cores of the block in the thermal storage wall with mortar as it is erected. This process is inexpensive and the resulting performance increment covers the increased cost. The design procedures developed herein are applicable to 8-

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inch concrete block thermal storage walls with filled or unfilled cores.

IV. VARIOUS TECHNOLOGIES OF PASSIVE SOLAR BUILDINGS

4.1 Passive Solar Technology

Passive solar energy technologies absorb solar energy, store and distribute it in a natural manner (e.g., natural ventilation), without using mechanical elements (e.g., fans). The term 'passive solar building' is a qualitative term describing a building that makes significant use of solar gain to reduce heating energy consumption based on the natural energy flows of radiation, conduction and convection. The term 'passive building' is often employed to emphasize use of passive energy flows in both heating and cooling, including redistribution of absorbed direct solar gains and night cooling. Day lighting technologies are primarily passive, including windows, skylights and shading and reflecting devices. A worldwide trend, particularly in technologically advanced regions, is for an increased mix of passive and active systems, such as a forced-air system that redistributes passive solar gains in a solar house or automatically controlled shades that optimize daylight utilization in an office building.

The basic elements of passive solar design are windows, conservatories and other glazed spaces (for solar gain and daylighting), thermal mass, protection elements, and reflectors. With the combination of these basic elements, different systems are obtained: direct-gain systems (e.g., the use of windows in combination with walls able to store energy, solar chimneys, and wind catchers), indirect-gain systems (e.g., Trombe walls), mixed-gain systems (a combination of direct-gain and indirect-gain systems, such as conservatories, sunspaces and greenhouses), and isolated-gain systems.

V. COMPONENTS OF TECHNOLOGIES

5.1 Solar Photovoltaic

Solar photovoltaic (SPV) is the process of converting solar radiation (sunlight) into electricity using a device called solar cell. A solar cell is a semi-conducting device made of silicon or other materials, which, when exposed to sunlight, generates electricity. The magnitude of the electric current generated depends on the intensity of the solar radiation, exposed area of the solar cell, the type of material used in fabricating the solar cell, and ambient temperature. Solar cells are connected in series and parallel combinations to form modules that provide the required power.

5.2 Standards for SPV Technology

Photovoltaic standards in India have been established by the Bureau of Indian Standards (BIS). So far, there are eight standards prescribed by the BIS for SPV. These standards mainly relate to the areas listed below:

Measurements of cells and modules
Methods of correcting the measurements
Qualification test procedure for crystalline silicon modules
General description of SPV power generating systems

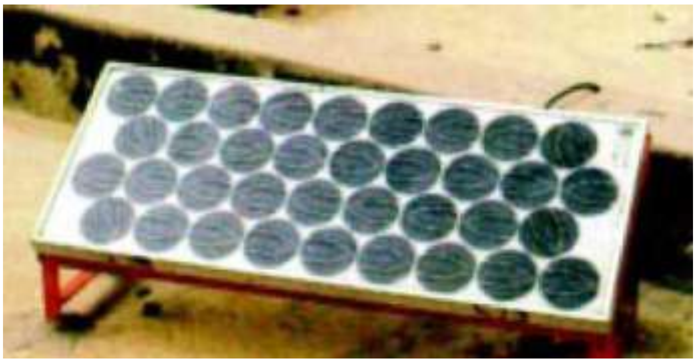
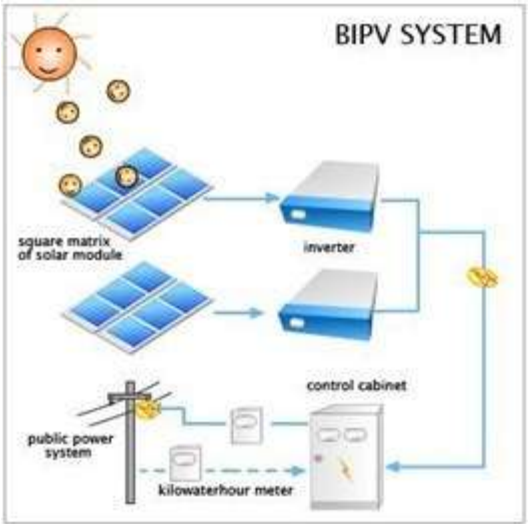


FIGURE 9 PHOTOVOLTAIC CELL

Standards are under preparation for BoS components such as batteries, inverters, and charge controllers. These standards are based mainly on the corresponding International Electro technical Commission (IEC) or European standards.

VI. BIPV-BUILDING INTIGRATED PHOTOVOLTAIC SYSTEMS

FIGURE 10 BIPV DIAGRAM



"BIPV refers to photovoltaic systems integrated with an object's building phase. It means that they are built /constructed along with an object. They are also planned together with the object. Yet, they could be built later on. Due to specific task, cooperation of many different experts, such as architects, civil engineers and PV system designers, is necessary. "From the expert's view "Building Integrated Photovoltaic (BIPV) refers to the architectural, structural and aesthetic integration of photovoltaic (PV) materials into buildings. They form part of the building exterior such as the roof, façade or skylight." They are usually used for off grid micro-generation for buildings, although on-grid applications can also be found. The above definition gives a fair idea about BIPV stating that it's an integration to the building but it's not simply the similar kind of integration just because of the orientation of the sun which is the ultimate focus of the whole BIPV system, thus it is necessary to place the components of BIPV system keeping in mind the peak intensity of the solar radiation.

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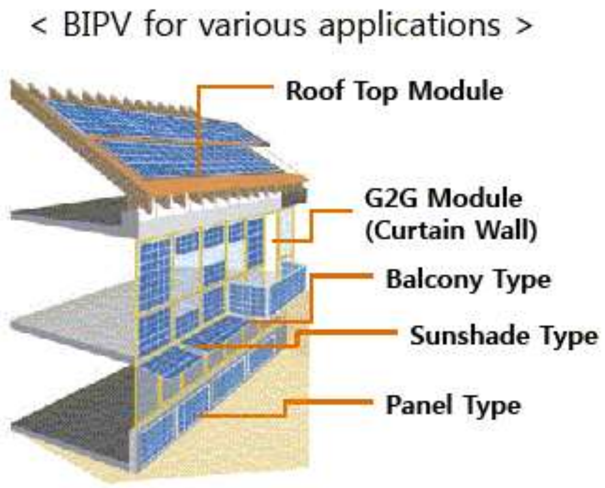
FIGURE 11 BIPV-Building Integrated Photovoltaic System



There are various types of BIPV system:
We have classified BIPV into the following four types:
1. Roof integrated systems
2. Facade integrated systems
3. Retrofit roof or facade systems
4. PV used as a shading system – either built with the building or retrofit.

6.1 Roof integrated systems:

The roof integrated BIPV system which is the integration of the panels into the roof of the building serves two purposes, first as a roof and secondly as an electricity generator. It replaces the conventional roof while allowing the natural sunlight to filter through.

6.2 Facade mounting:

The word façade comes from the French language, literally meaning "frontage" or "face". A façade is generally one side of the exterior of a building, especially the front, but also sometimes the sides and rear.

VII. ADVANTAGES OF PASSIVE SOLAR ENERGY SYSTEM

i. Environmental friendly
ii. Saves money
iii. Independent/ semi-independent
iv. Low/ no maintenance
v. Environmental Impacts
vi. Social Impacts
vii. Cost Trends

CONCLUSION

This brief discussion has been intended to introduce you to basic types of passive systems that may be used to heat buildings and thereby conserve energy, the roles of climate and solar availability in determining the feasibility of passive solar systems, and some guidelines that may be useful in undertaking feasibility studies and preliminary designs. This will give you a foundation for learning about and utilizing more technically rigorous methods that are available in the engineering literature.

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