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Solar House

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Abstract: In this high energy crisis age there is need to develop such a building mechanism such that maximum solar energy can be used to power the building which will be eco-friendly and cost effective. Solar energy is the most easily available and most eco friendly source of energy. For past three decades, tapping the energy from the sun has been considered as great potential resource to meet the future demand of energy but large scale utilization has faced many bottlenecks such as cost of technology, energy storage, distribution of solar power and daily/seasonal variation of solar resource. This paper presents an analysis of the state-of-art technology for a solar photovoltaic distributed energy source appliance for domestic residential buildings. It suggests ways to incorporate solar design into multi-unit residential buildings, and provides calculations and examples to show how early design decisions can increase the useable solar energy. Photovoltaic is a solar power technology that uses solar cells or solar photovoltaic arrays to convert light directly into electricity with no emission of dangerous gases and with least amount of industrials waste. Solar cells are a key technology in the drive towards cleaner energy production. Unfortunately, solar technology is not yet economically competitive and the cost of solar cells needs to be brought down. Growth of the photovoltaic (PV) market is still constrained by high initial capital costs of PV. One way to overcome this problem is to reduce the amount of expensive semiconductor material used. The success of implementation of photovoltaic (PV) power project is increased when PV module system is integrated with building design process and is used as multi purpose appliance for use with building elements. The improvement in overall system efficiency of building integrated PV modules embedded in building façade is achieved by minimizing and capturing energy losses. A novel solar energy utilisation technology for generation of electric and thermal power is presented by integration of ventilation and solar photovoltaic device with the heating, ventilating and air conditioning (HVAC) system.

Keywords*:* Renewable energy, Solar Photovoltaic cell, semiconductor material, solar tracking

I. INTRODUCTION

In this age of energy crisis there is a need of using renewable source of energy. With increase in cost of fuel and electricity and increased greenhouse gas productions, there is a rise in activity trend towards use of solar energy utilization technologies for energy and environment conservation. Sun is the main source of energy available on the earth (Fig.1). A virtually infinite amount of energy from the sun arrives on the earth each year but we use only a fraction of it. So there is need to appreciate the use of solar energy.

There are so many ways of using solar energy but the most useful way is to use it as electricity with the help of solar panel. There is need to design an ideal solar powered building which can use solar energy effectively. Day by day as technology improves, prices of pv cell decreases. There are two types of solar energy technologies; photovoltaic and thermal. Photovoltaic systems convert the sun's energy into electricity through the use of photovoltaic (PV) cells, typically composed of crystalline silicon, which are connected together into panels and mounted on a frame. Electricity generated from the cells are normally passed through an inverter which converts the direct current (DC) produced by the panels into alternating current (AC). That current is then consumed, stored, or routed into the grid system. In solar thermal systems, one or more solar collectors or panels heat water, air, or antifreeze. The solar heated air or liquid is then transferred into rooms or water supply. [1] This paper presents an analysis of the state-of-art technology for a solar photovoltaic distributed energy source appliance for domestic residential buildings. It suggests ways to incorporate solar design into multi-unit residential buildings, and provides calculations and examples to show how early design decisions can increase the useable solar energy.

II. THERMAL.

From the ancient time solar energy is being used in the form of direct heating house, cloth, and in so many manufacturing processes. By designing the building in a certain way solar thermal energy can be used for domestic purposes. Solar buildings work on three principles: collection, storage and distribution of the solar energy.

2.1 Passive solar building.

In this system solar energy is used for heating and cooling our building using natural energy flow through air and material like as radiation, conduction, absorption, convection, etc. In this system mechanical device is not used.

2.1.1 Thermal mass.

In the simplest way thermal mass is used which absorbs heat of solar radiation coming through the window and releases heat during night. An ideal thermal mass posses high heat capacity, moderate conductance, moderate density and high emissivity. Passive solar design in single-family residences shows that operational energy can be reduced by 30 to 50 per cent through window sizing and thermal mass storage [2].

2.1.2 Window designing.

The object is to design window in such a manner such that maximum heat can enter inside the room. By applying glazing mechanism to the window, the efficiency of heating effect is improved [3]. The Solar Heat Gain Coefficient (SHGC) is a useful measure of a window's ability to admit solar energy. SHGC is the amount of solar gain a window allows; divided by the amount of solar energy available at its outside surface, higher the SHGC better will be window's performance as solar collect. A recent glazing development is switchable glazing. These can vary their optical or solar properties according to light (photo chromic), heat (thermo chromic) or electric current (electro chromic). Visible light transmittance (VT) measures the visible spectrum admitted by a window (Fig.2). Typical daylight strategies require windows with a high VT. A low SGHC is also desirable where heat gain is a concern. Reflective glass is not recommended for day lighting. Window orientation should be in such a way so that maximum time sun light should fall perpendicular to the window. Spacers separate panes of glass in a sealed window to prevent the transfer of air and moisture in and out of the glass cavity. The low cost and good performance of warm-edge spacers make them suitable for all window systems and should be considered mandatory whenever lower coatings and inert gas fills are used [4].

2.2 Passive solar cooling.

Harnessing the stack effect, that is the upward movement of warmer, more buoyant air, is possible if a building is designed to capture solar heat and exhaust it at roof level. This warm air can be released to the outside, drawing cooler ground-level air into and up through the building. An atrium can act as a solar chimney which helps prolong the chimney effect well into the night to draw cool air into the building. In Europe, cool night air is passed (using fans) through hollow core floors to store coolness. During the day, room air is re circulated through the cool floor to provide free cooling

2.3 Active solar building.

In active application of solar energy, solar heat is used by using mechanical devices for the flow of energy for cooling or heating purposes.

2.3.1 Solar domestic hot water system.

This system consists of traditional hot water heating. In this system a glazed, flat plate collector in a closed glycol loop is used (Fig.3). A heat exchanger transfers the energy from the glycol to one or more solar storage tanks. These are usually connected in series to the hot water system. The traditional water heater comes on to keep the water at the required temperature if the solar heat is not enough. The hot water obtained is supplied to swimming pool or for other domestic purposes

2.3.2 Solar ventilation air heater.

This system provides the simplest and usually least costly way to bring solar heated fresh ventilation air into a building. It uses mainly off-the-shelf components in its design. Its major disadvantage is that it will reduce cost effectiveness of the building's ventilation heat recovery unit. Solar air pre-heat system concept wall is clad with dark metal panels, typically steel or aluminum, perforated with small holes (Fig.5). A gap is left between the cladding and the wall so that outside air passes through the holes in the collector panel.

3.1 Working of solar cell.

Photovoltaic effect converts solar energy directly into electricity. When sunlight strikes a photovoltaic cell, electrons in a semiconductor material are freed from their atomic orbits and flow in a single direction . This creates direct current electricity, which can be used directly as dc current or converted to alternating current (ac) or stored in a battery.

When ever sunlight arrives at its surface, the cell generates electricity. PV cells normally have a lifespan of at least 20-25 years. However, they usually last longer if frequent overheating temperatures in excess of 70º C are prevented. Main barrier behind the less use of pv cells is its high cost but as the technology is developing the price of pv cell is reducing. There are three types of solar pv cells available in market (Fig.12). (a) Mono crystalline silicon PV (b) Poly crystalline silicon PV (c) Thin film amorphous silicon PV.

3.2 Energy path.

Sun--solar panel--battery--inverter—load Energy coming from the sun in the form of radiation falls on the solar panel where it is converted into dc current. This dc current electricity is then stored in a battery. With the help of an inverter the d.c. current from the battery is converted into a.c. current and is used for the requirements of building inmates

3.3 Photo-Voltaic Principles.

Solar voltaic cell directly converts solar radiation into electric energy. It works on the principal that when solar radiation in the form of photons incident on the semiconductor material then they create free electron and thus due to these free electron an electric field is induced. The photo voltaic effect can be described easily for a p-n junction in a semiconductor. When the photons are absorbed on this semiconductor the free electrons of nside tend to flow to the p-side and the holes of p-side tend to flow to the n-side to compensate their respective deficiencies. This diffusion creates an electric field from n-region to p-region. If electrical contacts are made with two semiconductor material and the contacts are connected through an external electrical conductor then the free electron flow from n-type material through the conductor to the p-type material. The flow of electrons through the external conductor constitutes an electric current which continues as long as free electrons and holes are being formed by the solar radiation.

3.4 Power output and Conversion efficiency.

A solar cell usually uses a p-n junction. All the solar radiation energy falling on the solar cell can't be converted into electrical energy. Weak, low frequency photon does not possess sufficient energy to dislodge electrons. Strong, high frequency photons are too energetic and although they dislodge electrons, some of their energy is left over unused. Thus only about 45% of the energy in the solar radiation available at sea level is capable to produce electrons and holes in the Silicon. However, because of the electrical resistance of the semiconductor material, i.e. electrical losses and

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other losses such as some part of the solar energy is reflected back to the sky, absorbed by non photo-voltaic surface. So the actual efficiency is much lower. The best singlecrystal cell yields the efficiencies of 16% to 17%. Mass produced modules yield efficiencies seldom exceeding 10%. Efficiency of solar pannel also decreases as temperature increases for example for a commercial it is about 8% at 100 degree Celsius. Cells made of GaAs are superior to silicon cell for operation at elevated temperature.

IV. CONCLUSION.

1. The installation cost is high but it make us self dependent for energy requirement and it is also the best greener energy available on earth so there is need to develop solar powered buildings.
2. The market for technologies to harness solar energy has seen dramatic expansion over the past decade – in particular the expansion of the market for grid-connected distributed PV systems and solar hot water systems has been remarkable.
3. Energy plays the most dominant role in the economic growth and security of any nation. Future economic growth crucially depends on the long-term availability of energy from sources that are affordable, accessible and environmentally friendly.
4. An increase in development activities triggers the increasing demand for energy. India is a growing giant facing the critical challenge of meeting a rapidly increasing demand for energy.
5. With over a billion people, one sixth of the world's population, India ranks sixth in the world in terms of total energy consumption and needs to accelerate the development of the sector to meet its growth aspirations.

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