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1.1 The Sun

The sun is the closest star to the earth, and it is possible to understand how such an enormous sphere of gases, mainly hydrogen and helium at very high temperatures; inside, reaches temperatures up to 40 million Kelvin degrees, and on their surface reach 6000 Kelvin degrees approximately. The origin of the enormous radiant amount of energy that comes from the sun are the thermonuclear processes that happen inside, nuclear fusion processes where hydrogen, as basic fuel is transformed in helium and in this process gigantic quantities of radiant energy are generated. The sun has a diameter of 1.39×10^9 m and is located at 1.49 x 10 11 m from the earth, the earth has a diameter of 6.37×10^6 m.

1.2 Solar Energy

As it is known, solar energy coming to the earth comes from the sun. Solar energy is free and inexhaustible. It supports all life on earth and it is the basis for almost every form of energy we use. The amount of energy from the sun that falls on the earth is enormous. All the energy stored in the earth's reserves of coal, oil, and natural gas is matched by the energy from 20 days of sunshine. Outside the earth's atmosphere, the sun's energy contains about 1,300 watts per square meter. About one-third of this light is reflected back into space, and some is absorbed by the atmosphere (in part causing winds to blow).

By the time it reaches the earth's surface, the energy in sunlight has fallen to about 1,000 watts per square meter, at noon on a cloudless day. Averaged over the entire surface of the earth, 24 hours per day for a year, each square meter collects about the energy equivalent of a barrel of oil. So each day, on average, a square meter collects 4.2 kilowatt-hours of energy. This figure varies by location and by weather patterns. Deserts, with very dry air and little cloud cover, receive the most sun, more than 6.0 kilowatt-hours per day per square meter.

Solar Energy has been and is the most important energy source in the earth, it has allowed the evolving and evolution of life on it. For the human being, solar energy, has played an essential roll.

2 Use of solar energy in Building Planning and Design

Buildings designed for passive solar and day-lighting use features such as large south-facing windows and materials that absorb and slowly release the sun's heat. No mechanical means are employed in passive solar heating. Passive solar designs can reduce heating bills as much as 50 percent. These solar designs can also include natural ventilation for cooling.

2.1 Passive Solar Design

Passive solar designs are simple and of greater reliability, lower costs, and longer system life times. Passive solar heating and cooling of buildings seem to be cost effective, when appropriate techniques suited to the regional and micro climate of the place and site are chosen. Climate conscious and energy efficient designs should supplement the passive solar designs. Passive systems when effectively designed, would perform effortlessly and quietly, without mechanical and electrical assistance. They do not require special construction skills and much can be accomplished using locally available common building and insulating material. The additional financial investment may range from nil to 10 percent. Passive solar systems save fuel bills for the house owner and the nation.

Passive solar design uses sunshine to heat and light homes. It is usually part of the design of the building itself, using certain materials and placement of windows or skylights. A successful passive solar building needs to be very well insulated in order to make best use of the sun's energy. The result is a quiet and comfortable space, free of drafts and cold spots. Passive solar design can also achieve summer cooling and ventilating by making use of convective air currents which are created by the natural tendency of hot air to rise.

In the winter when heating is required, the sun is low in the sky, which allows the heat to penetrate into windows on the south face of a structure. In the summer, south-facing windows can be shaded by an overhanging roof or awning to keep out the high hot summer sun. Because much of a building's heat is lost through its windows, the majority of windows in a passive solar building are located on the south wall.

2.1.1 Orientation

In order for passive solar systems to work effectively, care must be take to ensure that the building is oriented to take advantage of year-round energy savings. The ideal orientation for solar glazing is within 5 degrees of true south. This orientation will provide maximum performance. Glazing oriented to within 15 degrees of true south will perform almost as well, and orientations up to 30 degrees off—although less effective—will still provide a substantial level of solar contribution. The warmer the climate, the more east and west-facing glass will tend to cause overheating problems. In general, southeast orientations present less of a problem than southwest. In the ideal situation, the house should be oriented east-west and so have its longest wall facing south. But as a practical matter, if the house's short side has good southern exposure it will usually accommodate sufficient glazing for an effective passive solar system, provided that the heat can be transferred to the northern zones of the house.

2.1.2 Direct Gain

The most common passive solar system is called direct gain**.** Direct gain refers to the sunlight that enters a building through windows, warming the interior space. During the sunlight hours, this heat can be stored in thermal mass incorporated into floors or interior walls made of adobe, brick, concrete, stone, or water. The heat held by the thermal mass will continue to radiate into the space after the sun goes down. Designing a direct gain system includes calculating how much window area and how much thermal mass are required to provide the desired quantity of heat for the space. In general, total direct gain glass area should be at least 7 percent, but not exceed 12 percent of the house's floor area. Night insulation, such as window shades, quilts or insulating drapes, improves energy efficiency dramatically.

2.1.3 Solar Control

To minimize the exposure of wall and window areas of the building, to the direct solar radiation by shading them is the basic approach of solar control. By treating the exposed wall and roof surfaces with white, off white, or light colour surface finishes, as much as 60 to 70 percent of solar energy can be rejected. . However shading of. windows is far more important as unshaded. clear window glasses, when exposed to direct solar radiation, transmit more than 85 percent. Once the sunlight hits the window glass, half the cooling battle is lost. South facing windows admit less sun in summer than in winter and it is also easy to shade them with overhangs. East and west window glasses are difficult to shade with overhangs alone. Vertical fins are the best means of shading such glasses. We all know that the sun path varies during the day from season to season and from place to place.

Fortunately solar geometry is well established. Once the latitude of a place is known, the sun angles with respect to horizontal, vertical and sloping surfaces or any orientation can be calculated or graphically determined with solar chart and shadow angle protractor, for any hour of the day and any day of the year. Shading effects of trees and adjacent buildings can also be determined by solar geometry. Operable internal shades, shutters, and curtains and the use of special glasses such as heat reflecting, heat absorbing and low emissivity types would provide some solar control but. reduce daylight day time heat gain control and also promoting night heat losses,

2.1.4 Daylighting

Daylighting, the use of natural light (indirect sunlight) to illuminate building interiors, is a well-known strategy for shaving a building's electric load at peak demand periods. Daylighting can cut peak loads by as much as two-thirds in new construction and nearly half in major retrofit projects. Daylighting is not only the coolest source of light available to building designers, but potentially the least expensive as well. As energy consumption in commercial buildings is dominated by the need to light and cool interior spaces, reducing the amount of heat-producing electric lighting per square foot reduces cooling loads as well. Architects are becoming increasingly aware that buildings with properly controlled natural lighting are more pleasant spaces to work or learn than conventional buildings.

2.1.5 South Facing Glass

South facing glass, also called glazing, is a key component of any passive solar system in the northern hemisphere. The system must include enough solar glazing for good performance in winter, but not so much that cooling performance in summer will be compromised. When the solar glazing is tilted, its winter effectiveness as a solar collector increases. However, tilted glazing can cause serious overheating in the summer if it is not shaded very carefully. Ordinary vertical glazing is easier to shade, less likely to overheat, less susceptible to damage and leaking, and so is almost always a better year-round solution. Even in the winter, with the sun low in the sky and reflecting off snow cover, vertical glazing can often offer energy performance just as effective as tilted.

2.1.6 Thermal Mass

Almost all passive solar systems work in conjunction with thermal mass, or materials with a high capacity for absorbing and storing heat (e.g., brick, concrete masonry, concrete slab, tile, adobe, water). Thermal mass can be incorporated into a building design as floors and interior walls. The sun does not need to hit these surfaces directly to store the heat, nor do these surfaces necessarily need to be a dark color. The thermal storage capabilities of a given material depend on the material's thermal conductivity, specific heat and density. Conductivity tends to increase with increasing density; generally, the higher the density of the material, the better.

Effective materials for floors include painted, colored or acid-etched concrete, brick, quarry tile, and dark ceramic tile. When more mass is required, interior walls or interior masonry fireplaces can be incorporated into the design. Mass walls serve the dual functions of serving as structural elements or fire protection as well as for thermal storage. From an energy standpoint, it would be difficult to add too much thermal mass in a house. But thermal mass has a cost, and so adding too much mass just for thermal storage purposes can be unnecessarily expensive. As with all aspects of solar design planning, it is necessary to achieve a workable balance.

2.2 Advantages to Solar Heating/Cooling

- High Reliability
- Low Operating Costs – Sunlight produces the energy, so the fuel is free.
- Once installed, can operate continuously with little upkeep & minimal costs.
- Environmental Benefits -Clean and Silent
- Modularity -Can be constructed to any size based energy requirements.
- Low Construction Costs

Disadvantages to Solar Heating/Cooling

- High Capital Cost Large investments have to be made in buying the equipment. It is estimated that the cost for this kind of electricity @ least doubles the cost of conventional electricity.
- Power to be used 24 hours a day (or at night) would require a storage battery – more investment
- Air pollution and Weather Dependent. Dependency on weather and pollution reduces the productivity of the power plants.

2.3 Old Solar Cooling Technique

There was a technique used or invented by the Romans a long time ago. A natural form of air conditioning / ventilation was used roughly as follows:

- A trench 6 to 12 feet deep and 100 to 200 yards long was dug leading from the "house" in a straight line away from the house.
- Into this trench a large diameter pipe (these days corrugated drainage pipe 2 or 3 feet diameter) was laid, with holes drilled into the bottom to drain water that condensed inside the pipe. The trench was then covered over.
- At the far end a 90 degree elbow was attached and more pipe added so that it reached above ground and the end covered with some sort of wire mesh attached to keep out unwanted things such as rodents, etc., and then another elbow could be added at this end to shield against rain.
- The house end of the pipe entered the house and was the source of incoming air.
- The key to making this work is to add a convection chimney.

- The Convection chimney is built such that it's inside opening is at a high point inside the building.
- On the outside, two intersecting sides of the chimney; are painted flat black, and the resulting V formed by the two connecting sides face south. In other words, the V needs to face the mid point between where the sun rises and sets.

The two other sides must be transparent, Plexiglas or some equivalent. Also, the higher/larger the chimney, the better. How it works: the sun heats up the chimney causing the air inside to rise, thus drawing air through the cool pipe. The pipe cools the air drawn from the outside to the temperature of the earth at the depth at which it is buried (which is virtually constant year around at this depth). By the way, an interesting note: Even in cold climates where the ground is frozen, the incoming air is only 32F when the air outside may be much colder, we need only heat the air by 38F to bring it to 70F; as opposed to heating outside air of say -15F to 70F we would have to heat the incoming air by 85F - quite a difference in the amount of heating energy we would have to supply by some other means.

In most cases, a moisture absorbing material called a desiccant is used to lower the humidity in the air stream to the point that an evaporative cooler can then cool the air. High temperature liquid collectors are used in this system to conduct heat energy which allows system to work. Usually solar space cooling is used in conjunction with space heating because both require similar components and return on investments will not be maximal if only a solar cooling system is used very costly.

3. FINANCING RENEWABLE ENERGY SOURCES

Leasing can be used to finance most type of RES and EE equipment over the full range of project sizes ranging from large industrial ones such as heat recovery or cogeneration to small, mass market programmes such as solar lantern, solar water heating system, compact fluorescent lighting (CFLs) or power factor correction capacitor installations. This allows the user of a leased asset (the lessee) to avoid using capital up-front to acquire the asset, and the lease can be so structured that cost savings will be greater than the lease payments, thus generating a positive cash flow to the lessee. India has a well established leasing industry and current tax policies allow 100 per cent, one year accelerated depreciation for RES and EE and renewable energy equipment.