Efficiency of Sustainable Green Concept Homes

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Abstract - *Houses / buildings that incorporate passive solar design concepts and use energy efficient equipment and devices that run on renewable energy are called energy efficient solar homes / buildings. These houses / buildings offer comfortable living and working conditions, both in winter and in summer, with minimal electricity consumption. Energy-saving houses / buildings can save between 30% and 40% of the electricity used for lighting, cooling or heating.*

Introduction

It is the design of energy efficient solar houses / buildings depends on the climate, the trajectory and the solar intensity, the humidity, the wind flow and the ambient temperature of a particular place. Therefore, the design parameters of houses / buildings vary according to the different climates.

Areas of the country.

The following are the three basic strategies that can be taken to reduce energy consumption in homes / buildings.

• Incorporate passive solar energy techniques into the design of a building and improve the specifications of building materials to minimize the load in conventional systems (heating, cooling, ventilation and lighting). Passive techniques vary depending on the climate, and simple techniques that are useful for new houses / buildings in different climates of India are listed in the brochure.

• Design of energy efficient lighting and air conditioning systems (heating, ventilation and air conditioning) in homes / buildings.

• Integration of renewable energy systems, such as solar photovoltaic systems and solar water heating systems, with buildings to cover part of their load.

Passive Design Features

- **Features of passive design**

Orientation of buildings

We all know that the sun travels every day from east to west. The movement of the sun from north to south and from south to north produces seasonal changes during the year. The orientation of a building in a particular direction, therefore, can heat or cool the building depending on the climatic zone in which it is built. Proper guidance can help increase or reduce the heat load by 5%. For example, if the long sides of the building in the composite climate zone look to the north and south and the short sides to the east and west, the thermal load can be reduced.

Umbrellas

These are installed in the upper part of the windows / doors to obstruct the solar rays that enter the building during the summers but allow them to enter during the winters. This helps protect the building from overheating during summers and keeps it warm during winters, thus reducing electricity consumption that would otherwise increase due to the more intensive use of room coolers / heaters.

Window design

The windows of a building allow the entry of light, heat and air. While natural light and air are welcome in buildings in

all climate zones, heat may or may not be required, depending on the climate zone in which the building is constructed. Therefore, the decision on the position of the windows should be based on the heat requirements of the building. The size of the windows and their blinds also depend on the climate zone. .

Double glazed windows

Insulation helps reduce the heat increase and heat loss of a building. Double glazed windows with airspace can act as good insulation. The insulating air gap reduces the heat build-up of the building. It must be used for spaces with air conditioning.

Insulation of buildings

Insulation can be added to walls or ceilings to reduce heat transfer. It also helps to moderate internal thermal comfort and is effective in reducing temperature fluctuations in spaces without air conditioning. Some commonly used insulation materials are mineral wool, extruded / expanded polystyrene, PUF (polyurethane foam) and vermiculite, among others. Since the roofs receive maximum solar radiation, it is advisable

Isolate them using any of the materials listed above. Cavity walls are an effective method of isolation. The aerated concrete blocks made from volatile ash and cellular concrete blocks have good insulation properties and can be used for wall insulation. An architect can provide the appropriate specifications based on the climate zone in which the building will be constructed.

Roof treatment

Some simple roof treatments, other than roof insulation, to reduce the increase in heat in buildings during the summer are as follows.

• Washing of the white roof before the beginning of the summer.

• Spraying water on the roof. Spraying water at regular intervals can reduce heat gain through the roof.

• Use of luminous and reflective material for the roof.

Evaporative coolant

When the water stored in a body of water evaporates in the surrounding air, the ambient temperature decreases. This phenomenon is known as evaporative cooling. The presence of a water body like a pond, a lake or a sea near the building or even a fountain in the courtyard can provide the cooling effect. The most commonly used system is a desert refrigerator, which includes water, evaporation pads, a fan and a pump. External cooling through humidification can also be achieved by keeping the roof surfaces moist with sprinklers or lawn sprinklers. Evaporative cooling is very effective in the hot and dry climatic zone, where humidity is low.

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Landscaping

Landscaping provides a buffer against heat, sun, noise, traffic and airflow. It is also effective in diverting the flow of air or the exchange of heat in a passive solar project. Deciduous trees, such as amaltas, champa and similar varieties, provide shade in summer and sunlight in winter when the leaves fall. Therefore, planting such trees to the west and southwest of a building is a natural solar passive strategy. Evergreens provide shade and wind control throughout the year. They are better located to the north and north-west of a building. Natural cooling without air conditioning can also be improved by planting trees to channel summer breezes into tropical climates. Hard surfaces and dark-colored floors, such as concrete sidewalks or concrete cement roads around a house, should be avoided, as they can increase the temperature of the environment. Increasing the temperature would cause thermal disturbances inside the house and increase

the air conditioning bills. Instead, soft surfaces such as organic flooring or vegetated areas should be used.

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Surface-to-volume ratio

A compact building gains less heat during the day and loses less heat during the night. The compactness of the building is the relationship between its surface area and its volume, or Compactness = S / V

(Surface/volume). In hot and dry climates, the S / V ratio should be as low as possible to minimize heat build-up. In hot and humid climates, the main concern is to create ventilated spaces. This would require a higher S / V ratio

Passive heating

In places in cold climatic zones, such as Shimla, where the outside temperatures are lower than the internal temperatures, the heat flows from the buildings through their outer sheaths and is due to the exchange of air. In such climates, passive heating measures are adopted to provide thermal comfort and also to reduce the demand for conventional heating. Two methods are popular for passive heating of buildings. Direct Earnings Method It is the simplest, cheapest, most common and effective way to heat the interior of a building. Sunlight is allowed in living spaces through an opening, allowing it to strike and directly heat the floor, walls or other interior objects. These, in turn, heat the air inside the room. The double glazed windows face south (in the northern hemisphere) to receive maximum sunlight in winter.

During the night, these windows act as insulating curtains and prevent heat loss. Moreover, during the day, when the areas of the building exposed to sunlight tend to overheat, the high thermal mass absorbs and stores the heat in massive walls or floors and stops the increase in room temperature. The heat stored in the mixture is released inside during the night, when the temperature decreases, keeping the environment adequately warm. Some examples of thermal storage materials are concrete, brick, stone and water, which are usually found on interior or exterior walls, floors and other integrated structures that receive direct sunlight. Indirect gain method In this strategy, a thermal storage wall is placed between the glazing and the living space. This prevents solar radiation from entering the living space. It is absorbed, stored and indirectly transferred into the living space. A wall of trumpets is a thick, solid wall with ventilation holes in its lower and upper ends. It is usually painted black or a dark color to increase its heat absorption capacity. This wall is positioned directly behind the window with an air gap in the middle. The air intakes act as inputs of hot air into the room and as exits to expel the fresh air from the room. The air in the space between the windows is heated and enters the living room through the upper vents.

Earth's air tunnel

At a depth of 4 m below ground, the earth's temperature remains more or less constant throughout the year. This temperature is almost equal to the average temperature of the place. The earth air tunnel exploits this phenomenon. The cement pipes are placed at a depth of 4 m below ground and are surrounded by earth. The earth acts as a heat exchanger for the air that runs through this tunnel. The hot summer air passes through this buried pipe, and when it passes, there is an exchange of heat between the air and the surrounding earth. Therefore, during the summer, the air becomes

Solar chimney

The solar chimneys are high and hollow structures that are preferably located in the south / south-west part of a building. These fireplaces can help ventilate the rooms and are ideal for warm climatic zones. Preferably, they should be dark in color with a light construction (eg Ferro-cement). The spaces inside a building have a ventilation that opens in this fireplace. The fireplace is heated during the summer days and the air inside the fireplace rises creating a low pressure zone. The air in the rooms of the house then replaces the exhaust of the fireplace, creating a low pressure area inside your home. This allows the outside air to enter the home in a natural and fresh way.

Passive characteristics applicable for different climatic zones.

As mentioned earlier, buildings in different climate zones require different passive characteristics for structures that need to be energy efficient. Some features that can be taken in particular areas are listed below.

Hot and dry

- Appropriate orientation and shape of the building.

• Insulation of the building envelope.

• Massive structure.

• Air locks, entrances, balconies and verandas.

• Remove weather conditions and plan air changes.

• External surfaces protected by protrusions, fins and trees

• Porcelain mosaic tiles and soft colors.

• Windows and drain pipes.

• Patients, wind towers and openings.

• Trees, ponds and evaporative cooling.

Hot and wet

• Appropriate orientation and shape of the building.

• Roof insulation and wall insulation.

• Reflective roof surface.

• Balconies and verandas.

• Glass walls with surfaces protected by cantilevers, fins and trees.

• Porcelain mosaic tiles and soft colors.

• Windows and drain pipes.

• Construction of ventilated ceilings, courtyards, wind towers and openings

• Cooling dehumidifiers and dehumidifiers.

Moderate

• Appropriate orientation and shape of the building.
• Insulation and insulation of the roof of the east and west walls.
• Walls facing east and west, glass surface protected by gutters, fins and trees.
• Porcelain mosaic tiles and soft colors.
• Windows and drain pipes.
• Layout of patios and openings.

Cold

• Appropriate orientation and shape of the building.
• Use of trees as barriers against the wind.
• Roof insulation, wall insulation and double glazing.
• Thicker walls
• Air closures and entrances.
• Weather zone
• Darker colors

• Solar spaces, greenhouses and walls of trumpets.

Composed

• Appropriate orientation and shape of the building.
• Use of trees as barriers against the wind.
• Roof insulation and wall insulation.
• Thicker walls
• Locks and air balconies.
• Weather zone

• Walls, glass surfaces protected by gutters, fins and trees.
• Porcelain mosaic tiles and soft colors.
• Escapes
• Patients, wind towers and openings.
• Trees and ponds for evaporative cooling.

• Cooling dehumidifiers and dehumidifiers.

Energy-saving lighting

The lighting of a house is generally responsible for 20% of the electricity bill. Efficient lighting reduces energy consumption, saving energy and money, without compromising the quality of light. Lighting improvements are the safest way to reduce energy bills. The use of new lighting technologies can reduce the use of energy at home between 50% and 75%. The lighting controls offer greater energy savings by reducing the time the lights are turned on without being used.

Interior lighting

Use fluorescent tubes and energy efficient compact fluorescent lamps (compact fluorescent lights) in home accessories for high quality, high efficiency lighting. Fluorescent lamps are much more efficient than incandescent bulbs (standard) and last up to six times longer. Although fluorescent lamps and compact fluorescent lamps cost a little more than incandescent bulbs, they pay for themselves while saving energy for life (A 15 W CFL can replace a 60 W incandescent bulb and a 20 W CFL can replace 100 W bulbs)

Outdoor lighting

Many owners use outdoor lighting for decoration or security. Consider photovoltaic lights for areas that are not close to an existing power line. Outdoor solar lights also come as independent accessories. An 11 W CFL, with a 74 W photovoltaic module and a 12 V / 75 A battery, costs Rs 22 000-24 000. When fully charged, the battery can power a light from dusk to dawn.

Energy efficient air conditioners.

Air conditioners (AC) are used to cool or heat a room and, in general, consume the highest energy among all appliances. The AC window and AC division are the most used. These are available in different sizes: 0.75 tons, 1 ton, 1.5 tons and 2 tons. The insulation

of the walls, the ceiling and the efficient windows in the room would allow to choose an AC with a lower tonnage.

- **Select the correct size**

The energy consumption of an AC depends on the size of the CA. Therefore, select a CA that suits your needs. A 1-ton AC is adequate for a 150-square-foot room, while a 2-ton AC is sufficient for a room, which has a surface area of 300 square meters.

• Selection of an efficient AC

The efficiency of a CA affects the energy.

Consumption is equal to the size of the CA. Select an efficient CA, preferably one that has a BEE Star label. The number of stars on the BEE label indicates the efficiency of a CA; the highest

The most efficient number of stars is the device. from
For example, a 4-star BEE CA with a capacity of 1.5 tons would consume
194 units of electricity in one month compared to a
AC inefficient of the same size that I would have consumed.

278 units during the same period. An efficient 1.5-tonne AC would cost around 16,500 rupees, while a normal AC would cost around 15,000 rupees. The additional Rs 1500 invested in the efficient CA will be recovered in less than six months due to savings in the electricity bill. In the event that there is no availability of the BEE star label, check the EER (energy efficiency index) mentioned in the CA. An EER of 8 equates to a 1-star BEE label and an EER of 10.6 or higher equals a 5-star BEE label.

Installation of a CA

When installing an AC, make sure that the exterior (or back) of the AC is not exposed to direct sunlight and away from sources of heat, such as chimneys. An efficient flow of air through the exterior would ensure efficient operation of the AC. Properly seal doors and windows to ensure that air does not escape through them. This would help reduce energy consumption.

Renewable energy / devices Solar water heating systems.

A solar water heater is a device that uses the thermal energy of the sun to provide hot water for various applications. In homes, it is useful for bathing, washing, cleaning and a solar water heater is a device that uses the thermal energy of the sun to provide hot water for various applications. In homes, it is useful for bathing, washing, cleaning and other household chores. A domestic solar water heater with a capacity of 100 lpd (liters per day) is sufficient for a family of four or five members. You can easily replace a 2 kW electric geyser and save up to 1500 units of electricity per year. Pay the cost in three to five years, based on the electricity tariff and the use of hot water in a year. After this, hot water is available almost free during the residual useful life of the system, which is around 15-20 years.

The system is usually installed on the terrace and requires minimal maintenance. It works automatically and you do not need to use any part of the system. Normally, an area of 3 square meters is required to install it. The system can also be installed in a south-facing window if there is no space available on the terrace.

Two types of systems are promoted: one based on FPC (flat-plate collectors) and the other on ETC (vacuum tube collectors). The life span of FPC-based systems is typically 15 to 20 years and is more expensive than ETC-based systems. There are 57 manufacturers of these systems approved by the Bureau of Indian Standards (BIS) and have had a stable market in the country in recent years.

ETC-based systems are relatively new and may be more reliable for colder and harder regions. However, the life span of these systems is lower, since their collectors include glass tubes, which are brittle.

In addition, some state governments provide state subsidies.

Construction of an integrated photovoltaic system.

A photovoltaic system can be incorporated into a building as part of the building structure. In new buildings, photovoltaic systems can be incorporated into the design and construction phase. They can also be adapted into existing buildings. Photovoltaic systems can be integrated into all the possible structures, from bus shelters to high-rise buildings. They can also be used as embellishment.
elements. Incorporating photovoltaics into the building results.

following value additions.

• Electricity generation at the point of demand without any further use of the geographical area

• Reduce building cooling load as it also acts as a shadow element.

• Replacement of building construction material, such as glazing elements, according to the building design

In the construction of integrated photovoltaic systems, photovoltaic modules are used as

part of the building envelope. It is possible to incorporate photovoltaic systems.

in a building in three basic ways 15-20 years, and they are More expensive than ETC-based systems.

Conclusion

There are various other renewable energy devices/ systems, such as solar cookers, solar lanterns, solar home systems, and solar inverters, which can be used for saving conventional energy after the home/building is constructed.

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