

# Innovative Practices in Energy & Environmental Management

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**Abstract** Global warming and climate changes have become a major concern for mankind today. In order to ensure that, development and environment conservation go hand in hand, major corporations around the world are empowering projects to slow down depletion of natural resources. The natural environment and energy are important components of our economy, community health and quality of life. Environmentally and economically sound design and development techniques are critical to design buildings and infrastructure that are sustainable, healthy and affordable.

We spend 90% of our lives in buildings that protect us from the extremes of the nature like heat, cold, rain, wind, snow etc. However, our buildings use enormous amount of energy, water, and material throughout their life cycle. They also create a large amount of waste and have a profound effect on ecosystem.

The economic, health and environmental impact of our homes is apparent in our society. To meet the challenges of our built environment and Creating Sustainable Environments, a new way of designing & construction has evolved. It's a Green Building, this system follows design and construction practices that significantly reduce or eliminate the negative impact of the building on the environment and the occupants.

**Keywords:** Green building, Afforestation, Green paints, Flyash, Rain water harvesting, Grey water, Nanotechnology.

## What is a Green Building?

Green building is the practice of promoting optimum utilization of resources like water, energy & material by the way of which, reducing building impacts on human health and the environment during the building's lifecycle, through better design, construction, operation, and maintenance which includes:

- Efficient use of energy, water, and other resources,
- Protecting occupant health and improving employee productivity,
- Reducing waste, pollution and environmental degradation.

## Need for Green Building in India

In a country like India where the population is ever increasing, so are the demands. The demand for houses, shopping malls, hotels, commercial complexes etc. are on the rise. An emerging alternative is to go green in housing too. Considering that an average person wastes about a liter of water while brushing their teeth, how much water do you think is wasted in a year? Will the environment be able to sustain this kind of wastage? Depleting natural forest cover, water and energy resources are not helping at all. Will our natural resources be able to withstand this kind of development? Going green can certainly help take care of a large amount of this harmful wastage.

## Features of Green Building

- ✓ Green building materials
- ✓ Reduced Energy Use
- ✓ Reduced Waste

## Green Techniques:-

**Emphasis of four 'R's:-** Via sound designing, construction and building commissioning without compromising structural durability, indoor pollutant levels, ventilation, building code requirements, or marketability includes:-

- **Reduce:** - lower quantity of building material, resources, and embodied energy are used.
- **Reuse:**-construction materials that are practical and structurally sound are reused.

- **Recycle:** - recycled materials are used, and home is designed for recyclables.
- **Renewable:** - energy from natural sources and renewable building materials are emphasized.

The technique which emphasizes these four 'R's are called as **Green Techniques**. These Green techniques can be classified as follows:-

- Structural & civil Techniques
- Electrical Techniques : i) Conservation Techniques ii) Generation Techniques
- Special Techniques

### Structural & civil Techniques

#### Insulated wall:-

Properly insulated exterior walls in your house will not only increase comfort but also help you save on heating and cooling costs. For energy savings, you can add insulation to your walls in an existing house. If you're building a new house, you have many energy-efficient wall insulation options to consider.

1. Air gap insulation
2. Mineral wool insulation
3. Cotton insulation
4. Plastic Fiber insulation

#### Green Cement:-

Green Cement is a combinations incorporating limestone, fly ash or ground granulated blast-furnace slag can be specified and, in some exposure conditions, may be more appropriate. The cement industry is actively recovering the energy from wastes by increasing the use of non-fossil fuels such as waste solvents; refuse derived fuel (RDF), certain unrecyclable paper and plastics, sewage pellet, and meat and bone meal. Using these alternative fuels not only reduces the need for landfill sites or disposal by incineration but also helps preserve our finite reserves of fossil fuels.

#### Fly ash brick:-

This is a fine, glass-powder recovered from the gases of burning coal during the production of electricity. These micron-sized earth elements consist primarily of silica, alumina and iron. When mixed with lime and water the fly ash forms a cementations compound with properties very similar to that of Portland cement. Because of this

similarity, fly ash can be used to replace a portion of cement in concrete, providing some distinct quality advantages. Adding fly ash to stabilized soil bricks or ordinary bricks can increase their compressive strength. Other benefits include:

- 1) Low water absorption
- 2) Less consumption of mortar
- 3) Economical & eco-friendly
- 4) Low energy consumption
- 5) No emission of green house gases

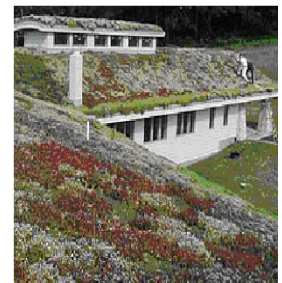
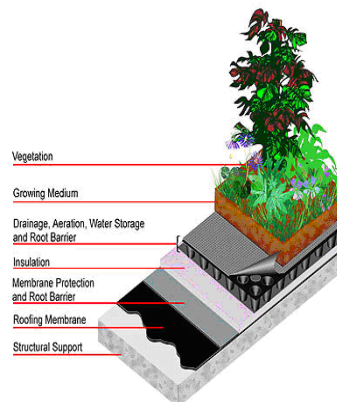
### Transparent roof / sustainable day lighting

Lighting accounts for around 15% of the energy bill in most homes, and around 25% in commercial buildings. The most sustainable lighting is natural daylight. It is not only a free renewable resource but it also has well-documented health benefits. Careful architectural design is required to maximize natural light in a building while maintaining indoor temperature regulation and reducing direct light glare. The strategic placement of windows, skylights, light shafts, atriums and translucent panels in harmony with other building components, such that light is reflected evenly throughout internal spaces, is known as day lighting design



### Green Roofs:-

It consists of covering the roof by the plantation of the different types. Other than enhancing the aesthetic sense it acts as the natural insulation. The basic build up of a green roof is three layered: - drainage, filter and vegetation layer. Each layer needs to fulfill several functions to decrease the height and the weight of the overall build-up.



### Green Paints:-

According to the EPA, the air inside a home is, on average, two-to-five-times more polluted than the air outside. Paint is a large contributing factor to poor indoor air quality and can emit harmful chemicals, such as VOCs, for years after application. There are serious health and environmental concerns surrounding paint. Using paints that are free of Volatile Organic Compounds (VOCs) such as benzene and toluene, free of heavy metals such as lead or cadmium, and/or made of post-consumer recycled content can aid in reducing exposure to toxics both for you and your environment.

### Eco Wood:-

Eco wood is the wood produced and processed by the man himself by recycling. Also the wood manufactured from bagasse of sugarcane can be classified into this category. This type of wood can again be recycled and reused. Thus it helps to keep the environment healthy.

### Green Glasses

Green Glass products are used in exterior applications both for energy generation (glass for photovoltaic applications) and energy conservation (tinted glass, solar control reflective glass, low-e glass etc.) as well as for interior applications (arsenic-free designer range, environmental friendly copper and lead free mirrors etc.).

### Electrical Techniques:-

#### Conservation Techniques

1. Optimum use of natural light.
2. Replacing incandescent lamps by compact fluorescent lamps (CFL's).
3. Replacement of conventional fluorescent lamp by energy efficient fluorescent lamp.
4. Replacing of mercury/sodium vapour lamp by halides lamp.
5. Replacing HPMV lamps by high pressure sodium vapour lamps.
6. Replacement of luminaries by more energy efficient luminaries.
7. Replacement of conventional ballast by energy efficient ballast.
8. Obtain flexibility in light control circuit by using sensors, microprocessors.

### Generation Techniques

#### Solar-Wind Hybrid:-

Hybrid systems are usually a combination of photovoltaic with wind turbines and/or generators running on diesel or bio-fuels. Power generated by the PV array during the day is stored in the battery bank through an energy manager, which controls the complete system. Hybrid systems make optimal use of sunlight and wind speeds - the two main resources readily available.

#### **Nano-technology on thin film is a new innovation in field of solar power technology**

#### **What is Nanotechnology?**

Nanotechnology is the engineering of functional systems at the molecular scale. Dr Eric Drexler popularized the word 'nanotechnology' in the 1980's. This technology deals with particles that are of the size of one billionth of a meter called "Nanometer" (10<sup>-9</sup>). A centimeter is one-hundredth of a meter, a millimeter is one-thousandth of a meter, and a micrometer is one-millionth of a meter, but all of these are still huge compared to the nanoscale. A nanometer (nm) is one-billionth of a meter, smaller than the wavelength of visible light and a hundred-thousandth the width of a human hair. Why do we need to go to such a minute level of matter?. The reason is at the nano scale the physical, chemical and biological properties of material differ in fundamental and valuable ways from the properties of individual atom and molecules at bulk. Nanosolar Technology focus is to safeguard the environment by using innovative technology that harnesses the most widespread and universal source of energy provided by the Sun.

#### **The biggest recent breakthroughs recently have come with CIGS-on-foil manufacturing. It has solar cells using a process that resembles offset printing. Here's how it works:**

1. Reams of aluminum foil roll through large presses, similar to those used in newspaper printing. The rolls of foil can be meters wide and miles long. This makes the product much more adaptable for different applications
2. A printer, operating in an open-air environment, deposits a thin layer of semiconducting ink onto the aluminum substrate. This is a huge improvement over CIGS-on-glass or CdTe cell manufacturing, which requires that the semiconductor be deposited in a vacuum chamber. Open-air printing is much faster and much less expensive.

. 3. Another press deposits the CdS and ZnO layers. The zinc oxide layer is non-reflective to ensure that sunlight is able to reach the semiconductor layer.

4. Finally, the foil is cut into sheets of solar cells. Sorted-cell assembly, similar to that used in conventional silicon solar technology. That means the electrical characteristics of cells can be matched to achieve the highest panel efficiency distribution and yield.

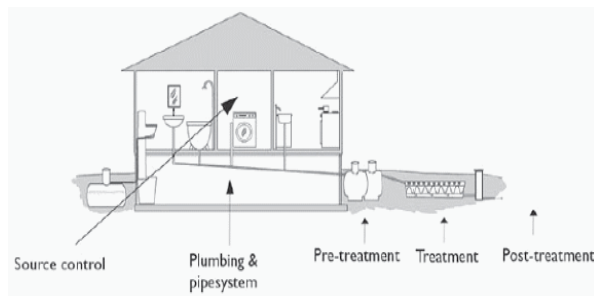
### **Lighting:-**

The system is provided with battery storage backup sufficient to operate the light for 10-11 hours daily. The system is provided with automatic ON/OFF time switch for dusk to dawn operation and overcharge / deep discharge prevention cut-off with LED indicators. Other Green Techniques in Electrical Field includes Energy Conservation in the appliances like Refrigerator, Oven, Air-Conditioners etc.

### **Special Techniques:-**

#### **Grey water Management:-**

All household wastewater, except toilet waste, is called grey water. Grey water from washing dishes, shower, sinks and laundry comprises the largest part of residential wastewater. This water when Filtered and recycled can be used in the toilets, or for irrigation.



### **Afforestation:-**

This green technique includes planting of deciduous trees around/surrounding the building. These trees have special property that they shade their leaves in the winter and allow the sun's heat to enter inside the house. While

during summer, it has maximum leaves so that the building gets natural cooling.

### **Rain water harvesting:-**

Rain water harvesting is a process of collecting the rain water that falls on terraces and roof tops during the monsoons and storing it in tanks, pits, trenches, bore wells, unused wells etc. or directing it so that it percolates into the ground water.

Rain water harvesting includes:-

1. Collecting rain water.
2. Purifying it to an extent.
3. Directing it to subsoil spaces below the plot where it can be stored, by gravity or mechanical means.

### **Passive solar heating and cooling**

Your building's windows, walls, and floors can be designed to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. This is called passive solar design or climatic design. Unlike active solar heating systems, passive solar design doesn't involve the use of mechanical and electrical devices, such as pumps, fans, or electrical controls to move the solar heat.

Passive solar buildings range from those heated almost entirely by the sun to those with south-facing windows that provide some fraction of the heating load. The difference between a passive solar home and a conventional home is design. The key is designing a passive solar building to best take advantage of your local climate.

You can apply passive solar design techniques most easily when designing a new commercial building or home. However, existing buildings can be adapted or "retrofitted" to passively collect and store solar heat.

## **Prevention of soil erosion**

The goal of this strategy is to reduce or eliminate runoff due to impervious (watertight) surfaces. Minimizing or eliminating impervious surfaces by designing driveways, walkways, and patios that allow storm water runoff to infiltrate into the ground minimizes the impact on aquatic systems.

## **Scope of Green Buildings in India**

Architects and builders have begun using green principles like water harvesting and waste management in their projects. They emphasize the use of eco friendly building materials like fly-ash cement and blocks, steel and tiles, recycled aluminum, bamboo based products, green roofing products and so on. On the technology front too, there are a lot of options available to build green homes. Energy saving air conditioners, high performance glass windows, water saving solutions, composting toilets, and efficient building management systems are just some of them.

Tapping solar energy is another method used by green homebuilders in India. The use of a photovoltaic array on the rooftop is a good source of alternate energy as are solar thermal arrays. This way energy can be obtained from the environment, stored and used as required. A combination of innovative green ideas and high technology may be able to address India's energy and water needs.

Now the Indian Green Building Council (IGBC) has introduced a system of rating green homes. This system is India's first foray in the sector. It will rate a building's infrastructure, eco friendly design, waste management, water and other natural resource conservation systems, among others. If you conserve natural resources while building and living in your home, you not only save money but also lay the foundation for a healthy lifestyle. With the increasing number of green projects, the IGBC sees a great future in going green. Will this give people an opportunity to build designer homes? In the wake of the recent rise in oil prices, will green homes be an answer to India's ever increasing demand for energy?

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the growth of industry in India, partnering industry and government alike through advisory and consultative processes. CII is a non-government, not-for-profit, industry led and industry managed organization, playing a proactive role in India's development process. CII – Sohrabji Godrej Green Business Centre (CII – Godrej GBC), a division of Confederation of Indian Industry (CII) is India's premier developmental institution, offering advisory services to the industry on environmental aspects and works in the areas

of Green Buildings, Energy Efficiency, Water Management, Renewable Energy, Green Business Incubation and Climate Change activities. The Centre sensitizes key stakeholders to embrace green practices and facilitates market transformation, paving way for India to become one of the global leaders in green businesses by 2015.

## **Need for `Zero Energy Building`**

The government is planning to enact a renewable Energy law that would stipulate mandatory procurement of prescribed minimum renewable energy in each state. The move is aimed at diversifying the country's energy mix that is dominated by oil, gas & coal as basic fuel feed. The new legislation is expected to give legal teeth to renewable energy policy that failed to get the desired investment in the sector.

So, taking a step ahead of Green Building, `*Zero Energy Building`* is the answer to this new step.

## **Introduction to Zero Energy Building**

A Zero Energy Building (ZEB) combines state-of-the-art, energy-efficient construction and appliances with commercially available renewable energy systems, such as solar water heating and solar electricity. The combination results in a home that produces its own energy—as much or more than it needs. Even though the home might be connected to a utility grid, it has net zero energy consumption from the utility provider. In other words, a zero energy building is a structure that produces more electrical or thermal energy, than it uses.

This can be measured in different ways (relating to cost, energy, or carbon emissions) and, irrespective of the definition used; different views are taken on the relative importance of energy generation and energy conservation to achieve energy balance. Although zero energy buildings remain uncommon in developed countries, they are gaining in importance and popularity. The zero-energy approach is promoted as a potential solution to a range of issues, including reducing carbon emissions, and reducing dependence on fossil fuels. Most ZEB definitions do not include the emissions generated in the construction of the building and the embodied energy of the structure which would usually invalidate claims of reducing carbon emissions.

A building approaching zero energy use may be called a *near-zero energy building* or *ultra-low energy house*. Buildings that produce a surplus of energy during a portion of the year may be known as *energy-plus buildings*. An energy autarkic house is a building concept where the balance of the own energy consumption and

production can be made on an hourly or even smaller basis. Energy autarkic houses can be taken off-the-grid.

### Cost

The most criticized issue about constructing environmentally friendly buildings is the price. Photovoltaic, new appliances and modern technologies tend to cost more money. Most green buildings cost a premium of <2%, but yield 10 times as much over the entire life of the building. The stigma is between the knowledge of up-front cost vs. life-cycle cost. The savings in money come from more efficient use of utilities which result in decreased energy bills. Also, higher worker or student productivity can be factored into savings and cost deductions. Studies have shown over a 20 year life period, some green buildings have yielded considerable amount of money per square foot back on investment. It is projected that different sectors could save billions of rupees on energy bills.

### Conclusion

In an environmentally stressed world, green buildings are moving from an exotic curiosity to a necessity. Buildings are perhaps the single greatest stress on the environment, accounting for the world's fresh water withdrawals, one-quarter of its wood harvest, and two fifths of its material and energy flows. In such a scenario of shortages of clean water and other materials, and the possibility of devastating climate change, the greening of buildings constitutes a collective vital. Given the political difficulties of obtaining energy, and likely future shortages of conventional energy sources, we cannot ignore the enormous conservation that green buildings make possible. And buildings with natural materials and lighting also create a happier, healthier, more productive atmosphere.

Yet evaluating, What makes a building green? is a critical task. Green buildings may be considered as a checklist of environmentally friendly elements, and such checklists are needed to authenticate that a given building is as environmentally friendly as it claims. Then the barrier between natural and artificial will break, as buildings move towards a harmony with natural processes. And, instead of being a great drain on energy and a destructor of ecosystems, buildings are evolving toward being part of a healthy, managed environment. A strong awareness of the advantages of green buildings, a conscious effort to change, will speed this process along. Introduction of Nanotechnology is developing nanoparticle-printing based CIGS technology. The world – record performance demonstrate that, with innovation in science and nano material, low cost processes can yield

solar cells whose film quality is good as that obtained with far more expensive high vacuum based deposition techniques. In the future years and decades the green building techniques will become commonplace for political, environmental, and economic reasons.

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