

# Green Technology Applications in Buildings

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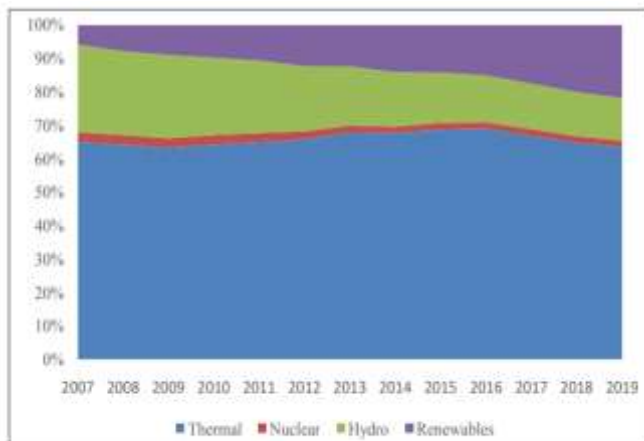
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**Abstract** – Why the need of Green Technologies in the field of construction? With urbanization and increase in the rise of industries, the supply of non-renewable resources is growing expensive and becoming rare; with adverse environment issues. It's time we start to construct green. The paper reports a review on the green technology applications that can be incorporated to all new facilities and existing structures.

**Key Words:** Sustainable, Buildings, Green, Technologies, Construction, Infrastructure, Environment, Climate Change, Energy-Efficient

## 1. INTRODUCTION

The construction sector has a tremendous impact on the growth of a society; with buildings contributing a major chunk of this sector. Hence it becomes essential to enter and transform this area. The market has also seen a significant rise of green engineering during the past ten years. Fig – 2 depicts an increase in the renewable energy resources.



Source: Central Electricity Authority

Fig-2: Share of various energy sources in total Installed Capacity in India

## 2. ASSESSMENT TOOLS

Rating systems have been developed to incorporate green technologies and sustainable construction. All these rating systems currently are voluntary rather than mandatory.

Launched in the 1990's, BRE's rating system BREEAM, was UK's first green rating system. It was followed by US' Leadership in Energy and Environmental Design (LEED) rating system in 2000. 600 green certification systems are

assumed to be there in the world today. Here we will talk about two green building rating systems prevalent in India:

1. LEED – Leadership in Energy and Environmental Design. Most widely used rating system globally.
2. GRIHA – Green Rating for Integrated Habitat Assessment. India's own rating system. Established in 2007, jointly by TERI and the Ministry of New and Renewable Energy, Government of India.



Fig – 1: LEED Credit Categories

“India ranks 3rd on the US Green Building Council's (USGBC) annual ranking of the top 10 countries for Leadership in Energy and Environmental Design (LEED) certified buildings. According to the survey by USGBC, the top 10 list highlights countries outside of the US that are using LEED and India, with more than 752 LEED-certified projects totalling over 20.28 million gross square meters of space, ranks third.”

## 3. GREEN BUILDING TECHNOLOGIES

An effort has been made to list down a few green technology applications prevalent and the advantages of incorporating them.

### 3.1. Rain Garden

Rain Garden basically comprises of shrubs planted in a depression in open areas. These are very different from the traditional gardens as they have better water infiltration capacity. The main purpose of them is to collect water

whenever it rains from impermeable surfaces such as roofs or driveways. The benefits to such a system is multifaceted:

- Aesthetic appeal
- Flood control and provides localized storm water
- Attracts fauna
- Easy maintenance
- Enhances water quality by removal of pollutants

The limitations to this lies in urban areas where open areas are reducing day by day. Residential apartments, commercial complexes, malls and other buildings are occupying most of the space. Flooding is the byproduct to such development. One way to tackle it; installation of rain gardens at the roofs of the buildings and has proven to be a success in the city of Rotterdam (Netherlands). The advantages to it are:

- Energy savings in the building as it provides a cooling affect with a considerable drop in temperature
- The green cover helps in controlling climate change by absorbing temperature rising emissions
- Modification of existing sewer and storm water systems not required
- Inhospitable patches can be made pleasant and provide outdoor space for the users



**Fig -2:** Edible flowers and trees grow on the DakAkker urban farm on top of an office building in central Rotterdam

### 3.2. Insulated Concrete Forms (ICF)

The preparation involves mixing of cement and wood chips and are further casted in moulds to construct cement blocks. Wall reinforcements are further added in the cavity and concrete is poured into the cavity as shown in Fig – 3. The environment benefits are listed:

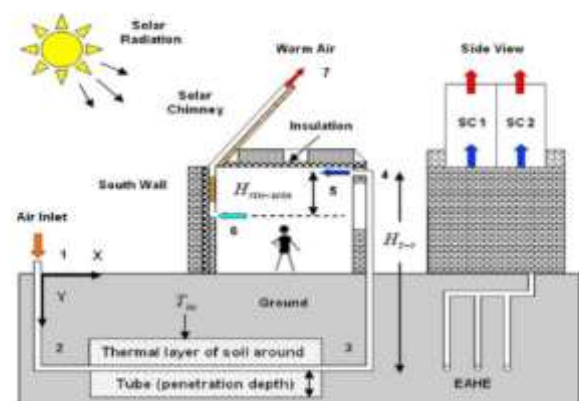
- Wood chips are a by-product of lumber industry
- Lighter than traditional cement blocks and hence reduction in the sizes of the structural components leading to saving of material
- Large air spaces give good insulating properties leading to efficient energy usage



**Fig -3:** ICF Blocks

### 3.3. Heat Stacks

One of the promising technologies that has come up in the field of Green buildings; Heat stack also known as Thermal Chimney or Solar Chimney. It is a part of Passive Solar Building Design and unlike Active Solar Based Design; it does not make any use of electrical or mechanical appliances to harness solar energy.



**Fig -4:** Schematic Diagram of Integrated Earth to Air Heat Exchanger and Solar Chimney (Maerefat and Haghighi, 2010)

Heat stacks are used to regulate the indoor temperature of the building as well as providing proper ventilation. They are hollow containers that connects the inside part of the building to the outside. They are coated in black so that

maximum amount of heat is absorbed and hence are located facing sunlight.

Especially for a country like India that lies in a sub-tropical region, it can play a significant role in summer as well as in winter:

- Winter Period - it acts as a passive solar heating system. The solar radiation results in the heating of air inside the column. The closed vent at the top of the stack forces the heated air back inside thereby raising the indoor temperature of the building.
- Summer Period - it acts as a cooling system by keeping the vent opened which is provided at the top of stack. Another opening is provided at the opposite end of building which allows the outside air to flow inside. The solar radiation results in the heating of air inside the column. The heated air rises and ultimately pulls the new cool air (coming via opening provided at opposite end) from outside and hence creates a cool indoor environment.

### 3.4. Electrochromic Smart Glass

Electrochromic Smart Glass is another upcoming technology that will join the sustainable construction. Also known as the electronic smart glass, this technology is a solution to cut down the incoming solar radiation and reduce the HVAC costs in a building. The amount of light reflected by the glass is changed by the use of tiny electrical bursts that can charge the ions on the window layer. They are attached to the smart building control systems and can quantify how much solar radiation is to be blocked. Smart glasses can be highly beneficial for skyscrapers that have thousands of windows which would tint automatically during the peak radiation hours and would return to normal transparency in the evenings. The developers expect a reduction of nearly 25% in the HVAC costs and are still improving it further for commercial use.

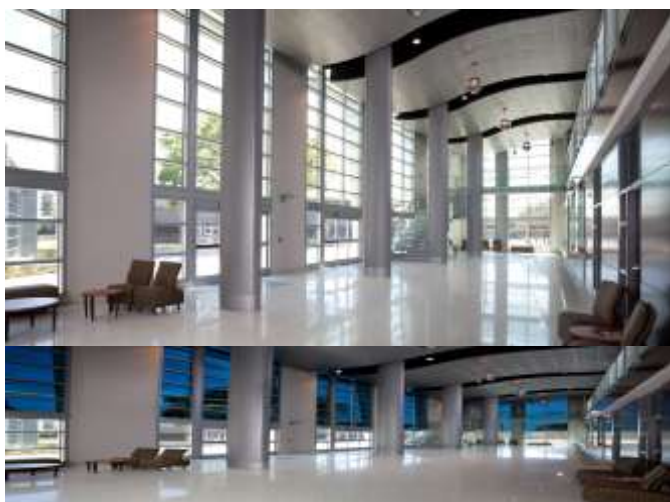


Fig -6: Building Interiors using Electrochromic Tinting Glass

### 3.5. Geothermal Insulation

Geothermal heating and cooling system is the best alternative to traditional HVAC system and is way more energy efficient. The initial installation cost for Geothermal system is comparatively high but the upfront additional costs are returned as energy savings and ultimately reduction in its life cycle cost.

The temperature beneath the earth surface (few feet) is relatively constant throughout the year and this energy can be utilized for heating and cooling the building. Geothermal system comprises of three main components:

1. Geothermal Loop: It is provided outside the building, beneath the earth surface. It harnesses the energy of stable temperature of the earth using a liquid which runs the entire length of loop.
2. Geothermal Heat Pump: It is provided inside the building and it transfers the heat energy from the liquid which runs the entire length of loop to heat and cool the indoor environment of the building.
  - a. Winter: During this period when the outside temperature is quite low, the Geothermal Heat Pump utilizes (pulls) the heat energy from the loop to raise the indoor temperature.
  - b. Summer: During this period when the outside temperature is quite high, the Geothermal pump discharges the warmer air to the loop, where the liquid running inside the loop cools down the warmer air and sends it back to cool the indoor environment of the building.
3. Distribution System: It is the network of conduit to distribute the cool or warm air throughout the building to maintain the indoor temperature.

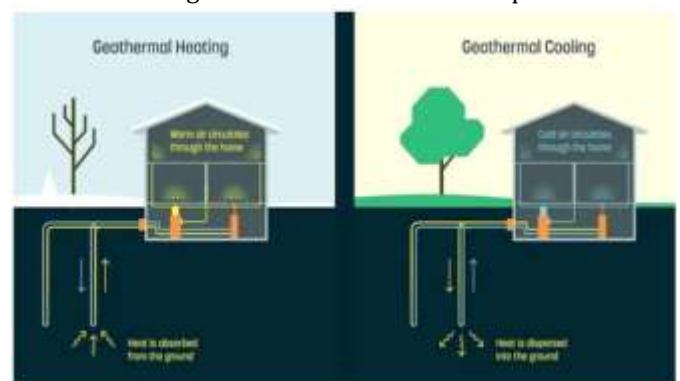


Fig -7: Geothermal Insulation

### 4. CONCLUSION

The paper discusses a few of the green technologies that are being used in construction but to limited projects. With a lot of governments focusing on the economic growth, the advantages to green construction are often overlooked. So it's important for the government to incentivize sustainable

construction so that the community flourishes in an environmentally, economically and socially responsible way.

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