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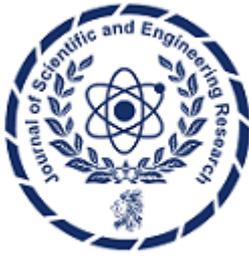
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Green Buildings and Eco-Friendly Construction Materials Sustainability Concept

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Abstract Conventional materials are supposed to be a threat to the Environment, thus concern towards the environment is increasing. This increasing ecological concern of the community has resulted in a renewed interest for the natural materials, process, and products that would be eco-efficient and environmentally safe. By using more efficient building materials it is estimated that we could reduce the energy, resource consumption and/or waste production by 50-60%. Without decreasing the value, aesthetics or function. All the building materials have an effect on our resource and thus it is becoming important to take a wise decision regarding the use of these resources to protect our environment and our ability to sustain ourselves. This paper discussed the concepts of Green building and the materials, which are also called as eco-friendly or green materials. The method of evaluation of these materials is discussed with reference to various materials. This paper also focuses on a case study of a residence, which is called as eco-friendly or Green residence.

Keywords Eco-friendly, Greenhouse, Green materials, Environmental, Green Construction

Introduction

The construction industry in India is one of the rapidly growing sectors and contributes significantly to the nation's economy. The sector contributes to 10% of the GDP. Indian construction Industry is growing at a rate of 9.2% as against the average of 5.5% and likely to grow in coming years. The government has already commenced a massive project to interconnect the major metro cities in India viz. New Delhi, Mumbai, Kolkata, and Chennai by road. This has opened new business opportunities for manufacturing sectors like cement power steel chemicals etc.,

What is an Eco-Friendly or Green Construction?

Eco-friendly or ecological construction is building a structure that is beneficial or non-harmful to the environment and resource efficient. This is also called as the green building.

This type of construction is effective in its use of local and renewable materials and in the energy generated while being with it for sustainable development.

In recent years, extensive research on environmental issues has been carried out in areas such as the environmental issue considerations for dam construction [1, 2], optimal reservoir operation [3-16], climate change [17-22], sedimentation and erosion [23, 24], flood [25-29], water quality [30-32], droughts [33], and so on [34-42]. Good studies have also recently been carried out on the construction of environmentally-friendly buildings, such as green building materials [43, 44], green building design [45-47], green building construction [48-51] and eco-friendly buildings [51-53]. Sustainability is the practice of being able to continue the harvesting, extractions, etc. with minimal long-term efforts on the environment and natural resources.



Green buildings are a smart step towards personal economic rewards. Green buildings also have a positive social and environmental ramification that assures you commitment to the future and the way we live for years to come.

Benefits of Green Building

Environmental Benefits

- Enhance and protect the ecosystem and biodiversity
- Improve air and water quality
- Reduce solid waste.
- Conserve natural resources.

Economic Benefits

- Reduce operating costs
- Enhance asset value and profit
- Improve employee productivity satisfaction
- Optimize life-cycle economic performance.

Health and community benefits

- Improve air, thermal and acoustic environment
- Enhance occupant comfort and health
- Minimize strain on local infrastructure
- Contribute to the overall quality of life.

Salient features of green building

- Minimal disturbance to landscapes and site conditions
- Use of recycled and environmentally friendly building materials
- Use of non-toxic and recyclable materials
- Efficient use of water and water recycling
- Use of energy efficient and eco-friendly equipment
- Use of renewable energy
- Effective control and building management systems.

Eco-friendly materials and techniques

In more conventional building construction, it is how technology and building materials merge and create ecological resources that are the key to green success, as well as using simple and readily available materials.

Green building materials are composed of renewable, rather than non-renewable resources. They are environmentally responsible as impacts are considered life long. Depending on the project-specific goals, an assessment of green material may involve an evaluation of one or more of the following criteria:

a) Resource efficiency

Recycle content

This is the criterion where materials are judged according to their contents so that the materials can be recycled. E.g. Materials like aluminum, steel or paper, which can be recycled and reused in the construction.

b) Natural, Plentiful or renewable

This criterion studies the materials harvested from sustainably manageable resources. E.g. Bamboo-which is a material which can be harvested within 3-4 yrs and need no finishing and is water-resistant. Bamboo has a wide range of use from flooring to walls to furniture

Cork flooring is also an eco-friendly option. Cork is the bark obtained from Quercus suber trees. As well as a stone is an option too with a wide range of use. Being tough and durable can sustain wear and tear. Can be used for flooring, walls, etc. and for stonewalls, plastering is not required.



**Bamboo flooring****Bamboo****c) Manufacturing process**

Products or materials manufactured with resource efficient process including reducing energy consumption, minimizing waste and reducing greenhouse gases.

E.g. Fly ash –It is a waste material generated from the power stations. This fly ash can be used with Cement in a percentage for concrete making. Fly ash blocks, Fly ash cement can be used for walls or plastering. Ferro cement is also an option which a combination of wire mesh and masonry which reduces consumption of cement.

**Fly Ash brick block****Earthen blocks****d) Locally available**

This happens to be the important criteria as a lot of energy is consumed by transporting the materials from one place to other, so in this issue, locally available materials can be used for construction as earthen blocks. After excavating the soil, the same is compressed with clay, sand and a stabilizing agent as lime or Portland cement, which gives earth blocks suitable to built walls.

Artificial sand can also be listed instead of conventional sand. The rocks from the quarries are processed in the machines to get sand of desired shape and size.

e) Salvaged, refurbished or remanufactured

This includes saving material from disposal and renovating, repair or dumping the same. E.g. Wood-an efficient and conventional construction material. Wood can be used for floors or partitions or for insulation. It exhibits the property to be strong, durable and beautiful and can be reused using reclaimed wood. Not only good but also it saves from deforestation too.

f) Durable

Any material used in the construction should be durable. Which are long-lasting or comparable conventional products with long size expectancies?

E.g. Straw or cork. Straw a product obtained can be used for tiles, plastering, etc. It is light, durable and flexible. It insulates, absorbs sound and vibrations. PVC Pipes for water supply needs etc,

**Straw****Non toxic paints****Papercrete block**

g) Indoor air quality:

The indoor air quality is enhanced by utilizing the materials that follow the following criteria

- **Low or non-toxic:** Materials, which emits low or no toxic irritants. e. g. The low VOC paints can be used for painting.
- **Moisture resistant:** These are the materials, which resist the moisture or inhibit the growth of biological contaminants in the buildings. The classic example for this can be the Papercrete concrete, which consists of the pulped paper fiber with Portland cement or clay. Its dimensionally stable both through the process of taking in moisture and drying out in various temperatures. It is highly insulating and resists rodent.
- **Healthfully maintained:** Materials, which require only non-toxic methods of cleaning.

h) Systems or Equipment

Products or materials which promote healthy air quality by enhancing air quality. E.g. West facing windows give ample of sunshade and thus the room remains cool in the night. A layer of Aledo (that has a high light reflecting quotient) also helps. Roof with glazed tiles etc.

i) Energy Efficient

Material components and systems that help reduce energy consumption in the building. e.g.: Use of recycled aluminum steel, Bamboo, natural finishes.

For the construction of walls, Rat trap method can be used. Solar heaters, Solarpanels, precast slabs, etc.

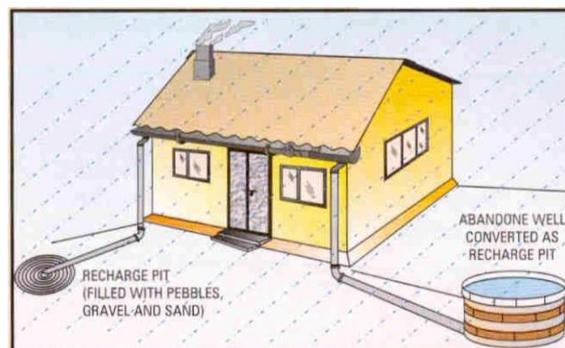
j) Water Conservation

Water conservation becomes an important accept in green buildings. So products or methods that help to conserve water are to be used in the area.

E.g. Rainwater harvesting Rainwater which falls on roofs or tanks is allowed to be stored or allowed to percolate in the ground.

Energy saving fixtures as low flow showers, Double flushing cisterns, etc. can be used.

Water also can be recycled which is used for washing or shower.



Rain Water Harvesting

k) Affordability

Affordability can be considered when building product life cycle costs are comparable to conventional materials or as a whole within a project define of the overall budget.

Apart from the above-mentioned materials some of other eco-friendly materials can be listed

- | | |
|------------------------------------|------------------------------------|
| • Bricks from Coal Washery Rejects | Coir Cement Board |
| • Fiber fly ash cement boards | Fibrous gypsum plaster boards |
| • Recycled tiles | High performance glazing glass |
| • Eco-friendly furniture | HFC based high efficiency chillers |
| • Building blocks from mine waste | Fly ash cellular concrete |



- Non-erodible mud plaster
 - Recast walling roofing components
 - Polytiles
- Jute fiber polyester
 - Prefab brick panel system
 - Insulating bricks from rice husk

Green Homes Requirements -Case study

A green home is one built with harmony with nature. Here is listed out few important ways to green your home. With the case study from an eco-friendly residence built in Bangalore.

The residence is built on a site of 40ftx60ft is facing south and landscape varying from 0 roadside to +7 on the northern tip. The total built-up area is 2200sq ft.

- Starting with the concept of the greenhouse the materials used must be eco-friendly materials like Fly ash, Fly ash blocks, soil, bamboo; etc. In our case study the earthen bricks were used with rat pat method of construction. Also, exterior walls were stonewalling with no plastering or painting.
- **Green your garden:** When you plant your vegetation avoid use of synthetic fertilizers and chemicals. As the picture shows our case study residence has used vemicompost, which is done by organic waste.



Pit for vermicompost



Vegetation in the residence.

Conserve water: Water conservation becomes an important factor for a green building. Use eco-friendly toilets, fitting faucets with aerosols.



Pop up filter

In this consideration, our case study residence doesn't have a BWSSB connection. The entire water requirement is met through Rainwater harvesting methods. The rainwater falling is channelized by 3 applications:

1. Roof top rainwater harvesting
 2. Roof top rainwater channelizes to recharge ground water
 3. Percolating water in garden area.
- **Energy efficient lighting:** Use of compact fluorescent light bulbs, which use 66% less energy. In the residence, roof is cladded with clay tiles and painted white. Light colors are adopted for interiors. Drip or sprinkle irrigation is used to water the plants. The height of the living room is 18ft. and provides ventilation and sky lighting in the roof.
 - **Upgrade to greener appliances:** Upgrade your home with star rated appliances. Theses appliances reduce energy consumption. E.g. Solar water heaters, Solar panels can be used for lighting. Solar cookers can be the part of the housed.





Solar cooker



Solar panels

- **Temperature control:** Use of ceiling fans can be best rather than AC'. In our case study residence, the wall is built with a Rat trap method for most of the exterior walls. Most of the living area is not exposed to the southern or western Sun. Large windows are provided towards East, north, and south fitted with sun control glasses.



Rat Trap Method



Skylight in the roof

Conclusion

Green buildings are now not only a wise decision but a necessary choice. The construction industry must adopt eco-friendly practices and materials that reduce its impacts before we reach a point of irreversible damage to our life supporting systems.

The industries should take their own initiative and find alternate ways of building, using green renewable energy resources and adopt nonpolluting practices and materials that reduce recycle and reuse before it is too late.

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