GREEN BUILDING CONSTRUCTION IN INDIA AND BENEFITS OF SUSTAINABLE BUILDING MATERIALS

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Abstract

The green building design aims to minimize the need for the non-renewable energy of these resources, optimize their sustainability and maximize their conservation, recycling and usage. The use of effective building materials and construction techniques is maximized. Architectural bioclimatic technology will also optimize on-site usage of sources and sinks. It requires only minimum electricity to fuel itself and efficient appliances to meet its lighting, air-conditioning and other needs. Green buildings architecture optimizes the use of renewable energies and efficient waste and water management methods to create practical and hygienic working conditions for indoor environments. Materials such as chemical, physical and mechanical material properties and an appropriate specification are the fundamental elements of construction design and responsible for the mechanical strength of the design. The construction of green buildings is also the first step in choosing and utilizing eco-friendly materials with or better characteristics than traditional building materials. Based on the practical, technical and financial requirements, construction materials are usually selected. But, given that sustainable development has been a core issue in recent decades, building industry that is directly or indirectly responsible for a substantial share of annual environmental destruction, by pursuing environmentally sound constructions and buildings should take responsibility for contributing to sustainable growth. The quickest way for manufacturers to start integrating environmental design practices into buildings would be the diligent procurement of eco-friendly sustainable construction materials, including options for new material uses, recycling and reusing, organic product creation and green resource use. This paper aims to show how green building materials will help reduce the impact on the atmosphere and create a cleaner building that can be healthy for the occupant or our environment. In the sustainable progress of a nation, the choice of building materials that have reduced environmental burdens is helpful.

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I. Introduction

Green construction is a term integrating a vast variety of strategies and best practices. It is a concept result philosophy that promotes the best usage of resources and enhances the quality of the use of resources. Green architecture sometimes referred to as sustainable architecture, sometimes referred to as sustainable construction.

Throughout the life-cycle of a house, environmentally friendly and resource-efficient: from sitting to architecture, construction, process, maintenance, restoration, and reconstruction[X].

This practice extends and complements the problems of economy, utility, stability and comfort of classical building architecture. The basic goals of these forms of buildings are:

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

Buildings have a huge environmental effect, using almost 40% of the natural resources produced in developed countries, using about 70% of energy and 12% of drinking water [XVII], and generating about 45% and 65% of the waste disposed of in our landfills [XV]. Furthermore, leading to their activity, they are responsible for a large amount of toxic pollution, accounting for 30 percent of greenhouse gases, and a further 18 percent indirectly caused by material exploitation and transport [VI]. At the same time, the low quality of indoor conditions will lead to health problems for workers in office buildings, thus reducing efficiency [V]. Building construction often uses 40% of the raw stone, gravel, and sand used annually worldwide, and 25% of the raw timber. The construction industry has a huge impact on the whole world from the viewpoint of the environmental impact [III]. A significant percentage of the urban environment represents residential structures, and the variety of materials and configurations is important for general sustainability.

To identify alternative sustainable building materials and low-technology approaches, significant efforts have been carried out by the academic community worldwide, leading to a more sustainable and accessible building that meets the comfort requirements expected today. An outstanding solution to achieving this aim is the use of green construction materials. In the sustainable development of a region, the collection of building materials that have minimal environmental burdens is useful. Construction-related contributions to environmental problems are thus significant and therefore necessary. An excellent way to improve the environmental efficiency of a house is to choose environmentally preferred building materials.

The energy use of commercial and residential buildings in various sectors is presented in Figures 1(a) and (b).

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II. Green Building Planning Concept and Strategies

In a greenhouse, the building structure is analyzed on an infrastructure based.
- Site planning.
- Envelope building architecture
- Design of building method.
- Ventilation heating and air conditioning (HVAC).
- Lighting, power, and water heating.
- Integration of renewable energy sources to generate energy onsite
- Governance of water and pollution.
- Ecologically sustainable content collection.
- Environmental standard indoors (maintain indoor thermal and visual comfort, and air quality).

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A. Basic Green Building Design Strategies

- Plan the orientation of the building carefully, so that smaller surfaces face east and west.
- Design of buffer areas such as balconies, equipment rooms and staircases on the east and west facades.
- Integrating screens to facilitate cooling of the building by natural ventilation and cross ventilation.
- Designing inclined windows on the south façade to prevent the windows from excessive sun radiation.
- To stop any gaps, such as the east and west windows.
- Using ceilings that mirror and carry the natural light deep into the building.
- Use green roofs and walls in green.
- Designing harvesting pits for rainwater to extract all rainwater from the site.
- Design of proper solid waste management for use as on-site fertilizer.

B. Characteristics Of Green Building

Building construction requires tremendous resources in ventilation, air-conditioning, appliance processes, etc. Green architecture, i.e. energy-efficient construction, will minimize energy consumption by at least 40 percent relative to conventional buildings. Compared to conventional buildings without energy conservation, the cost of designing energy-efficient buildings is expected to be 15 to 20 percent greater. This is, however, more than covered over the period, i.e. during the cost of the life cycle and function & living. The use of green building materials and components globally encourages the protection of non-renewable resources and also decreases the environmental effects associated with the transport, manufacturing, production, installation, reuse, recycling and disposal of these raw materials in the construction industry.

III. Advantages of Using Green Building Materials

Green construction materials give any or more of the following benefits to the building owner and building tenants:

- Reduced maintenance/replacement costs over the life of the building
- Energy conservation
- Improved occupant health and productivity
- Cost savings in the life cycle
- Lower cost associated with changing space configurations.
- Design flexibility will be more

A. Sustainable Development:

Sustainable development is described, according to the United Nations World Commission on Environment and Development, as "development that meets the needs of the present generation without understanding the ability of the future generation to meet its own needs."

Benefits for Building Owners
- Potential higher occupancy rates.

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B. Cost of Building Green

- Green buildings are usually considered to be much more costly and therefore not worth the additional expense than traditional buildings. Regarding the cost consequences of a greenhouse, extensive testing and study have been carried out. The price may be much higher than that of a traditional house.
- The incremental value is still proportional and depends on the level of eco-friendly attributes that are already taken into account during construction. If the baseline design is still at a certain degree of good eco-design, the incremental expense will appear small; if the base design has not considered green values, it will appear large.
- The second thing is to look at the incremental price concerning the cost of the life cycle.
- This type of approach could be informative. No one knows it will last for how many years, houses. The running cost will work out at 80-85% over its life span, while the additional cost, which is a one-time cost, is just around 8-10%. The marginal expense over the years is a declining pattern.

IV. Development of the Green Building

Green Building (GB) has become a modern building concept to minimize the effects of buildings during their life cycle, encouraging, among other things, the use of more environmentally sustainable materials, the introduction of techniques to conserve energy and eliminate waste use, and the enhancement of the quality of the indoor environment [VIII]. This could contribute to benefits that are natural, ecological, physical, and social. For example, operational and maintenance cost savings in GBs can be accomplished by the installation of high-efficiency lighting and insulation systems [IV] or through an effective material sourcing process that, for example, takes into account the reflection of the daylight roof [VII]. Other key benefits of GBs related to advances in the efficiency of the indoor atmosphere are the reduction in health costs and the rise in the productivity of employees [XII] by their perceived satisfaction with work areas [IX]. Also, intangible advantages such as the goodwill of the construction and contractor and the expected added value must be taken into account simply because they might direct investors' and potential owners' decisions [II]. GBs are not yet considered desirable projects despite their proven advantages since most builders compare green elements to costly cost-enhancing technology (e.g. photovoltaic panels, greywater reuse systems). Nevertheless, rather than a high investment in infrastructure, a cautious design

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procedure and a robust content sourcing system could be adequate to meet ideal environmental targets at a lower cost. In fact, some studies support an inadequate gap between the average cost of investment per square foot for some GBs, such as university buildings, hospitals, community centers and outpatient facilities, and the average return of capital per sq foot for non-green buildings with the same characteristics [XIII]. In comparison, in the long term, GBs have better dividends [IV] by restoring up to 10 times the green premium by recognizing the expected benefits [IX]. A GB's accomplishments will focus on the efficiency and efficacy of the green systems built. Therefore, a common approach is expected by the industry to differentiate GBs from conventional buildings through the use of normal, clear, objective and verifiable green initiatives to ensure that minimum green requirements are maintained.

A. Building Materials Problem

Usually, the material challenge for buildings takes many types. Green Energy and Pollution must be considered, as stated, and the manufacture of construction materials requires the use of higher-value energy and resources relative to building operations. The by-products of materials used in buildings also have environmental problems, and there are restrictions on the extraction of materials used in various building ingredients. Also, the facilities used to sustain the urban environment should be considered. There are plenty of technological advancements that need to be made to overcome the construction materials-related problems of resource scarcity, degradation, contamination, reliability, longevity, etc. Second, modern architecture has to be designed more sustainably so that it not only eliminates detrimental aspects of construction and operations but also mainly improves the lifespan of buildings, which can be achieved by removing increasingly redundant architectural elements. For recycling or raw material recovery, all required variables with minimum lifespans should also be planned. In all ways, this must be done by deliberately breaking down the complexities of the building into its elements and recognizing practically any trade-offs between interconnected structures to achieve a truly viable approach. Knowledge of the rapidly increasing variety of materials readily available for constructing buildings, enclosures and systems will support this. Finally, concerning the conclusion of a building's lifespan, the handling of the components must be highly closely regarded. During the construction process of any structure, where composites that are difficult to manage are reduced, this should be considered sooner. Materials that can be recycled directly without the need to remanufacture them should be used. They can be recycled as raw materials if they cannot be reused instantly. They can be used at the same degree of consistency if they are to be reused, thereby eradicating any down cycling or pollution.

B. Material selection

The main component in any high-performance design effort is the use of stable, desirable and environmentally friendly building materials. The use of sustainable and healthy materials adds to the well-being of the inhabitants and a sense of association with the natural world's abundance. Many construction materials have

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V. Constructing Eco-Friendly Building with Green Building Aspects

The following subject covers the entire considerations made in the experimented project to make an eco-friendly building using the green building method.

A. Foundation

While much can not be said for this aspect of the building as it depends on the priority concern of the soil conditions and protection of the building, it is advised to follow a foundation depth of 0.6 m for normal soil such as gravely soil, red soils etc. and use the un-coursed rubble masonry with the bond stones and good packaging. Similarly, the diameter of the base is rationalized to 0.6 m. The masonry must be thoroughly filled with cement mortar of 1:8 boulders and bond stones at intermittent intervals to eliminate crack forming in the foundation.

Fig.2 Foundation

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It is advised to dig the soil inwards before excavating the pits for the foundations, so that it will be ready where it is needed for infilling and some of the cost of excavation and infilling will be saved. In day-to-day building work, this practice is generally not practiced. It is recommended to use an under ream pile base in the case of black cotton and other soft soils, which saves around (20 percent to 25 percent) over the traditional construction process.

**B. Plinth**

Constructed with 1:6 cement mortar, a plinth 0.2 m above ground level was adopted. The conventionally supplied plinth slab of (100-150) mm was avoided and, in its place, impermeable blankets such as concrete slabs or stone slabs were given all over the building to minimize soil erosion and thereby prevent damage to the foundation surface and crack forming to take the required precautions. A plinth 0.2 m high above ground level, con-structured with 1:6 cement paste, was adopted. The conventionally supplied plinth layer of (100-150) mm was avoided and, in its place, impermeable blankets such as concrete slabs or stone slabs were given all over the building to minimize soil erosion and thereby prevent damage to the foundation surface and crack forming to take the required precautions.

**Fig. 3 Plinth**

**C. Rat-Trap Bond Walling**

This process was developed by the architect Laurie Baker and has been tried and proved in India over the past 40 years. By positioning the bricks on their ends, the rat-trap bond is laid with a cavity of (80-100) mm, with an altered path of stretchers and headers. In subsequent layers, the headers and gurneys are spaced to add additional weight to the walls. The key advantage of this bond is the brick economy, giving a wall of one brick thickness with fewer bricks than a solid bond.
The Main features of Rat-Trap Bond walls

- Strength is equal to the standard 230 mm. brick wall, but consumes 25% fewer bricks
- The overall saving on the cost of materials used for construction compared to the traditional 230 walls is about 26%.
- The air medium created between the layers of brick helps to retain good thermal comfort inside the house. For the tropical climate of South Asia and other hot nations, this phenomenon is especially beneficial.

Since construction is achieved by aligning the bricks with the flat plane faced outward on both sides, but in a few places, plastering is not required.

It is a cavity wall construction with thermal comfort applied to the benefit and the volume of bricks used for masonry work is minimized. It was possible to reduce the material cost of bricks by 25 percent and around (10 percent to 15 percent) in the masonry cost by following this form of bonding brick masonry relative to standard English or Flemish bond masonry. One can create an aesthetically appealing wall surface by following the Rat-Trap Bond system. Examine the thickness of the walls on the exterior doors or windows to decide if you have such a wall cavity.

1. Rat- Trap Bond Walling with Insulated Cavity Wall

Houses constructed before the 1930s had sturdy walls, so covering the void with new insulation methods for those walls with cavities would still help us only save money on fuel bills, but the temperature of our house will now be under regulation regardless of the exterior climate changes. The products used to fill wall cavity holes are often fiber-glass, cellulose insulation, and polyurethane or polystyrene foam, but here in this project, blow-in and foam cover insulation methods were used nuzzled between the two wall stages, which also helped prevent moisture in the bay. Between the walls, an opening is located or drilled and the insulation is pumped or blown in by mechanical means. The method was clean and very quick, and it was also very easy to install. The region that had previously been filled with air had been occupied, activating airflow and preventing the transmission of conventional heat. This mitigation proposal from decreased air circulation would also help keep homes colder in the winter, and so the insulation helped to keep cooler air.
inside throughout the summer. Moreover, CO2 levels have now been significantly decreased, encouraging a green approach to global warming. This has therefore proven to be one of the easiest and most cost-effective ways to make our house more energy-efficient, saving between 10 percent to 40 percent of the cost due to bills for home energy heating and air conditioning.

Fig. 5. Cavity in Wall

In the construction of walls all-round the building and 100 mm for inside walls, the wall thickness of 300 mm was provided in the present report. To build insulated walls, burnt bricks (which were soaked in water for 24 hours) were used. A wooden powder and other insulating material covered the cavity of the wall.

Fig. 6. Wall Cavity filled by wooden Powder

D. Doors and Windows

In the construction of walls, all around the buildings and 100 mm for inside walls, the wall thickness of 300 mm was provided throughout the present report. To build insulated walls, burnt bricks (which were soaked in water for 24 hours) were used. A wooden powder and other insulating material covered the cavity of the wall.

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The cavity was filled with wooden powder in the protected cavity wall building, so there were chances of fire due to the use of wooden materials through short circuits or some other unintended situation and even in case of heavy rainfall, chances of water infiltration also prevailed in the cavity. Hence, tiles were given on the outer and inner conditions to shield walls from certain dangerous conditions. Tiles also shielded the walls from coming into close contact with ambient heat, meaning that the temperature was decreased and also increasing the cooling results.

**E. Tiles on The Outer Face of The Wall**

RCC slabs are typically used for roofing residential buildings with a thickness of 12.5 cm. The roof can be level or inclined. But a green roof can be described as a building roof planted over a waterproofing membrane that is partially or fully covered with vegetation and with a rising medium.

Extra levels, such as root barriers, drainage and irrigation networks, can also be used.

For this experimental home, which served many functions for a structure, such as capturing rainwater, providing isolation, and helping lower urban air temperatures, the same green roof design was therefore used.

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*Fig. 7. Door Frame Fitting*

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VI. Observations and Analysis

A house built using traditional techniques and another experimental house built with a green roof and eco-friendly technology. The temperature measurements on both houses were taken and the observations found at the time of the experiment on typical and green buildings were reported:-

| OBSERVATIONS                        | TRADITIONAL BUILDING | GREEN BUILDING |
|-------------------------------------|----------------------|----------------|
| TEMPERATURE OUTSIDE NATURAL (32.0°C) | 31.4°C               | 29.3°C         |
| TEMPERATURE INCREASED BY LIGHTING (37.0°C) | 34.9°C               | 30.1°C         |

Fig. 8. Green Roof

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The Green Building has a difference of 2.1 degC for natural and 4.8 degC for lighting case in comparison to traditional building.

The reduction in temperature in natural (32.0°C) for the traditional building is 0.6 deg C and for green building is 2.7 deg C.

The reduction in temperature in lighting (37.0 deg C) for the traditional building is 2.1 deg C and for the green building is 6.9 deg C.

The above findings, therefore, suggest that, relative to the conventional building, a Green building would have decreased room temperature and have more cooling effect.

Thus, relative to the house built by the traditional process, the above readings greenhouse has a decreased indoor temperature.

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VII. Conclusion

At the time of the constant arrival to earth of UV rays, global warming and high emission levels. This green building approach, according to the above, will therefore prove very useful for mitigating excess heat over the season, lowering power demand, keeping the building sustainable and ensuring residents have a comfort level. A green building with a water collection system uses natural energy to reduce temperatures and increase groundwater levels, thereby minimizing the added costs necessary for the mechanical temperature regulation. The profit can be summarized as described below:

It removes CO2 and eliminates the impact of green buildings on the atmosphere. The plantation is also a fun appearance for the building and the surrounding areas. Sustainable construction materials are by definition local and developed materials that can slash transport and CO2 emissions, consist of reclaimed materials, are thermally tolerant, use less energy, use renewable energies, minimize toxic emissions and are less costly than conventional materials.

A stable building material must be used appropriately and in the context of urban development. In addition to lowering packaging, greenhouse emissions and materials costs in most cases, the use of recycled building materials often provides opportunities to enhance jobs and skills amongst city residents. It may take on the duty of the construction industry to promote sustainable growth, directly or indirectly producing a substantial proportion of its annual environmental degradation, by searching for environmental-friendly approaches for construction and maintenance. Recommendations for alternatives cover new materials, recyclability, reliable processing of products, or the use of solar energies.

Conflict of Interest:

There is no conflict of interest regarding this article

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