

Role of Building Materials in Procuring Sustainable Development

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1. INTRODUCTION

The remarkable 20th Century noticed the issues related to climate change for the first time and since then policymakers have been busy finding out ways and means of creating sustainable future. The agenda is to create safe natural environment. The Rio Earth Summit in 1992 explained sustainable development as, “development which fulfills current needs without compromising the capacity of future generations to fulfill theirs”. The concept of sustainable development is based on three principles:

- Consideration of the “Whole Life Cycle” of building material.
- Development of use of natural raw materials and renewable energy sources.
- Reduction in the materials and energy used in raw materials extraction, product use and destruction or recycling of waste.

Today the need for creating sustainable architecture has been identified worldwide. Building materials are a very important component without which wonders cannot be created. There lies a lot of scope in finding out the potential of building materials in creating sustainable architecture. Lot of materials have been identified as green building materials and they are playing a crucial role in creating sustainable architecture. The paper identifies some of the materials through case studies also to understand their importance.

2. NEED FOR STUDY

The sustainable development means allowing the people to live in a healthy and pollution free environment. Rapid growth in urbanization has taken the construction industry to new heights. The building construction in the world annually consumes 25% of the global wood harvest, 40% of stone sand and gravel and 16% of water. This construction Industry is a major contributor of CO₂ emissions. It generates 50% of the global output of Green House Gases. It is therefore important

to build sustainable buildings and one of the most important components of sustainable buildings is sustainable building material.

The construction industry is actively involved in carrying out the following activities:

- Production of building materials.
- Construction of building and its maintenance.
- The demolition of building after its useful life is over.

Careful selection of building materials can cut the cost and environmental hazards. The 11th Five year plan says that the construction Industry in India is the second largest after agriculture and largest employment generating sector. The building materials comprise of 40 - 60% of the total project cost. The building materials thus are a very important component and need due consideration before selection.

3. LIFE CYCLE OF BUILDING MATERIAL

Apart from structural and aesthetic properties a building material should satisfy the criteria of: energy efficiency, elimination of generated waste, low toxicity and water conservation. Any material can be considered as sustainable after it undergoes the following three stages:

- Preliminary research
- LCA (Life Cycle Assessment)
- Comparative analysis and selection

After gathering all the relevant technical information, all the material has to undergo Life Cycle Assessment. At this stage, the material is examined for its environmental impact right from the gathering of raw material to manufacturing, transportation, installation etc. The different phases of a material's life can be classified into three categories:

- Pre building Phase
- Building Phase
- Post building Phase

A careful study of these phases can help a lot in achieving sustainable architecture.

Pre Building Phase – This phase is related to the process of extraction, processing, manufacturing and transportation of the finished building material to the building site. Special measures should be taken here to reduce the waste production and pollution related to the manufacturing process. It is preferred to use naturally and locally available building materials. This reduces the Embodied Energy of the materials which is the amount of energy consumed to mine, manufacture and transport a particular product.

Building Phase – In this phase the construction work is going on the building site. The finished building material is to be assembled in the building structure. The goal here should be minimization of the construction waste, which means prior planning is very essential. Use of non-toxic or less toxic materials is advisable. Water needs to be conserved at every step. The maintenance and repair work is also a part of this phase. It is always preferred to use renewable sources of energy. Preference should be given to the choice of building materials with longer life and low maintenance.

Post Building Phase – This phase of the building starts after the useful life of the building is over and it becomes obsolete. It needs to be demolished. Pappu, Saxena et al presented in a study that a quantity of 14.5 million tons/year is generated as construction and demolition waste in India. If the planner has not been intelligent enough to make right choice of building material at planning stage then there is a problem here. The building materials should be so chosen that they can either be reused or recycled. Or in some cases they may be biodegradable also.

Table 1: Some of the building materials and their future prospect

Material	Source	Usage/Future Prospect
Concrete	Foundations, Lift wells	This concrete can be changed to other forms by downcycling and used as filler material/aggregate for road construction or in the foundation beds.
Ceramic tiles	Walls	These can be recycled further.
Timber	Doors and windows, frames	Reused as such or can be upcycled to various other products.
Steel	Sections of columns, reinforcement of sections, frames	Recycled and used again.
Brick	Walls and foundations	Can be reused as such or downcycled.
Gypsum	False ceilings	Can be recycled and used again.
Metals (nuts and bolts)	Mechanical fixing components	Reused as well as recycled.

Fixtures (WC etc.)	Services	Can be reused for further low cost construction, if removed safely.
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4. THE CONCEPT OF GREEN BUILDING MATERIAL

Any material can be said to have the properties of being Green if it satisfies at least one positive environmental characteristic. It is not always possible that the material satisfies all the characteristics. The majority of available green products have one or more of the following attributes:

- Promote good indoor air quality (typically through reduced emissions of VOCs)
- Durable and require little maintenance
- Incorporate recycled content
- Have been recycled from existing or demolished buildings
- Are made by using renewable resources
- Have low embodied energy
- Do not contain Chlorofluorocarbons, Hydrochlorofluorocarbons or other ozone depleting substances
- Obtained from local resources and manufacturers
- Recyclable
- Biodegradable etc.

5. CASE STUDY OF GREEN BUILDINGS

The following case studies have been selected and performed through the medium of secondary data, for the purpose of understanding the importance of right and thoughtful choice of building materials. The selected buildings have been rated by organizations like IGBC and GRIHA in India. The two case studies ITC Green Centre, Gurgaon and Transport Corporation of India, Delhi have been performed by secondary data collection and the study of

ITC Green Centre, Gurgaon

The building is Corporate Centre of ITC Business situated at Gurgaon. It was awarded LEED Platinum rating by IGBC. The data for this study has been collected by secondary resources.

- Over 40% of the building materials used in the construction of building was available within 800 km of the building site.
- More than 10% of the material used for woodwork was obtained or salvaged from other building site.
- Fly ash, which is a recycled material, was used in cement and concrete.
- The Autoclaved blocks, containing 55% fly ash were used.

- Over 10% of the construction material such as glass, ceramic tiles, steel and aluminium used in the building are recycled.
- The wood used in the building is Medium Density Fibreboard.

6. TRANSPORT CORPORATION OF INDIA, DELHI

The building is a corporate office building of the Transport Corporation of India located in Delhi. It has been rated by GRIHA. The data for this study has been collected by secondary resources.

- The energy is conserved through building fabric wall insulation in 25mm thick polyurethane foam protected by red sandstone slab cladding system.
- The roof insulation is 35mm thick and has a reflective glazed tile paving cover.
- Two layers of glass are used on daylight windows, with a venetian glass installed in between the two layers.
- The reduction of Embodied energy is achieved by use of less energy intensive materials. The material was chosen from the nearest possible source and should have been processed with minimum processing towards converting or installing it. This implies that there was a reduction in the Embodied energy.
- The material chosen for exteriors was undressed split red sandstone, with precast terrazzo sills and jambs.
- Flooring in the office areas was done with pre-polished granite from Jhansi, which was the nearest source available.
- The building was planned with a target of reducing the areas for glass and aluminum.

7. TRAUMA CENTRE, JNMC, AMU, ALIGARH

Ministry of Health and Family Welfare wanted to invest for Trauma Centre at the Jawaharlal Nehru Medical College, Aligarh. The project is not yet handed over to AMU, Aligarh but is on completion stage. It is targeted to achieve 3 star rating from GRIHA. The data for this study has been collected by primary resources.

- Fly ash is used in place of normal soil for filling purpose.
- All doors and windows have been constructed with recycled material.
- The plinth level of the newly constructed building is 3' higher than the surrounding buildings already existing in the Medical College, because there was a problem of water logging on site. Stone masonry was employed for construction of retaining walls instead of using RCC.
- Low VOC paints and sealants were used for health of occupants and environmental protection.
- Embodied energy was reduced by adopting low energy building materials. Brickwork was proposed for the building construction to reduce embodied energy. It was

not exposed red because of the general problem of efflorescence occurring on the surface of brickwork. On the contrary it was plastered and painted red to match the architecture of the other buildings of already existing campus of AMU.

8. CONCLUSION

The study shows that the building materials are on the world agenda and need to be planned carefully for making more green and sustainable buildings. The three phases of building material's life cycle; Pre building, Building and Post building Phase are crucial stages and need careful consideration. The material characteristics should be carefully well thought off during planning stage by the designer, right from its extraction as raw material to its processing, transportation, installation and demolition after its useful life is over. The recyclability, reusability and biodegradability are other important issues to be taken care off. The three case studies have also been presented to highlight, how the designer has been careful enough to choose various building materials and hence created Green building, which are successfully rated by reputed organizations like LEED IGBC and GRIHA. Right choice of material at the design stage can lead to solving of various environmental problems at later stage.

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