

Sustainable Construction Materials for Buildings

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Abstract: Sustainable construction is the way of adopting materials and products in building and construction that requires less use of natural resources and increases the usability of such materials and products for the same or similar purpose, thereby making reduction in waste generation as well. Moreover, sustainable construction technique enhances the resilience of the industry as such materials are readily available in the market. Steel and other metals, glass and prefabricated parts using combination of these, as well as recyclable alternatives for concrete are few examples of sustainable materials and products. Sustainable construction is to be started right with planning and design. So the roles of developers, builders and designers are pivotal. Nevertheless, as sustainable construction involves prefabricated products also, it would be helpful to assign relevant specialists and suppliers early in the design stage. Again implementation down the entire construction value chain is also necessary. There is a need for sharing and exchanging of knowledge and expertise in the design and the use of such materials. The capacity building and skill development in construction and installation are equally critical. From safety and quality point of view, the performance of such buildings and structures should remain high. In this paper, it is attempted to highlight the benefits and advantages of such materials and products for construction of buildings and structures.

I. INTRODUCTION

India is witnessing tremendous growth in infrastructure and construction development. The construction industry in India is one of the largest economic activities and is growing at an average rate of 9.5% as compared to the global average of 5%. As the sector is growing rapidly, preserving the environment poses a lot of challenges and at the same time presents opportunities. The construction sector therefore needs to play its role and contribute towards environmental responsibility.

II. BENEFITS AND ADVANTAGES OF STEEL

A. Strength and Lightness

Steel is found to be one of the highest strength to weight ratio of any construction materials. Steel framing weighs only one-third as much as conventional construction materials. A steel frame is stronger than traditional systems when it is connected by fasteners. This also offers saving in the foundation. Similarly dry walls are strong and yet lightweight. Drywalls are found to be only 10-15% of the weight of masonry walls, but they can support plasma TVs and kitchen cabinets just as well as conventional masonry walls.

B. Flexibility in Design

Because of its strength, steel can span greater distances offering larger open spaces and increased design flexibility without requiring intermediate columns or load bearing walls. For instance, an opening in a floor can be created by removing the desired number of steel beams with minimal hacking. Such flexibility also extends to dry walls.

Remodeling can be easily accomplished with non-load bearing drywalls. They can be readily relocated, removed or altered.

C. Better Construction Quality

Steel sections and joists are all manufactured according to international standards of strength and consistency under closely controlled conditions, resulting in uniform quality. No reworking is required at site. Moreover, steel does not suffer from creep or shrinkage and when properly protected, does not rot or decay. The other prefabricated components like drywalls are manufactured in factory under stringent quality control. The walls always are straight and smooth without the need of plastering.

D. Saving of Labour

Lightweight steel framing systems are generally simpler to erect than traditional systems. Once the workers are experienced with steel, labour time and costs will be reduced considerably. Again framing members are manufactured with pre-punched holes for running pipes and electrical wirings, minimizing preparation work for such arrangements.

E. Speedy Construction

Steel buildings can be erected in much shorter span of time in comparison to concrete buildings. The time saving in the construction period may be up to 40%.

F. Lesser Disruption

Steel construction can dramatically lessen the impact of building activities on the surrounding area. This is particularly important in city locations or sites close to residential areas. Steel construction minimizes dust, shortens the construction period and reduces waste generation.

G. Constructability

Most of the components for a steel framed building are prefabricated and pre-assembled in the factory. This lessens the amount of site work and increases the quality and precision of the site installation works.

H. Eco-friendly

Steel provides a clean, efficient and rapid construction method, which minimizes the impact of building activities on the environment. All steel products are 100% recyclable. Of late, 40% of steel is produced from recycled materials.

In modern construction, the key challenge is to make choice of materials that reduce burdens to the environment. The construction industry must recognize that developers, designers, builders and suppliers have a responsibility to develop systems, products and methods that are environmentally friendly.

After all, the construction industry needs to make a choice so as to ensure a better life for everyone now and for future generations, through the use eco-friendly materials that would minimize our dependence on non-renewal construction materials.

III. ADVANTAGES OF RECYCLING OF WASTE MATERIALS

For enhancing sustainability in the construction industry, wastes can be turned into resources to reduce disposal problems. A few types of wastes have been studied, such as spent copper slag fines which are residue from sand blasting and waste concrete from construction, renovation and demolition of old buildings.

A. Copper Slag

The application of copper slag in non-structural components like partition walls and roads has proven its efficiency as a sand replacement. For structural usage, the use of copper slag as partial replacement of sand in concrete is allowed for up to 10% by mass. Test has to be conducted to ensure that chloride and sulphate contents in the slag are within the allowable limits.

B. Construction, Renovation & Demolition Waste

Concrete from construction, renovation and demolition (CRD) of old building can be recycled. The researchers are currently conducting studies for local usages of such waste concrete. Nevertheless, the use of waste concrete for non-structural concrete components such as partition walls, road kerbs, paving blocks are possible. Such application has been proven to be efficient and economical.

IV. BENEFITS OF OTHER SUSTAINABLE BUILDING MATERIALS

A. Solar Tiles

As roof tiles are the most exposed portion to the sunlight that can absorb energy from the sun, so many companies are developing solar tiles as an alternative for conventional roof tiles. Unlike most solar units which are fixed on top of existing roofing, solar tiles are fully integrated into the building protecting it from the weather and generating power for its inhabitants.

B. Compressed Stabilized Earth Blocks (CSEB)

Compressed Stabilized Earth Blocks by natural soils suitable for making CSEBs increases their strength and durability.

C. Flyash Bricks

Flyash bricks are sometimes used in the construction of toilets and other field of low cost sectors.

D. Composting Toilets

A composting toilet is a dry toilet that uses a predominantly aerobic processing system that treats excreta, typically with no water or small volumes of flush water, via composting or managed aerobic decomposition. Composting toilets may be used as an alternative to flush toilets in situations where there is no suitable water supply or waste treatment facility available.

A few other green materials for buildings are flyash cement, flyash blocks, recycled aluminium, recycled tiles, low VOC paints, bamboo based products, recycled wood, high performance glass, waterless urinals, low VOC adhesive and sealants, CRI certified carpets, FSC certified wood etc.

V. CONCLUSION

Through adoption of sustainable construction techniques, we can do our part to optimize the use of natural resources via recycling and reuse of materials. This will also reduce our dependence on raw building materials, given the current disruption in the supply of concreting sand and granite for construction of buildings.

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