

Some Aspects of Sustainable Buildings for Hilly Regions

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Abstract – Today, there is a great need to save environment. Construction industry is responsible for appreciable contribution to environmental impacts after energy production and automobiles. Sustainable buildings can be seen as a good solution towards minimising this problem. Their construction and operation are environmental friendly. Here, various materials which have been used for sustainable construction in hilly regions are discussed. Problems faced by builders and contractors in construction of buildings in hilly regions regarding labour availability, transportation, random soil strata, time lapse in construction process, safety and health are certain factors that may lead to adaptation of sustainable construction practices. Emphasis is needed on fast and lightweight construction by using latest building materials and methods. Light weight steel superstructure, CAD software, drywalls, fibre cement boards, gypsum boards, thermocrete, etc. are required to earn more LEED credit points.

Index terms - green buildings, sustainable construction, time and money saving construction techniques, light weight steel, cement panels, sandwich panels, gypsum boards, thermal insulation.

1 Introduction

Time and money are crucial elements for builders and developers. A tremendous demand for eco-friendly or green buildings for the purpose of fast and sustainable buildings such as residential buildings, resorts, cottages, farm houses, industrial buildings, power projects which need to be put up in a tight schedule increase the use of smart building materials to save time and environment. The pace of Indian construction industry is fast and new technologies are replacing old and laid back building materials like brick work and mortar. Construction in mountain regions is more difficult as compared to the plains. Difficulties due to hilly terrain, different types of rock and soil strata make it difficult for contractors to execute construction work. Accessibility, carriage cost, storage of materials, quality management, climatic conditions, shortage of labor and high cost of labor in these regions is now a major setback to the construction industry in hilly regions. Therefore, the sustainable buildings with fast and innovative construction practices are the need for hilly terrains.

As per Indian Green Buildings Council (IBGC), “green building is one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building.” According to LEED-India (Leadership in Energy and Environmental Design), there are 150 LEED registered and 23 LEED certified green buildings in India, with Mumbai on the top with 44 buildings registered. None of these include buildings in hilly regions. There is a need to develop green buildings in mountain regions.

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2 Need for sustainable construction

Present trends indicate that global consumption patterns are unsustainable. There is a dire need to address concerns of loss of bio-diversity, depleting natural resources and climate change. One thing is certain though that it will take a combination of technological advances and significant lifestyle changes to restore the balance. There is no doubt that new technology advancements directly address these global challenges, which will lead the way in the future. But, the consumers are not expected to choose a product simply because it meets the criteria of sustainability. Rather quality, value addition and attractive pricing must be in excitably linked to the idea of sustainability to make green products a smart choice for the consumer.

Traditional construction practices have now chosen the path of innovation. It has led to new technology sustainable solutions. A range of green building practices is destined to be a game changer in the construction, architecture and interior designing businesses. Green buildings solutions range of sustainable material are a result of cutting edge research, a keen understanding of consumer needs and its responsibility towards the environment. These world class technology alternatives are ideas for a brave new world. They set new global standards with their aesthetic appeal, exceptional functionality and extreme durability. It is not just an answer to the universal problem of depleting natural resources. The use of these revolutionary products could transform the way the construction industry does business.

3 Green building materials for hilly regions

The design which is mentioned here is innovative, fast, light-weight and involves sustainable building construction. There would be no concrete mixers, no cement, sand, bricks, aggregates, form work, shuttering at the construction site. Few of the materials and construction practices are given below.

3.1 Steel construction

For hilly regions, steel buildings are to be preferred for quality, cost efficiency and speed of erection for building constructions. The ease with light weight steel buildings lies in the fact that they are computer-based designed and computer-controlled manufactured. This is cost effective alternative to traditional brick-mortar and has an advantage over conventional building in terms of quality, cost, durability and speed. Light steel-frame building consists of structural wall frames and roof trusses manufactured from cold-formed galvanized or Zinc Aluminum structural steel sections. Various interior and exterior cladding options ensure that almost any style of building can be achieved. Electrical and plumbing considerations are essentially encompassed within the framework of the cladding. Reduced wastage, lower logistical costs and reduced time of construction could offer cost savings of 15% or more, compared with conventional building. Steel framing has many advantages over conventional brick and timber structures. A completed house using an internal steel frame, typically clad with exposed face brick or painted plastered finishes, is virtually indistinguishable from homes built using conventional South African techniques. It is also estimated that steel framing saves up substantially on building costs, mainly owing to reducing construction duration and eliminating a large portion of inefficient site labour. The client saves owing to reduced damage clean-up cost, holding charges and ongoing mortgage costs. Figure 1(a) shows a building under construction and 1(b) after it is completed.



Figure 1. Steel frame under fabrication and a completed house on a slope.

Quality is another aspect that differentiates steel framing from conventional building methods. Steel frames are produced only from computer-aided design (CAD) software, which ensures that all elements of the home conform to the designer's plans and also allows optimum design freedom. Steel does not sag or rot over time and represents a significant improvement in quality over existing timber roof-framing systems. In addition, steel framing also has some environmental benefits. Steel is a reusable resource and steel frames can be erected in environmentally sensitive areas with minimal impact. It is interesting to point out that lightweight steel-framing systems offer similar environmental performance over the life of the product to that of conventional double-brick construction techniques. The steel frame walls are load bearing and thus eliminate any need of wet masonry work on site. The internal walls are usually clad using gypsum boards or gypsum boards over cement board in case additional strength is needed. Other less conventional options can be aluminum composite panels, metal sheets or wood panels. For external walls options are cement boards, fiber cement sidings, brick veneer or stone finish. The homes are insulated using insulated material like rock wool, glass wool inside the wall cavities and on the roof. The roofing options include colored metal sheet, decrabond tiles, and terra cotta tiles.

3.2 Cement-wood-boards

Cement bonded particle boards made out of cement and wood is also a green material. The wood used is of fast growing species like eucalyptus and casuarinas. Due to adoption of special manufacturing process, the panel acquires the strength and durability of cement and easy workability of wood. These sustainable boards are fire resistant, weather resistant, termite resistant, sound insulated, dimensionally stable, smooth surface, wood workability, chemically stable. They can be used for fixed furniture and wardrobes, false ceilings, lamination, kitchens, flooring, partitions and work stations.

3.3 Sandwich panels

These panels possess all the benefits of masonry wall, but are pure dry fixing system which provides a clean and safe working site condition due to its light weight, strength, durability, water and termite proof, thermal insulation and for fire resistance features. These panels comprise two thick boards (fiber reinforced cement sheets) which do not contain asbestos enclosing with weather core that is light weight concrete mix of Portland cement, expanded polystyrene bead aggregates and admixture. These panels have special semicircular tongue and

groove jointing system which provides rapid installation with minimal disruption of work. False ceilings, Wall paneling, Mezzanine flooring, Structural glazing back lining and Wall partitions efficiency of this products application is truly unbeatable. Other sandwich panel of two fiber-reinforced cement sheets enclosing a light weight core composed of Portland cement, binders and a mix of siliceous and micaceous material aggregates. These are fully cured at factory and are ready for installation.

3.4 Aerated concrete panels

These are made of a mixture of fine fly ash, together with lime, gypsum and cement as binding agents, water and aluminium powder acting as foaming agent. These can be used in high rise claddings for overcoming the masonry difficulties such as brick by brick construction, plastering and curing.



Figure 2. Panels used as walls.

3.5 Gypsum plasterboards

Gypsum plasterboards and special boards are the ultimate lining solution for today's buildings, providing high levels of performance in terms of fire rating, acoustic and thermal insulation, and moisture resistance to create modern internal environments that offer comfort and safety for occupants. They offer superior aesthetically inspiring solutions for walls, ceilings, lift shafts, stairwells and corridors in buildings as diverse as residential, schools, hospitals, offices, cinemas and hotels. Gypsum plasterboard construction for walls is also called dry wall construction, implying no water usage. So there is typically 100% water conservation during the construction process compared to any masonry process. Gypsum plaster boards, gypsum plasters, ceilings panels and jointing compounds all have substantial degrees of post consumer and post industrial recycle content. Exact contents vary depending on the plants and products. Figure 2 illustrates panels and boards being used as walls.

4 Thermal insulation for green buildings

Thermal insulations for green buildings reduces energy consumption by up to 30%, zero ozone depleting potential, minimum voc, excellent fire properties, uses abundant and renewable raw materials. Glass wool insulation is one of the most widely used insulation forms of insulation world-wide because of its excellent thermal and acoustic insulation properties, light weight, high tensile and exceptional resilience. Glass wool is the most dominant type of insulation used in applications with services temperatures between -50°C to $+250^{\circ}\text{C}$. Glass wool insulation

consists of fine, long, inorganic fibres bonded together by a high temperature binder. The fibers are distributed in such a way as to traps millions of tiny pockets of air in the product, thereby creating its excellent thermal and acoustic properties. The product is light gold in colour and its superior tensile strength and resilience makes the product ideal for applications in which there will be vibration, jolting or high compression. The light weight and handle ability of glass wool also offers significant advantages during transport and installation. In addition, glass wool is chemically inert and has no properties such as iron shots, sulphur chloride. The product is non corrosive to metal and does not support any mold growth.

Electrical under-floor heating is the preferred method of heating for tiled and wooden laminated in concrete and stone floor areas indoors and now even outdoors for houses. Its works faster, is easier to install and is less expensive than nearly all other forms of heating.

5 Roofing and cladding

Corrugated tiles are designed to give roofs a pleasant look reminiscent of traditional clay tiles, while at the same time being extremely light. Tiles are made of a single layer of organic fibers and bitumen combined with resin. A unique coating of zinc-aluminum combination provides the highest level of corrosion resistance. These sheets are ideal for roofing and cladding all kinds of constructions.

Polyurethane is an upcoming construction material available in different forms used for void fillings, air sealing, glazing, connection joints metal fabrication, and flooring, etc.

6 Concluding remarks

Where time is a critical element, conventional building materials may be undesirable. Simply because brick and mortar construction is by its nature, time consuming and requires long lead time for curing. Green building is a representative of sustainable building environments. This approach ensures health and comfort of the building occupants through the use of sustainable building materials. New technology methods save energy and environment as these have high insulating properties, low embodied energy, reduced environmental impact due to local transportation, high recycled content, improved indoor air quality and water efficiency (dry construction).

Steel frame work, thermal insulations with different types of glass wools or fibers, interior and exterior cladding with different types of eco-friendly boards, roofing with fibrous and bitumen materials contribute highly towards a faster and energy-efficient construction practice. Time saving is surely a cost saving move and thus going to be a breakthrough in the construction of buildings in hilly regions, in coming days.

7 References

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