

Sustainable Construction with Cost Reduction Methods

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Abstract: “Sustainable construction” the concept of sustainability embraces the preservation of the environment as well as critical development-related issues such as the efficient use of resources, continual social progress, stable economic growth, and the eradication of poverty. Thus the concept of Green building evolved (also known as green construction or sustainable building) which refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: from sitting to design, construction, operation, maintenance, renovation, and demolition. In this study a comparison will be made between convectional construction methods and low cost housing methods by review and studying definitions and concepts of sustainability in building and architecture sector, as sustainable design, architecture and construction. Also, some aspects and main categories of sustainability in architecture and building are presented with scoring points for GRIHA.

Keywords: Sustainable, green building, nonrenewable resources, GRIHA

1. INTRODUCTION

By Sustainable construction we mean Capable of being continued with minimal long-term effect on the environment. Environmentally Sustainable means low embodied energy and minimum operational energy, Embodied energy includes manufacture and transportation of building materials, construction on site etc. Sustainable and low cost housing is a new concept which deals with effective budgeting and fallowing techniques which help in reducing the cost of construction through locally available materials along with improved skills and technology without sacrificing the strength, performance and life of a structure

Now question arises what is the need for Sustainable low cost construction?

1) **Sustainability issues**- India makes up 2.4 percent of the world's land, while supporting 16 percent of the world's population. Thus the compounding result is a severely unsustainable use of natural resources which is happening for several generations. Currently, India is experiencing rapid and widespread environmental degradation at alarming rates. Tremendous pressure is placed upon the country's land and natural resources to support the massive overpopulation.

2). **Safe and affordable Cost of construction-** Now a day the cost of construction is increasing day by day. Every construction material like cement, brick, late rite and labor charges are increasing. Thus In this situation we feel the need of a low cost housing material is important.

For construction of any Building cost can be divided into two parts namely:

- 1) Building material cost: 65 to 70 %
- 2) Labor cost: 65% to 70% (in low cost housing cost of reduction is achieved by selection of more efficient material and improved design)

Ways by which reduction in cost can be achieved

Cost reduction by proper planning.

By Proper planning we mean consulting a good structural engineer for safe structure with durable and low cost material. A structural engineer can reduce the unnecessary cost and optimum utilization of space. Reduce plinth area by using thinner wall concept Ex.15cms thick solid concrete block wall. Using alternate low cost material like soil cement blocks in case of burnt bricks use environmentally friendly substitute like R.C.C door steel door, plastic door instead of wooden will reduces the cost all these substitutes are used in construction without comprising with the strength of structure.

Preparation of low cost plan model

At Preparation level itself rationalization of building dimensions can help us to reduce the cost of rooms and boundary wall to great extend. For ex. The boundary wall length will be shorter for square plot compared to rectangular or triangular plot. Similarly to room design also by planning a square room, the cost of brickwork, plastering, wall base and paint will less.

Cost comparison with techniques to construct sustainable low cost housing along with scoring points for GRIHA (**GRIHA**, stands for **Green Rating for Integrated Habitat Assessment**, is the National Rating System of India. GRIHA is an agency which attempts to minimize a building's resource consumption, waste generation, and overall ecological impact to within certain nationally acceptable limits / benchmarks. Its main purpose is to evaluate the environmental performance of a building holistically over its entire life cycle, thereby providing a definitive standard for what constitutes a green building. its rating systems are based on accepted energy and environmental principles, which will seek to strike a balance between the established practices and emerging concepts, both national and international.

Conventional construction methods	low cost construction with GRIHA Criteria
<p>Foundation- Normally cost comes to about 10 to 15 % of total cost of construction by conventional methods of construction.</p>	<p>Foundation-If instead of conventional footing we opt for an arch foundation in ordinary soil cost reduction can be 40%, In case of black cotton soft soils under reamed pile can be used which saves 20 to 25 % in cost of construction</p> <p>GRIHA-It satisfies Criterion 4 (which states that design which should include existing site features)</p>
<p>Walling- Normally 6 to 9” thick walls are constructed with burnt bricks in English or Flemish bond overall cost is 5 to 10% of total cost of construction.</p>	<p>Walling- instead we can opt for:1) Rat –trap bond wall-it is a cavity wall construction with added advantage of thermal comfort and reduction in the quantity of bricks an overall saving of material cost by 25% and 10 to 15% in masonry cost</p> <p>2) concrete flyash block walling/ Soil cement block technology– since high energy is consumed by burnt brick it is suggested to use concrete block (block hollow and solid) which consumes about only 1/3 of the energy of the burnt bricks in its production or we can use concrete block masonry by which we can reduce the wall thickness from 20 cms to 15 Cms. Concrete block masonry not only saves mortar consumption, speedy construction of wall resulting in higher output of labour, plastering can be avoided thereby an overall saving of 10 to 25% can be achieved</p> <p>Griha-It satisfies following Criterion9: which states to Reduce air pollution during construction</p> <p>Criterion 15 which emphasizes on use of flyash</p>

	<p>in the building structure;</p> <p>Criterion 16: which suggests to Reduce volume, weight, and time of construction by adopting an efficient technology</p> <p>Criterion 18: which emphasizes on Renewable energy utilization</p>
<p>Doors and windows-By conventional materials like wood Cost normally comes around 5-6 % of total cost of construction</p>	<p>Door windows-It is suggested not to use wood for doors and windows and in its place concrete or steel section frames shall be used for achieving saving in cost up to 30 to 40%.Similarly for shutters commercially available block boards, fiber or wooden practical boards etc., can be used for reducing the cost by about 25%.By adopting brick jelly work and precast components effective ventilation could be provided to the building and also the construction cost could be saved up to 50% over the window components.</p> <p>Griha- it satisfies this Criterion 16: which emphasis is on Reduction in volume, weight, and time of construction by adopting an efficient technology.</p>
<p>Lintels and Chajjas- RCC lintels and chajjas Costs upto 2 to 3 % total cost of construction.</p>	<p>Lintels and Chajjas- it is suggested that instead of traditional R.C.C. lintels which are costly can be replaced by brick arches for small spans and save construction cost up to 30 to 40% .By adopting arches of different shapes a good architectural pleasing appearance can be given to the external wall surfaces of the brick masonry</p> <p>Griha- It satisfies Criterion 4: which suggests to design to include existing site features.</p>

	<p>Criterion 16:emphasis is on how to Reduce volume, weight, and time of construction by adopting an efficient technology</p>
<p>Roofing- Normally 5" thick R.C.C. slabs is used for roofing of residential buildings costs upto 15 to 20 % of total cost of construction</p>	<p>Roofing-It is suggested that By adopting rationally designed in situ construction practices like filler slab and precast elements the construction cost of roofing can be reduced by about 20 to 25%.</p> <p>Griha-it satisfies fallowing Criterion 9: To Reduce air pollution during construction</p> <p>Criterion 15 Use of fly ash in the building structure;</p> <p>Criterion 16: To Reduce volume, weight, and time of construction by adopting an efficient technology</p> <p>Criterion 18: To use Renewable energy</p>

Thus after looking at various alternative methods of sustainable low cost construction we can conclude.

2. CONCLUSION

Whether Can we design a green building? Does it cost more than a conventional building?

The answer to above question is Yes we can easily design a green building, by integrating resource-efficient features into building design from the pre-design stage itself and also by ensuring that the architects engineers and contractors fallow established environment principles addressing local needs, designing a green building is easy and at times it may cost lesser than a conventional building: The stage wise steps that we can fallow are:

Steps

- 1) We need to adopt an integrated design approach such that the client, architect, engineers, and consultants design the building in a coordinated manner with a common goal – sustainability.

- 2) By following regional development plans (such as the UDPFI guidelines, master plans) and local building by-laws
- 3) By following India's national codes and standards
- 4) By optimizing site conditions (trees, water bodies, wind-flow, orientation, etc.) and harnessing them to cater to the thermal / visual comfort requirements of the building
- 5) By adopting sound architectural practices and taking examples from India's traditional architecture
- 6) By adopting locally available construction materials and giving impetus to local arts, crafts, architecture and artisans
- 7) By designing precisely-sized energy systems and not basing them on broad thumb-rules
- 8) By reducing the resource consumption of the building and its inhabitants so that the waste generating there-from is reduced
- 9) By adopting energy efficient technologies (EETs) and equipment
- 10) By adopting renewable energy technology (RETs) applications to reduce the demand on conventional Energy.

Literature review

Amit Bandyopadhyay, RA, AIA, Bahar Zoghi, Ph.D., PE State University of New York – College of Technology at Farmingdale in their paper titled Sustainable Construction – An Education and Research Perspective they have emphasized on how LEED (Leadership in Energy and Environmental Design) criteria are used in various sustainable courses in US and how it could be integrated in a construction management program. Prof. Ambrose A. Adebayo in his paper on the topic Sustainable Construction In Africa have tried to explain how African countries are facing problems in terms of sustainable construction. The conflict between theory and practice is highlighted as is the misconception of sustainable construction in Africa relative to the level of development in different countries.

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