International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 5 ǁ 2022 ǁ PP. 128-133

Environment Friendly Indian Building Materials for Cost Effective Housing

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Abstract— *Since economical factors have influenced the construction industry dramatically in recent years and in many parts of the world steel is scarce and expensive, many researchers are searching for low-cost materials as a substitute or alternative for the present situation. Recently, various materials have shown promise for future use as a major construction material. The purpose of this report is to highlight alternative low-cost building materials for possible use in low-cost housing having advantages on areas such as India where concrete or steel housing is expensive. Affordable housing projects are characterized by an increasing demand mainly due to urbanization. The selection of building materials should meet the needs of local conditions to improve quality of life for the most needed ones by building new structures and/or by improving existing structures..*

Key words: *Environment friendly, bamboo, building materials*

Date of Submission: 15-05-2022 Date of acceptance: 30-05-2022

I. INTRODUCTION:

Growing urbanization has led to migration towards cities and resulted in an increased demand for affordable low-cost housing. Moreover, with sustainability gaining momentum, there is a need to balance both energy consumption and the environmental impact of materials used for building houses. Low-cost building materials not only increase access to permanent housing for people from low and middle-income groups but also contributes towards sustainability, particularly when locally available building material is used.

The materials commonly used for modern low-cost construction are hollow concrete blocks, bamboo, extruded clay bricks, compressed earth bricks, concrete panels, along with non-conventional materials like polymers and recycled composite blocks, as they can reduce construction time by half.

What are Conventional Building Materials?

Conventional building materials are those materials that have been traditionally used to make buildings, monuments, structures, etc. They are defined by the term conventional because these materials are what people tend to use the most, and it has been that way for many years.

What are Environment-friendly materials ?

environmentally friendly building materials that have risen to recent popularity due to the rising environmental sustainability issues. Alternative building materials have been named so because they have become an alternative solution to the conventional building materials that have been used over centuries.

Why Environment-friendly materials?

Phenomenal growth in the construction industry that depends upon depletable resources.
Production of building materials leads to irreversible environmental impacts.
Using eco-friendly materials is the best way to build a eco-friendly building.

There are properties of Environment-friendly materials are:

Local availability
Renewable source -Rapidly renewable sources
Biodegradable
Reuse of waste product
Reuse recycle
Aids energy efficiency in building
Reduction in air, land and water pollution- Air Pollution Use of materials with low VOC emissions e.g. Cement, Paints
Durability and lifespan

II. OBJECTIVES:

The objectives of the project are to:

1. Comparison of conventional and environment friendly building materials.
2. Analysis the cost difference for the construction of building projects of environmental friendly building materials against the conventional building materials.
3. Identifying the most eco-friendly building materials for construction.

III. LITERATURE REVIEW:

1. "Environment Friendly Indian Building Material for Cost Effective Housing"
Society For Excellence In Habitat Development Environment Protection and Employment Generation (SHEE), 2019.
This research includes variety of production technologies of building materials as developed and practiced in India. These technologies utilize locally available raw materials, waste and by-products from industry, agriculture and natural fibers.

2."Meeting Global Housing Needs with Low-Carbon Materials"
Christina Cheong and Donovan Storey, 2019.
This report proposes the greater use of low-carbon building materials in addressing the low cost housing gap in cities . In recent decades, building materials have predominantly been concrete and steel. However, the high embodied energies of these materials demonstrate the unsustainable environmental cost of meeting the global housing need with such conventional materials. This study highlights some low-carbon alternatives which can be used for low-cost housing construction. In the selection of building materials, design, location and local specificities must be considered holistically from the very early stage of any project.

3. "Cost Estimation of a Building using Cost Effective Building Materials"
Vishal Kumar S D, Syed Nehal Hussain Ozair, Zaid Ur Rahman Sindhe, Afnan Ur Raheman Sindhe, Syed Ruman Ali Aamer,2019.
This project reviews the cost effective construction materials and techniques for building design in the field of civil engineering. In this project the plot size is 40'x60' or 12.2mx18.28m. Accordingly the building has been laid in the centre of the plot leaving ample space on all the sides for land scaping and pathways for cars and for parking. The total reduction in cost by using cost effective building material is Rs 916650. It is observed that using AAC Blocks, HVFAC and Vitrified tiles 26.03% of total project cost can be reduced. Addition of 50% fly ash reduces 7day strength by about 20% when compared to control mix. But it acquires strength almost equal to that of control mix at 28 days and attained higher strength thereafter.

4. "A Comparative Study on Sustainable Building Construction With Conventional"
Vishnu Vijayan, Geethu Elsa Thomas,Athira Madhu A,Devipriya P, Teena Thomas, 2018.
This paper aimed to make comparative study of practice of Reinforced cement concrete framed structure with traditional material and using other new eco-friendly material.

5. "Sustainable Building Materials for Low Cost Housing and Challenges Facing there Technological Developments"
Bredenoord, 2017.
This article provides information on the use of building materials for low-cost housing in developing countries, specifically materials that can be seen as 'sustainable'. Promising Building Materials for Low-cost Housing Construction The construction aspect must always be well attended, meaning it requires adequate foundations and structures. Below, attention is given to the following five groups of building materials. 1. Bamboo and timber 2. Compressed earth bricks/blocks 3. Adobe blocks 4. Interlocking blocks of recycled materials 5. Improved concrete panels.
All of the building materials described above is sustainable in a certain way. The possible applications of these materials depend on local and regional circumstances. In each country or region, the specific conditions of the soil and the plants and trees, etc., can be examined, to find suitable soil for bricks and plants (bamboo, etc.) for the making of building materials.

6. "Low Cost Building Material"
Prof. Chaure A.P , Prof. Shinde P.A , Prof. Khotkar R.G, Prof. Raut H.M ,Prof.Dudal P.D , 2017.
This report mainly focus on low cost building materials in cost effective housing for a group of people within a specified income range.
Materials :Rubber -Tire Veneer; Insultion- Straw and Resin Panels, Flax Insulation,Wood Fiber Insulation;

Grancret; Concrete/ cement;Rice husk ash/ Pozzolanas; Cannabrick; Syndecrete; Textiles.
In a building the foundation, walls, doors and windows, floors and roofs are the most important components, which can be analyzed individually based on the needs thus, improving the speed of construction and reducing the construction cost.

MARKET SURVEY OF MATERIALS IN PUNE REGION:
List of some conventional building materials:

Materials	**Average Cost**
Cement	463.1/- per 50 kg bag
River Sand	5445/- per tonne
Medium Sand	4247.1/- per tonne
Bricks	11/- per unit
Cement Blocks	27.5/- per unit
Gravel	25.3/- per kg
TMT Steel	62013.6/- per tonne
Granite	181.7/- per square feet
Marble	501.4/- per square feet
Tiles	75/- per tile

List of some environment friendly materials:

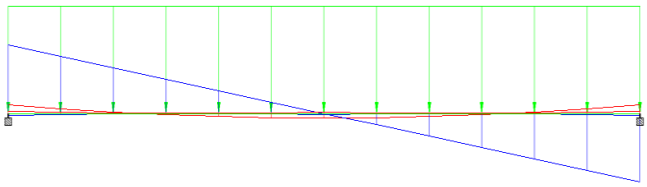
Materials	**Average Cost**
Bamboo Mat Board for ceiling (4mm Thick)	47/- per square feet
20 feet bamboo poles	40/- per piece
Brown bamboo profile sheets(3 mm)	125/- per kg
Paddy Straw, (Pack Size 51*39*27 Inch)	8500/- per tonne
Fly Ash Bricks (9*4.5*3)	6/- per piece
Recycled steel	40/- per kg
Cow Dung Bricks	10/- per unit
Plastic waste and fly ash bricks	4.8/- per unit
Eco Friendly clay brick	2.5/- per piece

From above market rate tables of conventional & environment friendly materials, we can conclude that most of the environment friendly materials are cheaper than conventional building materials.

COMPARISON BETWEEN CONVENTIONAL AND ENVIRONMENT FRIENDLY BUILDING MATERIALS:

Parameters of Comparison	**Conventional Building Materials**	**Alternative Building Materials**
Flooring	Uses concrete flooring.	Uses wood flooring.
Concrete	Uses cement and other substances harmful to the environment.	Uses 'green concrete', which contains recycled items also can use ferrock as alternative for concrete.
Aim	Does not have any environmental goals.	Aims to reduce environmental pollution.
Reinforcement	Steel reinforcement.	Bamboo reinforcement.
Wall System	Brick walls.	Walls are made of straw or bale.
Roofing	Concrete and steel	Coconut leaf Thatch or bamboo roofing or recycled steel.

MATERIAL ANALYSIS USING STAAD PRO:

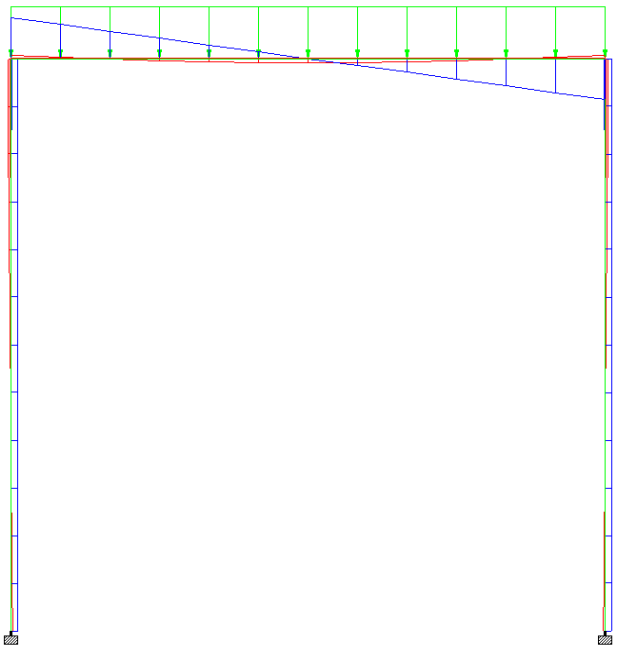


Part A(Beam):
Analytical results for
1. Concrete beam:
Shear Strength of concrete is 44.8873 KN at ends , bending strength is 132.33997 Kip-in and deflection is 0.051 inch at 2 m. distance.

2. Timber beam:
Shear strength of timber beam is 40.8130 KN at ends, bending strength is 120.4089 Kip-in and deflection is 0.0973 inch at 2 m. distance.

3. Bamboo beam:
Shear Strength of bamboo beam is 42.3537 KN at ends , bending strength is 124.9542 and deflection is 0.0522 inch at 2 m. distance.

Part B(Column):



1. Concrete column:
Shear strength of concrete column is 7.4117 KN , bending strength is 44.5333 and deflection is 0.0026 inch at 2 m. distance.

2. Timber column:
Shear strength of timber beam is 6.7414 KN, bending strength is 40.4950 Kip-in and deflection is 0.0046 inch at 2 m. distance

3. Bamboo column:
Shear strength of bamboo column is 7.0166 KN, bending strength is 41.9015 and deflection is 0.0025 inch at 2 m. distance.

Comparison Table:
Part A(Beam):

Materials	Distan.ce(m)	Shear(KN)	Bending(Kip-in)	Deflection(inch)
Concrete Beam	0 m 2 m 4 m	44.8773 0.0000 -44.8773	264.7993 -132.3997 264.7993	0.0000 -0.051 0.0000
Timber Beam	0 m 2 m 4 m	40.8130 0.0000 -40.8130	240.8178 -120.4089 240.8178	0.0000 -0.0973 0.0000
Bamboo Beam	0 m 2 m 4 m	42.3537 0.0000 -42.3537	249.9085 -124.9542 249.9085	0.0000 -0.0522 0.0000

Part B(Column):

Materials	Distance(m)	Shear(KN)	Bending(Kip-in)	Deflection(inch)
Concrete Column	0 m 2 m 4 m	7.4117 7.4117 7.4117	175.7327 44.5333 -86.6660	-0.0052 -0.0026 0.0000
Timber Column	0 m 2 m 4 m	6.7414 6.7414 6.7414	159.8279 40.4950 -78.8380	-0.0092 -0.0046 0.0000
Bamboo Column	0 m 2 m 4 m	7.0166 7.0166 7.0166	166.1055 41.9015 -82.3025	-0.0051 -0.0025 0.0000

From above , analytical results of beams and columns, we can conclude that concrete has more shear and bending strength than timber and bamboo, bamboo and concrete has nearly same deflection. Bamboo and timber can be used as alternative for concrete because they don't have much difference in bending strength , shear strength and deflection.

IV. CONCLUSION:

The main difference between conventional and alternative building materials is that conventional building materials use non-recycled products that cause harm to the environment, while alternative building materials use recycled products, hence they are environmentally preferable. The conventional building material for flooring is cement, while that for alternative building materials is wood. Alternative building materials aim to reduce environmental pollution, while conventional building materials have no such aim. Conventional building materials use steel reinforcements, while alternative uses bamboo. Conventional building materials have brick walls, while alternative building materials have walls made of straw.

When we compare both conventional and environmental materials in economical manner , low cost house built by using environment friendly building materials is suitable and sustainable for particular income class people.

From analytical results ,we can conclude that environment friendly materials are best alternative for conventional building materials.

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