A COMPARATIVE STUDY ON SUSTAINABLE BUILDING CONSTRUCTION WITH CONVENTIONAL RESIDENTIAL BUILDING

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Abstract
This project is deals with sustainable construction aspects in residential building. For this, there is a huge demand for affordable urban housing developments by using locally available building materials. Sustainable houses can reduce the impact of buildings on the environment. It protects the environment, climate and the natural resources. So specific materials that could be meeti ng the minimum requirement are considered in the project. In general the use of concrete is not a sustainable one it consumed plenty of energy during the production and manufacturing of cement and its constituent as well as the construction stages. However the relevance of building constructed by using sustainable materials are vital in the point of environmental aspects as well as technical aspects.
The main focus of the project is to develop life cycle data and cost analysis to investigate the feasibility of a sustainable residential structure constructed mainly using mud instead of traditional residential structure.
Keywords: Mud building, Sustainable materials, Material testing, Cost effective construction

1.INTRODUCTION

In India various tremendous environmental problem are rising in construction industry due to leading urbanization. Increase in demand of houses which lead to consumes more energy, resources and raw materials which are responsible for the rise in carbon content in air and which are harmful to environment and human health. Nowadays we are facing various environmental impacts due to which we need to build with more sustainable materials which will lead to reduction of impacts on environment. Buildings are actually responsible for maximum resource consumption therefore green building is only solution to the present trend of construction. Green building is described as people with healthy, comfortable and safe living, working and activities of the space, while the building full life cycle (material production, construction planning, design, construction, operation and maintenance) process to achieve efficient use of resources (energy, disabilities, the water, materials) with minimum impact on the environment of buildings, also known as sustainable building envelope.

A sustainable shelter is inevitable for a greener future. Earlier people lived in houses constructed by themselves using locally available materials in nature. Thus mud, a soft, sticky matter resulting from the mixing of earth and water became the most common material for construction. Mud was being used either in its raw nature for wall construction or in the form of mud blocks. The potential of mud as a building material is examined through this project.

1.2 OBJECTIVES OF PROJECT

The major of the objectives of the projects are:

1. To develop a building using locally available resources without adversely affecting the environment.
2. To compare the construction cost of sustainable and conventional houses.
3. To find out the environmental benefits of using Green buildings over the conventional buildings

4. To check the durability of sustainable building.

1.3 SCOPE OF THE PROJECT

1. Future need of a country and its leads to us towards the healthier and wealthier environment
2. Popularizing the concept of mud construction
3. Approach to save natural resources
4. Idea to reduce impact of building on environment and energy consumption

2.MUD ARCHITECTURE

Mud, a mixture of earth and water, is economical, practical, functional and attractive. It is easy to work with, and it takes decoration as well. Mud is especially useful in humid and hot climates. Mud is a natural building material that is found in abundance, especially where other building materials such as bricks, stone or wood are scarce due to affordability and or availability. The mud architecture is a great resource that focuses on architecture constructed of mud brick, rammed earth, compressed earth block and other methods of earthen construction. The proliferation of concept to use mud and improved techniques in order to raise the level of living in the population is a very welcome idea. This can go a long way not only in the form of changing the look of population centers, rural as well as urban, but also in solving environmental problems and problems related to energy and other finite resources.

3.GREEN BUILDING MATERIALS

A green building needs special materials and systems to adapt sustainability compared with a conventional building. In line with the growing trend of green building development the industry of green building materials and services is also developing in India. The sustainable building incorporates many strategies during design construction and operation of building project. Using green building material is one of the sustainable design construction and operation strategies. The green materials are environmentally responsible materials as they help in reducing environmental impacts (Greenomics). The sustainable building materials should have resource efficiency, indoor air quality energy efficiency and affordability. Green building rating for integrated habitat assessment GRIHA also recommends selection of ecological sustainable material. Ecological sustainable materials are those which have high recycled content, rapidly renewable resources with low emission potential. For example, low volatile organic compound (VOC) pint is a sustainable material. Similarly, door frames and flooring tiles made using recycled materials are the examples of sustainable materials. The materials such as lime, fly ash, sand lime bricks, eco-friendly tile, wood, bamboo which we have selected looking in to their local availability, benefits, cost, and durability.

4.CASE STUDY

Bodhi – the mud house located in Mundakal ,Kollam

It is designed by architect Eugene Pandala and it is a nature friendly home. It has no regular shape mode of construction and is constructed as a free flowing organic shape structure and looks like a soil heap erected from the earth.

Wall Construction

The soil suitable for mud wall construction is added with 5% cement and 20% clay. Cob technology is used for construction purpose. The finishing of wall is done by carving using showel.

ROOF

The suitable material used for roof construction of such a free flowing organic construction is Ferro cement. Ferro cement rafters are pre-casted then it is welded together to the position, then a layer of wire mesh and baby metal is provided over it. They are concreted together for small thickness with mortar. Tar coating for waterproofing and clay tile are finally paved over it. Roof is given by extra projection outward for protecting the wall from raining. In formal living area, built in furniture are provided

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Flooring

Terracoat tiles are used for flooring purpose. Low level seating is provided in the family living area.

Organic forms and shapes and inbuilt bed space, side table etc. is provided. In dining area, hot air vents are provided at the meeting area of wall and roof and also from family living area to dining area. This reduces the temperature inside the room. Small sized ventilated kitchens are the specialties of the building. Permanent opening which are provided with only grills for safety purpose. For wind circulation circular openings are provided

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Hot air vents

Building is designed as two blocks which are connected with a pathway with utility spaces. A well with some design features and holes are provided for proper air circulation. The pathway faces to courtyard on other side. The space between the two blocks is designed as a courtyard. Two bedrooms are set out on the sides of pathway.


Well Courtyard

5. RESULTS AND DISCUSSIONS

UNCONFINED CONFINED COMPRESSION TEST

Sample diameter (mm) = 39
Cross section area of the sample (cm^2) = 11.95
Height of the sample (mm) = 69.33
Strain rate (per min) =0.5
Proving ring constant (Kg) =0.455
Least count of deformation dial gauge (mm) =0.01

TABLE 5.1 UCC FOR TEST SAMPLE

TEST SAMPLE (20% clay & 5% cement)

SI.NO	Proving ring reading	Load in Kg	Deformation dial gauge reading	Compression dl	strain e =dl/he	Increased cross section area $A_1=A/(1-e)$	Actual stress load/A_1
1	1	.455	50	0.5	.00721	12.03	3.71
2	2	.91	100	1	.01442	12.125	7.36
3	4	1.82	150	1.5	.02164	12.214	14.61
4	6	2.73	200	2	.02885	12.305	21.76
5	7	3.185	250	2.5	.03605	12.3969	25.204

6	10	4.55	300	3	.04327	12.49	35.737
7	13	5.915	350	3.5	.05048	12.585	45.76
8	15	6.825	400	4	.05769	12.68	52.89
9	18	8.19	450	4.5	.0649	12.779	62.187
10	19	8.645	500	5	.0721	12.878	65.852
11	20	9.1	550	5.5	.07933	12.979	68.78
12	22	10.01	600	6	.08654	13.082	75.06
13	22	10.01	650	6.5	.09375	13.186	74.47
14	21	9.56	700	7	.1009	13.29	70.56
15	21	9.56	750	7.5	.10817	13.399	69.99
16	20	9.1	800	8	.1153	13.507	66.09
17	19	8.645	850	8.5	.1226	13.619	62.27
18	18	8.19	900	9	.1298	13.73	58.517
19	18	8.19	950	9.5	.1370	13.84	58.05
20	17	7.735	1000	10	.1442	13.96	54.36
21	17	7.735	1050	10.5	.15145	14.08	53.89

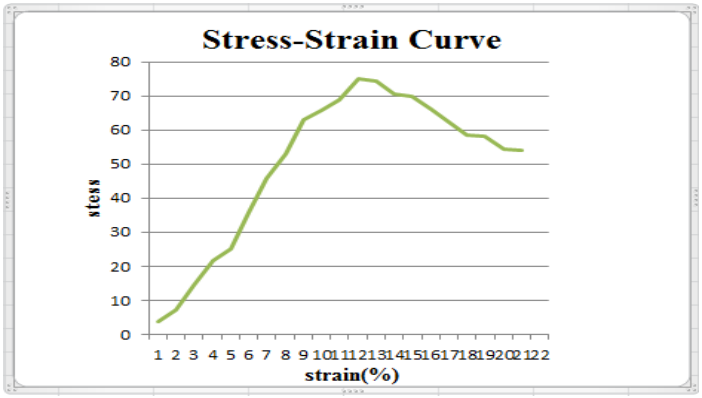

Fig: 5.1 Stress strain curve for test sample

RESULT: The Compressive Strength of Test Sample = 75kN/m^2

TABLE 5.2 UCC FOR RAW SAMPLE

RAW SAMPLE

SI.NO	**Proving ring reading**	**Load in Kg**	**Deformation dial gauge reading**	**Compression dl**	**strain e =dl/he**	**Increased cross section area $A_1=A/(1-e)$**	**Actual stress load/A_1**
1	1	.455	50	0.5	.00721	12.03	3.71
2	1	.91	100	1	.01442	12.125	3.68

3	2	1.82	150	1.5	.02164	12.214	7.3
4	4	2.73	200	2	.02885	12.305	14.5
5	5	3.185	250	2.5	.03605	12.3969	18.002
6	6	4.55	300	3	.04327	12.49	21.44
7	7	5.915	350	3.5	.05048	12.585	24.83
8	11	6.825	400	4	.05769	12.68	38.72
9	12	8.19	450	4.5	.0649	12.779	41.91
10	13	8.645	500	5	.0721	12.878	45.05
11	14	9.1	550	5.5	.07933	12.979	48.146
12	15	10.01	600	6	.08654	13.082	51.18
13	16	10.01	650	6.5	.09375	13.186	54.16
14	17	9.56	700	7	.1009	13.29	57.09
15	18	9.56	750	7.5	.10817	13.399	59.96
16	19	9.1	800	8	.1153	13.507	62.787
17	20	8.645	850	8.5	.1226	13.619	65.54
18	20	8.19	900	9	.1298	13.73	65.01
19	19	8.19	950	9.5	.1370	13.84	61.277
20	19	7.735	1000	10	.1442	13.96	60.75
21	18	7.735	1050	10.5	.15145	14.08	57.06

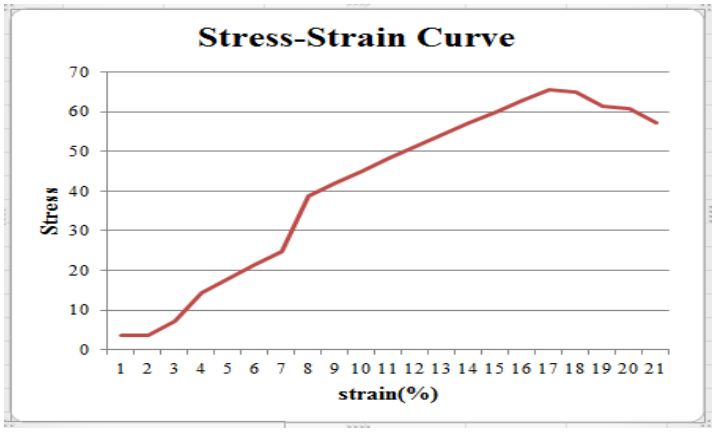

FIG 5.2 Stress strain curve for raw sample

RESULT: The Compressive Strength for raw sample = 65kN/m^2

6.COMPARISON

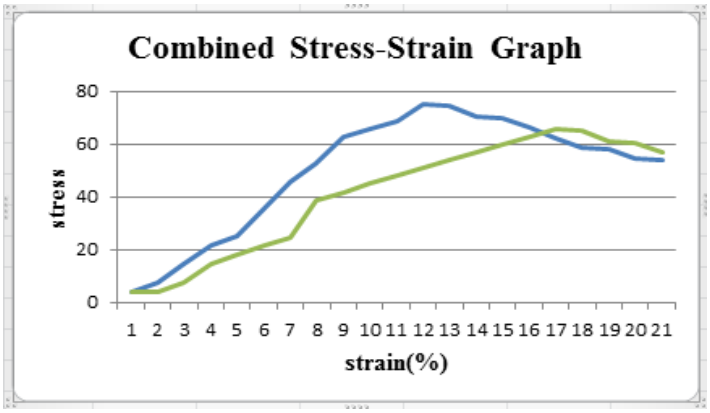

FIG 5.3 Comparison between test sample and raw sample

RESULT:

Compressive strength of soil with 20% clay &5% cement is greater than that of raw sample

7. CONCLUSIONS

From the study it may be concluded that sustainable buildings are more preferable than conventional building because it save natural resources, energy and reduce environmental impact. The running cost of Green building up to 8% less than a conventional building. It provide cooling effect in summer and warm in winter. The soil should be selected after conducting relevant test. Compressive strength of soil with 20%clay and 5% cement is high. Present work is an attempt in the direction to make people, communities and general public aware about the advantages of green buildings for sustainable environmental development and management .It is a step towards safeguard of nature and it will pave a way towards healthy and green future. Nowadays energy sources are decreasing fast and also the use of natural resource is more. Here is the relevance of sustainable building which optimizes energy efficiency. If the intention is to construct a new Home to live in, it is advisable to go for a GREEN HOME rather than the ordinary conventional home. Because, the percentage increase of 12.94% in the total cost is not a negligible amount when the intention is just to renovate or retrofit an Old Home.

So through this project we could disclose the relevance of sustainable building for the present situation of our earth and also we could check the durability of such houses so as to prove that it is safe as normal buildings. In our project we mainly focus on the mud which is a good example of sustainable material also gone through the tests used to identify the soil which is useful for the construction or not. There by describes the usability of soil in construction. So the entire project is the study on the sustainable buildings, to check its durability, environmental benefits etc. and to popularize the concept of green building.

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