

TECHNO-ECONOMICAL FEASIBILITY OF MODERN GFRG PANELS

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Abstract: The construction industry everywhere faces problems and challenges. However, in developing countries like India, these difficulties and challenges are present alongside a general situation of socio-economic stress, chronic resource shortages, institutional weaknesses and a general inability to deal with the key issues. There is also evidence that the problems have become greater in extent and severity in recent years. Traditionally materials like clay, sand, stone, gravels, cement, brick, block, tiles, distemper, paint, timber and steel are being used as major building components in construction sector. All these materials have been produced from the existing natural resources and will have intrinsic distinctiveness for damaging the environment due to their continuous exploitation. The cost of construction materials is increasing incrementally. The need of the 21st century is for energy efficient and ecofriendly products. The building industry accounts for 40% of CO₂ emissions. Rapid wall, also called GFRG panel is an energy used as intermediary floor slab/roof slab in combination with RCC as a composite material. Since the advent of innovative Rapid wall panel in 1990 in Australia, it has been used for buildings ranging from single storey to medium - high rise buildings. Light weighted Rapid wall has high compressive strength, shearing strength, flexural strength and ductility. It has very high level of resistance to fire, heat, water, termites, rot and corrosion. Concrete infill with vertical reinforcement rods enhances its vertical and lateral load capabilities. Rapid wall buildings efficient green building material with huge potential. It is use as load bearing and non-load bearing wall panels. Rapid wall is a large load bearing panel which have modular cavities suitable for both external and internal walls. It can also be are resistant to earthquakes, cyclones and fire.

I INTRODUCTION

General overview: The construction of building systems using Glass Fiber Reinforced Gypsum (GFRG) panels is a very promising and emerging building technology. Huge housing shortage in countries like India invites innovative solutions that are not only sustainable, affordable and of good quality, but which also facilitate rapid construction. Based on extensive research carried out at IIT Madras for more than a decade, this technology has been demonstrated by constructing around 300 buildings in India. GFRG buildings can completely avoid cement plastering, and uses much less quantities of steel, cement sand and water compared to conventional buildings. GFRG buildings consume much less embodied energy (less carbon footprint) and recycles industrial waste gypsum, contributing to sustainable development.

General overview of GFRG panels:

GFRG (Glass Fiber Reinforced Gypsum) is a product introduced in India by Rashtriya Chemicals & Fertilizers Mumbai. The Australian Technological breakthrough of combining glass fiber strands with Gypsum Plaster produced in an energy Efficient fluidized bed calcining process resulted in GFRG panels, which have desired properties of strength and water resistance. Typical dimension of GFRG building panels is 12 m Long, 3m high and 124 mm Thick with modular cavities. Each segment of Panel contains four cells; thus, each panel has 48 modular cavities of 230mm x 94mm x 3mm dimensions. The Cellular cavities are formed between two outer skins. This makes the panels very light and weight of these panels is 10-12% of weight of comparable concrete or brick masonry

ADVANTAGES OVER CONVENTIONAL BUILDING

GFRG building system has following advantages over conventional building systems:

- 1) High speed of construction.
- 2) More carpet area for the same built-up area: thickness of wall panels is only 124mm.
- 3) Less embodied energy and carbon footprint significant reduction in use of steel, cement, sand and water; recycling of industrial waste gypsum.
- 4) Less cost of construction, savings in materials; no cement plastering.
- 5) Less building weight (panels weigh only 44 kg/m²), thereby reduction in design for seismic forces and savings in foundation, especially in multi-storeyed buildings.
- 6) The 8 to 10 storeyed buildings can be designed using GFRG panels, without the need of conventional RC beams and column.
- 7) Very good finishes of GFRG buildings: use of factory-made panels for all the walls, floors and staircases.
- 8) Less CO₂ emission compared to other conventional building materials.
- 9) Better thermal comfort inside GFRG building compared to conventional building

DESIGN OF GFRG BUILDING

- The design capacities are based on limit state design procedures, considering the ultimate limit state for strength design, treating the 3.0 m high GFRG building panel as the unit material and considering the strength capacity as obtained from the test results. The design should be such that the structures should withstand safety against all loads (as per relevant Indian Standards) likely to act on the structure during its lifetime. It shall also satisfy the serviceability requirements, such as limitations of deflection and cracking. In general, the structure shall be designed on the basis of the most critical limit state and shall be checked for other limit states.
- Detailed design Guidelines are given in “Use of Glass Fiber Reinforced Gypsum (GFRG) Panels in Buildings - Structural Design Manual” prepared by IIT Madras and

published by BMTPC. It may be obtained on request from BMTPC.

- Experimental studies and research have shown that GFRG Panels, suitably filled with reinforced concrete, possess substantial strength to act not only as load bearing elements, but also as shear wall, capable of resisting lateral loads due to earthquake and wind. It is possible to design such buildings up to 10 storeys in low seismic zone (and to lesser height in high seismic zone). However, the structure needs to be properly designed by a qualified structural engineer. Manufacture of GFRG Panels with increased thickness (150 mm – 200 mm) with suitable flange thickness can facilitate design and construction of taller buildings.

Why do we need GFRG panel construction technique :

- Growing population day by day.
- We need a solution that is fast.
- Easy to build.
- Fulfills the needs of conventional houses.

SCOPE OF STUDY

GFRG Panels provides a new method of building construction in fast track, fully utilizing the benefits of prefabricated, light weight large panels with modular cavities and time tested, conventional cast-in-situ constructional use of concrete and steel reinforcement. By this process, man power, cost and time of construction is reduced. These of scarce natural resources like river sand, water and agricultural land is significantly reduced. Rapid wall panels have reduced embodied energy and require less energy for thermoregulation of interiors. Rapid wall buildings thereby reduce burdening of the environment and help to reduce global warming. Rapid wall use also protects the lives and properties of people as these buildings will be resistant to natural disasters like earthquakes, cyclone, fire etc. This will also contribute to achieve the goal of much needed social inclusive development due to its various benefits and advantages with affordability for low-income segments also. Fast delivery of mass dwelling/ housing is very critical for reducing huge urban housing shortage in India. Rapid wall panels will help to achieve the above multiple goals.

II LITERATURE REVIEW

Kuldeep Kumar And Devika Nayal , (2020) —The rural housing shortage in India stands at 44 million dwelling units. India’s urban housing shortage is 18.78 million units, of which 96% pertains to Economically Weaker Section (EWS) and Low-Income Group (LIG) type. Hence, the use of rapid techniques for time and cost-effective delivery of construction projects by adopting alternate building materials and fast construction methodologies is essential in India, given the tremendous housing shortage. Use of Glass Fiber Reinforced Gypsum (GFRG) panels (also known as the rapid wall) construction is considered as one of the innovative solutions to meet this challenge.

Gaurav Saini , Kshitij Pant , Deepanshu Soni , Dipesh Jangid , Jitendra B. Jangid , (2019)

The urban housing requirement in India is growing at a very fast rate. To fulfil the requirements, India require energy efficient and energy innovative building material for stronger and long-lasting housing at affordable cost. Our research has found that gypsum is a durable material. Experts predict that a building made of GFRG panels is expected to have a life span of 60 years. That’s why GFRG panels are heavily in use as partition walls. A GFRG building does not require beams and columns. Also United Nations Framework Convention on Climate Change (UNFCCC) has also approved the material as a green building material

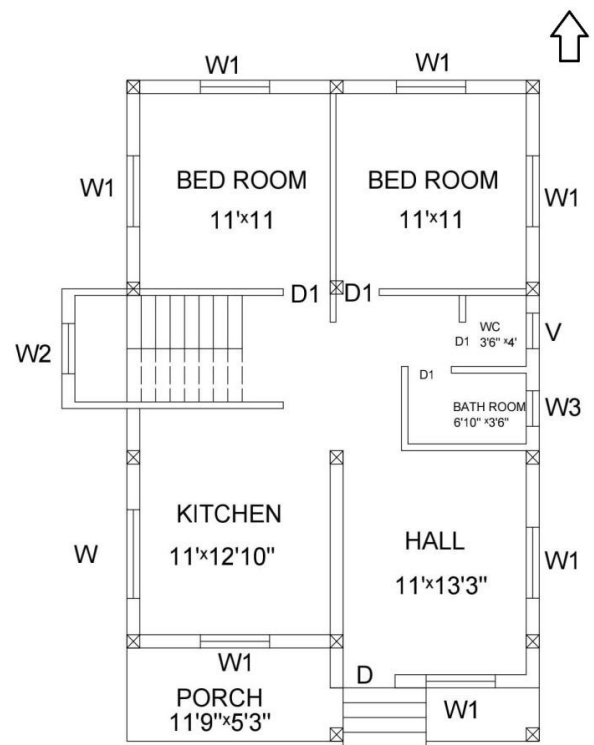
Bijimol Joseph, Amal Joe Abraham, Jowin Mathew John, Rahul P R, Vyshagh M (2019) ,

Affordable rehabilitation possibility is one of the most sought-after things after a major calamity. Kerala is currently facing such a need. Kerala is in the aftermath of an unprecedented flood havoc. The calamity has caused immeasurable misery and devastation. Around thousands of homes were totally destroyed and many more were partially damaged. At present Kerala is going through the phase of rebuilding. ‘Rebuild Kerala’ is a Kerala State Government initiative in consultation with KPMG, for crowd funding of projects envisaged for rebuilding Kerala.

Anna Sara Thomas, Athul Mukund A , Ejas Salim , Gokul D4& Er. M Gayathri Devi , (2019) Housing sector is one of the largest consumers in India. This reveals the

demand for affordable housing thereby introducing Glass Fiber Reinforced Gypsum (GFRG) panels, an energy saving in housing sector. GFRG panel is an energy efficient green building material with huge potential for use as a load bearing and non-load bearing wall panels. the cost of construction thus making the structure uneconomical. This project aims to make the construction using GFRG panels more economical and sustainable along with increasing its compressive strength. Here recycled aggregate concrete is used instead of normal

Anjana R, Silambarasan.G, P.Balamurugan (2018) , Nowadays there is a need for quick period construction for our society. By comparing the commercial concrete construction, the Rapid wall construction gives good result for our construction needs in the society. Glass Fiber Reinforced Gypsum (GFRG) is a new building material and it is also known as Rapid wall building panel. It is mainly used to overcome the lack of natural resources like River sand, water, gravel, etc.,



GROUND FLOOR

III RESULTS:

This section includes cost and time comparison between conventional and GFRG building construction techniques, % savings and result interpretation with graphical representation of results.

Comparison between time and cost of Conventional and GFRG building

Following table contains comparison between time and cost of conventional and GFRG building

Table Comparison between time and cost of Conventional and GFRG building

Sr .No.	Particulars	G Cost (Rs.)	Time (Days)	G+1 Cost (Rs.)	Time (Days)
1.	Conventional Building	1139107	95	1639107	132
2.	GFRG Building	825745	60	1225745	102

Comparison between percentage savings in GFRG building with respect to

Conventional building (consider on single storey)

Following Table shows percentage savings by using GFRG building technology.

Table 8.0 Comparison between percentage savings in GFRG building with respect to Conventional building

Sr. No.	Materials/ Factors	GFRG Building	Conventional Building
1	Bricks	0	near@38995
2	Gfrg panel	509.34sqm	-
3	Water	less	More
4	Construction time	60 days	95 days
5	Construction cost	Rs. 825745	Rs.1139107
6	Quality control	more	less
7	Transportation cost	more	less

Result Interpretation:

From the above Table, we can interpret that,

- For single storeyed building, there is not much difference in cost construction but difference between time of construction is more, so GFRG technology saves upto 60 to 70% time of construction.

- As we increases the storey in building the cost difference increases and there is not much difference between the time as compared to singly storeyed building i.e. percentage saving of time similarly upto 65%.

- Cost of brickwork, plaster and colouring totally reduced and also save water required for construction.

Only cost of transportation of panel is more because of plant of manufacturing of GFRG panel is located at Kochin, Kerala.

Expected outcomes:

- 1) To estimate the quantity of materials for different building components, and thereby evaluating the total cost of the project.

- 2) To compare the methods by cost and time duration for finishing each construction activities.

- 3) To create awareness among people about the innovative construction at affordable cost with good life span.

IV CONCLUSION

From this project work we can conclude that,

- This project helpful for our group to understand the difference of the two construction methods such as GFRG wall panel system and traditional construction system based on the estimation value and also we have to understand some construction management results.

- Rapidwall construction is a new approach to construction. It is better in all aspects related to conventional method of construction. This method of construction takes a giant leap towards sustainable living creating a positive effect on environment. It is more affordable housing to low income groups. Use of rapid wall protects the lives of people as these buildings will be resistant to natural disasters like earthquakes, cyclone, fire etc. and most important this new technology is having potential to provide shelter to the “homeless”.

- From the detailed estimate of both GFRG and conventional building helps to understand evaluation of

total cost of project. There is not much cost difference in case of single storied building and this cost difference increases in multistoried mass housing, so GFRG panel affordable to use in mass housing.

•From the study of scheduling of project by MS Project helpful for understand the rapid wall construction technology saves 60 to 70% in construction time and 15% in construction cost for four storied residential building compare with conventional building.

•Many of the people are not aware about this technology, so in this we can tried and in future also trying to create awareness among people about the innovative construction at affordable cost with good life span, so we can achieve last objective of project.

In this way we can achieve our whole project objectives successfully.

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