



## GFRG PANELS IN CONSTRUCTION INDUSTRY

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**ABSTRACT** use of rapid technique's for timely delivery of construction projects by adopting fast methodology and alternate building materials is necessary in India, given the tremendous housing shortages, further the construction has to be affordable and sustainable. It is a need for quick period construction for our society. By comparing the commercial concrete construction. The construction technique purpose in this paper, by making use of glass fiber reinforced gypsum (GFRG) panels to build homes, promises such a solution for rapid affordable mass housing in India. The motive of selecting this material for construction is to construct standard, good quality, sustainable and high strength houses with good architectural appearance in affordable price. GFRG is economical, eco-friendly building system material so as to prevent from environmental hazards. GFRG panels are composite material consisting of calcined gypsum plaster and glass fiber this material can be manufactured out of either natural or industrial. In India, these panels have been manufactured from the fertilizers by product waste. GFRG panels, manufactured in standardized parts or section ready for rapid assembling and erection as buildings are readymade gypsum panels with hollow cavities. GFRG walls are used architecturally and structurally as walls and slabs, with no column's and beams needed. As result, the structural performance of rapid wall and the related building systems are more sophisticated than that of other conventional building systems. In this paper we study construction techniques and its use in housing industry.

**KEYWORDS :** GFRG panel, rapid, affordable, sustainable, cost-effective, energy efficient, eco-friendly.

### INTRODUCTION

As we know India is the biggest country identically for population point of view in the world. Increasing growth in population also increase the demand of food, shelter cloths but as per economic condition of India 35% population is in poverty and remaining 65% divided in lower middle class and rich people, while studying and researching on this subject to find out equivalent solution according to this issue was the motive of this research. Housing is one of the basic needs of society and is an essential component of the built environment. The Ministry Of Rural Development estimated that the rural shortage in India stands at 44 million dwelling units. India's urban housing shortage is 18.75 million units of which 96% pertains to economically weaker section (EWS) and low income group (LIG) type as per the estimate of the estimate of the Ministry Of Housing And Urban Poverty Alleviation (1,2). The demand for conventional building materials used in the housing sector such as burnt clay bricks, cement and steel is growing every year. Reduction in use of these energy intensive construction materials and speedy delivery of housing units at affordable cost are the key challenges faced in the mass housing sector today.

GFRG panels were introduced in Australia in 1990 and now manufactured in India. GFRG, better known as rapid wall in the industry is a new building panel product. GFRG is a particular relevance to India, the product is economical, ecofriendly or green house resistant, waterproof, fire resistant. GFRG panels are presently manufactured to a thickness of 124mm, a length of 12m and a height of 3m although its main application is in construction of walls, it can also be used in floor or slab in combination with reinforced concrete. The development of building systems especially with respect to use of GFRG panels as floor slabs and earthquake resistant structure for use in India. The panel contains cavities that may be filled with concrete and reinforced with steel bars to improve additional strength and provide ductility. Experimental research and study shows that GFRG panels suitably filled with reinforced concrete possess great strength to act as load bearing element and as shear walls, capable of resisting lateral loads due to earthquake and wind. The climatic change caused by the increasing amount of green house gases in the atmosphere crisis situation with universal concern. The requirement of this century is for environmental aspect, energy efficient, and ecofriendly product. Building industry counts for 40% of CO<sub>2</sub> emission as a result of embodied energy consumed in this production of energy intensive building material as this perspective GFRG panels are very relevant and essential for construction so it provide easy, simple and rapid construction.

### II. LITERATURE SURVEY

Kadam sagar . p, Darade milind. M(2016): compared about rapid wall panel construction with respect in cost and time of construction. Rapid wall panels are used instead of bricks. Rapid wall panels have

undergone testing by Indian Authorities and are presently exporting to India to satisfy the need for a cost effective, easy to construct and environment friendly solution to their housing crises. Rapid wall panels being low cost building materials, and easy to install, fit exactly the current void or demand for houses in India. Apart from being low cost and easy construction. Rapid wall panels are also easy handling water resistant and fire proof. The objective of the paper is to make the economical comparison between construction take 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. after detailed study and survey of building it is observed that rapid wall construction saves 67% in construction time and 27% in construction cost compare with conventional buildings.

### STRUCTURAL STUDIES WITH STRENGTH

Yu-fei wu, et. Al (1,2,3): In their research papers had implemented the seismic design principle applied to the GFRG building was of "strong columns, weak beams, and stronger joints", mainly in mainland china.

Abhishek Kumar (2016): In his paper he summarized developments in the field of building systems, using glass fiber reinforced gypsum panels. The manufacturing process, its use in construction industry, assembling and erection as buildings, economical, affordable houses, essential for lower middle class people, to maintained architectural beauty and environment friendly construction this panels were used in construction industry, to analyze its conveyance and involvement in nation development in his paper he also wrote structural rectitude and strength of GFRG panels. Relative moment and partial interactivity of GFRG panels. Shear strength of GFRG panels. Axial strength of GFRG panels, etc.

Nithya Nandan A, Renjith R (2016) : He experimentally investigated about glass fiber reinforced gypsum panels field with Alternet concrete min using shredded thermocol photogypsum. Glass fiber reinforced gypsum . (GFRG) panels is a green product. They are made with modified gypsum platter and reinforced with cut glass fiber. The panels contain cavities that may be field with concrete and reinforced with steel brass to impact additional strength and provide ductility phosphor gypsum is a byproduct of fertilizer industries .thermocool is a type of polystyrene used for packaging. The effective disposal of photogypsum is done by the manufacturing of glass fiber reinforced gypsum ( GFRG) panel, also known as rapid gypsum (GFRG) panel, also known as rapid wall. These can be used as load bearing as well as non load bearing structures. Photogypsum and shredded thermocol are used as partial replacement of cement and fine aggregates respectively and formulating an alternate light weight mix equivalent in strength to that of M20 grade concrete. The test was done for all the alternate concrete mixes for determining 7 and 28 day compressive strength.

D. Menon (4): In his research paper elaborated this whole concept of GFRG building system. In which the GFRG panels, which were used by the Australians as for vertical loads, i.e, it takes only gravity loads due to its own self weight, were now for the first time used as slabs, i.e it now also takes lateral loads subjected to earthquake. GFRG panels with ribs aligned in direction of bending posses flexure, whose strength can be significantly enhanced by providing micro T-beams in each cavity of slab. Joints only provide axial and shear resistances which are unaffected by the discontinuity of GFRG panels. The whole building system proves to form a highly robust structure.

Mehar Prasad IIT madras (2013): He mentioned in his paper that manufacture of GFRG panels from the raw material gypsum viz, natural gypsum, mineral gypsum, photo-gypsum or chemical gypsum, with purity more than 90 percent, entails less energy in comparison to energy intensive conventional building material like brick, concrete , etc. GFRG panels have been approved as a green material by the united nations framework convention on climate change ( UNFCC) under clean development mechanism (CDM). " Increased thermal resistance of gypsum reduce the air conditioning load on the building, thus reducing the operational energy need in GFRG buildings. " says Prasad. This technology was introduced in India in 2003, using all kinds of gypsum. IIT Madras is carrying significant research on the same in order to introduce affordable mass housing construction.

S K. Shubham Alisha et al. (2016): found gypsum is a durable material, and it is already heavily use as partition walls. Experts predict that building made of GFRG panels can have a life span of 60 years. A GFRG building does not requires beams and column and the material by the United Nations framework convention on climate change. The panel cavities can be partially or fully filled with reinforced concrete to provide addition strength. The foundation cost comes to about 10 to 25% of the total building total building. It is suggested to adopt as arch foundation in ordinary soil for affecting reduction in construction cost up to 40%. The traditional R.C.C lintels are costly can be replaced by brick arches for small spans and save construction cost up to 30 to 40%. Over the traditional method of construction. By adopting rationally designed construction. Practices like filler slab and precast elements the construction cost of roofing can be reduced by about 20 to 25% It is observed the construction procedure and techniques are being used for GFRG panels construction, complete cost and estimation of building, relevant procedure used for panel manufacturing, analysis and duration of the every element of every building. Here we studied about how to reduce cost by estimating the quantity of materials for different building components, and there by evaluating the total cost of the project.

**III. GFRG Panels Diementions And Mechanical Properties.**

GFRG panels are manufactured to a standard size of 12.0m length, 3.0m height and 124mm thick. With modular cavities, these cellular cavities are formed between outer skins (flange) 15mm thick, and interconnecting ribs, 20mm thick, at 250mm spacing. Each one meter of size 230mm length and 94mm wide. The mechanical properties of GFRG panels, for both empty panels and panel filled with m20 concrete in all cavities are given in Table 1, based on tests.

**Mechanical properties**

**1.Mechanical properties of GFRG panels**

Sr. No	Mechanical property	Characteristic value
1.	Unit weight	0.43 kN/m <sup>2</sup>
2.	Uni-axial compressive strength	160 KN/m (empty ) 1310 KN/m (full)
3.	Ultimate shear strength	21.6 KN/m (empty) 61.0 KN/m (full)
4.	Water absorption	1% in (1 hour) 3.85% in (24 hour)
4.	Fire resistance	2.30 hour rating (empty) 4.0 hour rating (full)

**IV. Manufacturing And Transportation Of GFRG Panels.**

- The manufacture of GFRG panels is done in a semi- automatic plant using the slurry obtained by heating the calcined raw gypsum.
- The calcined raw gypsum (plaster ) is mixed with water, while cement and certain chemical like D50 (retarder) and BS94 (water repellent) in a mixer.
- Different layers of slurries are then spread over a table and are interspersed with glass, fiber and aluminum pegs (for creating

hollow cavities).

- After half an hour or so, the aluminum pegs are removed and the panels are sent to a dryer.
- GFRG panels can be easily transported from factory to site via trucks or trailers. It must be ensured that the panels are put in a vertical position (using stillage) to avoid any damage during transportation.

**MANUFACTURING PROCESS OF GFRG PANELS.**



**V. Application And Advantages Of GFRG Panels.**

- As a light-weight bearing wall.
- As high-capacity vertical and shear load bearing wall.
- As a partition wall .
- As roof slab/ horizontal floor.
- As compound wall/ security wall.
- As pitched roofing.
- As cladding in industrial structures.
- Economical and affordable houses.
- Strong and safe construction.
- Rapid and high-tech construction.
- Easy to assemble.
- Ecofriendly construction
- Fire resistant and earthquake resistant.
- Cooler than a conventional building.
- Water resistant and durable.
- More carpet area

**VI. CONSTRUCTION WITH GFRG PANEL**

- The construction process up to the plinth level remains similar as in the conventional method. No special foundation is required for the installation of GFRG panels.
- Concrete belts are built at the plinth area with protruding iron rods which are meant to strengthen the interlocking with the cells of the panels.
- GFRG panels are placed at the appropriate position using mechanical means, preferably a crane, and external support are provided to maintain the vertically. Cuts for doors, windows, sanitary fittings, vents etc are made as per the design.
- The hollow cavities are filled with concrete and reinforcement as per the requirement to strengthen the panels. Generally, concrete is filled in every third cavities can be filled with and the remaining cavities can be filled with waste materials like quarry dust.



- Finally, water proofing treatment is carried out for the roofs and floors of the building.

## VII. GFRG Panels In Asian Countries

This method of construction is broadly accepted by a few Asian countries such as India, Saudi Arabia, Oman and China. Glass fiber reinforced gypsum panel is a modern gypsum panel is a modern building component used for mass-scale construction of houses in a very short span of time. The use of prefabricated light weight GFRG panels for the entire building system facilities substantial reduction in building self-weight, construction time and work force requirement. So far, more than 300 buildings are constructed in India, most of them are individuals residential buildings, but also for industrial institutional buildings. The building system gain popularity in Asian countries.



GFRG panels construction in Saudi Arabia



GFRG panels construction in Madurai



GFRG panels construction in Australia

## VIII. SUMMARY

GFRG panels can be effectively used for the entire, superstructure of a buildings, including all walls, slabs, staircase, parapets, etc. this building system has many advantages over conventional buildings. GFRG buildings have the potential to meet the challenge of providing rapid affordable mass housing. This is an ecofriendly and sustainable building system, making use of recycled industrial waste gypsum or natural gypsum and minimizing the use of cement, steel, sand, water and labor input. This technology is now gaining acceptance in India and other Asian countries.

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