Glass Fiber Reinforced Gypsum Panel use in Building Construction

Prof. Shyam Doshi
Assistant Professor
Department of Civil Engineering
Bhagwan Mahavir College of Engineering & Technology

Jay Rathod
UG Student
Department of Civil Engineering
Bhagwan Mahavir College of Engineering & Technology

Kevin Lad
UG Student
Department of Civil Engineering
Bhagwan Mahavir College of Engineering & Technology

Parth Parmar
UG Student
Department of Civil Engineering
Bhagwan Mahavir College of Engineering & Technology

Pratik Patel
UG Student
Department of Civil Engineering
Bhagwan Mahavir College of Engineering & Technology

Abstract

There is large growing requirement of building materials in India due to urbanization. To meet this challenge, India requires innovative and efficient building material. Glass fiber reinforced gypsum (GFRG) wall panel is made essentially of gypsum plaster reinforced with glass fiber. The panels are hollow, in conventional building brick work is can be used to load bearing walls and GFRG panels can be used as load bearing walls. The hollow cores inside the walls can be filled with in-situ plain or reinforced concrete for increase the strength. The axial load carrying capacity obtained from the numerical analysis and the test results comparable for this load case. While assessing the axial load capacity for design under compression, a minimum possible eccentricity is accounted for. An engineering model is proposed to assess the strength of unfilled and concrete filled GFRG wall panels in multi-storied building system subjected to lateral load such as earthquake.

Keywords- Glass Fiber, Gypsum Panel, Reinforcement, Costing, Rate Analysis, Masonry

I. INTRODUCTION

GFRG panels are ready-made gypsum panels with hollow cavities and are made of calcined gypsum plaster and reinforced with cut glass fibers. Glass fiber reinforced gypsum (GFRG) panel is a green product ready for immediate use and construct as building. This design guidance are applicable to GFRG building panels, recently manufactured as a rapid wall, for the typical dimensions and material properties described in this manual. The typical dimensions of a GFRG building panel are 12.0 m X 3.0 m X 0.124 m, as shown in figure. Each 1.0 m segment of the panel contains '4 cells'. Each cell is 250 mm wide and 124 mm thick, containing a cavity 230 mm X 94 mm, as shown in figure below. The application of GFRG wall is finite for its perform as sideways rigidity even though it is filled with concrete in its hollow cavities. GFRG are panels used for the construction of walls in increasing rate. The construction of walls in increasing rate. The product is not only eco-friendly or green factor but also resistant of water and fire and corrosion. In building construction, the standard GFRG panels are cut in the manufacturing factory unit into that may possess window and door openings. These elements are then moved to the construction location and hoisted in a similar process as in the construction process of precast concrete panels. This concrete belt is made on the foundation on which reinforced later are erected. The panels are then fixed on the base. They need to be given support till they are completely fixed. It is through the small vacuum space inside the panels that the rods of glass fiber or steel reinforcement from the foundation go by. This place is later concerted to strengthen its order.

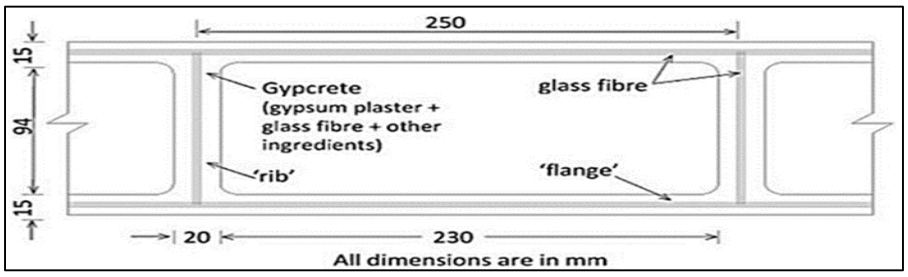

Fig. 1: Cross section of Panel

This panel can be cut and resize to suit our needs and requirement and they simply need to be fitted on the foundation using a equipment i.e., crane or lifting equipment. Everything from walls to ceilings can be built in this particular manner.

A. Objectives

The IIT Madras, India research group extended the application of this product to the entire building system including floors, roofs, and staircases, thus significantly reducing the expenditure of reinforced concrete. Bending moment in beams for the conventional building is to determine and to be checked with the absolute value.

Provision of reinforcement also has been calculated. Shear force and axial force in Beam to be determined. To determine base shear of the building because of panel.

The concept of GFRG panels used to save the cost of construction compared to conventional building along with providing the more carpet area of the building.

To determine dynamic and static frequency of the conventional building and to compare it with the GFRG building.

II. METHODOLOGY

The Quantity of various items such as excavation, Foundation concrete brick work in Foundation and plinth, Brick work in superstructure, etc. The estimation work is carried out for both wall panel system and conventional building system. The scheduling of each work is also carried out by using Primavera. From scheduling we can calculate the time requirement and time difference for every work of wall panel system and conventional Building system. The estimation of the building quantities can be carried out by any one of the following three methods

A. Long wall – short wall method or "out to out" & "in to in" method
B. Centre line method
C. Crossing method

A. Long Wall-Short Wall Method

In this method, the longer walls in a building are considered as long wall measured from out to out; and the shorter walls in a perpendicular direction of the walls , are considered as short wall and are measured from in to in for a particular layer of work. These lengths of long and short walls are multiplied separately by the breadth and height of the corresponding layer and are added to get quantity. Such lengths of long and short walls vary in every layer of footing.

To calculate length of long and short wall determine first their centere to centere individually from the plan. Then the length of long wall out-to-out may be calculate after adding half breadth of wall at each end to its centere to centere length, Length of long wall out-to-out = Centere to centere length + half breadth on one side + half breadth on other side, Then the length of short wall in-to-in may be calculate after subtracting half breadth at each end to its centere to centere length ,Length of short wall in-to-in = Centere to centere length - half breadth on one side - half breadth on other side

B. Centre Line Method

In this method, Sum of total Length of centere lines of walls, long and short, has to be found out. Find the total length of centere lines of wall of same type, long and short having same type of foundations and footings and then find the quantities by multiplying the total centere length by the respective breadth and height.

In this method, the length will remain same for excavation in foundations, for concrete in foundation, for all footings for superstructure. This method is quick but require attention and consideration at the junction, meeting poin and cross wall etc.

Centere line length of one wall = Inner dimension of room + Wall thickness

- Difference between Conventional and GFRG building

Table 1: Difference between Conventional and GFRG Building

Factors	*Conventional*	*GFRG*
Cost	*Higher then GFRG*	*Can save 20-30%*
Time(G+1)	*Approximately 6 months*	*30 days*
Eco-friendly	*No*	*Yes*
Fire resistant	*Melts in 1000 degree*	*Can withstand 1000 degree with 4 hours*
Earthquake resistant	*Cannot resist earthquake unless designed separately*	*Can resist earthquake (Panel itself act as a shear wall)*
Cooling effect	*No cooling effect*	*Cooler up to 4 degrees*
Life	*50 years*	*80 years*
Water resistant	*No unless water coating is made*	*Water proof*
Carpet area	*9" wall thickness, Hence less carpet area*	*5" wall thickness, hence more carpet area*
Strength	*Less-stronger*	*5 times stronger than conventional.*

III. RESULT ANALYSIS: PLAN AND COST

A. Plan

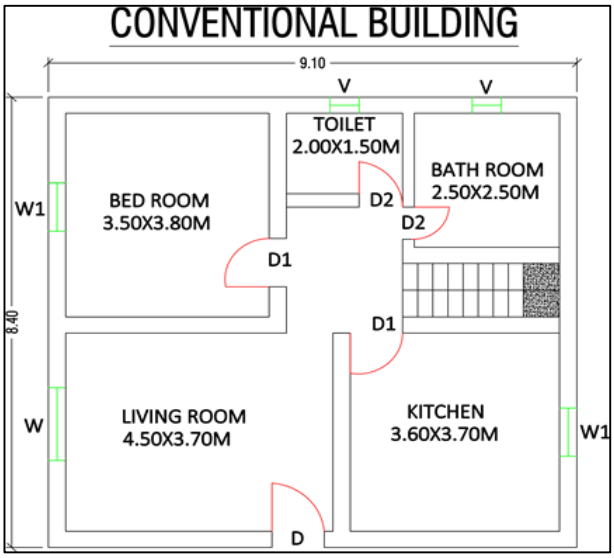

Fig. 2: Plan of ground floor of conventional Building

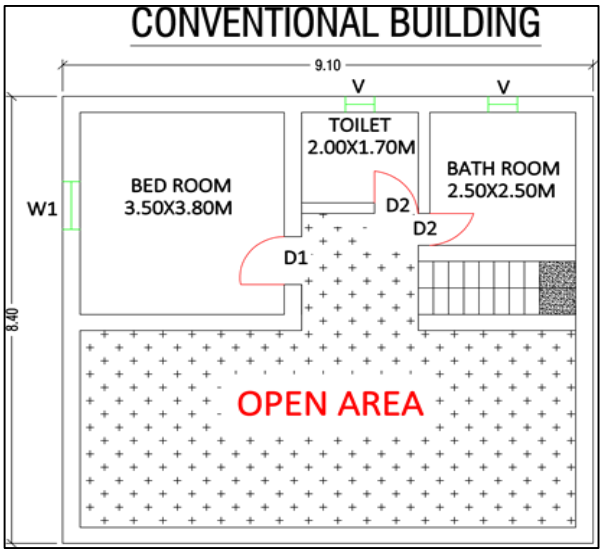

Fig. 3: Plan of first floor of conventional building

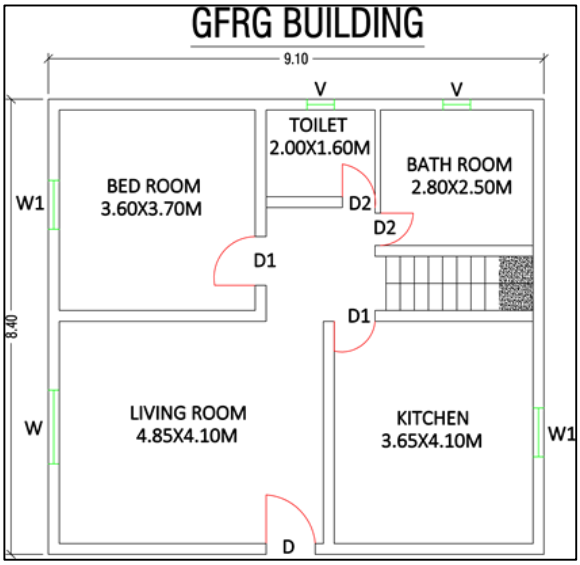

Fig. 4: Plan of ground floor of GFRG building

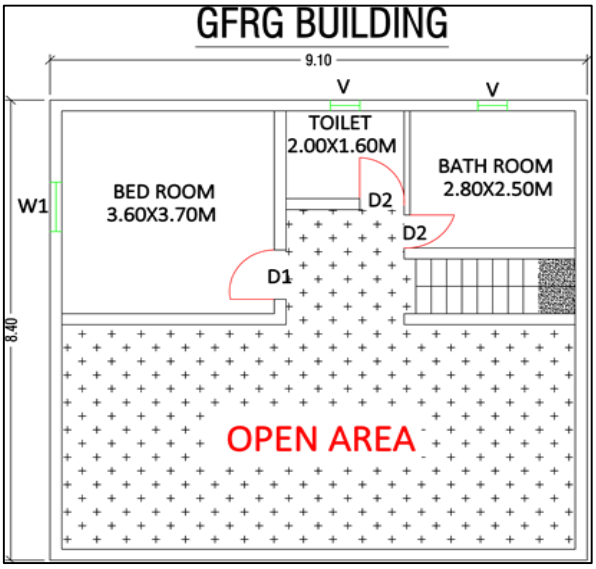

Fig. 5: Plan of first floor of GFRG building

B. Costing and Rate Analysis Conventional Building and GFRG Building

Table 2: Costing and Rate Analysis of Conventional Building

Particular Items	*Quantity*	*Per*	*Rate (Rs.)*	*Amount (Rs.)*
Sub structure		-	-	*1,48,824*
Super structure				
Brick work in super structure	*83.687*	m^3	*4600*	*3,84,960*
RCC work in slab	*18.145*	m^3	*8800*	*1,59,676*
Internal Plaster	*302.95*	m^2	*163*	*49,380*
Outer Plaster	*265.84*	m^2	*189.40*	*50,350*
Inner Painting work	*302.95*	m^2	*450*	*1,36,327*
Outer Painting work	*265.84*	m^2	*450*	*1,19,628*
Cleaning work	*1*	-	*L.S.*	*50,000*
			total	*10,99,145*
Extra cost work		*In %*	*Work in times*	*Rate (Rs.)*
Maintenance up to 20 years		*10%*		*1,09,914*
Painting work up to 20 years			*3 times*	*7,67,865*

Electric work		*8%*		*87,931*
Plumbing work		*5%*		*54,957*
Steel		*6%*		*65,948*
General		*6%*		*65,948*
Material		*5%*		*54,957*
			total	*12,07,520*
			Over all Total cost	*23,06,665*

Table 3: Costing and rate analysis of GFRG building

Particular Items	*Quantity*	*Per*	*Rate (Rs.)*	*Amount (Rs.)*
Sub structure	-	-	-	*1,48,825*
Super structure				
Ground floor	*156.72*	m^2	*1000*	*1,56,720*
Slab-1	*76.44*	m^2	*1000*	*76,440*
First floor	*104.34*	m^2	*1000*	*1,04,340*
Slab-2	*36.5*	m^2	*1000*	*36,400*
Painting work	*528.34*	m^2	*450*	*2,37,753*
Estimated concrete work	-	-	-	*5,66,000*
			total	*13,26,478*
Extra cost work		*In %*		*Amount (Rs.)*
Maintenance up to 20 years		*5%*		*66,323*
Painting work up to 20 years		-		
Electric work		*8%*		*1,06,118*
Plumbing work		*5%*		*66,323*
Steel		*6%*		*79,588*
			total	*3,18,358*
			Over all Total cost	*16,44,836*

Difference between typical costing rate of conventional building and GFRG building is Rs. 6, 61,829

IV. CONCLUSION

- GFRG panel Provide new method of building construction in fast track.
- By this process, man power, cost and time of construction can be reduced.
- Use of GFRG material given more facility such as more cooling effect fire resistance earth quake resistance compare to conventional building.
- The uses of important natural resources like river sand, water, agriculture land, can be significantly reduced.
- We can save our environment by reducing co2 production in conventional construction method.
- And the most important this new technology is having potential to provide shelter to the “homeless”

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