International Journal of Scientific & Engineering Research, Volume 11, Issue 5, May-2020
ISSN 2229-5518

A Comparative analysis on the performance of GFRG (Framed & Non-Framed) building over RC building

Salini S.[1], D.Vimal[2]

Abstract— Even though the construction industry is one of the booming industries in the world which is measured as a sign of growth and development, one of the major setbacks is the time consumption involved in operation and progress of this industry. Many techniques and methodologies are adopted to overcome that hindrance, one of among that is GFRG panels. GFRG panels also known as rapid wall. This technology is widely used in construction of walls, roof and floor slabs in with or without in combination with RC concrete. This project is mainly contributed to provide a study to Comparison between the conventional RC building construction technique, GFRG panel construction technique and a composite building of GFRG + RC. The analysis of the three structures is carried out in E-Tabs. From the results of analysis shear force, story drift, story displacement of the three structures are compared and represented graphically to study their performance

Index Terms— E-Tabs, GFRG panels, performance, story drift, story displacement, shear force, walls.

1 Introduction

GFRG is Glass Fibre Reinforced Gypsum. It is the name of the new building panel product, made essentially of gypsum plaster, reinforced with glass fibres and it is also known as rapid wall [1]. This technology, suitable for rapid mass scale construction, was originally developed and used in 1990 in Australia and widely used throughout afterwards.

So the main aim of this project is to provide a comparative picture between GFRG panel construction (framed and non-framed) and conventional RC construction. Framed GFRG panel building uses GFRG panel for slabs and walls and columns and beams are made as RC members. Whereas unframed GFRG building uses GFRG wall panels as load bearing members So the whole analytical process is carried out for both the cases under similar serviceable conditions are studied. The response of both the building is obtained and it is compared to provide a study. The various parameters like storey drift, time period, bending moment and shear are compared [3].

- *Salini S. is currently pursuing masters degree program in Structural engineering in Vel tech High tech Dr.Rangarajan Dr.Sakunthala Engineering College, Chennai, India, PH-9841631123.*
  E-Mail : saluselvakumar@gmail.com
- *D.Vimal is currently working as an Assistant Professor in Vel tech High tech Dr.Rangarajan Dr.Sakunthala Engineering College, Chennai, India. PH-7708671712.*
  E-Mail : vimal.danny@gmail.com

2 Material and Methods

GFRG panels are manufactured to a thickness upto 125mm under carefully controlled conditions to a length of 12m and height of 3m [5] with glass fibres dispersed throughout. Each 1m of the panel has 4 cells of dimensions 230mm x 125mm. Cells may be filled, partially filled or unfilled. For the given situation, the panels are filled with M25 grade of concrete and Fe415 steel reinforcing bars.

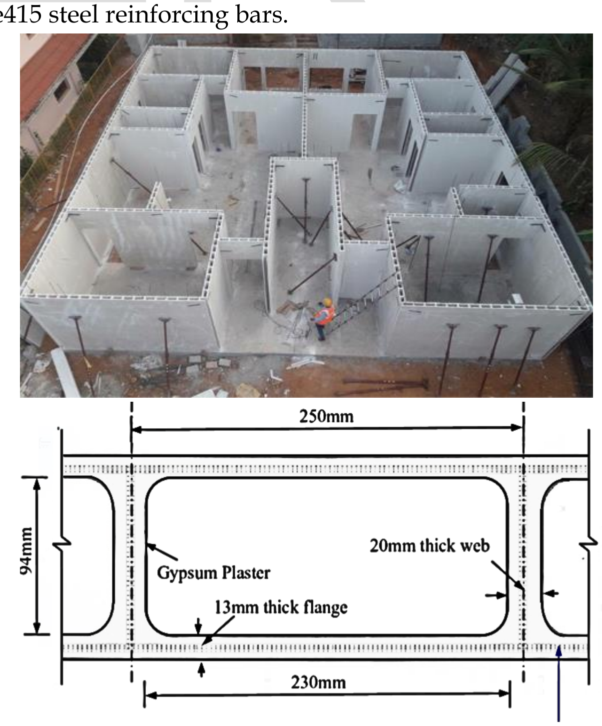

Fig. 1. GFRG wall panel

International Journal of Scientific & Engineering Research, Volume 11, Issue 5, May-2020
ISSN 2229-5518

These GFRG wall panels have a unit weight of 0.433Kn/m^3 and a modulus of elasticity of 7500N/m^2 (unfilled).

So the first steps involved is drafting a common plan for all three types of structures. Here a G+5 building in seismic zone iii is considered.

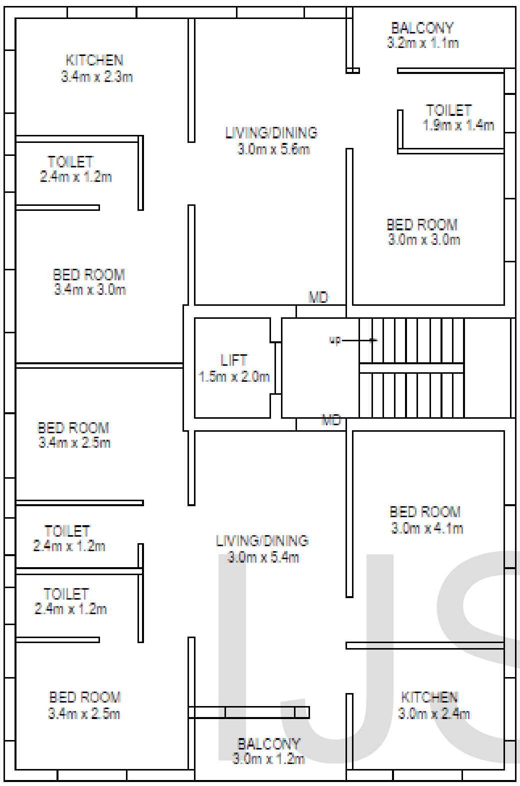

Fig. 2. Building Plan

After creating the plan, column placement is finalised and a skeletal frame work is created in E-Tabs where further analysis is carried out. The properties and assignment of members as per the type of structure i.e. GFRG/RC/GFRG+RC is done [9]. The grade of concrete used is M25 and steel is Fe415. The panel size is 12m x 3m x 0.124m where the length of the panel is altered to suit the plan. The loading involves dead load, live load (As per IS 875 – 2, 1987), wall load and seismic load (as per IS 1893 – 2002).

The various load combinations used for the purpose of analysis is as follows:

- 1.5(DL $\pm$ LL $\pm$ WL)
- 1.2(DL $\pm$ LL $\pm$ WL $\pm$ Ex / Ey)
- 1.5(DL $\pm$ Ex / Ey)

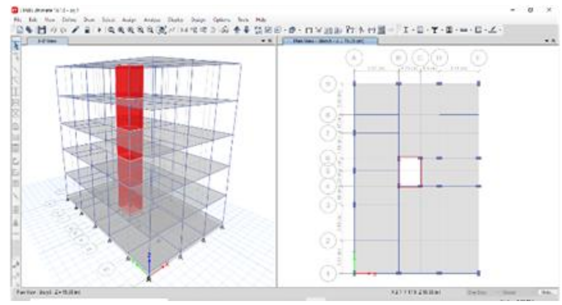

Fig. 3. Framework of GFRG+RC building

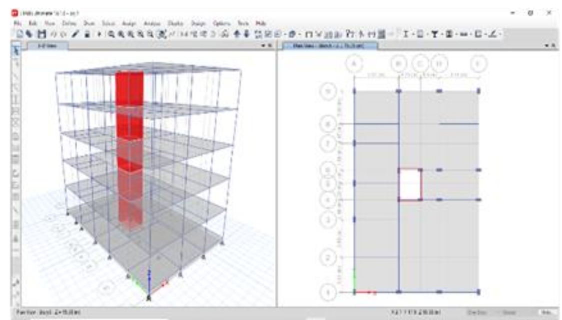

Fig. 4. Framework of GFRG building

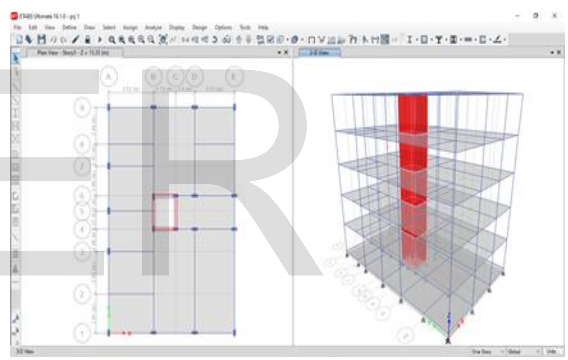

Fig. 5. Framework of RC building

In each stage of analysis, the results of analysis is noted and designing is done. In GFRG building, the panel is designed for a thickness of 124mm with each cell at 95mm spacing. The cells are reinforced and filled with concrete. To serve as a slab the panel is provided with a screed of 60mm with 10mm guage at 100mm c/c. In RC and GFRG+RC building, the size of column used is 400mm x 230mm and the size of beam is 230mm x 300mm and 350mm x 300mm.

International Journal of Scientific & Engineering Research, Volume 11, Issue 5, May-2020
ISSN 2229-5518

3 Results

After the analysis has been carried out, the various parameters like story displacement, story drift, time period for each mode and story shear [3] are noted for each structure and they are graphically compared.

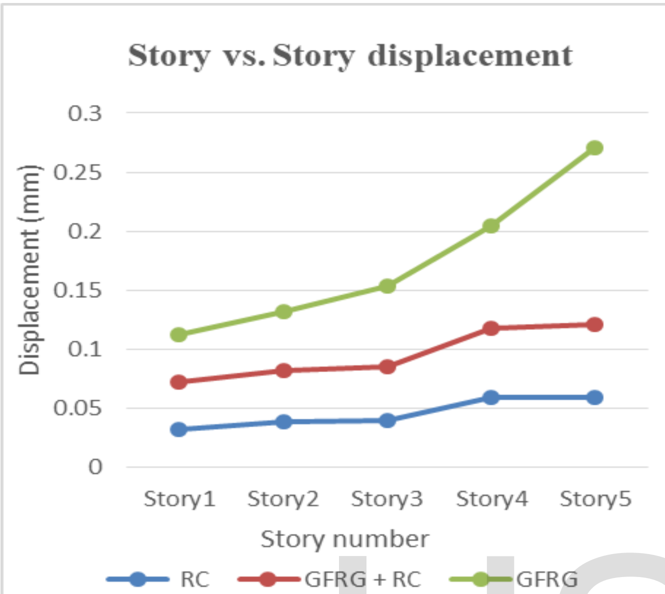

Fig. 6. Story vs. Story displacement curve

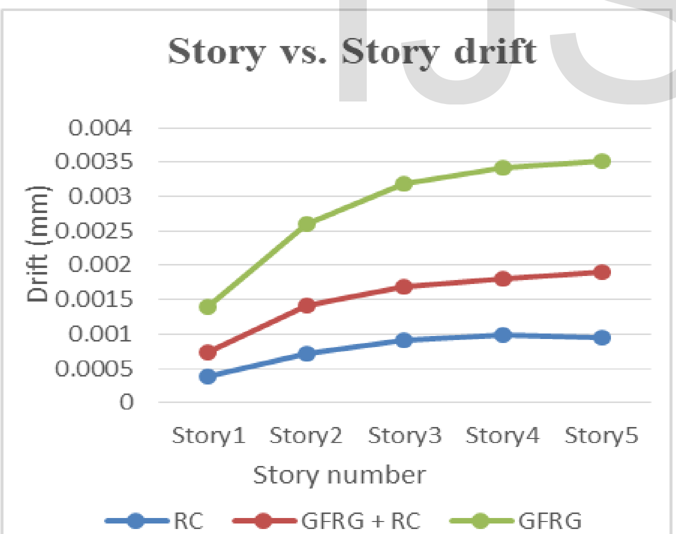

Fig. 7. Story vs. Story drift curve

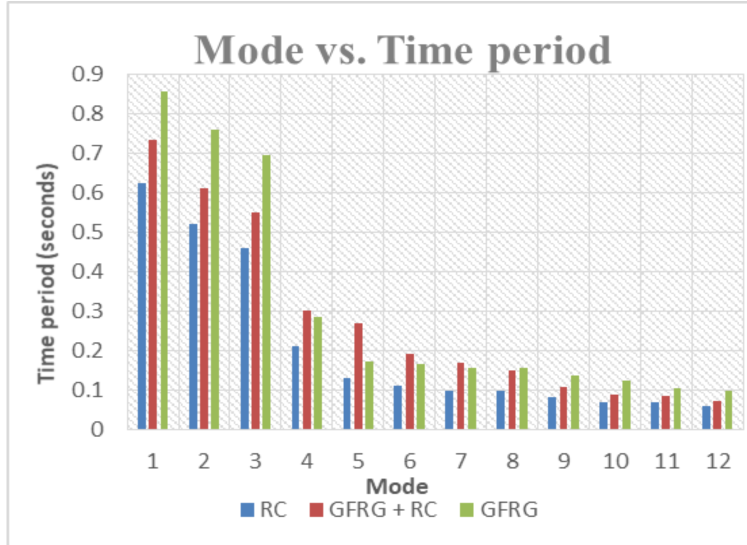

Fig. 8. Mode vs. Time period curve

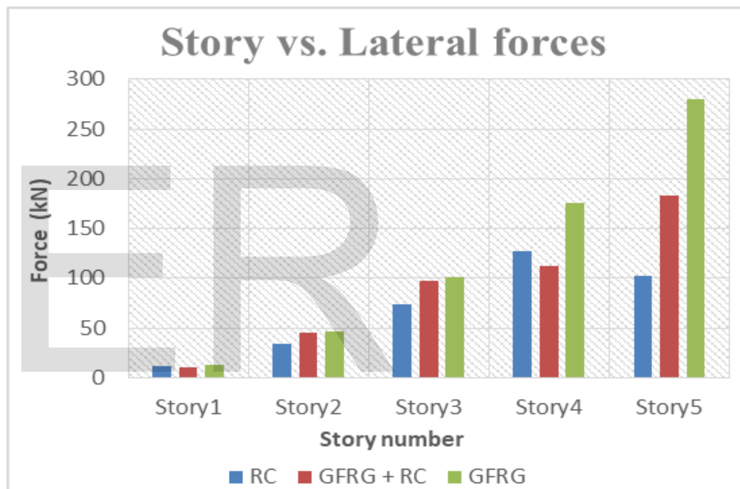

Fig. 9. Story vs. Lateral forces curve

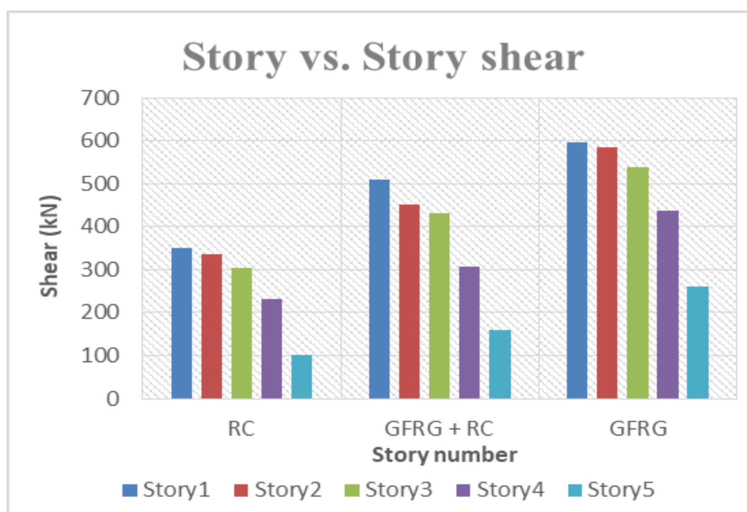

Fig. 10. Story vs. Story Shear curve

International Journal of Scientific & Engineering Research, Volume 11, Issue 5, May-2020
ISSN 2229-5518

4 Conclusion

The various conclusions that have been inferred from this study is as follows:

- The displacement is checked in accordance to IS codes is H/300 (mm). The displacement pattern of RC building and framed GFRG building i.e. GFRG + RC building is almost similar. But however non-framed GFRG building differes from RC building i.e. the displacement is within maximum limits upto story number 3 after which a drastic difference is observed.
- The story drift as per IS 1893-2002 should be within 0.004h (mm). This maximum limit is satisfied by all three types of structure.
- The time period for various mode of displacement (12 modes considered) is higher for non-framed GFRG building compared to RC and framed GFRG building.
- The shear acting on the building is similar in RC and framed GFRG building and comparatively less compared to non-framed GFRG building.
- The lateral forces have maximum impact on the topmost floor and it has most effect in non-framed GFRG builfding.

From the above results, it is inferred that behaviour of RC building is similar to that of framed GFRG building and well within serviceable limits. But however the non-framed GFRG building holds good upto story number 3. As the height increases, the displacement and drift increases and exceeds the serviceable limits. Hence further alterations of the panel maybe necessary for usage of panel as load bearing members in increasing heights.

References

[1] Aishwary Shukla, Mohd. Afaque Khan, Abhishek Kumar, "A Review of Research on Building System Using Glass Fiber Reinforced Gypsum Wall Panels," *International research journal of Engineering and Technology*, vol. 3, no. 2, pp. 1443-1445, April 2016.

[2] ArvindReddy, "Studies on seismic analysis of RC regular and irregular structures," *International research journal of Engineering and Technology*, vol. 5, no. 6, pp. 43-49, March 2012.

[3] Athulya Chandran, Namitha Prasad, "Static Analysis on GFRG and conventional multi-storied building using ETABS," *International research journal of Science, Engineering & Technology*, vol. 2, no. 12, pp. 563-567, November 2016.

[4] Athulya Chandran, Namitha Prasad, "Dynamic Analysis on GFRG and conventional multi-storied building using ETABS," *International research journal of Science, Engineering & Technology*, vol. 6, no. 7, pp. 5-7, March 2016.

[5] Building Material & Technology Promotion Council, "Technology profile on Glass Fibre Reinforced Gypsum (GFRG) building system," *Prospective construction system on mass housing*, November 2014.

[6] Eldhose M. Manjummekudiyil, Basil P.Alias, Sarath Rajan "Study of GFRG panel and its strengthening," *International research journal of civil and structural engineering*, vol. 2, no. 2, pp. 161-165, March 2014.

[7] Gouri Krishna, Dixon David,"Seismic behavior of GFRG-OGS building" *International research journal of civil and structural engineering*, 16th world conference on Earthquake, 16WCEE , pp. 1-10, march 2017.

[8] Hariprasad, Praveen Reddy, Sathish," A review on analysis of multi-storied building using STAADPRO," *International research journal of civil and structural engineering*, vol. 5, no. 6, pp. 121-125, August 2011.

[9] Ramyateja, Narasimhalu, G.Madhusudhanan," A seismic analysis of GFRG & regular RC building using ETABS," *International research journal of scientific research & development*, vol. 5, no. 6, pp. 355-361, October 2015.

[10] Shyam Doshi, Jay Rathod, Kevin, Parth Parmar, "Glass Fibre Reinforced Gypsum panels use in building construction" *Gloabal research and developmental journal for engineering*, vol. 3, no. 3, pp. 47-32, April 2018.