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# COMPARATIVE STUDY OF AUDITORIUM OF RCC AND GFRG

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***Abstract*** *- During the past twenty years, different components of the building made by Fiber Reinforced Polymers are used. It has good resistance to corrosion in aggressive environmental conditions, good fatigue strength, high strength to weight ratio and the capability to mould into any shape of fiber reinforced polymer (FRP) composites makes GFRG or Glass Fiber Reinforced Gypsum as an alternative to conventional construction materials. The panels made from Glass Fiber Reinforced Gypsum has high flexural property. So, it is necessary to study the structural behavior of buildings made with GFRG Panels. In this project, a comparative study is made for an RCC structure and a GFRG structure. The maximum storey displacement as well as the base shear of these two models are analyzed and compared using linear static method of analysis. It has been observed that GFRG building is better in terms of seismic performance.*

**Keywords:** *GFRG, RCC. maximum storey displacement, base shear*

## I. INTRODUCTION

The design of buildings for good seismic performance is mainly concerned with structural safety during major ground motions, but durability and the potential for economic loss are also a major concern. Behavior of the building under such loading is fundamentally different from wind or gravity loading, which is requiring much more detailed analysis to assure acceptable seismic performance beyond the elastic range. Some structural damages in the building can be expected when the building experiences design ground motions because almost all building codes allow inelastic energy dissipation in structural systems. The resistance to corrosion in aggressive environments, good fatigue strength, high stiffness to weight ratio, high strength to weight ratio and capability to mould into any shape of fiber reinforced polymer (FRP) composites makes GFRG or Glass Fiber Reinforced Gypsum as an alternative to conventional construction materials and structural steel in the construction of marine structures such as offshore and berthing structures.

***Figure. 1: Glass Fiber Reinforced Gypsum Panel***

During the past twenty years, several building components made by Fiber Reinforced Polymers as basic materials have been developed. The FRP consists of the union of a polymer matrix and fibers. To manufacture building products, fiber glass is most widely used(GFRG). In the present study, linear static analysis of a RC structure is compared with the structure with GFRG Panel. Modelling and analysis is carried out using ETABS 2015.

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## II. METHODOLOGY

A. Modelling

A real existing RCC Auditorium building located in Pathanamthitta district, Kerala is considered for this project work. Since the soil condition at that site were particularly poor, soil type III is considered for the analysis purpose. Here the actual structure is of conventional reinforced cement concrete. For the purpose of study of newly arrived and rapid construction material called gypsum panels, different models along with conventional concrete are made with such panels and seismic parameters such as maximum storey displacement as well as base shear is evaluated and compare using linear static method.

The structure consists of two types of beams. For longer span beam of dimension 230mm × 450mm is used and for shorter span, beam of span 230mm × 300mm is provided. For better appearance, circular columns are provided interior of the structure and square columns are provided at the exterior. The dimension of the column used is 300mm for circular column and 300mm × 300mm for square column.

RCC Slab thickness = 110mm.

wall thickness is 230mm.

For modelling of GFRG and combined model, Slab thickness considered was 124mm since the standard thickness of GFRG slab is so.

Wall thickness of GFRG model = 124mm

Column dimension of GFRG model = 248mm × 270mm

TABLE 1 . PROPERTIES USED FOR ANALYSIS

| | |
|---|---|
| Zone | III |
| Number of floors | G +1 |
| Typical storey height | 4.2m |
| Ground floor height | 3.6m |
| Grade of concrete | M25 |
| Grade of steel | Fe415 |
| Thickness of brick wall | 230mm |
| GFRG wall thickness | 124mm |
| Density of concrete | 25 kN/m$^3$ |
| Density of brick wall | 20kN/m$^3$ |
| Poisson ratio for concrete | 0.2 |
| Poisson ratio for GFRG | 0.2 |
| Unit weight of GFRG | 40kg/m$^2$ |
| Poisson ratio for brick wall | 0.15 |
| Response reduction factor | 3 |
| Importance factor | 1.5 |

Models considered for the study

1. RCC model
2. GFRG model

Loads used on the models:

- RCC SLAB

Slab thickness = 110mm

Self-weight = 2.75kN/m$^2$

Floor finish = 1kN/m$^2$

Total dead load = 3.75 kN/m$^2$

Dead load of stair slab is taken as 5 kN/m$^2$

- BRICK WALL

Wall thickness = 230mm

Density = 20 kN/m$^3$

Self-weight of brick wall = 19.32 kN/m

 

- GFRG

Density = 11.12kN/$m^3$
Slab thickness = 0.124m
Self-weight = 1.38kN/$m^2$
Assume floor finish of 1 kN/$m^2$
Total dead load on GFRG Slab = 3.47 kN/$m^2$

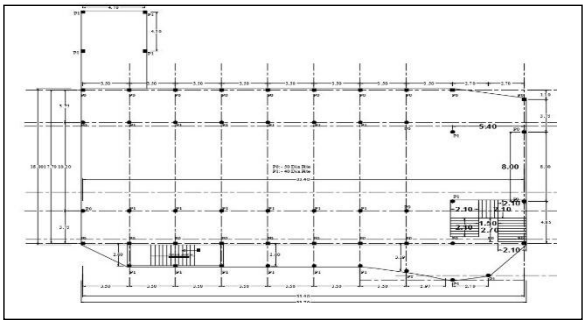

***Figure. 2: Plan view of the cellar***

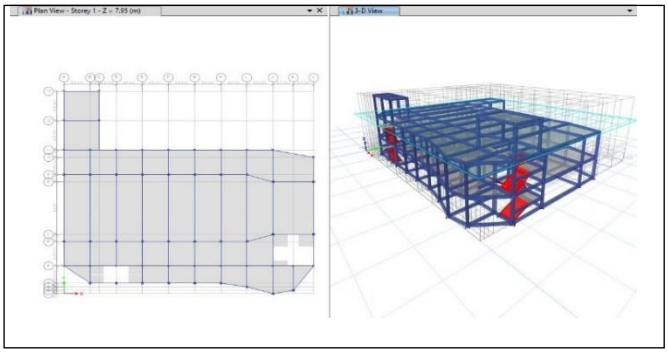

***Figure 3.Plan view & three-Dimensional view of the RCC model***

B. Load combinations

1. 1.5(DL+IL)
2. 1.2(DL+IL±EQ)
3. 1.5(DL±EQ)
4. 0.9DL±1.5EQ

## III RESULTS AND DISCUSSIONS

A. Maximum storey displacement

TABLE 2. MAXIMUM STOREY DISPLACEMENT IN mm

| MODEL | MAXIMUM STOREY DISPLACEMENT IN mm |
|---|---|
| RC | 35.76 |
| GFRG | 19.98 |

Table 2 represents the maximum storey displacement in which Storey displacement is maximum at the combined model followed by the RC model and the maximum storey displacement is least at the GFRG model. Graphical representation of maximum storey displacement is shown below.

 

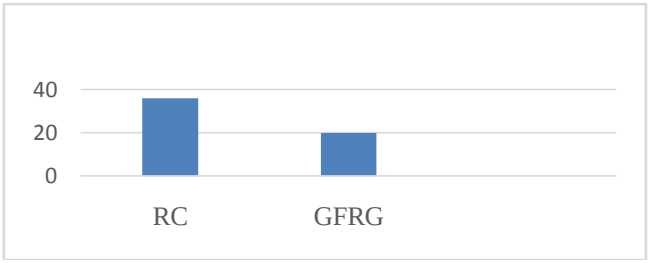


***Figure. 4.Graph showing maximum storey displacement***

B. Base shear

Base shear of three models in linear static is obtained which is shown in the table 14 below. In linear static analysis, base shear of RC is obtained as maximum while compared to GFRG and combined model. Fig5 shows the graphical representation of base shear in linear static analysis

TABLE 3. BASE SHEAR FOR LINEAR STATIC

| FORCE | RC | GFRG |
|---|---|---|
| FY | 2489.16kN | 1106.19kN |
| FX | 2621.21kN | 1685.04kN |

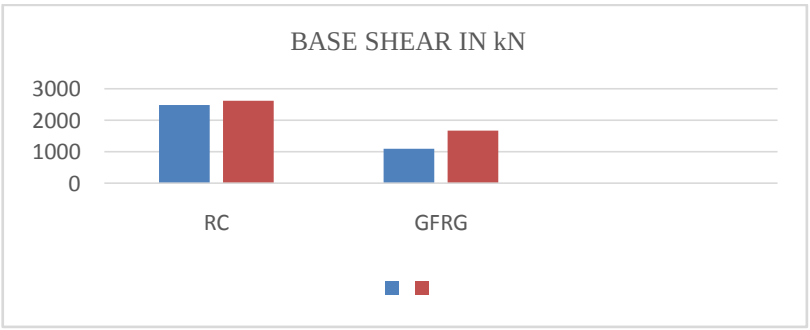


***Figure. 5Graph showing base shear for linear static***

As we know, the base shear is the maximum lateral force that will occur due to seismic ground motion at the base of the structure. From the table, it can be seen that the base shear for the RCC model is greater than GFRG model by 55.55% in y axis and 35.71% in x axis respectively in linear static analysis. The reason for the significant reduction in base shear for GFRG model is due to its lower dead weight

## III. CONCLUSION

An existing Auditorium building located in Pathanamthitta district, Kerala is considered for the study. Since the soil condition at that site were particularly poor, soil type III is considered for the analysis purpose. Here the actual structure is of conventional reinforced cement concrete. For the purpose of study of newly arrived and rapid construction material called gypsum panels, different models along with conventional concrete are made with such panels and seismic parameters such as maximum storey displacement as well as base shear is evaluated and compare using linear static method. The overall conclusion is descripted below

- Maximum storey displacement of Reinforced Cement Concrete structure is greater than GFRG model in linear staticanalysis.
- The maximum storey displacement is greater in RCC model than the GFRG model since the stiffness is lesser in RCC model.
- The base shear for the RCC model is greater than GFRG model by 55.55% in y axis and 35.71% in x axis respectively in linear static analysis since the Seismic weight of GFRG model is significantly lesser than the RCC model.

Hence while considering the structural point of view, GFRG or Glass Fiber Reinforced Gypsum Paneled structure is more satisfactory and performance wise better than the RCC structure

 

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