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Comparative Study of R.C.C and Steel-Concrete Composite Multi-Storey Building Based On Seismic Analysis

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***Abstract*— Steel-Concrete composite constructions are nowadays very popular due to their advantages over conventional Reinforced Cement Concrete constructions. Composite Construction combines the better properties of both steel and concrete along with economical, speedy construction, hazardous formwork etc. Hence the objective of this paper is to compare a R.C.C frame building and Steel- concrete composite frame building located in seismic zone-IV and analysis of (G+12) stories R.C.C frame building and Steel- concert composite frame building under the effect of earthquake using ETABS 2016 software. The method of equivalent static analysis has been used for the seismic analysis as per is 1893(part I):2002. The comparison of results analysis in terms of time period, axial force, story drift, story shear, is presented here. It is observed that Steel-concrete composite building is better option than R.C.C building.**

***Index Terms*— Composite, RCC Structures, Earthquake, Time period, Axial force, Storey drift, Storey shear, etc.**

I. INTRODUCTION

The population in cities is growing exponentially and the land is limited, there is a need of vertical growth of buildings in these cities. So, for the fulfillment of this purpose a large number of medium to high rise buildings are coming up these days. For these high rise buildings it has been found Structural steel and concrete material is widely used. Though these materials may have different properties and characteristic, they both balance to each other in many ways. Steel has excellent resistance to tensile loading but lesser to compressive force. On the other hand concrete is good in resistance to compressive force. Steel may be used to induce ductility an important criteria for tall buildings, while corrosion protection and thermal insulation can be done by concrete. Composite construction is widely preferred with steel encased with concrete are economic, cost and time effective solution in major civil structures. So, it is necessary to analysis a structure to perform well under seismic loads.

OBJECTIVE

To comparative analysis of (G+12) storey R.C.C and Composite multi-storey building are analyzed by static analysis method. The analytical result of R.C.C and Steel-Concrete Composite structure such as time period, axial force, storey displacement, storey shear,storey drift etc.

COMPOSITE STRUCTURE

The structure in which sections made up of two different materials such as structural steel and concrete are used for the structural framing system is called as composite structure. In composite construction two different materials act as a single unit under loading. The typical cross-section of composite member is shown in figure no.1.

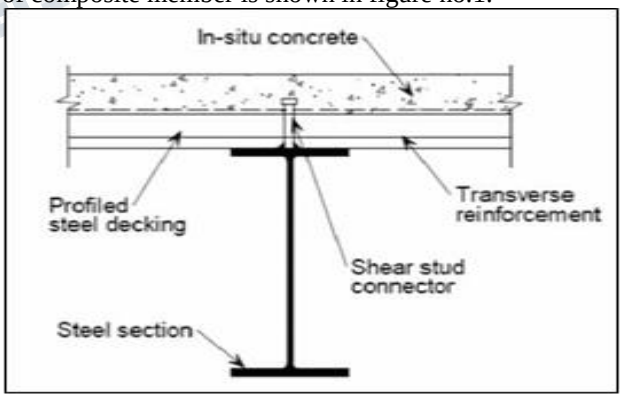

Fig.1:Typical cross-section of composite member

BUILDING DESCRIPTION

The building considered here is an commercial building having G+12 stories located in seismic zone IV and for earthquake loading. The symmetrical plan dimension of building is 20mX 20m. As shown in figure 2. Height of each storey is kept same as 3.0m except bottom height be 2.5m and total height of building is kept as 38.5m. The columns

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are placed at a span of 4m center to center and are taken to be square. The basic loading on both the building kept same and another relevant data is tabulated in table 1.

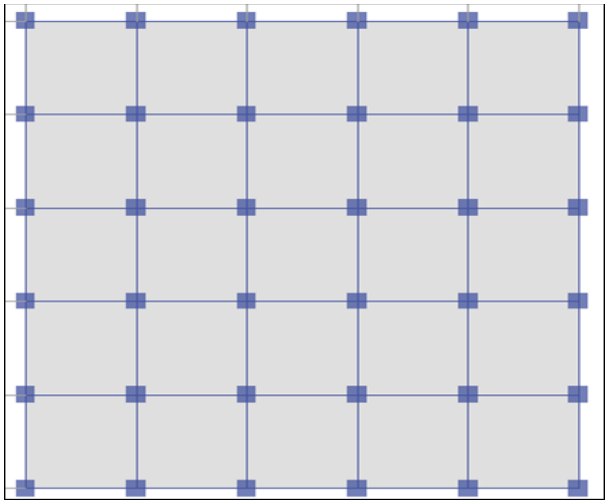

Fig.2: Plan of building

Table -1 Data for analysis of RCC and Composite Building

Particulars	RCC Structure	Composite Structure
Story	G+12	G+12
Plan dimensions	20 X20 m	20 X20 m
Height of each story	3.0 m	3.0 m
Plinth height	1.0 m	1.0 m
Height of parapet	1.0 m	1.0 m
Total height of building	39.5 m	39.5 m
Thickness of wall	230 mm	230 mm
Live load at top roof	2KN/m2	2KN/m2
Live load at roof	5KN/m2	5KN/m2
Floor finish	1KN/m2	1KN/m2
Graid of concrete	M25	M25
Graid of structural steel	Fe250	Fe250
Graid of R/F steel	Fe415	Fe415
Density of concrete	25KN/m2	25KN/m2
Density of brick masonary	20KN/m2	20KN/m2
Seismic zone	IV	IV
Soil type	Hard	Hard
Importance factor (I)	1.0	1.0
Response reduction R	5.0	5.0
Zone factor (Z)	0.24	0.24
Column	0.7X0.7m	0.6X0.6m
Beam	0.23X0.53m	ISMB250
Slab/Deck	150 mm	150 mm

MODELLING OF BUILDING

The analytical models of the building include all components of structure. Beam and column is a model as two nodded beam with six DOF at each node. The floor slab is assumed to act as diaphragms which distribute the vertical load at each resisting element. For a simple static analysis fixed supports are used. For the models under consideration, the connections between beam-column are rigid and supports are restrained against the translational and rotational motions. The 3D building models are shown in figure 3.

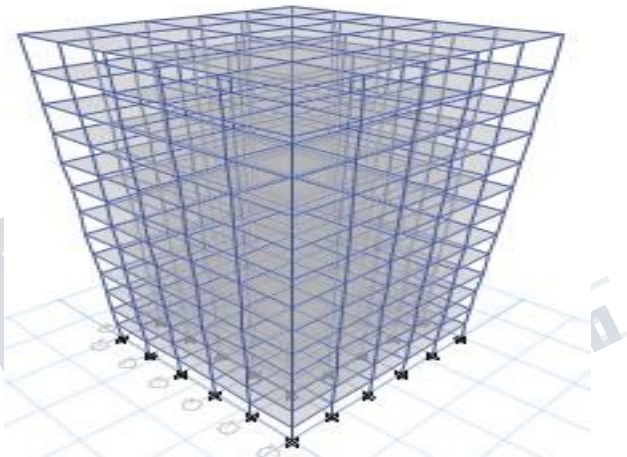

Fig.3: 3D Model of Commercial Building

II. RESULTS AND DISCUSSION

In this paper the comprasion between R.C.C and Steel-concrete composite multistory building is done by static analysis results of the models are presented here in terms of time period, axial force, storey displacement, storey drift and story shear.

Time period

From figure 4 shows that variation in time period of RCC and Composite building. Composite building has greater time period as compared to RCC so it clearly indicated that it is more flexible to oscillate back and forth when lateral force act on the building.

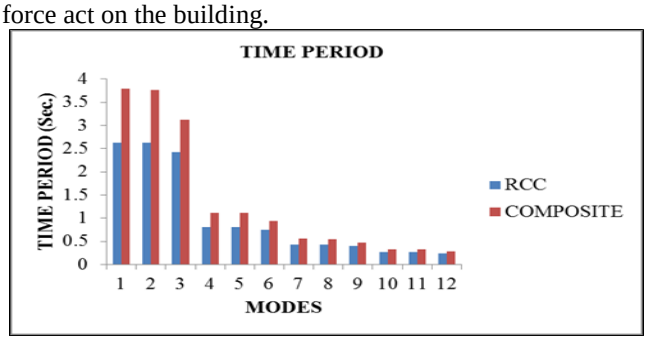

Fig.4: Variation in time period

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Storey drift

The variation storey drift of RCC and Composite building are as shown in figure 5. It is observed that in a composite building storey drift value is higher compared to RCC building. For earthquake load, as per IS: 1893-2002, clause: 7.11.1, the storey drift in any storey due to minimum specified lateral force with partial load factor of 1.0 should not exceed 0.004 times storey height.

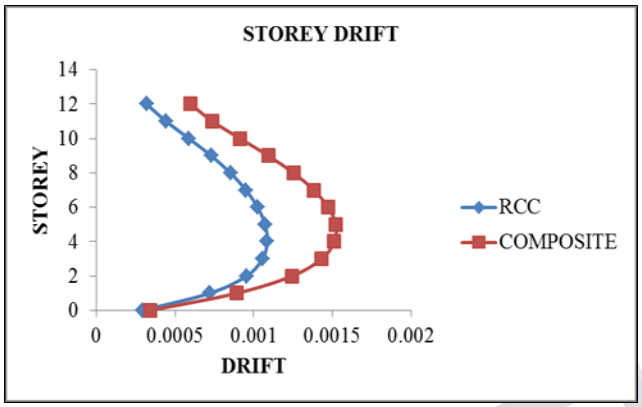

Fig.5: Variation in storey drift

Axial force

From figure 6 shows that the variation in axial force in a column have been reduced by an average 4%-14% in a composite building as compare to RCC building.

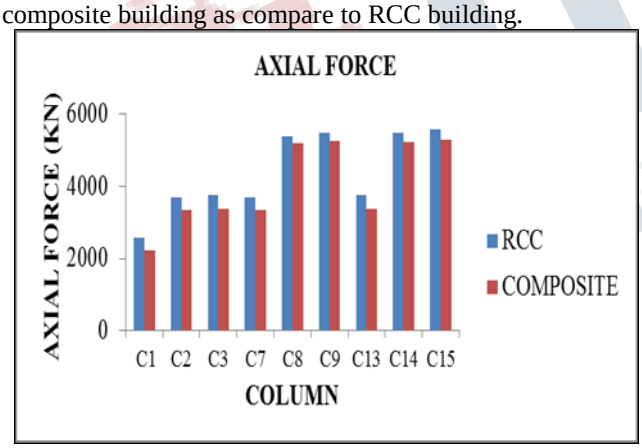

Fig.6: Variation in axial force

Storey shear

The variation in story shear are as shown in Figure 7. It is observed that RCC building gives 24% to 36% more storey shear than composite building.

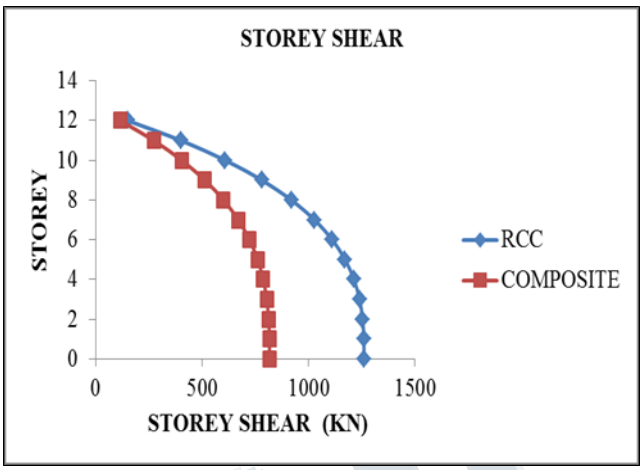

Fig.7: Variation in storey shear

Storey displacement

The story displacement are as shown in Figure 8. It is observed that the displacement at performance point for composite building is 10% to 40% more as compared to RCC building. This is because; composite building is more flexible as compare to RCC building.

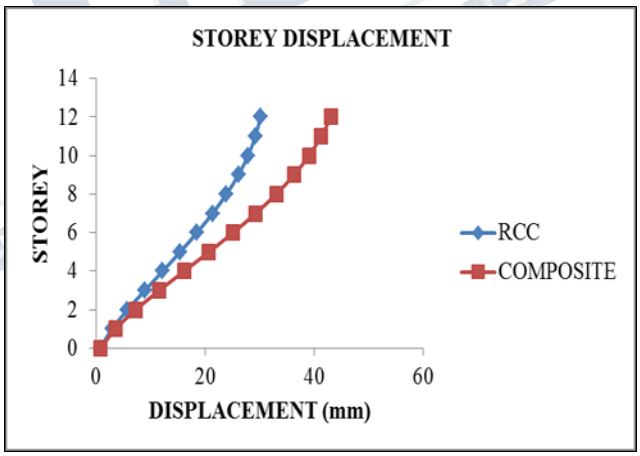

Fig.8:Variation in storey displacement

III. CONCLUSIONS

Based on the Analysis and Design results of G+12 storied Composite and RCC building following conclusions are drawn. The displacement and storey drift RCC building is less than Composite building. This is because; Composite building is more flexible as compare to RCC building. Construction time in RCC building is more than that of Composite building. Weight of composite building is low as compared to RCC building resulting in reducing the foundation cost.

Under the earthquake consideration Composite building perform better than a RCC building. This is because; Composite building is more ductile as compare to RCC building. For the construction of high rise structures, composite structures are the best solution.

IV. ACKNOWLEDGEMENT

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