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Comparative Seismic Behaviour of RCC and Composite Column With RC Beam Structure

[1]Arshiyasultana Sayyed,[2]Prof.Vishwajeet Kadlag

[1]PG Student, Department of Civil Engineering Dr. D Y Patil School of Engineering and Technology, Charholi (BK), Pune-412 105, Maharashtra, India

[2]Associate Professor, Dept. of Civil Engineering, Dr. D Y Patil School of Engineering and Technology, Charholi (BK), Pune-412 105 Pune, Maharashtra, India

Abstract : RCC structure is no longer suitable for high rise construction because of failure of members during earthquake.Due to this loss of life of peoples and structural damage occur .By use of composite column i.e steel-concrete with RC beam we usually lowers the damage and prevent life of people In this study the seismic response of a 15 storey reinforced concrete building and composite column i.e steel-concrete with RC beam building is analysed by displacement control pushover analysis. It is assumed to be located in seismic zone 3 and seismic response is compared with composite column structure..In this paper 15 storey of RCC and composite column structure is modeled in ETABS software.Material and geometric non-linearity is consider .Geometric non-linearity is considered in the form of p-delta effect. And results are compared.

***IndexTerms* - P-delta effect,Non linear analysis,Seismic Response,RCC structure, Capacity Curve**

I. INTRODUCTION

Necessity of high rise Building is due to Rapid growth of population in urban communities,Expensive land prices,Other factors, such as terrain conditions or the lack of land area.This high rise building is mostly effected by lateral forces in form of wind, earthquake.Earthquake shakes the ground makes structure unstable. There are different types of seismic analysis are performed on structure to study the behaviour of structure during earthquake.Mainly static and dynamic analysis is on forefront.Some static and dynamic analysis easily detect the which member is weak,which member fails before. So,by performing analysis we can easily predict the structure is safe or not.

- Pushover Analysis:

Pushover analysis is nonlinear static analysis.In this analysis monitored displacement is provided to the strcture which gives capacity curve. As shown in figure 1.Pushover analysis demonstrate the building performance in IO LS CP state.By providing nonlinear hinges to member we can easily determine which member is weak. Is retrofitting is needed for this existing structure.Due to this we can easily reduce the structural damage and life peoples.

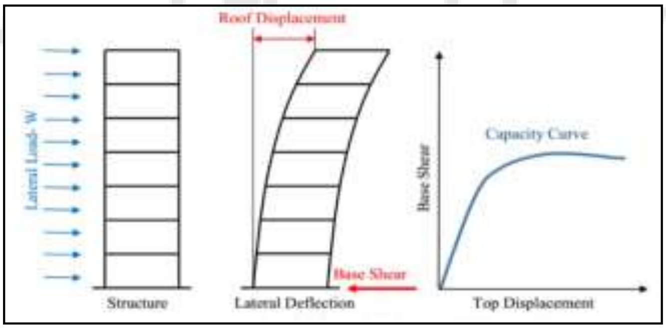

Fig -1: Static approximation used in pushover analysis

- Composite Column:

By combining the two or more materials composite column is casted. Espectially Steel is encased in concrete.In the era of 1980 many buildings were built by using composite column and many developed countries like Japan,Germany,USA etc adopt the composite construction technique into practice for speedy construction.Nowdays high rise building is needed.As height of building is increases column size is also increases.Because in earthquake resistance structure strong column weak beam concept is uses.Therefore must be strong as compare to beam.Usually composite column plays a role of strong column weak beam concept.Reduction in sizes of column as compare to RCC column gives good results.Therefore by use of this new technology we can make structure more earthquake resistance.

1.1 Objective to Study

1.To study behavior of RCC and steel concrete composite column structure under seismic loading.
2.To perform nonlinear static analysis i.e. Pushover analysis for all the model using Etabs software and to demonstrate the Pushover Curve .
3.To check whether the steel-concrete composite sections are the best alternative to RCC sections used in high rise building.
4.To check the result for base shear , story drift, story displacement for all models.
5.To decide feasibility of the structure from its performance point by using pushover analysis

2. METHODOLOGY

1.Forming Models of 15 storey of RCC & Steel-concrete composite fame (encased I section)
2. EIS column (Encased I- section) with RC beam is modeled. For composite structure.
3. Modeling of structure: The proposed model presented herein is the non existing multistoried (G + 14) building located in seismic zone 3.
3. And nonlinear static analysis i.e. pushover analysis of both RCC & steel-concrete composite frame are carried out using software tool ETABS .
4. Different parameters such as shear force, story drift, story displacement & performance points of both RCC & composite frame are discussed.
5. Decide which strcture is good for earthquake resistant structure.

Table -1: Data Used in G+14 i.e. 15 Storey Structure

Description	G+14 RCC Structure	G+14 Composite Column Structure
No. of grids in x-direction	5	5
No. of grids in y-direction	4	4
Plan dimension	16mX12 m	16 mX12 m
Height of each story	3.00 m	3.00m
Size of beam	300mmX 600 mm	300 mmX600 mm
Slab thickness	150 mm	150mm
Dead load of wall	7.2 kN/m	7.2 kN/m
Dead load of parapet wall	2.7 kN/m	2.7 kN/m
Live load	3 kN/m^2	3 kN/m^2
Grade of concrete	M30	M30
Rebar	HYSD415	HYSD415
Steel		Fe345

Table 2: Column sizes use in structure

Composite building	Model-1 15 storey RCC	Model-2 15 storey Composite
1st to 5th floor	600mmx600mm	Encased ISMB300 500mmx500mm
6th to 10th floor	500mmx500mm	Encased ISMB200 400mmx400mm
11th to 15 th floor	400mmx400mm	Encased ISMB100 300mmx300mm

Table 3: Seismic Load

Code	IS 1893:2016
Zone	III
Zone factor	0.16
Soil type	Medium
Importance factor	1.2
Response reduction factor	5

3.1.ETABS MODEL

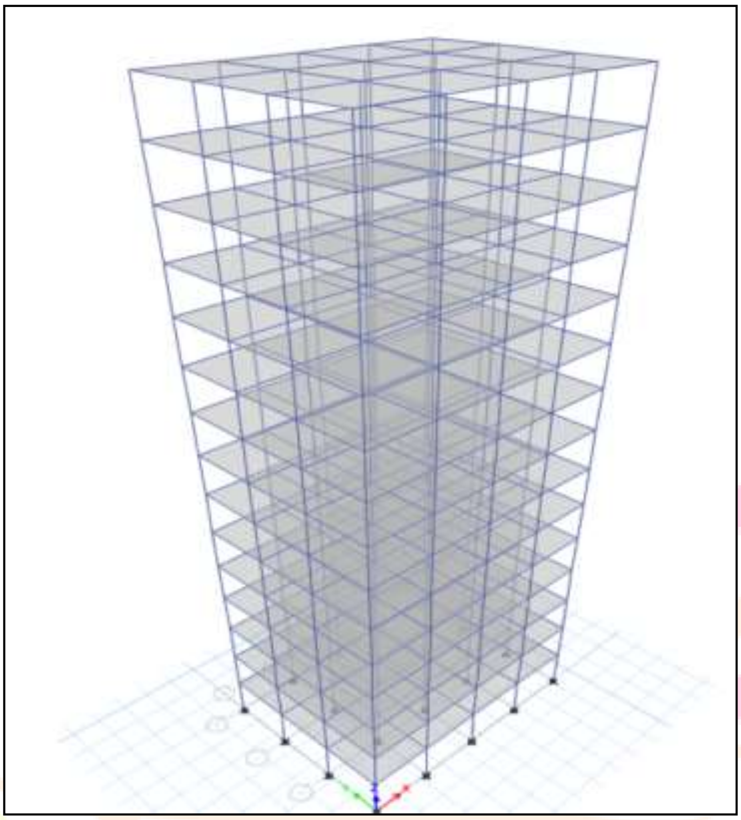

Fig -2: 3D view of 15 storey Model

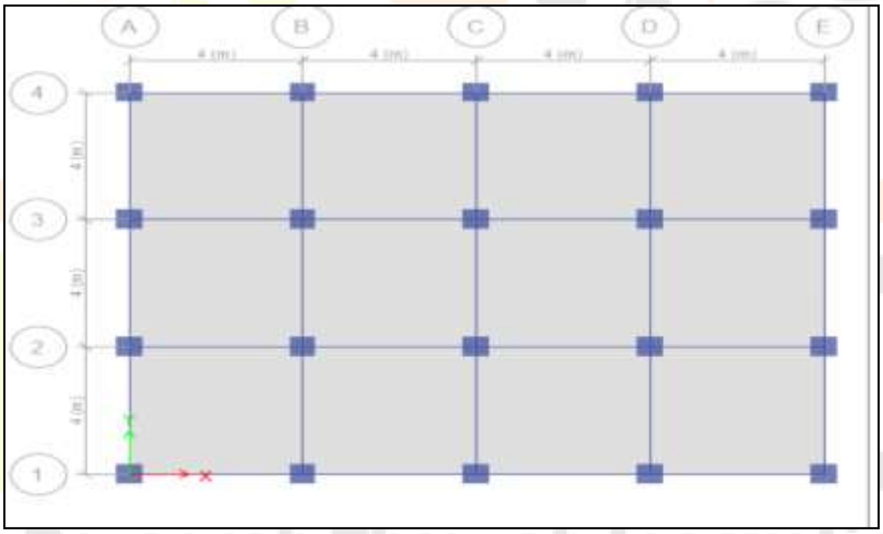

Fig -3: Plan of RCC Structure

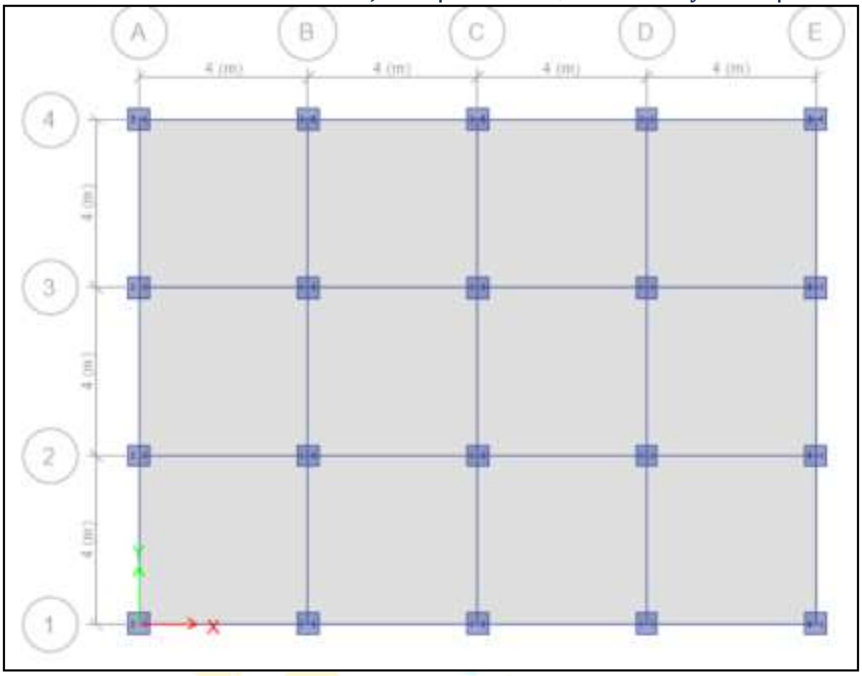

Fig -4: Plan of Composite Column Structure

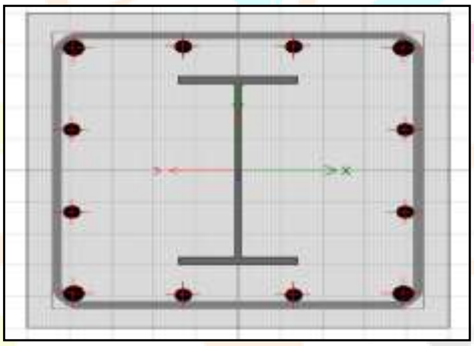

Fig -5: Cross section of composite column
Encased ISMB300
500mmx500mm

IV. RESULTS AND DISCUSSION

4.1 Storey Displacement

Storey displacement is the total displacement of any storey with respect to the ground.

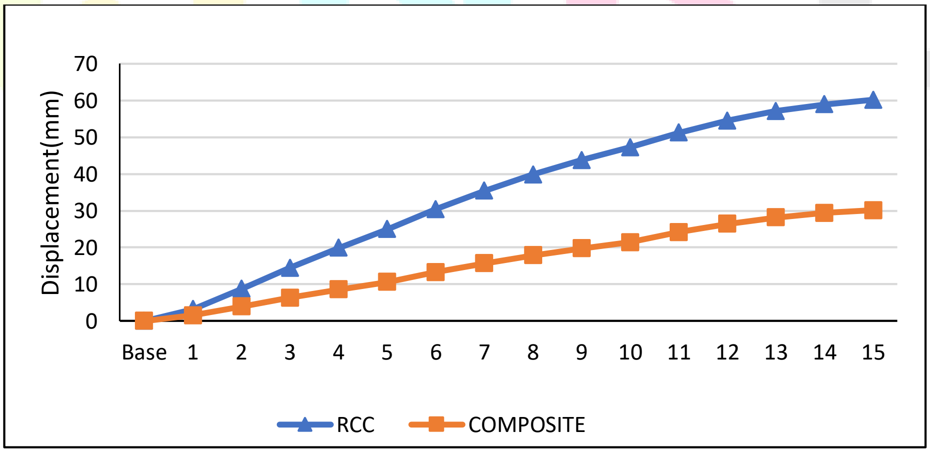

Chart -1: Storey Displacement

From above graph it clearly seen that RCC structure is more displacement as compare to Composite structure. The storey displacement is reduced for composite column structure is about 50% as compare to RCC structure.

4.2.Storey Drift:

Storey drift is the lateral displacement of one storey minus lateral displacement of the above or the below storey divide by height of particular storey.
As per IS: 1893(Part 1)-2002, the story drift in any storey due to specified lateral force, shall not exceed 0.004 times the storey height.

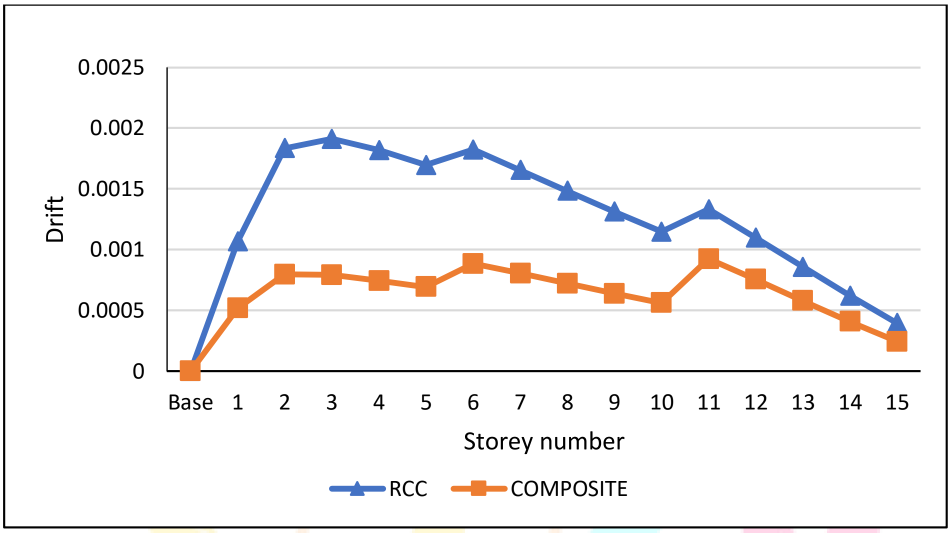

Chart -2: Storey Drift

The result shows the storey drift for composite column structure is comparatively less than RCC structure.The maximum storey drift is reduced by 51% in composite column structure .

4.3.**Performance Point:**

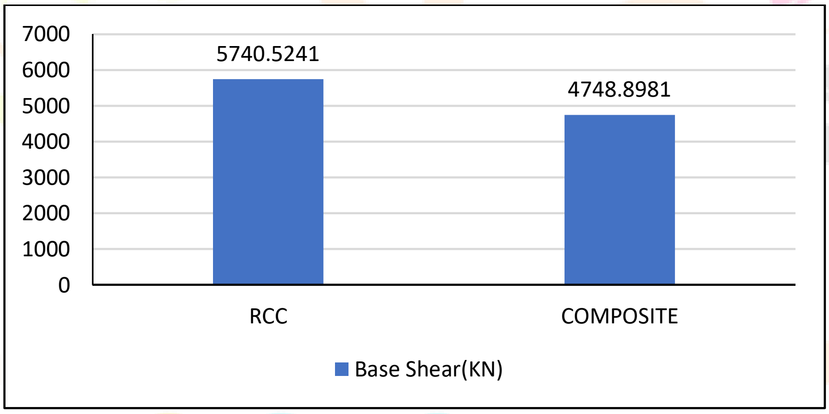

Chart -3: Base shear at performance point

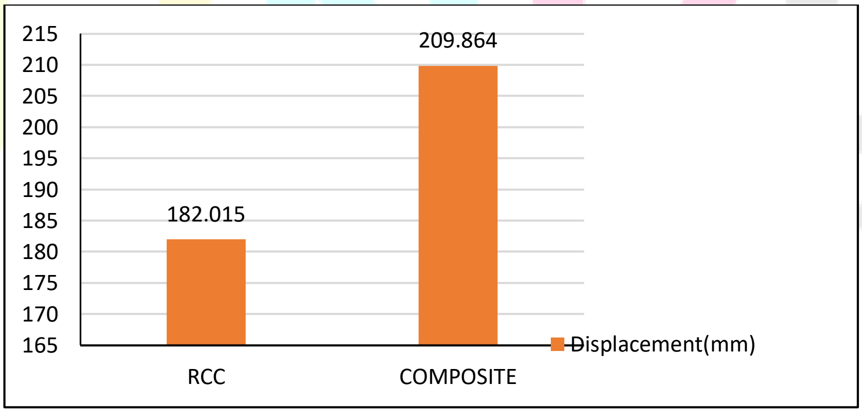

Chart -3: Displacement at performance point

The performance Point of structure is the point where demand spectrum and capacity spectrum of the structure intersects each other. Composite column structure shows maximum variation of displacement as compare to RCC.As we can observe and composite column structure is 15.3% displacement is more than RCC structure and Base shear is maximum in RCC structure. Base shear of composite 17%reduces seismic effect on structure as compare to RCC.

4.4. CONCLUSIONS

1. Storey displacement: All the structures are found to have the permissible displacement value. it is found the composite column with RC beam least maximum top storey displacement as compare to RCC stucture. This shows that this composite steel-concrete column is best in resisting lateral loads among RCC structure. And RC structure has maximum values of displacement and is least recommended for tall buildings.

2. Both the structures are found to have the permissible drift values as per IS 1893-2016. It has the least storey composite column with RCC beam drift compared to the RCC structure.

3. Performance point of composite column with RC beam structure occurs at high displacement with low base shear..Performnace point defines when capacity and demand of structure meets.

4. Composite column are provided for model is reduced in size of column as compare to RCC strcture.And this reduced size of column with uniform size of beam in composite i. e. steel -concrete structure resist all seismic forces efficiently as compare to RCC structure.

5. Finally I conclude that steel concrete composite column with Rc beam is good for high rise structure.

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