ORIGINAL RESEARCH PAPER

Engineering

ANALYSIS AND COMPARISON OF A SOFT STORY BUILDING USING RCC AND COMPOSITE MATERIALS

KEY WORDS:

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ABSTRACT

Now-a-days soft story or open first story is the most important key features of multi-story buildings. It is mainly occupied for the parking purposes. But this feature is undesirable in seismically active areas. Steel-concrete composite system of construction has widely accepted worldwide due to its advantage over conventional RCC system. The main objective of this project is to analyseand compare the behaviour of G+10 story building made with conventional RCC and composite structure using ETABS 2016.

I. INTRODUCTION

A soft story building is a multi-story building in which one or more floors have windows, wide doors, large unobstructed commercial spaces, or other openings in places where a shear wall would normally be required for stability as a matter of earthquake engineering design. A story is considered as soft story when its stiffness is 70% less that of the above story or 80% less than the average stiffness of above three floors. Nowadays this is an unavoidable feature of multistory building and is mainly used for the parking purpose which is unavoidable.

Composite structure is structure made with steel and concrete having hot rolled steel section as its structural member. This has occupied worldwide acceptance because of its advantage against pure steel and pure concrete construction.

A steel concrete composite column is a compression member, comprising either of a concrete encased hot rolled steel section or a concrete filled hollow section of hot rolled steel. It is generally used as a load bearing member ina composite framed structure. Composite members are mainly subjected to compression and bending.

Composite structure or columns are mainly of two types:

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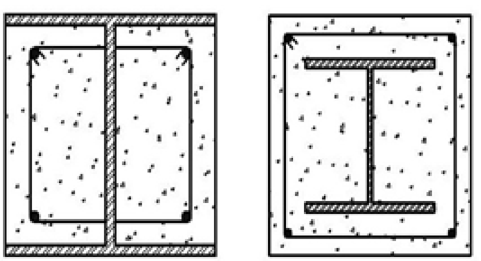

Fig 1.1: Concrete partially and fullt encased I section.

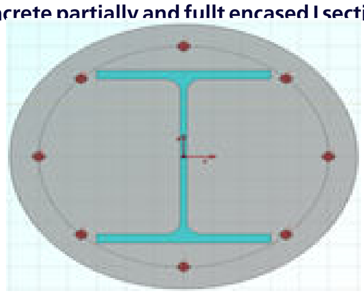

Fig 1.2: Concrete encased circular column.

- **Concrete filled steel tube**

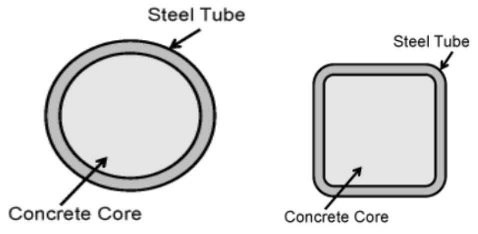

Fig 1.3: Concrete filled circular and rectangular tube.

Advantages of composite columns:

- Protection against corrosion
- Fire resistance
- Even smaller dimension gives better results
- Increased buckling resistance
- Increased stiffness which influence in reduction of slenderness of column
- Higher stiffness reduces the deflection

In conventional composite construction, concrete slabs rest over steel beams and are supported by them. Under load these two components act independently and a relative slip occurs at the interface if there is no connection between them. With the help of a deliberate and appropriate connection provided between them can be eliminated. In this case the steel beam and the slab act as a "composite beam" and their action is similar to that of a monolithic Tee beam. Though steel and concrete are the most commonly used materials for composite beams, other materials such as pre-stressed concrete and timber can also be used. Concrete is stronger in compression than in tension, and steel is susceptible to buckling in compression. By the composite action between the two, we can utilize their respective advantage to the fullest extent. Generally in steel-concrete composite beams, steel beams are integrally connected to prefabricated or cast in situ reinforced concrete slabs.

I. BUILDING DETAILS

The main objective of modeling is to study, analyse and compare a building with soft story at with made of convention RCC and composite members.

The structure considered here is a G+10 story building made for commercial purposes located in seismic Zone III and wind velocity 39m/s.

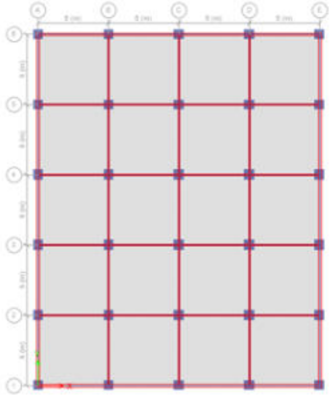

Fig 2.1: Plan

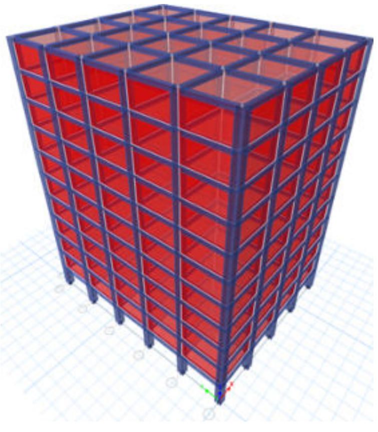

Fig 2.1: Elevation

Table 1: Building details:

Details	RCC	Composite
Plan dimension	24m x 30m	24m x 30m
Total Height of the building	38.5m	38.5m
Height of each story	3.5m	3.5m
Depth of foundation	2.5m	2.5m
Plinth Height	1m	1m
Height of parapet	1m	1m
Thickness slab	0.125m	0.125m
Thickness Exterior wall	0.230m	0.230m
Thickness of Interior wall	0.115m	0.115m
Seismic zone	Zone III	Zone III
Soil Condition	Medium Soil	Medium Soil
Wind Speed	39 m/s	39 m/s
Importance factor	1.5	1.5
Zone factor	0.16	0.16
Response reduction factor	5	5
Floor Finish	1.875 kN/m2	1.875 kN/m2
Live Load	4 kN/m2	4 kN/m2
Roof Live	2 kN/m2	2 kN/m2
Staircase load	3kN/ m2	3kN/ m2
Grade of concrete	M 25	M 25
Grade of concrete incomposite column	---	M30
Grade of reinforcing steel	Fe 415	Fe 415
Grade of structural steel	---	Fe 500
Density of concrete	25 kN/m3	25 kN/m3
Density of brick masonry	20 kN/m3	20 kN/m3
Damping ratio	5%	3%

Table 2: Beam and Column size of RCC and Composite structure:

Type of Building	Beam Size	Column Size
R.C.C. Structure	450 mm X 450 mm	850 mm X 850 mm
Composite structure	500mm X 500mm of ISMB 250	500mm X 500 mm with ISHB 250

I. RESULTS AND DISCUSSION

DISPLACEMENT

Table 3.1 shows the value of displacement in x direction for both made of RCC and composite materials respective to the story level for a load combination of 1.5 x(dead load+ live load+ earth quake X dir, wind load X dir). Here the displacement is found more in composite building than in RCC building. But composite structures are more ductile and resist lateral load better than RCC structures.

Table 3.1: Story Displacement

Story	RCC	Composite
Story 11	10.594	17.609
Story 10	10.164	17.149
Story 9	9.608	16.603
Story 8	8.947	15.987
Story 7	8.207	15.319
Story 6	7.415	14.619
Story 5	6.595	13.904
Story 4	5.772	13.191
Story 3	4.964	12.496
Story 2	4.217	11.848
Story 1	3.363	11.159
Base	0	0

STORY DRIFT

Displacement is more in composite structure than in RCC which gradually leads to increment of story drift in composite building than in RCC building since displacement and drift are directly proportional to each other.

Table 3.2: Story Drift

Story	RCC	Composite
Story 11	0.000123	0.000131
Story 10	0.000159	0.000156
Story 9	0.000189	0.000176
Story 8	0.000211	0.000191
Story 7	0.000226	0.0002
Story 6	0.000234	0.000204
Story 5	0.000235	0.000204
Story 4	0.000231	0.000199
Story 3	0.000214	0.000185
Story 2	0.000244	0.000197
Story 1	0.000961	0.003188
Base	0	0

STORY SHEAR

Table 3.3 shows the value of story shear in both RCC and composite structures. The story shear is lesser in composite building when compared to RCC buildings.

Table 3.3: Story Shear

Story	RCC	Composite
Story 10	-5221.4972	-3360.2806
Story 9	-9450.9099	-6082.1078
Story 8	-12792.6681	-8232.6873
Story 7	-15351.2017	-9879.2248
Story 6	-17230.9407	-11088.9258
Story 5	-18536.315	-11928.996
Story 4	-19371.7545	-12466.6408

Story 3	-19841.6893	-12769.0661
Story 2	-20050.5492	-12903.4773
Story 1	-20097.1499	-12933.2822
Base	0	0

SHEAR FORCE

Table 3.4 gives the value of shear force in composite and RCC building. Composite building produces lesser shear force than in RCC building.

Table 3.4: Shear Force (kN)

RCC	730.1581
Composite	443.685

BENDING MOMENT

Bending moment in composite building is much lesser than that of RCC building.

Table 3.5: Bending Moment (kN-m)

RCC	1376.5831
Composite	786.6526

AXIAL FORCE

Axial force in composite and RCC doesn't show greater differences. But still when comparing composite gives lesser value than that of RCC building.

Table 3.6: Axial Force (kN)

RCC	10839.1401
Composite	9481.2142

IV. CONCLUSION

In the analysis of G+10 story building with soft story made of RCC and composite building, it is not possible to tell that the composite building much better than that of RCC building in all aspects.

- The displacement in composite building is higher than that of RCC building. But composite structure being more ductile can yield more lateral load than that of RCC structure.
- Since the displacement id higher gradually story drift is also higher than that of RCC building.
- Story shear is lesser in composite building.
- Composite building produces lesser axial force, shear force and bending moment.

Multi story building with soft story at bottom made of composite structures have greater advantages over RCC structures.

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