PAGES: 01-9
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Analysis And Comparative Study On Multistoried Building With Composite Column And Conventional Column

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ABSTRACT

This paper describes the analytical study of composite column and conventional column. The high-rise structure of RCC give less stiffness, so in order to increase the stiffness so we can use different material such as steel we can get by using composite column.

Keywords – Composite column, Conventional column, Displacement, Story drift.

I. INTRODUCTION

Skyscrapers and other high constructions are more prevalent in the modern period. When compared to prior high buildings, the sway is increased. This is a stronger argument against the engineering field's ability to withstand lateral loads, such as wind, earthquake, and gravity loads. Prior to recently, structures were only ever constructed for gravity loads, but this has changed as a result of increased height and innovative design. in order for the engineers to be cautious about lateral loads brought on by the wind. hence, engineering. Introduce the composite column. Which is basically made by adding steel section in RCC column i.e.,concrete en cased composite column (CEC) and another one is filling steel tube with concrete i.e., concrete filled steel tube (CFST) .The greatest advantage of composite column is resist displacement due to lateral load i.e.,wind

For concrete-filled steel tubes and concrete-encased columns, the design approach is laid in the foreign Code Book, or ACI 318-2014 clause No. 20.4. Steel-concrete composite columns can be built using any of these specifications (composite column design phases). The design process for concrete filled steel tubes and concrete encased columns is described in the United States Concrete Institute's Building Code ACI 318-2014 clause number 20.4. Any of these criteria may be applied to build steel-concrete composite columns (design steps of composite column).

II. LITERATURE REVIEW

1) Comparison of RCC, Steel and Composite (G+30) Storey Building (D. R. Panchal and P. M. Marathe DECEMBER, 2011):.

   The current work compares steel concrete composite, steel and R.C.C. options for a G+30 story commercial structure situated in seismic zone IV. Equivalent static analysis is the name of this method. The results of modelling composite, steel, and R.C.C. structures with ETABS software are compared, and it is shown that composite structures are more economically viable.

2) Comparison of a Structure's Seismic Behavior with Composite and Traditional Columns (Hajira Nausheen1, Dr.H.Eramma2 Nov-2015)

   In this study, conventional and composite constructions are contrasted. Simply switching the type of column between the two structures, i.e. using composite and traditional columns, while maintaining all other structural elements the same Composite columns are developed in line with Euro Code 4, where as conventional columns are constructed in accordance with IS 4562000. It is thought that the constructions actually belong in seismic zone III. Seismic design is outlined in IS1893-2002. Although there are different types of composite columns, we have chosen the concrete-encased composite column for the purposes of our inquiry. The steel column's load resistance would be increased with a concrete encasement

3) Comparative Study On RCC And CFT Multi Storeyed Buildings (Faizulla Z Shariff 1, Suma Devi2June-2015):

In the current research, which evaluates a G+10 multi-story structure made up of RCC columns and two distinctive composite columns, rectangular tubes used as infill and enclosed columns are evaluated using the ETABS programme. In this study, storey drift, storey shear, time period, and the displacement of the structure are compared using RCC and composite columns

4) Performance analysis of rcc and steel concrete composite structure under seismic effect (Abhishek Sanjay Mahajan , Laxman G. Kalurkar Apr-2016) :

This study shows how FEC (Fully Encased Composite) affects a G+ 20 story special moment frame. During the seismic analysis in this work, two different structures are taken into consideration for comparison. For a G+20 story building, linear static analysis and nonlinear static analysis, sometimes referred to as "Pushover analysis," are carried out. The building is evaluated for seismic loads and developed using ETAB software. For the two structures, the results of the Base shear, Modal time period, Storey displacement, and Storey drift are compared

III OBJECTIVES OF STUDY

1) To use similar static analysis in the Etabs program to determine the building's more effective column for resisting lateral loads
2) Creation of three-dimensional models and analysis of the lateral stresses on a FRAME BUILDING
   - Model 1-Conventional column structure
   - Model 2-Composite column structure
3) To compare the behavior of high rise building with composite column and conventional column.
4) Model 1 i.e., conventional column structure's determined base shear, lateral displacements, and storey drifts
5) Base shear, lateral displacements, and storey drift calculations for composite column structures i.e., Model 2
6) The different model are analyse and among them which model is more effective .compare between Model 1 and Model 2

IV SUMMARY OF THE MODELS

Dimensions of the models:

- The height of floors are 3.4 m.
- The overall building is 71 m.
- The dimensions is 36m * 36m in size.
- X and Y directions there is 9 bays
- X and Y directions the distance between column is 4m
- M40 concrete grade
- Rebar HYSD Fe500

V DIFFERENT TYPES OF MODELS CONSIDERED FOR PRESENT STUDY :

MODEL 1: Model 1 with normal conventional column i,e (RCC column) place at 4m spacing as shown in fig
MODEL 2: Model 2 as a composite column place at 4m spacing as show in fig

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APPLIED LOADS:
The load applied on the structure in etabs for analysis of building are , live load ,floor finish load ,and wall load
In frame self weight is automatically applied by etab software and the load on slab are :

- live load = 4kn/m2 (IS875 PART 2)
- floor finish load = 1.2 kn/m2 (IS 875 PART 1)

The wall/frame load UDL on the beam as Dead = 13.8 kn /m2
The seismic load in both directon i.e., eq-x and eq-y are Applied in load pattern by utilizing IS 1893 : 2002 code book.Which is use for earth quake design. Simultaneously lateral load is also applied in both direction i.e,. wl -x and wly by using code book IS 875 : 2015 part 3

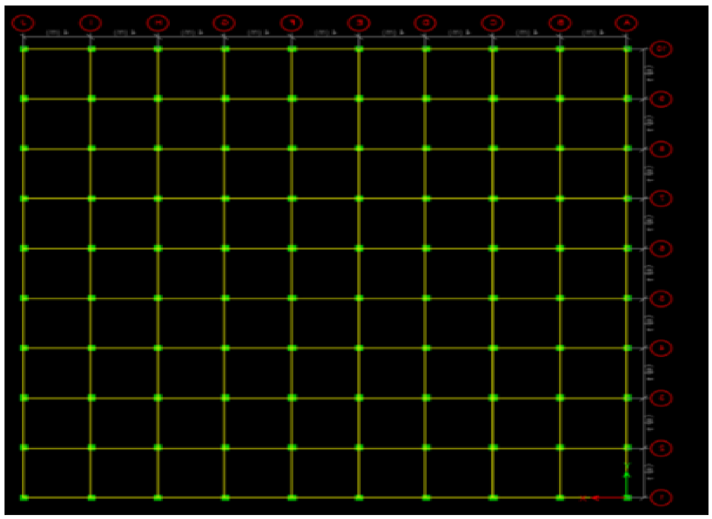


Fig of model 1 (rcc structure)

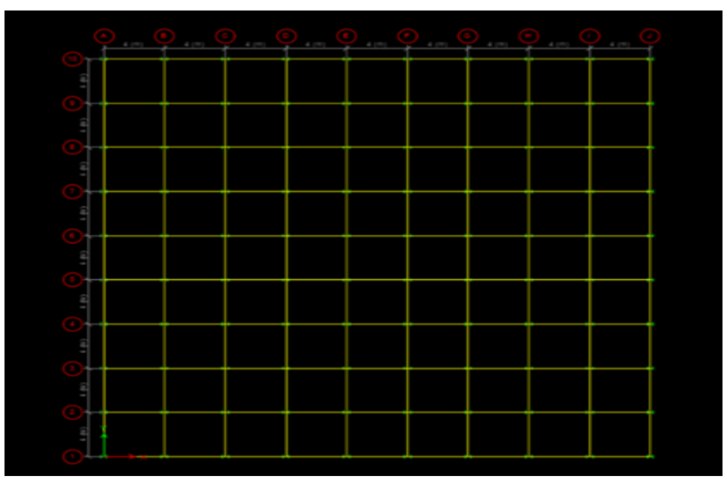


Fig of model 2 (composite structure)

CROSS SECTIONS OF STRUCTURAL ELEMENTS OF THE FRAME:

- Slab portion - Composite deck slab
- Column type: composite column
- Column dimensions – 500mm x 500mm
- Beam - ISHB 450

SEISMIC DATA:

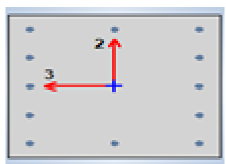
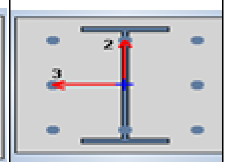
- ZONE FACTOR =0.1(ZONE II)
- IMPORTANCE FACTOR = 1.2
- REDUCTION OF RESPONSE FACTOR =3
- TYPE 2 (MEDIUM) OF SOIL

WIND DATA :

- PART 3 OF CODE IS 875:2015
- TERRAIN CATEGORY =3
- STRUCTURE CLASS EQUALS C.
- 1.15 IS THE RISK COEFFICENT.
- 0.8 IS THE WINDWARD COEFFICIENT.
- 0.5 IS THE LEEWARD COEFFICIENT.
- TOPOGRAPHY FACTOR EQUALS ONE
- WIND SPEED IN BANGALORE IS 33 M/S

VI. LIST OF TABLE

Project preference

PROPERTIES OF BUILDING	**BUILDING WITH SQUARE RCC COLUMN**	**BUILDING WITH SQUARE COMPOSITE COLUMN OF (CFST)**
MATERIAL PROPERTIES		
SHAPES OF COLUMN		
CONCRETE GRADE (fck)	M40	M40
REBAR (fy)	FE500	FE500
GRADE OF REINFORCING STEEL	—	FE345
UNIT WEIGHT OF CONCRETE	25 KN/m3	25 KN/m3
SECTIONAL PROPERTIES		
COLUMN SIZE	500mm x 500 mm	ISHB-450 500mm x 500mm

X - DIRECTION BAYS	9	9
Y - DIRECTION BAYS	9	9
X - DIRECTION C/C DISTANCE B/W COLUMN	4m	4m
Y- DIRECTION C/C DISTANCE B/W COLUMN	4m	4m
HEIGHT OF STOREY	3.4m	3.4m
TYPE OF SUPPORT	Fixed	Fixed

VII METHODOLOGY

MODELLIG IN ETABS SOFTWARE**:**

1) Opening the ETABS programme
2) look at the model's units in the drop-down box in the ETABS window's bottom right corner, then click the drop-down arrow to change the units to Kn-m
3) Select "New model" from the File menu
4) Following your selection of the NO button, The Building Plan Grid System and Story Data Definition will then display in the following format.. Specify the grid's lines and the space between them. This Modification Narrative data order may be used to set the story height data
5) Use the command Options > Preferences > Concrete Frame Design to specify the design code
6) Select the Material Properties option under Define To define material properties, either Add New Material or Modify/Show Material
7) Use Define > To specify the sections of columns and beams, use the frame section Define wall/slab
8) Designate a slab as a one-way, shell-thin element by using a specific one-way load distribution.
9) Drow the model The Create Line command should be used to draw the beam, and the Create Column command should be used to draw the column
10) There are three ways to make a slab: first, draw an area of any form; second, draw a rectangular area; and third, create an area between grid lines
11) The above-mentioned option was utilised to produce the model as indicated in the following figure
12) Define diaphragm. Define>diaphragm>add new diaphragm (D1) >Rigit>ok
13) Define mass sources. Define>add new mass sources> ok
14) Define load pattern.Define >load patern>add new loads (DL ,LL, floor finish and earth quick load>modify lateral load >ok
15) Define load combination.Define >load combination>add default combination>ok
16) Dead Load: The self weight multiplier is set to 1 by default when calculating deadload. Select the member to whom you will allocate the live load or any other defined load before pressing the assign button. (Takeliveload=4KN/m2,floorfinish=1.5KN/m2, earthquake (IS1893 2016)>wall load on beam 13.8KN/m3
17) Assign an evenly distributed load and a point load Click the assign button after choosing the assigning point or member element

18) give it a support condition Using only the bottom single-story level, choose the assign > Joint/Point>Restrain (Support) command to apply fixed support using the drop-down box in the lower right corner of the ETABS window
19) Assign diaphragm Assign >shell> diaphragm>select D1>ok

VIII RESULTS AND DISCUSSION

Both earthquake and wind loads are used to analyze all building models. Using the software from ETAB, all of the various building models are analyzed. All building model analysis findings, including displacements and story drifts, are shown and contrasted**.**

DISPLACEMENT:
The building's maximum inter-storey elastic lateral drift ratio (max/h) under operating loads (unfactored wind load) is determined by design lateral forces.50-year return period combinations), which is predicted using accurate section properties discussed in 7.2, clause of IS16700 and shall be limited to H/500
Where H =height of building
The maximum permitted displacement for the investigation's models = 71000/500 =142mm

i) MAX DISPLACEMENT DUE TO WIND FOE ALL MODELS

a)DISPLACEMENT DUE TO WIND IN X – DIRECTION :

MODEL	MAX DISPLACEMENT IN MM	REDUCATION COMPARED TO MODEL 1
MODEL 1	28.092	0
MODEL 2	22.959	19%

b)DISPLACEMENT DUE TO WIND IN Y – DIRECTION

MODEL	MAX DISPLACEMENT IN MM	REDUCATION COMPARED TO MODEL 1 IN MM
MODEL1	28.092	0
MODEL2	24.172	14%

ii) MAX STORY DRIFT DUE TO EARTHQUAKE FOR ALL MODELS:

a) STORYDRIFT DUE TO EARTHQUAKE IN X – DIRECTION :

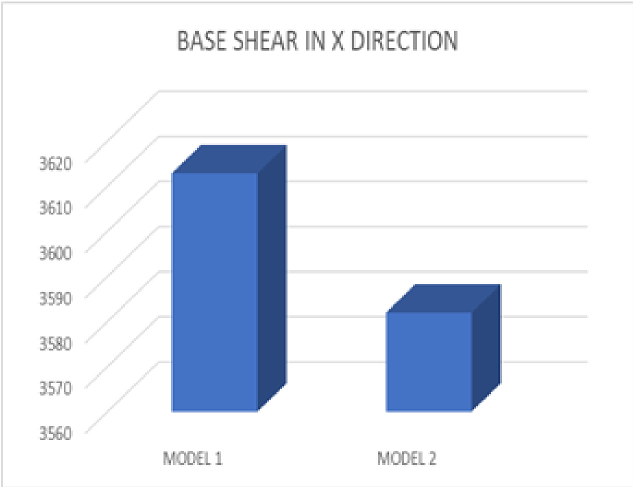
MODEL	MAX STORY DRIFT IN MM	REDUCATION COMPARED TO MODEL 1
MODEL1	0.001176	0
MODEL2	0.000952	19%

b) STORYDRIFT DUE TO EARTHQUAKE IN Y – DIRECTION :

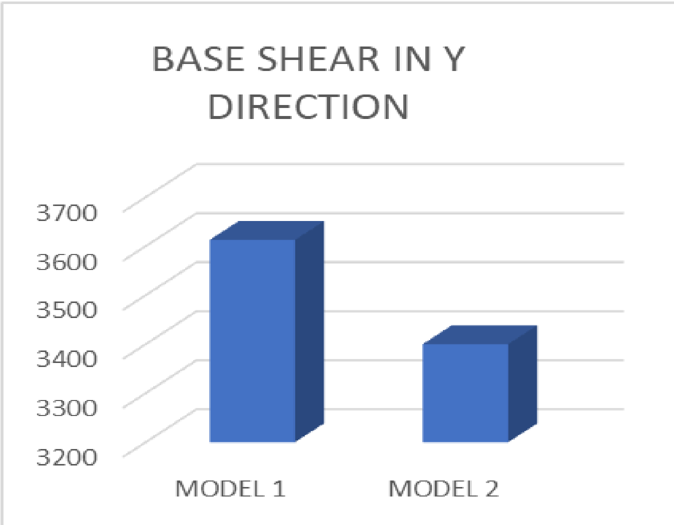
MODEL	MAX STORY DRIFT IN MM	REDUCATION COMPARED TO MODEL 1 IN MM
MODEL1	0.001025	0
MODEL2	0.000943	8%

iii) BASE SHEAR:

a) BASE SHEAR IN X – DIRECTION



b) BASE SHEAR IN Y – DIRECTION



XI CONCLUSIONS

- Displacement in X – directions when compared between model 1 and model 2 .The model 2 gives 19% less displacement
- Displacement in Y – directions when compared between model 1 and model 2 .The model 2 gives 14% less displacement
- Storey Drift in X – directions when compared between model 1 and model 2 .The model 2 gives 19% less storey drift
- Storey Drift in Y – directions when compared between model 1 and model 2 .The model 2 gives 8% less storey drift
- Base shear values when model 1 and model 2 are contrasted. Model 1 displayed the largest base Shear value, whereas Model 2 provides a lower base Shear value. These numbers demonstrate unequivocally that model 1's rigidity is significantly high in comparison to other models
- The above result highlight that conventional column building are less efficient in resist lateral load and gravity load i.e wind and earthquake

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