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# Wind and Seismic Analysis of Vertically Irregular Buildings with Floating Column

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**ABSTRACT:** In our country that is in India many structures are of low ascend. Nowadays people are moving towards cities due to many of the reasons, this movement causing increase in population in cities. To satisfy the population needs in a restricted space it is necessary to increase the structures height. As the height of the building increases wind and seismic activities also affects the structure. In this project wind and seismic analysis of vertically irregular building along with floating column is carried out using ETABS 2015 software. Various models have been created and analysed for wind and seismic effects. Loads have been applied as per the IS codes and the analysis carried out in seismic zone 2. The result obtained in terms of Displacement, drift, mode shapes and base shear

**KEYWORDS:** Vertical irregularity, Floating column, wind, seismicity, Etabs, Analysis, Displacement, Drift, Mode shapes, Base shear.

## I. INTRODUCTION

Structures having physical dis-continuities in the vertical direction or in their lateral force resisting systems then those constructions are termed as vertically irregular structure. In tall constructions perfect regularity of a construction is an idealisation but in real the buildings are almost irregular ones. Original strengths which act on constructions are always more than design strengths. wind and seismic forces causes, displacement extra shear, and torsion is induced on a vertically irregular construction that causes reduction in overall performance of the structure. In order to get a safe structure and the modelling of the structure should pass all the design and checks.

## II. LITERATURE REVIEW

1. **Syed Mudassir and Dr. Kuldeep Dabhekar (2020)** : In this study authors revied about the wind analysis of tall structures. They reviewed many papers in this study and finally concluded that, the types of irregularities are one is plan irregularity and another one is vertical irregularity. irregularity weakens the structure and may cause the failure, due to mass separation and stiffness.
2. **Shaikh A. Aijaj and G.S. Deshmukh (2013)**, this study tells about the understanding of irregularities response due to plan and vertical irregularity, and to analyze "Geometric irregular"- building. And they said that irregularities cause's damage during earthquake. They should be carefully analyzed for deflection.
3. **Varadharajan (2013)** Paper review existing works regarding plan irregularities and justified the preference of multi storey building models over single storey building models. It was found that strength irregularity had the maximum impact and mass irregularity had the minimum impact on seismic response.
4. **Usha K N and Mohd Khadeer Ahamed (2020)**: In this study they have done an examination of multistory structures with and without floating columns at different positions. In this study ETABS 2005 software is used to create various models and analyze the structures, response spectrum analysis was used in the study for analysis and they have concluded that: In analysis displacement values shows floating column buildings are more critical compared to without floating column buildings. Mode shapes shows all models are in symmetrical and good condition.

## III. OBJECTIVE

- To study wind, seismic behaviour and the structural performance of vertically irregular multi-storied structures along with floating columns using ETABS software.
- To study the variations of forces along with the floating column and without floating column.



- To know the safe and reliable irregular structure under wind and seismic response.

#### IV. METHODOLOGY

- Create the standard RC frame building model with and without irregularity and with and without floating column using ETABS 2015.
- Analyze the structure for vertical and lateral load as primary load cases. Load combination as mentioned in IS codes.
- Analysis includes wind and seismic analysis.
- Analyse the models created.
- Compare the analysis results of models with and without irregularities and floating columns.

#### V. DESCRIPTION OF MODELS

Table 1: Structural details of models used for study

Foundation depth	1.5 m
Floor to floor height	3 m
Dimension of building	(16*16) m
Number of gridlines in X	5
Number of gridlines in Y	5
Steel type	Fe-415
Concrete grade	M-25
Size of column	(450*850)mm & (450*600)mm
Size of beam	(450*450) mm
Thickness of masonry wall	230 mm
Slab thickness	130 mm
Live load	3 kN/m <sup>2</sup>
Flooring finishes	1.5 kN/m <sup>2</sup>
Wall load	13.8 kN/m
Seismic zone, Z	0.1
Importance factor, I	1
Response reduction factor, R	3
Soil type	Medium
Height of the building.	45 m

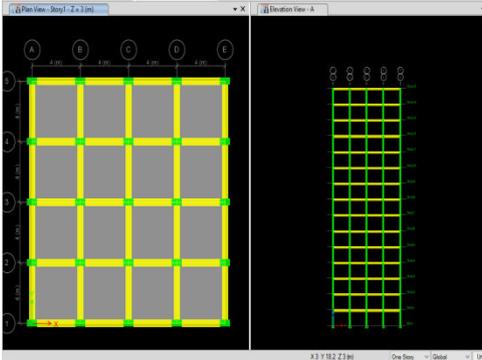


Fig 1: Plan and elevation of model 1

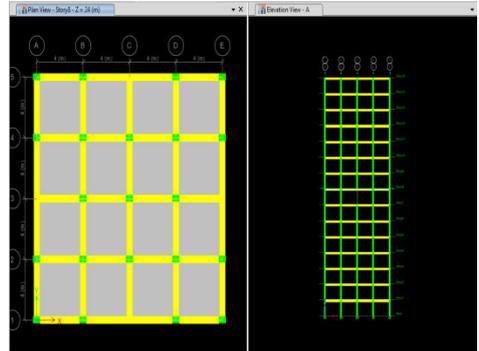


Fig 2: Plan and elevation of model 2

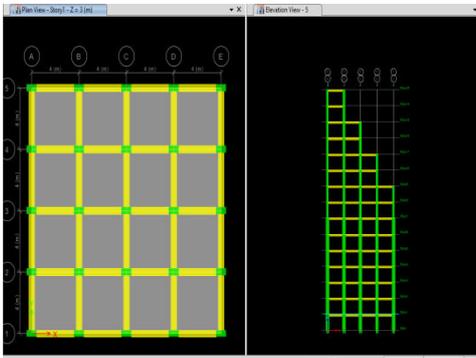


Fig 3: Plan and elevation of model 4

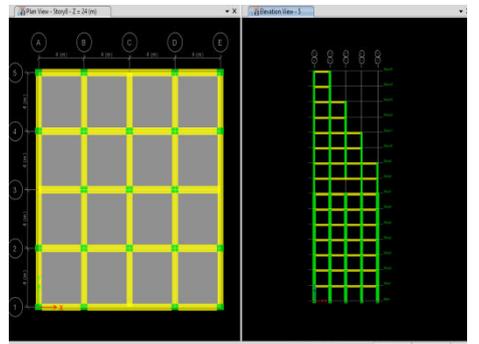


Fig 4: Plan and elevation of model 4

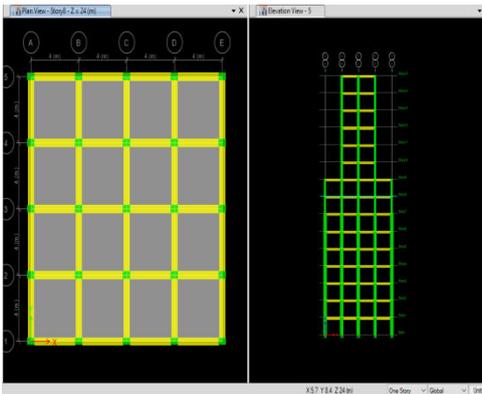


Fig 5: Plan and elevation of model 5

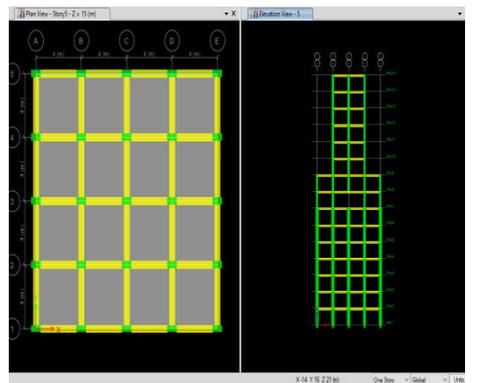


Fig 6: Plan and elevation of model 6

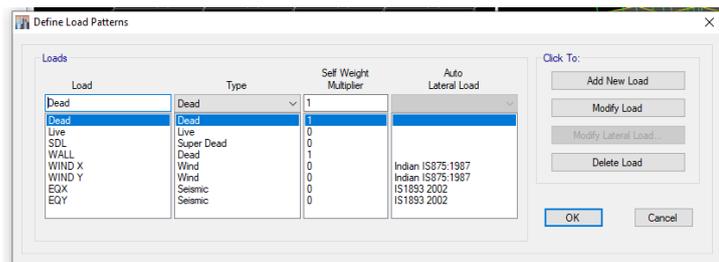


Fig 7: Loading pattern details

VI. EXPERIMENTAL RESULTS

DISPLACEMENT RESULTS

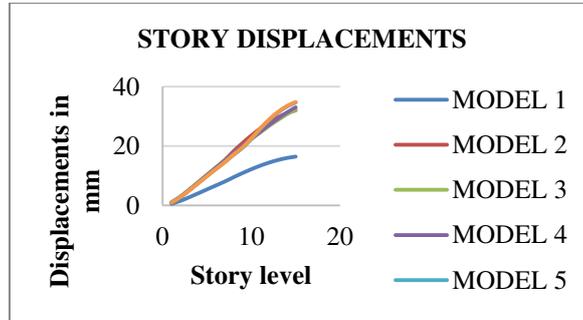


Fig 8: Displacement in EQX direction

- In static analysis results showed that model 1 displacement as 16.404mm and in vertically irregular building with and without floating column 2,3,4,5,and 6 are respectively increasing by 31.97,32.227,32.988,34.609,34.801in mm compared to model 1.
- Comparing models 3, 5 without floating column with model 1, model 3 and 5 are increasing respectively by 32.227 and 34.609 mm.
- Comparing model 4,6 with floating column with model 2, model 4 and 6 are respectively increasing by 32.988 and 34.801mm.

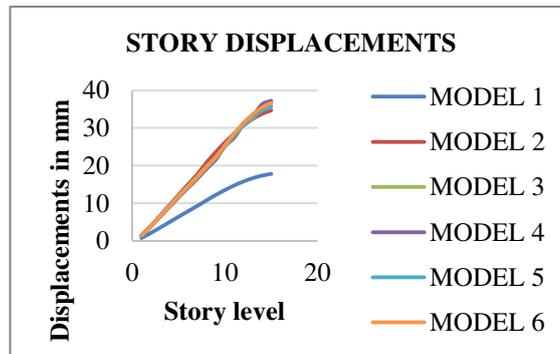


Fig 9: Displacement in EQY direction

- In static analysis results showed that model 1 displacement 16.404mm and in vertically irregular building with and without floating column 2,3,4,5,and 6 are respectively increasing by 34.667,36.558,37.232,35.723,36.649mm compared to model 1.
- Comparing model 3,5 without floating column with model 1, Model 3 and 5 are increasing respectively by 36.558 and 35.723 mm.
- Comparing model 4,6 with floating column with model 2, Model 4 and 6 are respectively increasing by 37.232 and 36.649 mm.

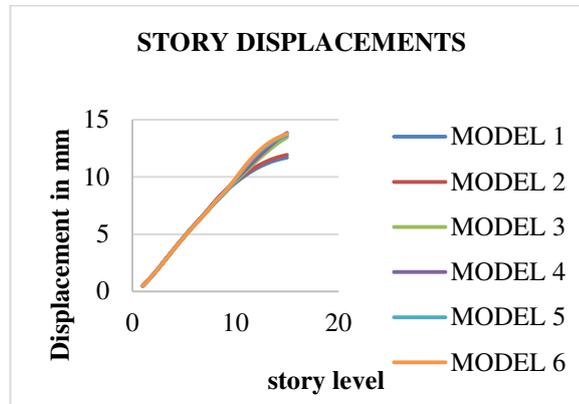


Fig 10: Displacement in WIND X direction

- In wind analysis results showed that model 1 displacement 11.69mm and in vertically irregular building with and without floating column 2, 3, 4, 5, and 6 are respectively increasing by 11.936,13.475,13.855,13.624,13.764 in mm compared to model 1.
- Comparing model 3,5 without floating column with model 1,Model 3 and 5 are increasing respectively by 13.475 and 13.624 mm.
- Comparing model 4,6 with floating column with model 2, Model 4 and 6 are respectively increasing by 13.855 and 13.764 mm.

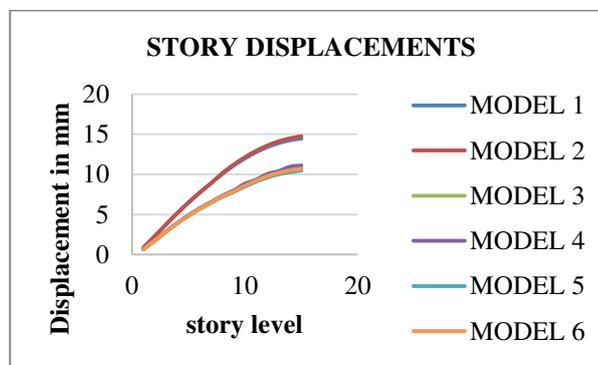


Fig 11: Displacement in WINDY direction

- In wind analysis results showed that model 1 displacement 11.69mm and in vertically irregular building with and without floating column 2, 3, 4, 5, and 6 are respectively decreasing by 14.749, 10.888, 11.108, 10.452, 10.712 mm compared to model 1.
- Comparing model 3,5 without floating column with model 1, Model 3 and 5 are decreasing respectively by 10.888 and 10.452 mm.
- Comparing model 4,6 with floating column with model 2, Model 4 and 6 are respectively decreasing by 11.108 and 10.712 mm.

**DRIFT RESULTS**

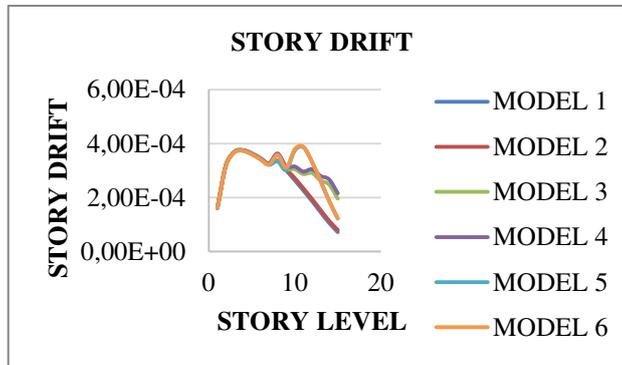


Fig 12: Drift in EQX direction

In seismic analysis comparing the drift values it is observed that:

- Comparing model 3,5 without floating column with model 1, Model 3 and 5 are increasing respectively by 0.000532 and 0.000463 mm.
- Comparing model 4,6 with floating column with model 2, Model 4 and 6 are respectively increasing by 0.000583 and 0.000464 mm.

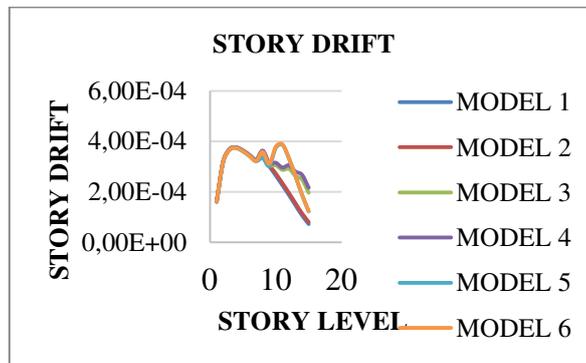


Fig 13: Drift in WINDX direction

In wind analysis comparing the drift values as shown below:

- Comparing model 3,5 without floating column with model 1, Model 3 and 5 are increasing respectively by 0.000196 and 0.000122 mm.
- Comparing model 4,6 with floating column with model 2, Model 4 and 6 are respectively increasing by 0.000216 and 0.000123 mm.

**MODE SHAPES**

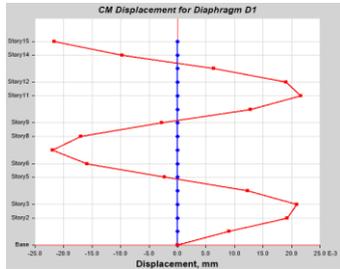


Fig 14: Mode shape of model 1

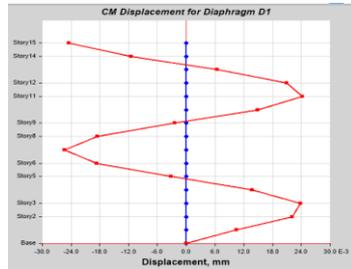


Fig 15: Mode shape of model 2

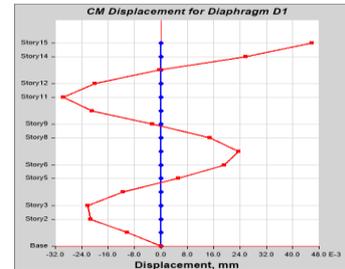


Fig 16: Mode shape of model 3

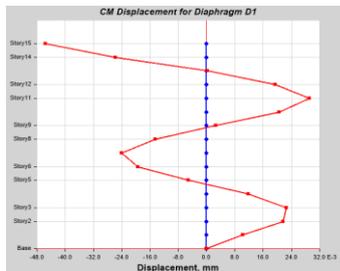


Fig 17: Mode shape of model 4

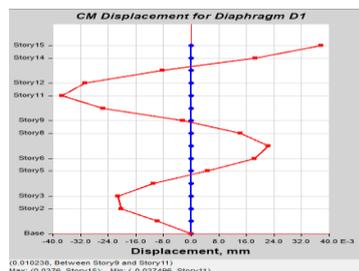


Fig 18: Mode shape of model 5

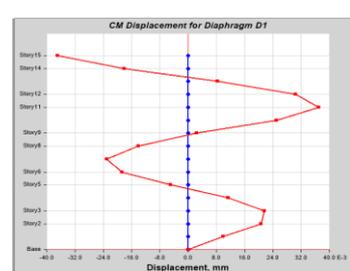


Fig 19: Mode shape of model 6

**BASE SHEAR**

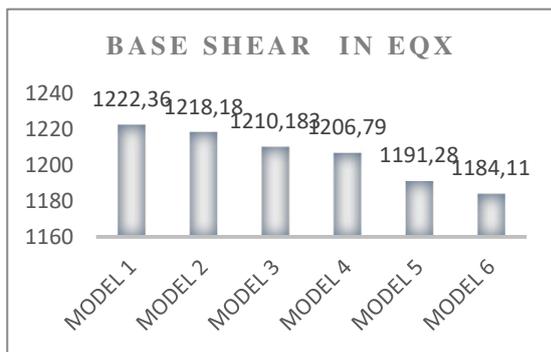


Fig 20: Base shear in EQX

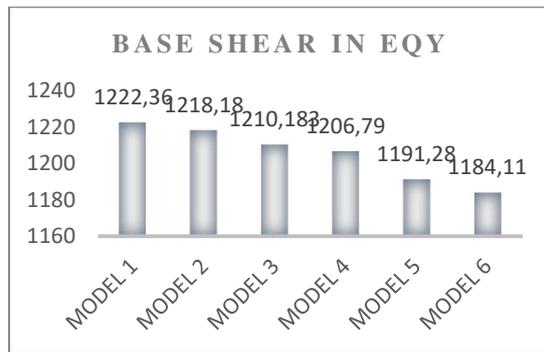


Fig 21: Base shear in EQY

**VII. CONCLUSION**

In this thesis seismic and wind analysis has been carried out to study the behaviour of vertically irregular multi-storied structures along with floating columns. Six models were considered with vertical irregularity, with and without floating column. By comparing various parameters following conclusion were made.

- In analysis, the limiting displacement is height/250 that is 180 mm, it is compared with displacement of all models. So displacement values are within the limit.
- Limiting value for Story drift is it should not exceed 0.0004 times the height of the building so all the drift values are within the limit..



- Base shear in model 1 is 1222.36 kN and it is decreasing for the vertically irregular building for both with and without floating column.
- Comparing models of vertical irregularity model 3 has showed better results.
- Comparing model of vertical irregularity with floating column model 4 showed the better results.
- However the model 5 and 6 are also also showed the results within the limits.

Hence we can conclude that for high rise structures vertical irregularity and floating column can be provided.

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