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"Parametric Evaluation of Super Tall Building Subjected to Seismic Forces with Tubular Forms"

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Abstract - The advancement of technology and the increased economic development of the countries have brought about a new era in construction of high-rise buildings. With the significant improvement in construction technology it is witnessed that new structural systems being adopted in the design of Highrise buildings. One among them is the tubular structural system. Tubular structural system resists lateral loads. In the present study, a 45-storey high rise structure is considered. Five different tube forms are modelled using ETABS software. The models such as simple framed structure, simple tube structure, tube in tube, bundled tube and hybrid tube structure is considered. Models are analyzed for static and dynamic response spectrum analysis. The results are extracted and compared. The conclusions are as below. The Displacement values of static and dynamic analysis are not same and having a difference of around 25%. This is a huge reduction. The dynamic analysis is more suitable for high rise building and it is proved to be economical in terms of displacement and reduces the major construction cost by reducing unnecessary increase in member sizes.

1.INTRODUCTION

A multi-story building is a building that has multiple floors above ground. Multi-story buildings aim to increase the floor area of the building without increasing the area of the land. The multi-story building can be transformed to tall building to increase the floor space further more. A building whose height creates different conditions in the design, construction, and use than those that exist in common buildings of a certain region and period. The tall building design is influenced by the lateral loads such as wind, seismic, etc.

The advancement in construction field is increased day by day. The numbers of buildings, height of building is increased. The effect of lateral load is increased with respect to the increase of height. Modern construction methods and structural systems are to be introduced to enhance the structural safety. Different types of structural systems are to be used to resist the effect of lateral loads on the buildings. Rigid frame structures, braced frame structures, shear wall frame structures, outrigger systems, tubular structures are the different types of structural systems used in the buildings to enhance structural safety by reduce the effect of lateral loads on the buildings. The tubular systems are widely used and which is to be considered as a better structural system for tall buildings.

2. MATERIALS AND METHODOLOGY

Here models are proposed to have 50 storey RCC tube structures with various forms. The Following tables gives the information on the data considered for modelling and analysis.

Table** Error! No text of specified style in document.**-Material Properties and Design Parameters

Sl. No.	Description	Data
1.	Seismic Zone	III
2.	Seismic Zone Factor (Z)	0.16
3.	Importance Factor (I)	1.5
4.	Response Reduction Factor (R)	5
5.	Damping Ratio	0.05
6.	Soil Type	Medium Soil (Type II)
7.	Height of the building	150m (50 Storey)
8.	Story to story Height	3.0 m

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9.	Span Length	6m
10.	Column used	RCC and Steel
11.	Thickness of Slab	200 mm
12.	Floor Finish	1.5 KN/m^2
13.	Live Load	4.0 KN/m^2
14.	Grade of Concrete (f_{ck})	M60
15.	Grade of Structural Steel (f_{ys})	Fe 350
16.	Grade of Reinforcing Steel (f_{yr})	Fe 500

Figure -1: MODEL 1

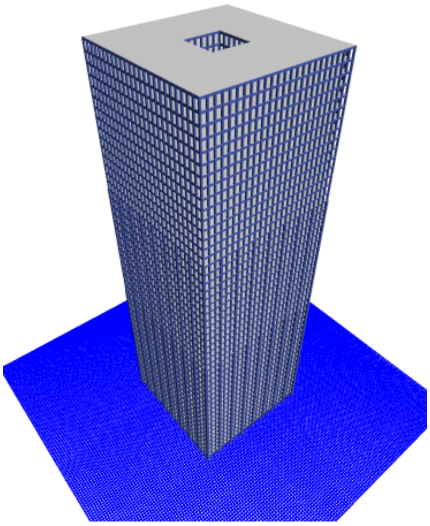

Figure -2: MODEL 2

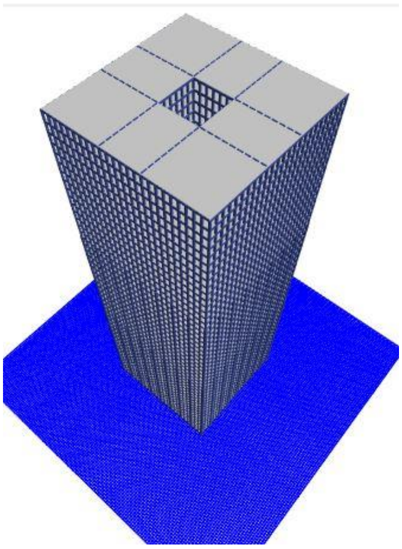

Figure -3: MODEL 3

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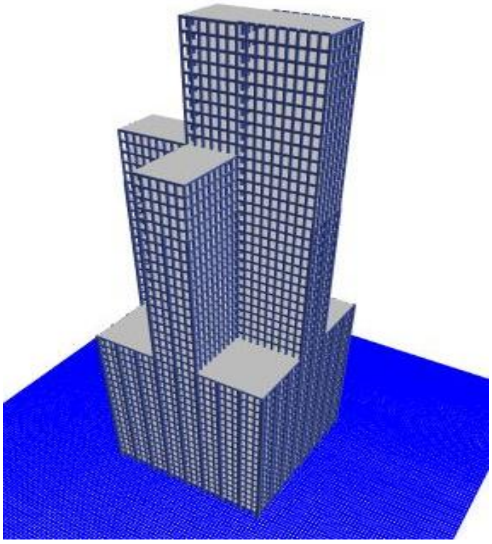


Figure -4: MODEL 4

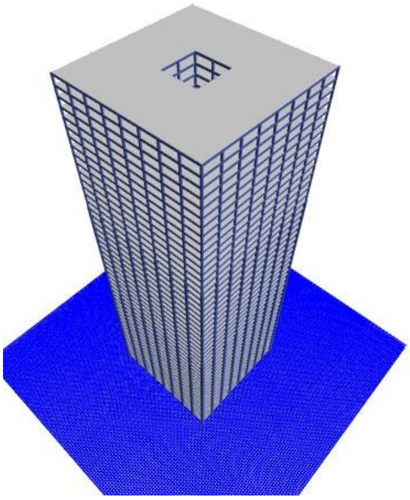
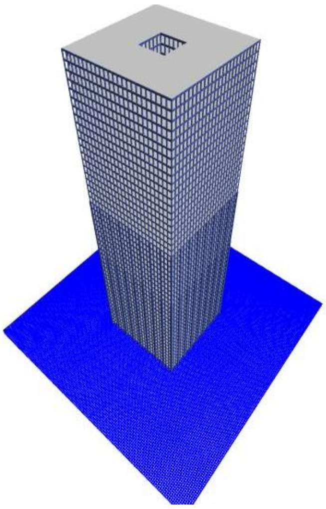


Figure -5: MODEL 5



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3. RESULT AND DISCUSSION

- *Response spectrum analysis*

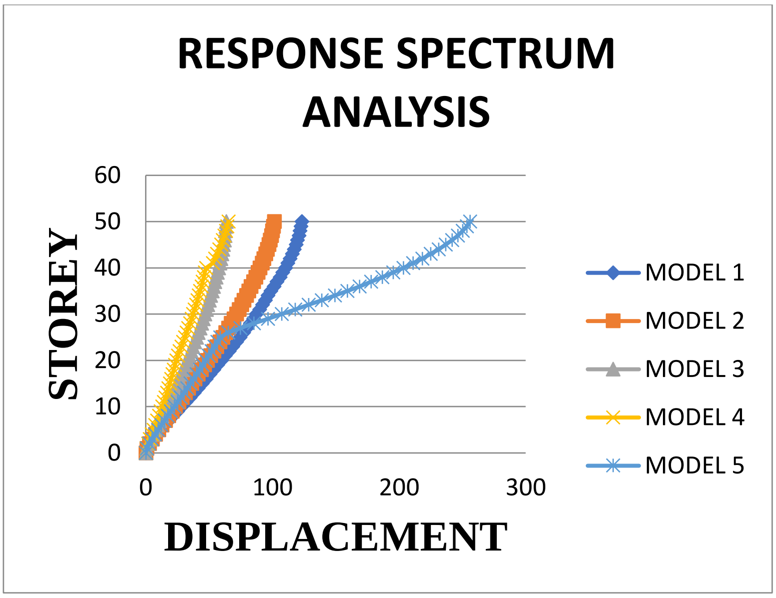

Figure 3.1 Displacement vs Storey _ SPECX

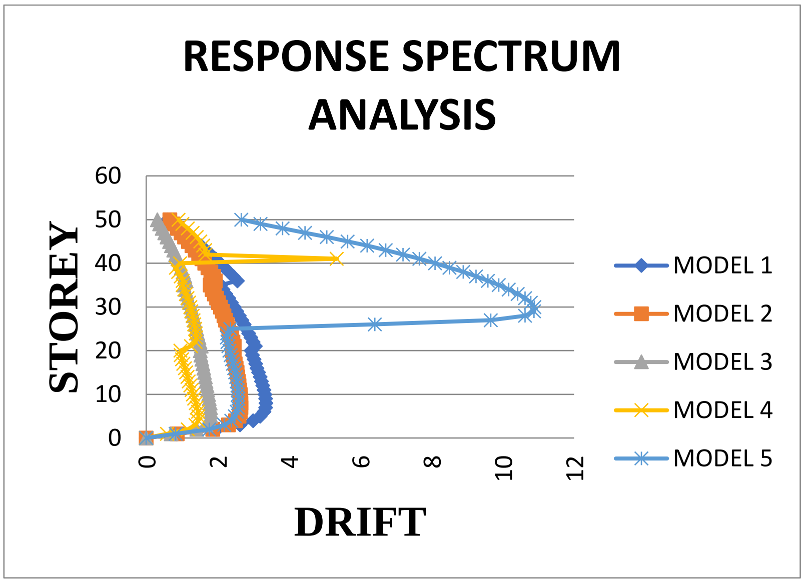

Figure 3.2 Drift vs Storey _ SPECX

In the above figure. It is observed that model 5 is having highest displacement at top storey. The other models are comparatively lesser in terms of displacement. The Model 3 is exhibiting very less displacement compared to all other models because of higher stiffness.It is observed from graph, that the model 5 with steel structure portion is exhibiting highest drift for some stretch, whereas the RCC part it reduces. The Model 4 shows some dips in the drift, it is the change of the shape at that particular location. Compared with all other models, Model 3 is having lesser drift values.

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- *Equivalent static analysis*

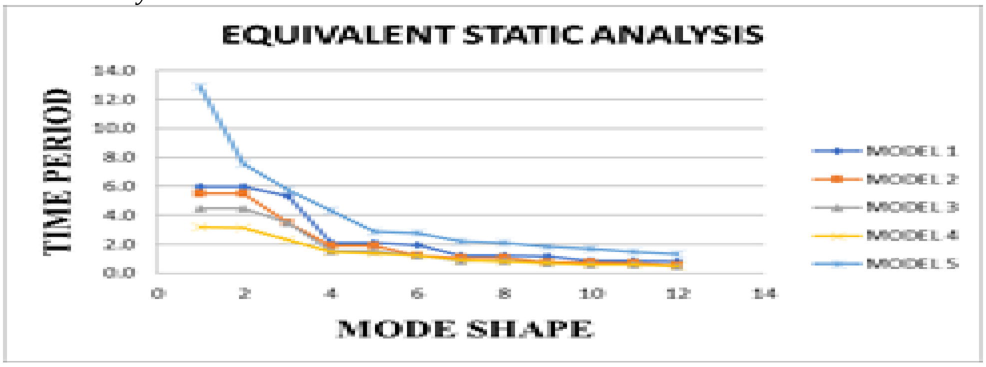

Figure 3.3 Time Period_ EQX

The model 5 is having highest flexibility than any other model. Since it is steel structure at top levels, its flexibility increased. The model 1 is having highest displacement compared to other models with RCC. The Model 4 is having very less flexibility compared to all other models

3. CONCLUSIONS

- The Displacement values of static and dynamic analysis are not same and having a difference of around 25%. This is a huge reduction from static and dynamic analysis, hence dynamic analysis is must in tall structure.
- The Model 3 is having very less displacement compared to all other models. This proves that this model is having highest stiffness comparatively.
- The model 5 is having highest displacement compared to all other model, this is due to the steel structure is having highest flexibility which is decreasing the stiffness drastically.
- The limiting value depends on the storey height i.e., h/250 = 3000/250 = 12. However, model 5 at steel concrete junction level, its drift values are exceeding. And it is not acceptable. It is required to provide bracing of other strengthening measure to reduce the drift values.
- For regular configuration, Model 5 is having lesser base shear compared to other models. This proves that the steel structure is having lighter in weight and reduces the construction cost. And hence steel structure in economical in cost point of view.
- There will a reduction of around 17% in weight compared to other model and hence cost reduction and ease of construction pace will increase.
- From the overall analysis, it can be concluded that, for high rise building equivalent static analysis is not feasible and hence underestimating material and over estimating the earthquake forces.

FUTURE SCOPE:

- Further different levels of steel and RCC structure can be analysed.
- The Steel and RCC combination can be checked for low rise structure to assess the performance.
- Pushover analysis can be performed to check for low rise structure to assess the patter of stress and hinges formation at steel and RCC structure.

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