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"COMPARISON & ANALYSIS OF VARIOUS PARAMETERS FOR ASSYMETRICAL MULTISTOREY BUILDING FOR WIND FORCES AND SEISMIC FORCES IN SEISMIC ZONE V"

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Abstract: Shear As a result of modern civilization, constructions of multistoried building of elevated height are increasing day by day. These structures are made safe prior to earthquake and wind load. For the durable constructions, the study of impacts of earthquake loads and wind loads on these structures with respect to different elevated heights is compulsory.

It is exceptionally rudimentary to consider the impacts of horizontal loads initiated from wind and earthquakes in the analysis of strengthened RCC structures. In this study, three different types of asymmetrical buildings are used in seismic zone V of G+20 floors are selected for analysis and layouts of these structures are drawn in AutoCAD. These structures are modeled in STAAD PRO.

All the floor finish (FF) and live loads (LL) were considered as per design and code. After successful modeling, the structures were analyzed for both earthquake and wind load on STAAD PRO as per the codal information. The purpose of this research is to conduct a thorough comparative examination of an asymmetrical multistory structure subjected to wind and seismic stresses in seismic zone V. The structural reaction and performance of the structure are evaluated using the STAAD.Pro programme. The basic goals of this study are to investigate structural factors such as storey drift, time period, base shear, and average displacements.

The analysis is carried out the help of Staad Pro V8i Structural Software. The building model in the study has twenty storeys with constant storey height of 3.3m. Models are used to analyze with different bay lengths and the number of Bays and the bay-width along two horizontal directions are considered un equivalent to make building asymmetrical values of SEISMIC ZONE FACTOR (z) in ZONE V is taken and the corresponding effects are interpreted in the results.

The technique entails a thorough examination of the building's structural characteristics in accordance with applicable codal rules such as IS 456-2000, IS 1893-2016, and IS 875 parts 1 to 5. The structure's asymmetrical character, as well as its special geometrical and material qualities, are modelled in the STAAD.Pro programme. The wind forces are simulated using the relevant wind load provisions, and the seismic forces are estimated using the seismic zone V design response spectrum.

I. INTRODUCTION

The design and analysis of multistory buildings in high seismic zones, such as seismic zone V, require careful consideration of both wind forces and seismic forces. These forces can have significant impacts on the structural integrity and overall performance of the building. In particular, when dealing with asymmetrical building configurations, the effects of wind and seismic forces become even more critical to assess.

This comparative analysis aims to evaluate the behavior and response of an asymmetrical multistory building to wind forces and seismic forces in seismic zone V. The analysis will provide insights into the structural performance of the building under these extreme loading conditions, allowing for the identification of potential vulnerabilities and the development of appropriate mitigation strategies.

The structural design phase involves comparing the wind and seismic loads to the building's capacity to resist these forces. Adequate consideration is given to the structural elements, connections, and overall system to ensure resilience against wind and seismic forces. Factors like ductility, redundancy, and detailing requirements play a vital role in achieving structural integrity during extreme events.

When conducting a comparative analysis of an asymmetrical multistory building for wind forces and seismic forces in seismic zone V, several factors need to be considered. Seismic zone V represents the highest level of seismicity, indicating a region prone to frequent and severe earthquakes. Here's a general framework for the comparative analysis:

1. Building Configuration:

- Assess the asymmetrical nature of the building, including its plan and elevation configuration. Identify the irregularities and their potential impact on both wind and seismic forces.

2. Wind Forces:

- Evaluate the wind load provisions of the local building code specific to seismic zone V.

- Consider the building's height, shape, and exposure category to determine wind pressures.

- Analyze the wind effects on the building's structural system, cladding, and components, considering the asymmetrical design.

3. Seismic Forces:

- Determine the design ground motion parameters, such as the spectral response acceleration, from the local seismic hazard analysis.

- Perform a seismic analysis, such as response spectrum or time history analysis, to calculate the forces and displacements induced by earthquakes.

- Evaluate the response of the building's structural system, including its lateral load-resisting system, such as moment frames, shear walls, or braced frames, considering the asymmetrical configuration.

4. Structural Design:

- Compare the wind and seismic loads to the building's capacity to resist those forces.

- Assess the adequacy of the structural elements, connections, and overall system in resisting wind and seismic forces.

- Consider factors such as ductility, redundancy, and detailing requirements to ensure structural integrity during extreme events.

In conducting this comparative analysis, the goal is to provide valuable insights into the behavior of asymmetrical multistory buildings under wind and seismic forces in seismic zone V. The findings will contribute to the development of safer and more resilient building designs, ultimately reducing the risks associated with natural hazards in high seismicity regions.

II. METHODOLOGY

Details of model data of asymmetrical building of G+20.

The geometrical shape of the structure is taken as T, C and general Shaped Building i.e Asymmetrical in geometry.
`It will be designed as considering as residential building.
`Floor height will be 3.3 m.
`All the three building will be consisting G+20 floors.
`All the buildings will be having same floor area.

THE STRUCTURE WILL BE ANALYSED AND COMPARED FOR THE FOLLOWING PARAMETERS AS MENTIONED BELOW :

- Storey Drift
- Time Period
- Average Displacement

Table 1. load calculation.

COMPONENT	COMPONENT	LOAD CALCULATION
BRICK WALL Brick Density –22 KN/m^3	**Internal Wall** 115 mm thick (considering FOS =2)	Width X Ht. X Density 0.115m X 2.8m X 22 KN/m^3 = **7.084KN/m**
	External Wall 230 mm thick	Width X Ht. X Density 0.230m X 2.8m X 22 KN/m^3 = **14.168KN/m**
	Parapet Wall 150 mm thick & 1.2 m high	Width X Ht. X Density 0.15m X 1.2m X 22 KN/m^3= **3.960KN/m**
2.SLAB Concrete Density – 25 KN/m^3	**Slab** 125mm thick with Floor finish	Depth X length X Density+ Floor finish 0.125m X 1.0m X 25 KN/m^3+ 1 KN/m^3= **4.125 KN/m**
	Slab 115mm thick with Floor finish	Depth X length X Density+ Floor finish 0.115m X 1.0m X 25 KN/m^3+ 1 KN/m^3= **3.875 KN/m**
Toilet Sunken load	**285 mm deep** **Density of Filling = 20KN/m^3**	Length X Ht. X Density 1m X 0.285m X 20 KN/m^3 = **5.7 KN/m**
Water Proofing provision on terrace only		Depth X Density 0.15m X 20KN/m^3 = **3 KN/m^2**
STAIRCASE Concrete Density – 25 KN/m^3	**Tread : 300 mm** **Riser : 165 mm** **Floor to Floor Ht. : 3.3 m**	L_{eff} ^{2}= Height ^{2} + span ^{2}= **3.86 m** = Depth of slab x density of concrete + floor finish x eff. Span/2 = 0.135 X 25+1 X 3.86/2 = **8.45 KN/m**

III. MODELLING AND ANALYSIS

Load Combos:

1. LOAD COMB 2 D.L + L.L
2. LOAD COMB 1 D.L+0.25L.L
3. LOAD COMB 3 1.5 D.L + 1.5 L.L
4. LOAD COMB 4 DL+0.8LL+0.8EQX
5. LOAD COMB 5 DL+0.8LL-0.8EQX
6. LOAD COMB 6 DL+0.8LL+0.8EQZ
7. LOAD COMB 7 DL+0.8LL-0.8EQZ
8. LOAD COMB 8 D.L + EQ X
9. LOAD COMB 9 D.L + EQ Z
10. LOAD COMB 10 D.L - EQ X
11. LOAD COMB 11 D.L - EQ Z
12. LOAD COMB 12 1.5 D.L + 1.5 EQ X
13. LOAD COMB 13 1.5 D.L + 1.5 EQ Z
14. LOAD COMB 14 1.5 D.L - 1.5 EQ X
15. LOAD COMB 15 1.5 D.L - 1.5 EQ Z
16. LOAD COMB 16 1.2D.L + 1.2 L.L + 1.2 EQ X
17. LOAD COMB 17 1.2D.L + 1.2 L.L + 1.2 EQ Z
18. LOAD COMB 18 1.2D.L + 1.2 L.L - 1.2 EQ X
19. LOAD COMB 19 1.2D.L + 1.2 L.L - 1.2 EQ Z
20. LOAD COMB 20 0.9 D.L + 1.5 EQ X
21. LOAD COMB 21 0.9 D.L + 1.5 EQ Z
22. LOAD COMB 22 0.9 D.L - 1.5 EQ X
23. LOAD COMB 23 0.9 D.L - 1.5 EQ Z
24. LOAD COMB 24 DL+0.8LL+0.8WLX
25. LOAD COMB 25 DL+0.8LL-0.8WLX
26. LOAD COMB 26 DL+0.8LL+0.8WLZ
27. LOAD COMB 27 DL+0.8LL-0.8WLZ
28. LOAD COMB 28 D.L + WL X
29. LOAD COMB 29 D.L + WL Z
30. LOAD COMB 30 D.L - WL X
31. LOAD COMB 31 D.L - WL Z
32. LOAD COMB 32 1.5 D.L + 1.5 WL X
33. LOAD COMB 33 1.5 D.L + 1.5 WL Z
34. LOAD COMB 34 1.5 D.L - 1.5 WL X
35. LOAD COMB 35 1.5 D.L - 1.5 WL Z
36. LOAD COMB 36 1.2D.L + 1.2 L.L + 1.2 WL X
37. LOAD COMB 37 1.2D.L + 1.2 L.L + 1.2 WL Z
38. LOAD COMB 38 1.2D.L + 1.2 L.L - 1.2 WL X
39. LOAD COMB 39 1.2D.L + 1.2 L.L - 1.2 WL Z
40. LOAD COMB 40 0.9 D.L + 1.5 WL X
41. LOAD COMB 41 0.9 D.L + 1.5 WL Z
42. LOAD COMB 42 0.9 D.L - 1.5 WL X
43. LOAD COMB 43 0.9 D.L - 1.5 WL Z

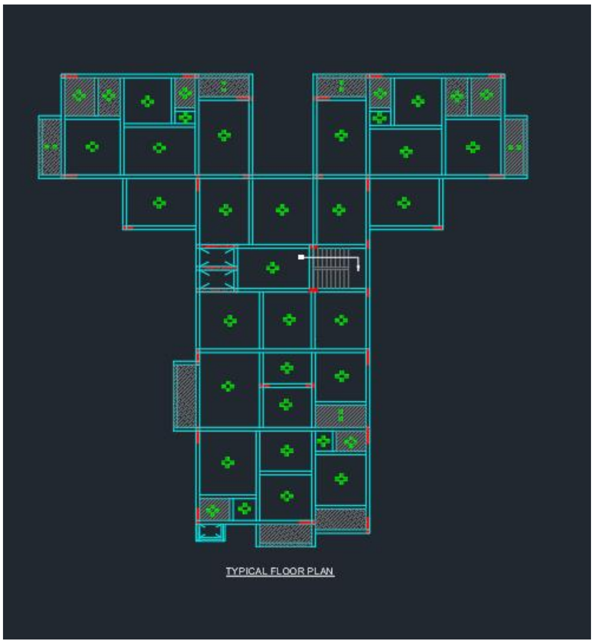


Figure 1: Building plan for model 1.

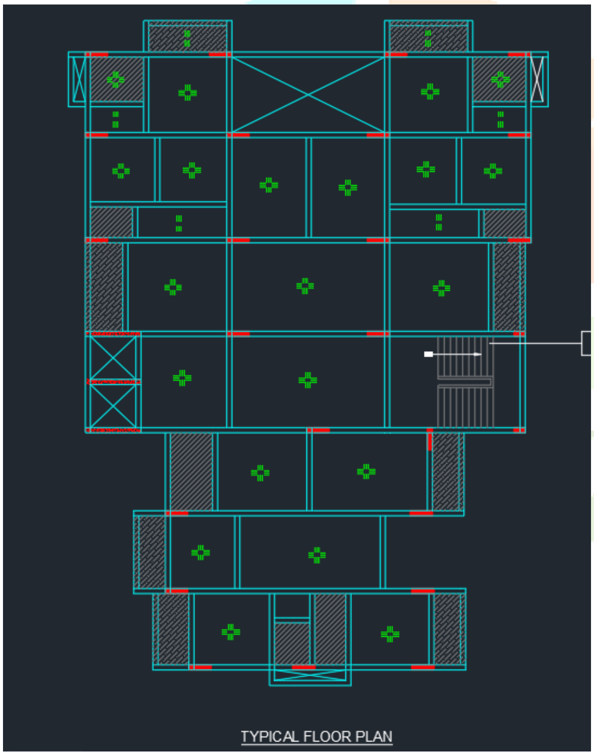


Figure 2: building plan for model 2.

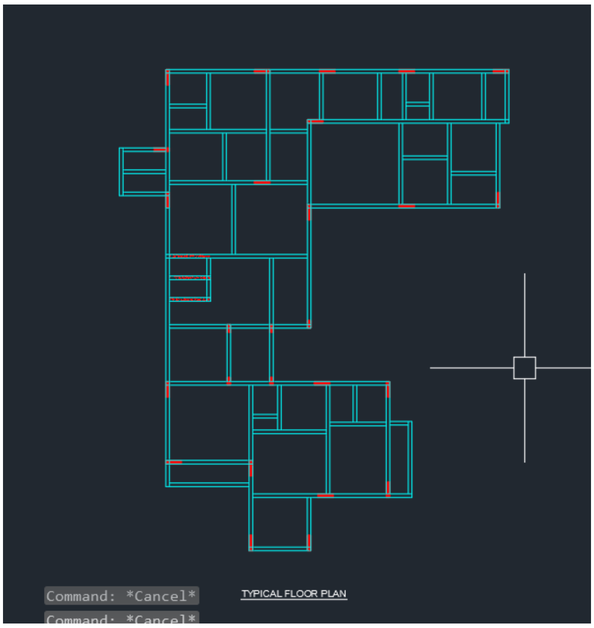
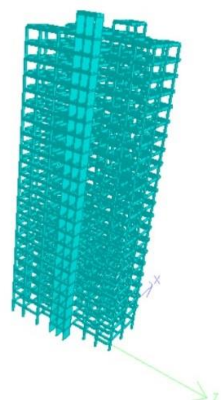
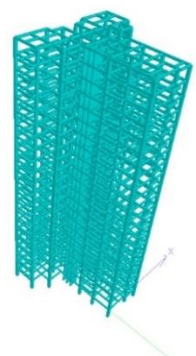
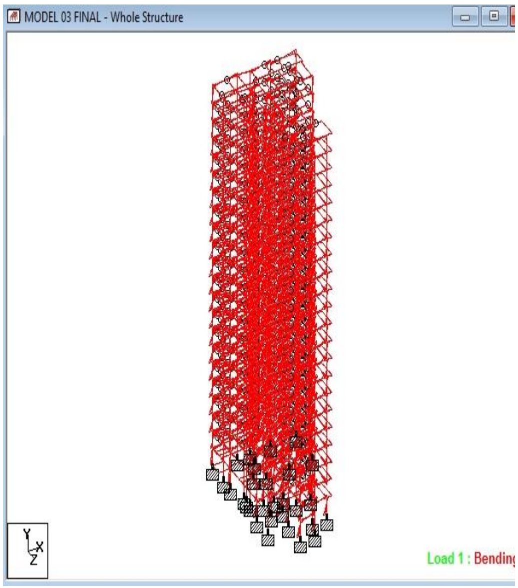
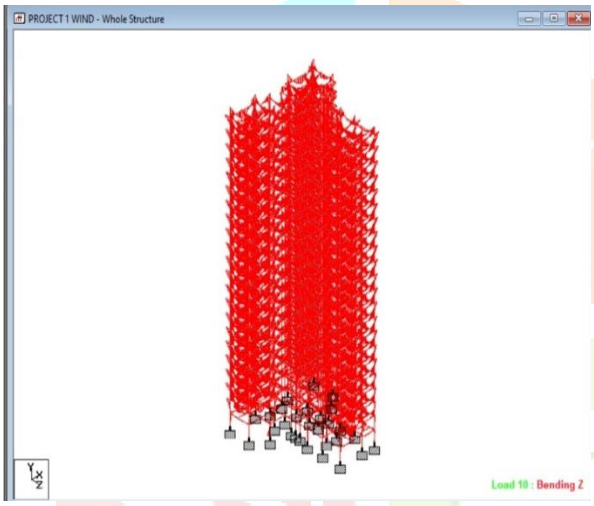


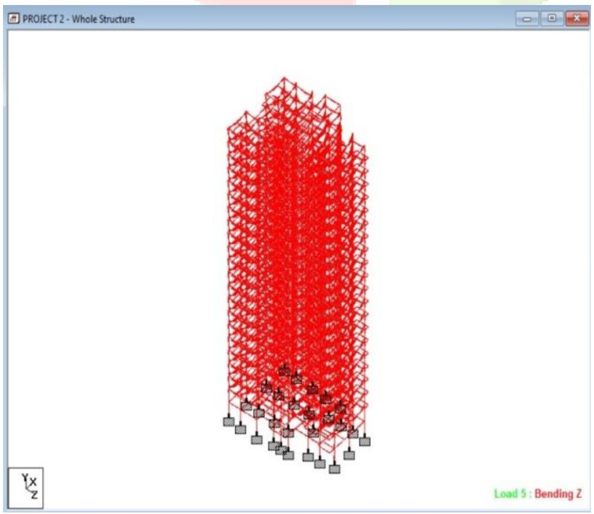
Figure 3: Building plan for model 3.











The seismic analysis should be carried out for the buildings that have lack of resistance to earthquake forces. Seismic analysis will consider seismic effects hence the exact analysis sometimes become complex. However for simple regular structures equivalent linear static analysis is sufficient one. This type of analysis will be carried out for regular and low rise buildings and this method will give good results for this type of buildings. Dynamic analysis will be carried out for the building as specified by code IS 1893-2002 (part1). Dynamic analysis will be carried out either by Response spectrum method or site specific Time history method. Following methods are adopted to carry out the analysis procedure.

- Equivalent Static Analysis
- Response Spectrum Method
- Time History Analysis
- Pushover Analysis.

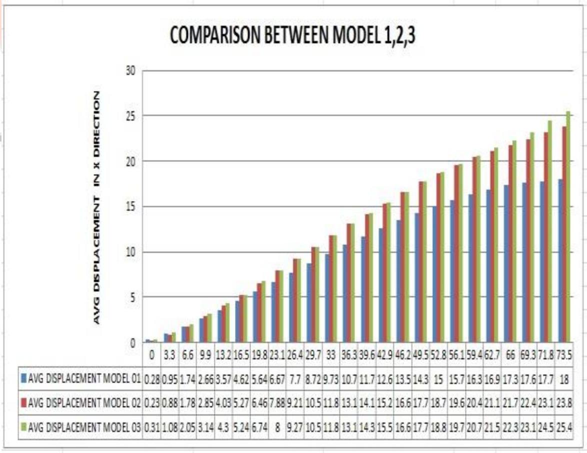
IV. RESULT AND DISCUSSION

These are the results for time period and base shear:-

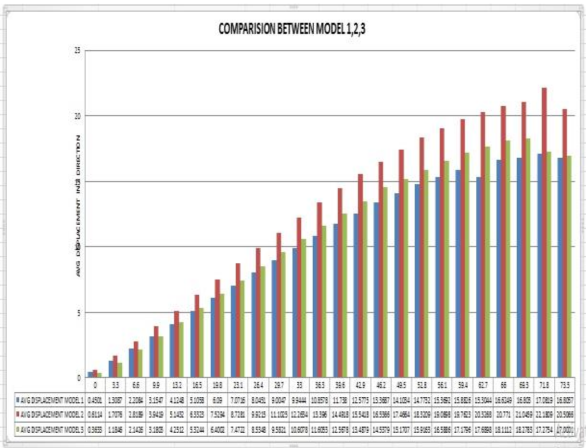
MODEL	TIME PERIOD IN X DIRECTION	TIME PERIOD IN Z DIRECTION
MODEL 01	3.99004 SEC	3.95638 SEC
MODEL 02	4.48772 SEC	4.84296 SEC
MODEL 03	4.08715 SEC	4.11975 SEC

MODEL	BASE SHEAR IN X DIRECTION	BASE SHEAR IN Z DIRECTION
MODEL 01	2749.72 KN	2773.11 KN
MODEL 02	2064.59 KN	1913.15 KN
MODEL 03	2229.37 KN	2211.72 KN

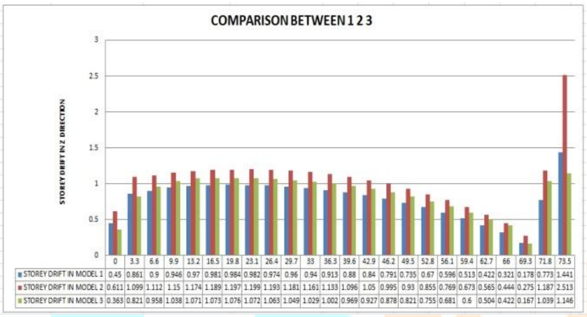
These are the result for avg displacement in X direction:-



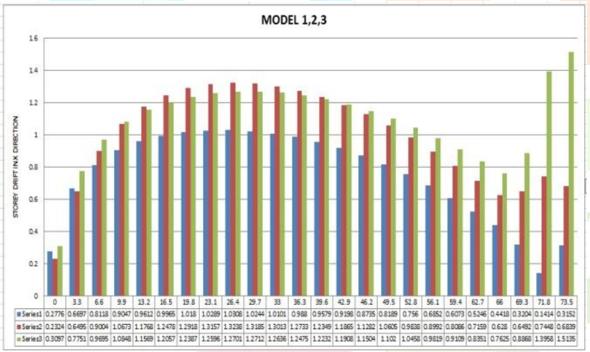
These are the result for avg displacement in Y direction:-



These are the result for Storey Drift in X direction:-



These are the result for Storey Drift in Y direction:-



V. CONCLUSION

- On Comparing Avg Displacement Of The Three Models, We Found That The Most Displacement In X&Z Direction Occurs In Model 02comparing To Model 01&03.

- On Comparing Storey Drift Of The Three Models, We Found That The Most Drift In X&Z Direction Occurs In Model 02 Comparing To Model 01&03.

- On Comparing Time Period And Base Shear Of The Three Models, We Notice That The Time Period For Model 02 Is Greater Than Model 01&03, While The Base Shear Is Less Than Model 01&03.

- Therefore, Model 01 is the most economical building followed by model 03 and hence model 02 is the most uneconomical building.

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