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DYNAMIC ANALYSIS OF SYMMETRICAL & UNSYMMETRICAL HIGH RISE STRUCTURE WITH CURTAILED SHEAR WALL

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Abstract: The purpose of this research is to investigate the performance and behavior of the symmetrical and un-symmetrical high rise structures with shear wall curtailment subjected to seismic forces and result concluded in terms of base shear, axial forces, max. node displacement, storey drift, maximum shear forces and bending moment. Analysis showing that high rise symmetrical and un-symmetrical type of structures without shear wall have un-acceptable performances for stability and serviceability of high rise structures due to seismic forces but both type of structure with full height shear wall have excellent performances. Similarly shear wall curtailment as in symmetrical high rise structure from 70% height of the structure and shear wall curtailment in un-symmetrical high rise structure from 80% height of the structure as compared to full height shear wall structures having variation in results onlyof 40% in symmetrical structure and 50% in un-symmetrical structures and all results also within required limits. Hence in this investigation we have defined the height of shear wall curtailment for symmetrical and un-symmetrical type of high rise structures reduces the cost, weight and enhances aesthetic view of the high rise structures.

Keywords: *Shear Wall, Axial Force, Node Displacement, Base Shear*

I.INTRODUCTION:

In recent years, Shear walls are specially designed structural walls which are incorporated in buildings to resist lateral forces that are produced in the plane of wall due to earthquake, wind and flexural members. Shear walls are structural members used to elongate the strength of R.C.C. structures. These shear walls will be construct in each level of the structure, to form an effective box structure. It is necessary to provide these shear walls when the tolerable span-width ratio for the floor or roof diaphragm is exceeded. The present work deals with a study on the improvement location of shear walls in symmetrical high rise building. Position of shear walls in symmetrical buildings has due considerations. In symmetrical buildings, the center of gravity and center of rigidity coincide, so that the shear walls are placed symmetrically over the outer edges or inner edges. So, it is very necessaryto find the efficient and ideal location of shear walls in symmetrical & un-symmetrical buildings to minimize the torsion effect. Generally shearwall has highly in plane stiffness and strength which canbe used to simultaneously resist large horizontal loads and support gravity load. Shearwalls are specially designed structural walls include in the building to resist horizontal forces that are induces in the plane of the wall due to wind, earthquake and other forces. To bring the maximum drift down, lateral displacements & behavior of the structure to allowable limits.

II.OBJECTIVE OF STUDY

The objectives of the present study can be identified as follows:

To study the maximum Storey displacement of the structure under different condition of shear wall as mentioned above for both symmetrical & un-symmetrical type of structures.

To study the storey drift of the structure under different condition of shear wall as mentioned above for both symmetrical & Un-symmetrical type of structures.

To study the maximum base shear of the structure under different condition of shear wall as mentioned above for both symmetrical & un-symmetrical type of structures.

To study the bending moments and shear forces of the structure under different condition of shear wall as mentioned above for both symmetrical & un-symmetrical type of structures.

To study Axial forces of the structure under different condition of shear wall as mentioned above for both symmetrical & un-symmetrical type of structures.

III. MODELLING AND ANALYSIS

Details of structural elements

For the analysis symmetrical and un-symmetrical models we have considered with the following terms as follows-

3.1.1Plan Dimension of model : 10m x 30.9m

3.1.2No. of stories : 21

3.1.3Floor height : 4m

3.1.4Column sizes : 0.230m x 0.600m

3.1.5Beam sizes : 0.230m x 0.600m

3.1.6Slab thickness : 0.125m

3.1.7Wall thickness : 0.230m

3.1.8Shear wall thickness : 0.230m

3.1.9Density of concrete : 25 KN/m3

3.1.10Density of aac blocks : 6.5 KN/m3 (used for masonry work)

3.1.11Floor weight or dead weight : 4 KN/m2 (Including 1 KN/m2 finishing load)

3.1.12Member Weight : 5 KN/m (for external & internal walls of storey) & 1.5 KN/m (for 1m height of parapet wall above terrace)

3.1.13Live load : 4 KN/m2

3.1.14Method of analysis : Response spectrum method

Zone-V factor=0.36, Response factor=5, Soil type-I, Depth of foundation = 4m, method-SRSS, Cutoff mode shapes=30.

3.1.15Software used: Staad.Pro.V8i.

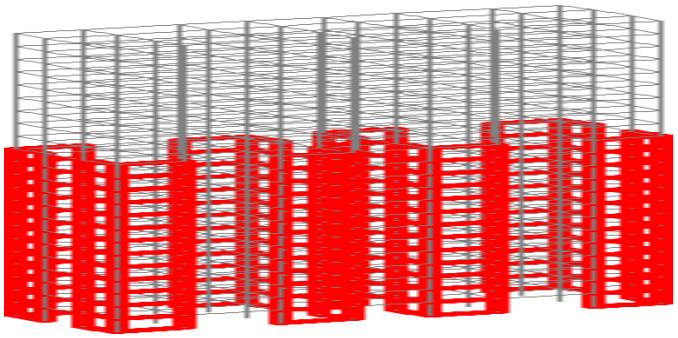
Details of geometry of framed models for analysis

a.) Symmetrical Model (G+21) – SM21

MODEL-01-G+21 Model with full height shear wall.

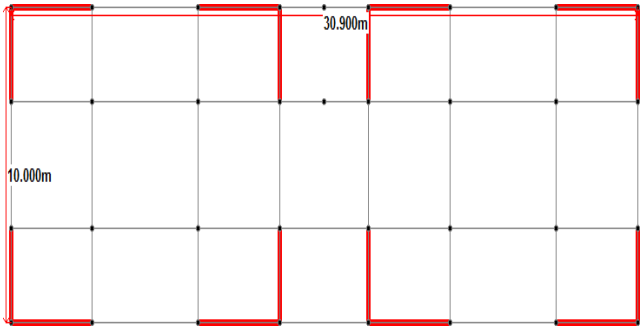
MODEL-02-G+21 Model with shear wall Curtailed from top

3-storey.



MODEL-03-G+21 Model with shear wall Curtailed from top 6-storey.
MODEL-04-G+21 Model with shear wall Curtailed from top 9-storey.
MODEL-05-G+21 Model without shear wall.
b.) Un-Symmetrical Model (G+21) – USM21
MODEL-01-G+21 Model with full height shear wall.
MODEL-02-G+21 Model with shear wall Curtailed from top 3-storey.
MODEL-03-G+21 Model with shear wall Curtailed from top 6-storey.
MODEL-04-G+21 Model with shear wall Curtailed from top 9-storey.
MODEL-05-G+21 Model without shear wall.
Symmetrical Models (G+21) – SM21
MODEL-01-G+21 Model with full height shear wall

Figure no. 3.1 Plan of symmetrical model-01



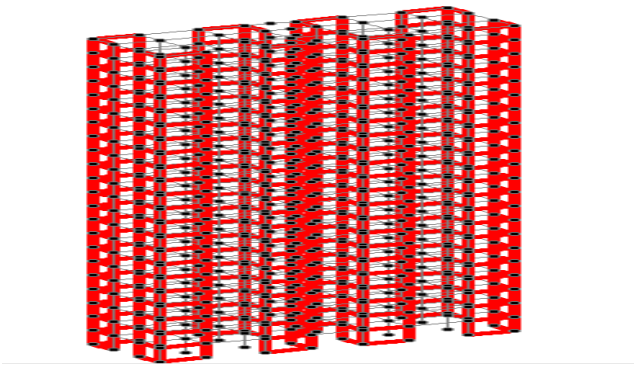


Figure no. 3.2 3D View of symmetrical model-01

II. MODEL-02-G+21 Model with shear wall Curtailed from top 3-storey

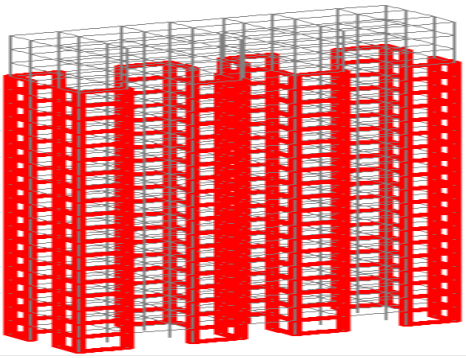


Figure no. 3.3 3D View of symmetrical model-02

III. MODEL-03-G+21 Model with shear wall Curtailed from top 6-storey.

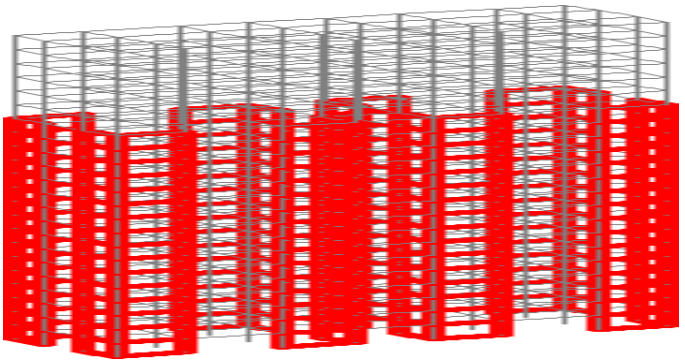


Figure no. 3.4 3D View of symmetrical model-03
IV.MODEL-04-G+21 Model with shear wall Curtailed from top 9-storey

Figure no. 3.5 3D View of symmetrical model-04
V.) MODEL-05-G+21 Model without shear wall

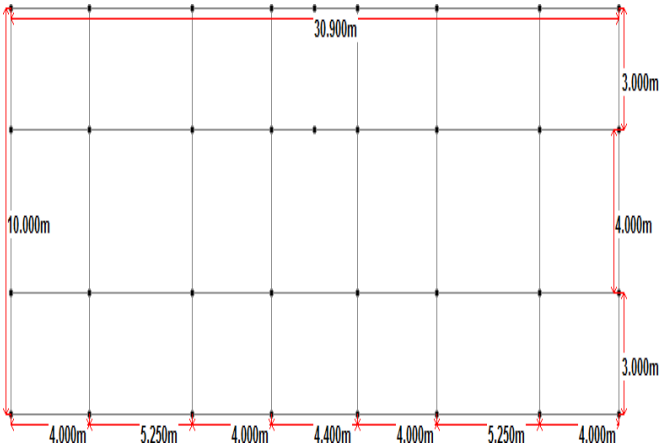


Figure no. 3.6 Plan of symmetrical model-05

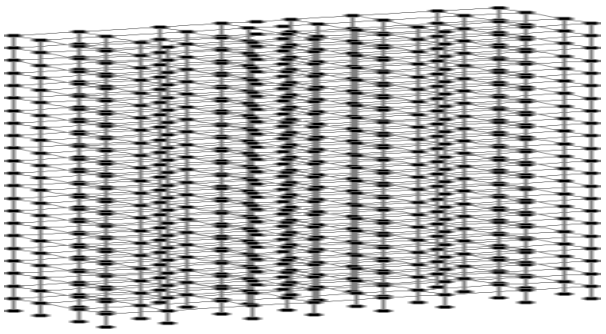
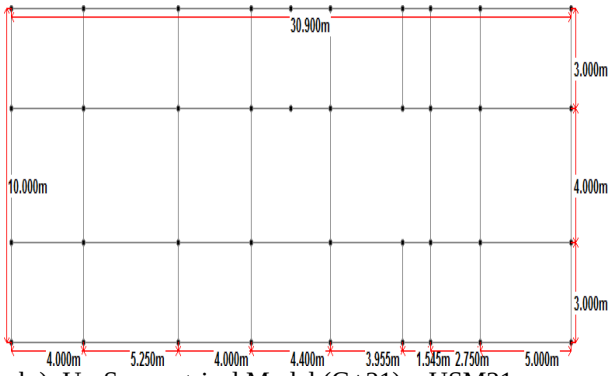


Figure no. 3.7 3D View of symmetrical model-05



b.) Un-Symmetrical Model (G+21) – USM21

I.) MODEL-01-G+21 Model with full height shear wall.

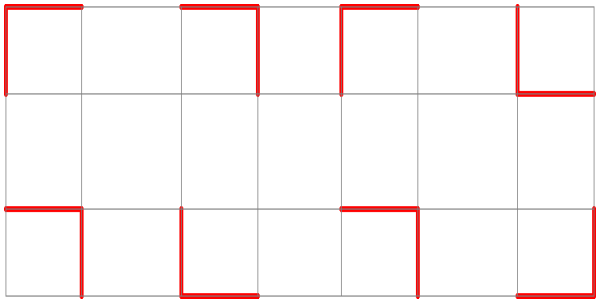


Figure no.3.8 Plan of Un-symmetrical model-01

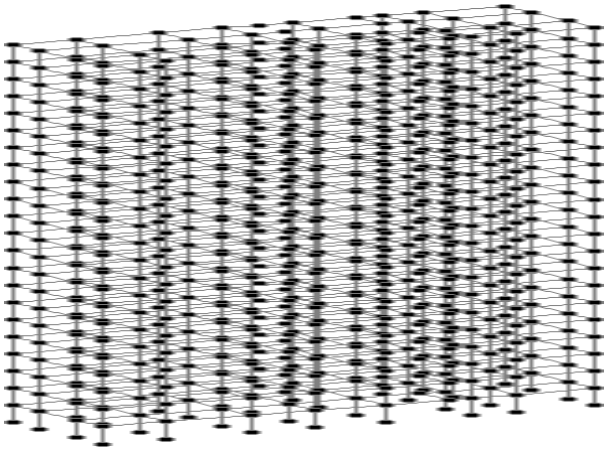


Figure no.3.9 3D View of Un-symmetrical model-01

II.)MODEL-02-G+21 Model with shear wall Curtailed from top 3-storey.

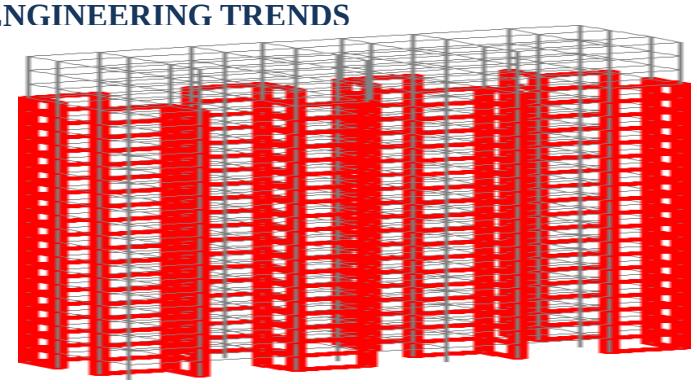


Figure no.3.10 3D View of Un-symmetrical model-02

III.)MODEL-03-G+21 Model with shear wall Curtailed from top 6-storey

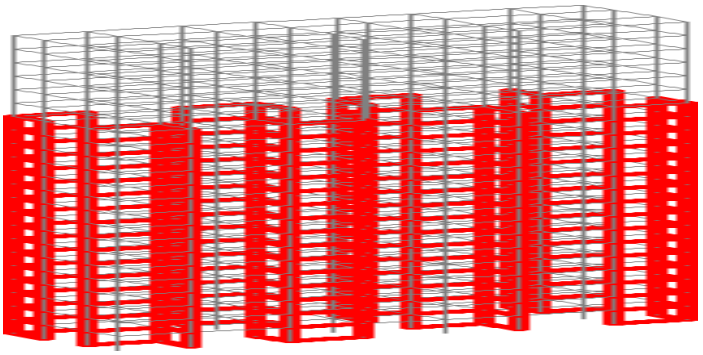
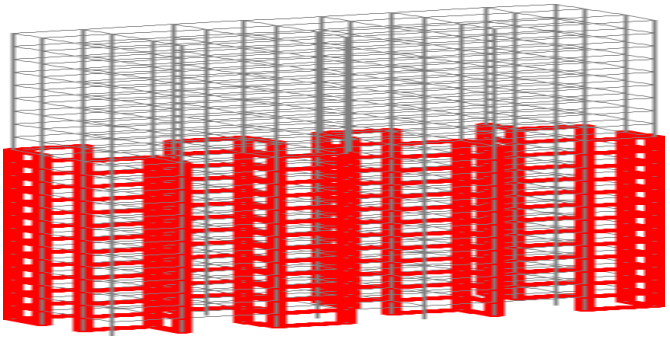


Figure no. 3.11 3D View of Un-symmetrical model-03

IV.)MODEL-04-G+21 Model with shear wall Curtailed from top 9-storey.

Figure no.3.12 3D View of Un-symmetrical model-04



V.)MODEL-05-G+21 Model without shear wall.

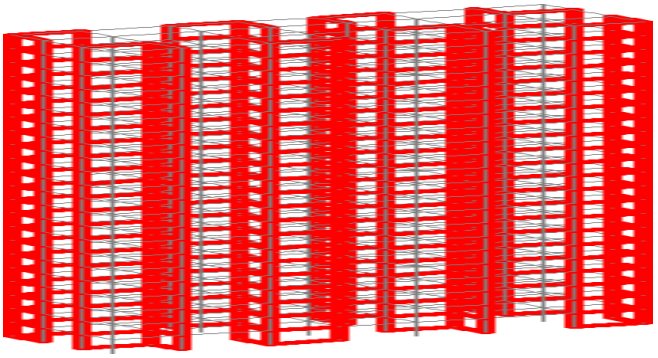


Figure no.3.13 Plan of Un-symmetrical model-05

Figure no.3.14 3D View of Un-symmetrical model-05

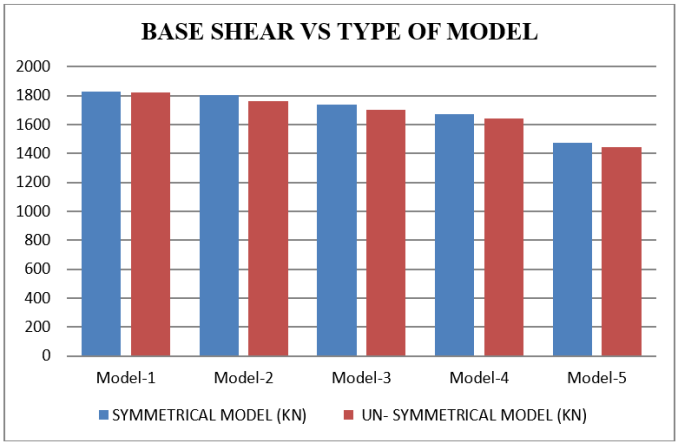
IV.RESULT & DISCUSSION

4.1Comparison of results-

1.) Comparison of base shear-

Table no.4.1 Base Shear of Symmetrical & Un-Symmetrical models-

MODEL' SNO.	DESCRIPTION OF MODELS	BASE SHEAR OF SYMMETRICAL MODEL (KN)	BASE SHEAR OF UN-SYMMETRICAL MODEL (KN)
1	MODEL-01 - G+21 Model with full height Shear wall.	1830.581	1824.731
2	MODEL-02 - G+21 Model with shear wall Curtailed from top 3-storey.	1803.737	1763.851
3	MODEL-03 - G+21 Model with shear wall Curtailed from top 6-storey.	1737.543	1703.031
4	MODEL-04 - G+21 Model with shear wall Curtailed from top 9-storey.	1671.454	1642.207
5	MODEL-05 - G+21 Model without Shear wall.	1475.986	1442.936



Graph : 1. Base shear V/S type of models

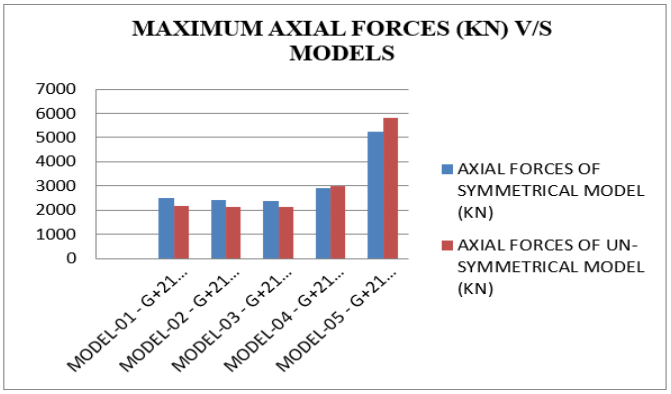
According to the results as mentioned above in symmetrical models-02,03,04,05 base shear continuously decreases by 1.47%, 5.08%, 8.69%, 19.37% as compared to model-01. Similarly in un- symmetrical models-02,03,04,05 base shear continuously decreases by 3.33%, 6.67%, 10%, 20.92%as compared to model-01.

Comparatively un-symmetrical models have variation approx 2% more as compared to symmetrical models

2)Comparison maximum axial forces-

Table no.4.2Axial forces of Symmetrical & Un-Symmetrical models –

MODEL' SNO.	DESCRIPTION OF MODELS	AXIAL FORCES OF SYMMETRICAL MODEL (KN)	AXIAL FORCES OF UN-SYMMETRICAL MODEL (KN)
1	MODEL-01 - G+21 Model with full heightshear wall.	2509.998	2180.196
2	MODEL-02 - G+21 Model with shear wallCurtailed from top 3-storey.	2407.038	2141.146
3	MODEL-03 - G+21 Model with shear wallCurtailed from top 6-storey.	2394.095	2121.135
4	MODEL-04 - G+21 Model with shear wallCurtailed from top 9-storey.	2908.99	2992.930
5	MODEL-05 - G+21 Model withoutshear wall.	5232.182	5828.667



Graph : 2. Maximum Axial force V/S type of models

According to the results as mentioned above in symmetrical models-02,03 axial force decreases by 4.10%, 4.61% but in model-04,05 increased by 15.89%, 52.02% as compared to model-01. Similarly in un-symmetrical models-02,03 axial force decreases by 1.79%, 2.70% but in model- 04,05 increased by 27.15%, 62.59% as compared to model-01. Comparatively un-symmetrical models-02,03 have approx 2% less variation and models- 04,05 have approx 10% to 12% more variation as compared to symmetrical models-02,03 & models- 04,05 in comparison with model-01.

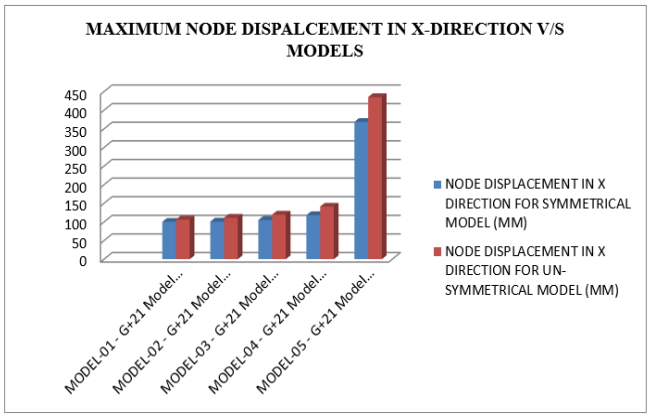
3.) Comparison maximum node displacement in X & Z direction-

Table no. 4.3 Node displacement in X-Direction of Symmetrical & Un-Symmetrical models-

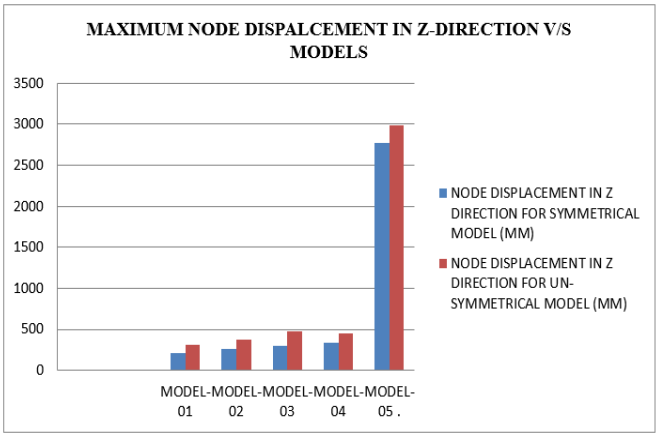
MODEL 'S NO.	DESCRIPTION OF MODELS	NODE DISPLACEMENT IN X DIRECTION FOR SYMMETRICAL MODEL (MM)	NODE DISPLACEMENT IN X DIRECTION FOR UN-SYMMETRICAL MODEL (MM)
1	MODEL-01 - G+21 Model with full heightshear wall.	100.551	106.546
2	MODEL-02 - G+21 Model with shear wallCurtailed from top 3-storey.	101.155	111.295
3	MODEL-03 - G+21 Model with shear wallCurtailed from top 6-storey.	105.256	119.585
4	MODEL-04 - G+21 Model with shear wallCurtailed from top 9-storey.	118.260	141.232
5	MODEL-05 - G+21 Model without shear wall.	368.826	435.39

Table no. 4.4 Node displacement in Z-Direction of Symmetrical & Un-Symmetrical models-

MODEL' SNO.	DESCRIPTION OF MODELS	NODE DISPLACEMENT IN Z DIRECTION FOR SYMMETRICAL MODEL (MM)	NODE DISPLACEMENT IN Z DIRECTION FOR UN-SYMMETRICAL MODEL (MM)
1	MODEL-01 - G+21 Model with full heightshear wall.	209.451	306.901
2	MODEL-02 - G+21 Model with shear wallCurtailed from top 3-storey.	257.820	369.668
3	MODEL-03 - G+21 Model with shear wallCurtailed from top 6-storey.	296.871	470.538
4	MODEL-04 - G+21 Model with shear wallCurtailed from top 9-storey.	337.065	452.3408
5	MODEL-05 - G+21 Model without shearwall.	2767.8	2983.208



Graph: 3.Maximum Node displacement in X- Direction V/S type of models



Graph : 4. Maximum Node displacement in Z Direction V/S type of models

According to the results as mentioned above in symmetrical models-02,03,04,05 node displacement in X-direction continuously increases by 0.6%, 4.4%, 14.97%, 72.73% as compared to model-01. Similarly in un-symmetrical models-02,03,04,05 node displacement in X-direction continuously increases by 4.26%, 10.9%, 24.59%, 75.52% as compared to model-01.

Comparatively un-symmetrical models have variation approx 4% to 10% more as compared to symmetrical models.

According to the results as mentioned above in symmetrical models-02,03,04,05 node displacement in

Z-direction continuously increases by 18.76%, 29.44%, 37.86%, 92.43% as compared to model-01. Similarly in un-symmetrical models-02,03,04,05 node displacement in Z-direction continuously increases by 16.97%, 34.77%, 32.15%, 89.71% as compared to model-01.

Comparatively un-symmetrical models have variation approx 2% to 5% less as compared to symmetrical models.

V. CONCLUSIONS

From the above discussion following conclusions can be made.

- 1.On the basis of results and discussion performance of symmetrical and un-symmetrical models-02, 03, 04, 05 as compared to model-01, in terms of base shear, axial forces, max. node displacement, max.
- 2.It has been concluded that model-05 shows un-acceptable performances as compared to model-01 and model-01 shows excellent performances in all conditions. Hence it is necessary to provide shear wall in high rise structure for its serviceability and stability against gravity and lateral loading conditions but
- it is not necessary that shear wall role in high rise structure is same throughout of the structures as discussed on the basis of results of model-02,03,04. Because in results of symmetrical model-02, 03, 04 have approx 40% variation in all results as compared to symmetrical model-01 upto 48m height of structure and all results are within required limit. Similarly in un-symmetrical there is approx 50% variation in results of model-02,03,04 as compared to un-symmetrical model-01 upto 48m height of structure and all results are within required limit.

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