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EFFECT OF CHANGE IN THICKNESSES AND HEIGHTS IN SHEAR WALL ON DEFLECTION, STORY DRIFT AND STIFFNESS OF MULTISTORIED BUILDINGS

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ABSTRACT

The race towards new heights and architecture has not been without challenges. When the building increases in height, the stiffness of the structure becomes more important. Tall structures have continued to climb higher and higher facing strange loading effects and very high loading values due to dominating lateral loads. The design criteria for tall buildings are strength, serviceability, stability and human comfort. Thus the effects of lateral loads like wind loads, earthquake forces are attaining increasing importance. Generally shear walls are provided in a high rise building and have been found to be immense use to avoid total collapse of building under the seismic forces. Shear wall may be defined as structural elements, which provide strength, stiffness and stability against lateral loads. In many cases, high rise buildings are designed as a framed structure with shear walls that can effectively resist horizontal forces.Lateral forces generated either due to wind blowing against the building or due to the inertia forces induced by ground shaking tend to snap the building in shear and push it over in bending.

In this paper study of G+25 story building in zone III Aurangabad region is presented with some investigations which is analyzed by changing the thickness of shear wall at interval of each five story in same building for determining the parameters like story drift, , story shear and deflection is done by using ETAB software. In this paper the positions of shear walls are fixed which are provided at the corners of building and at centre portion of building for vertical lift.

***Key Words*: ETAB, Shear wall**

I. INTRODUCTION

In this paper we are done the twenty five models for five different thicknesses of shear wall and for different height. The thicknesses for shear wall are 100 mm, 150 mm, 200 mm, 250 mm and 300 mm. and height of shear wall are up to G+4, G+9, G+14, G+19 and G+25 and determine the parameters like story drifts, story shear and deflection by using ETAB by keeping the same position of shear wall and analyzed the above things for these models.

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II. DESCRIPTION OF BUILDING

The building consists of Twenty five stories. All columns in all models are assumed to be fixed at the base for simplicity. The floor to floor height is 3.0 m. Slab is modeled as rigid diaphragm element of 0.125m for all stories considered. Live load on floor is taken as 3 kN/m^2 and on roof is 1.5 kN/m^2. Floor finish on the floor is $1kN/m^2$. Wall thickness is of 230mm on all the external beams and for internal 100 mm.

The unit weight of concrete is taken as 25 kN/m^3. The grade of concrete for column is M-25 and for beam and slab M-25.The building is special moment resisting frame considered to be situated in seismic zone III having medium soil and intended for residential use.

Table shows the dimensions of Beams and columns.

Story	No of Bay X direction	No of Bay Y direction	X direction bay in M	Y direction bay in M	Column size	Beam size
G+24	6	03	4.50	3.00	800 x 800 mm	230 x 600 mm

III. STORY DRIFT

Story drift**:-** is the lateral displacement of one level relative to the level above or below.

Story drift ratio :-is the story drift divided by the story height.

Story shear**:** The summation of design lateral seismic forces at levels above the story under consideration.

Maximum Limits Drift or horizontal displacements of the structure shall be computed where required by this code. For Allowable Stress Design and Strength Design, the Maximum Inelastic. Response Displacement, M, of the structure caused by the Design Basis Ground Motion shall be determined in accordance with this section. The drifts corresponding to the design seismic forces of Section 1630.2.1, S, shall be determined in accordance with Section 1630.9.1. To determine M, these drifts shall be amplified in accordance with Section 1630.9.2. 1630.9.1 Determination of S. A static, elastic analysis of the lateral force-resisting system shall be prepared using the design seismic forces from Section 1630.2.1. Alternatively, dynamic analysis may be performed in accordance with Section 1631. Where Allowable Stress Design is used and where drift is being computed, the load combinations of Section 1612.2 shall be used. The mathematical model shall comply with Section 1630.1.2. The resulting deformations, denoted as S, shall be determined at all critical locations in the structure. Calculated drift shall include translational and tensional deflections. 1630.9.2 Determination of M. The Maximum Inelastic Response Displacement, M, shall be computed as follows: M 0.7 RS (30-17) EXCEPTION: Alternatively, M may be computed by nonlinear time history analysis in accordance with Section 1631.6. The analysis used to determine the Maximum Inelastic Response Displacement M shall consider P effects. 1630.10 Story Drift Limitation. 1630.10.1 General. Story drifts shall be computed using the Maximum Inelastic Response Displacement, M. 1630.10.2 Calculated. Calculated story drift using M shall not exceed 0.025 times the story height for structures having a fundamental period of less than 0.7 second. For structures having a fundamental period of 0.7 second or greater, the calculated story drift shall not exceed 0.020 times the story height.

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The maximum limit for seismic drift is:-

Delta M shall not exceed 0.025 x story ht (if building seismic period is less than 0.7)

delta M shall not exceed 0.020 x story ht (if building seismic period is equal or greater than 0.7)

Important to note here is that it talks about SEISMIC drift so SEISMIC building period not the WIND period.

delta M = Max inelastic response displacement = 0.7R delta S

where R = from Table 16-N

delta S = displacement from static, elastic analysis

this value is read from ETABS multiply this value by 0.7R to get delta M

This was all about seismic drift, but for wind drift code is mute. I will refer you to ASCE 2005 commentary CC.1.2

IV. STIFFNESS

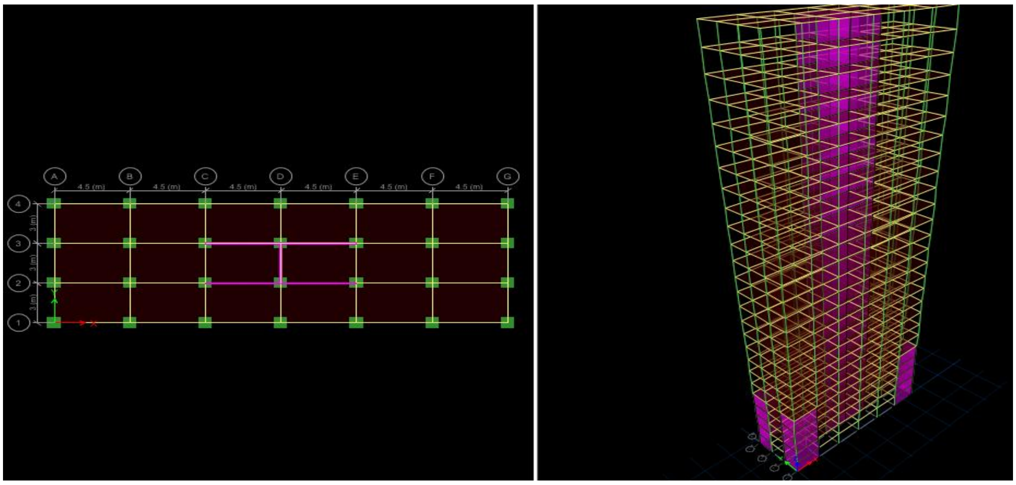
The deflection of a structure under loading is dependent on its stiffness. The dynamic of a structure to dynamic loads is also dependent on its stiffness.

In a structure made up of multiple structural elements where the surface distributing the forces to the elements is rigid, the elements will carry loads in proportion to their relative stiffness - the stiffer an element, the more load it will attract. This means that load/stiffness ratio, which is deflection, remains same in two connected (jointed) elements. In a structure where the surface distributing the forces to the elements is flexible (like a wood framed structure), the elements will carry loads in proportion to their relative tributary areas.

A structure is considered to fail the chosen serviceability criteria if it is insufficiently stiff to have acceptably small deflection or dynamic response under loading.

V. RESULTS AND DISCUSSION:

For model 1 G+4



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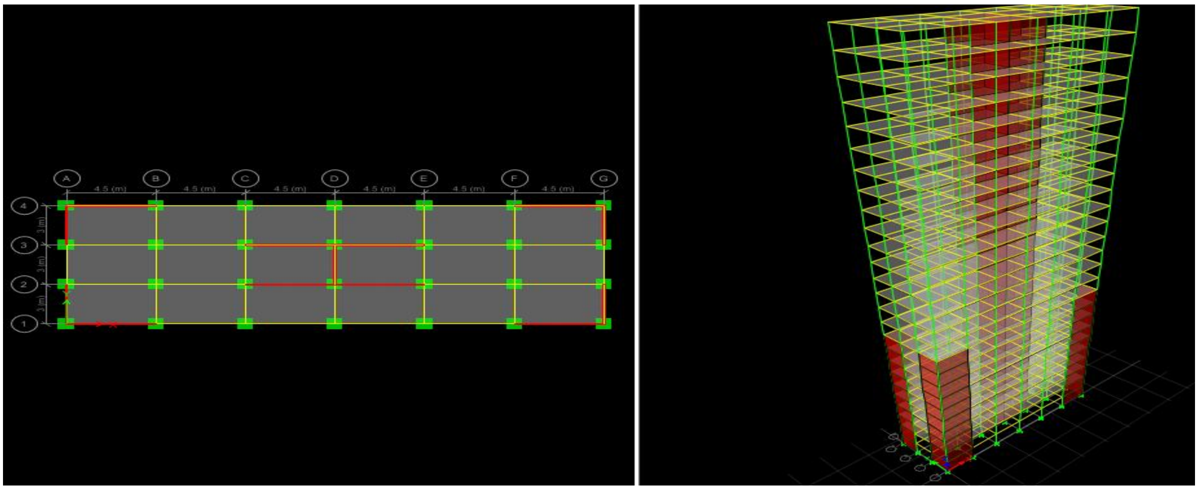
Model No	Story Height	Shear wall thickness	Deflection in		Stiffness		Drifts		Story Shears	
			X Dir.	Y Dir.	(X-dir) KN/M	(Y-dir) KN/M	(X-dir)	(Y-dir)	X-dir. KN	Y- dir. KN
1	G+4	100	15.7	39.2	187423.94	72316.76	0.000175	0.000459	98.62	99.34
		150	15.1	37.8	186981.0	73808.84	0.000181	0.000460	101.38	101.77
		200	15	37.8	186892.54	73769.17	0.000180	0.000459	100.93	101.31
		250	14.7	36.8	187516.10	75014.88	0.000184	0.000460	103.33	103.60
		300	14.1	35.5	189730.85	77037.75	0.000188	0.000463	106.74	107.03

For model 2

G+9

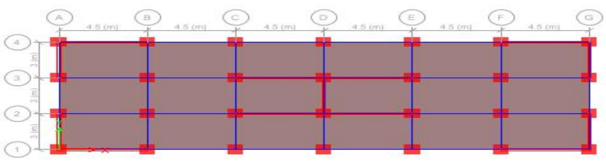


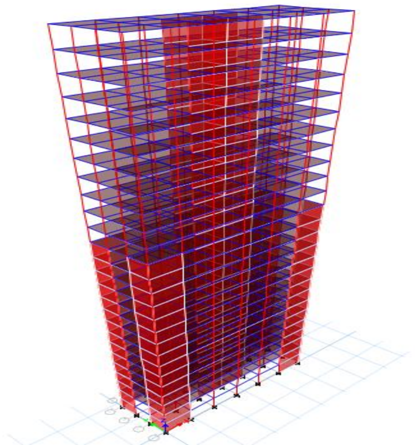
Model No	Story Height	Shear wall thickness	Deflection in		Stiffness		Drifts		Story Shears	
			X Dir.	Y Dir.	(X-dir) KN/M	(Y-dir) KN/M	(X-dir)	(Y-dir)	X-dir.	Y- dir.
II	G+9	100	14.2	35.8	200544.41	78006.53	0.000169	0.000442	99.13	100.68
		150	13.6	34	201020.82	80127.03	0.000169	0.000427	102.07	102.64

		200	13.6	34	201042.88	80135.51	0.000169	0.000427	102.11	102.69
		250	13.2	32.7	203241.12	82742.49	0.000171	0.000422	104.21	104.74
		300	12.7	31.1	208091.32	86925.11	0.000174	0.000417	108.37	108.85

For model 3

G+14





Model No	Story Height	Shear wall thickness	Deflection in		Stiffness		Drifts		Story Shears	
			X Dir.	Y Dir.	(X-dir) KN/M	(Y-dir) KN/M	(X-dir)	(Y-dir)	X-dir.	Y- dir.
III	G+14	100	12.1	30.2	211595.35	83764.76	0.000149	0.000382	94.76	95.98
		150	12.1	30.2	211595.35	83764.16	0.000149	0.000382	94.76	95.98
		200	11.8	29	214513.84	87296.17	0.000151	0.000374	96.89	98.04
		250	11.6	28.1	217448.89	90403.58	0.000152	0.000369	98.89	100.01
		300	11.4	27.4	220323.86	93183.00	0.000153	0.000365	100.81	101.92

For model 4

G+19

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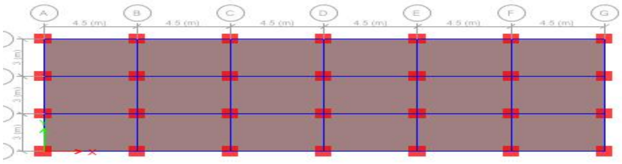
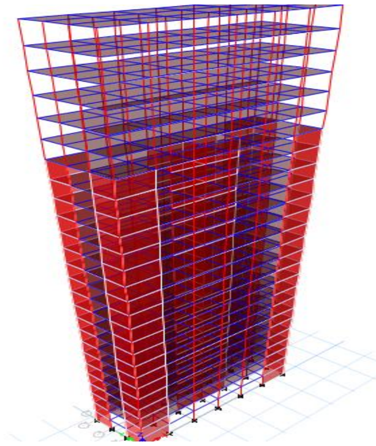
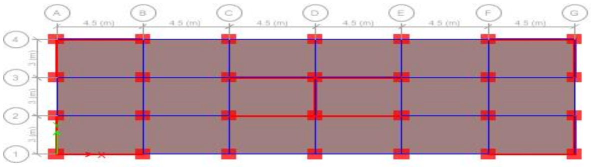


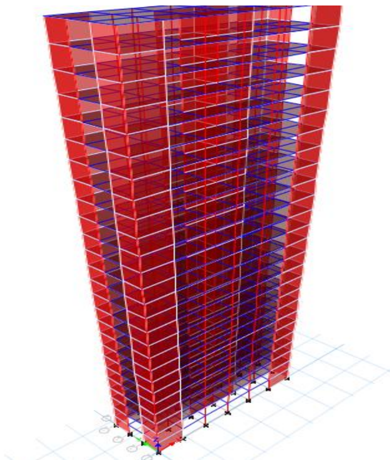


Model No	Story Height	Shear wall thickness	Deflection in		Stiffness		Drifts		Story Shears	
			X Dir.	Y Dir.	(X-dir) KN/M	(Y-dir) KN/M	(X-dir)	(Y-dir)	X-dir.	Y- dir.
IV	G+19	100	12.1	30.3	208150.15	77698.19	0.000135	0.000369	84.17	85.97
		150	11.6	28.8	210511.66	82212.26	0.000137	0.000357	86.51	88.05
		200	11.4	27.7	212981.14	86085.24	0.000139	0.000348	88.58	89.96
		250	11.2	27	215330.39	89482.51	0.000140	0.000342	90.52	91.80
		300	11.1	26.4	217538.83	92501.83	0.000142	0.000337	92.39	93.60

For model 5

G+25





Model No	Story Height	Shear wall thickness	Deflection in		Stiffness		Drifts		Story Shears	
			X Dir.	Y Dir.	(X-dir) KN/M	(Y-dir) KN/M	(X-dir)	(Y-dir)	X-dir.	Y- dir.
V	G+25	100	12.8	32.2	207915.79	78237.06	0.00015	0.000405	93.60	95.14
		150	12.4	31	211920	83098.33	0.000153	0.000394	96.97	98.16
		200	12.3	30.1	215411.17	87415.87	0.000155	0.000385	100.12	101.06
		250	12.2	29.5	218511.50	91296.01	0.000157	0.000379	103.16	103.91
		300	12.2	29	221336.97	94811.98	0.00016	0.000375	106.16	106.75

VI. CONCLUSION

The present study has been carried out the earthquake response of tall building by using varying thickness of shear wall by keeping the same position. The purpose of the study is to investigate deflection, story drift and stiffness of building performance. The following conclusions were drawn from the analysis:

1. Providing shear walls at adequate locations substantially reduces the displacements due to earthquake, percentage of lateral drift and displacement. 2. Model with greater thickness of shear wall, lesser the deflection of building.

3. In model G+24, the deflection of building in X direction for 300 mm thick and 250 mm thick is same so we will use 250 mm thickness of shear wall for achieving economy.

4 In all models, as the stiffness of the building increases the storey drift also increases.

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