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Seismic and Wind Effects on High Rise Structure Using ETABS

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Abstract: For the analysis G+16, G+24, G+32 R.C.C. framed building is modeled for three different zones. A high-rise is a tall building or structure. Buildings between 75 feet and 491 feet (23 m to 150 m) high are considered high-rises. Buildings taller than 492 feet (150 m) are classified as skyscrapers. High-rise structures have certain features. The structures are high & lead to higher vertical loads and higher lateral loads (mainly due to wind stress) in comparison with lower buildings. If high rise structures are not properly designed it may cause complete failure of structure. When a structure deforms, the applied loads may cause additional actions in the structure that are called second order or P-Delta effects. In evaluating overall structural stability, it is necessary to consider the P-Delta effects. All analysis is carried out by software ETABS. Although quick and easy for simple structures, ETABS can also handle the largest and most complex building models, including a wide range of nonlinear behaviors, making it the tool of choice for structural engineers in the building industry. ETABS can handle easily: Complex shear walls and cores with arbitrary openings, buildings based on multiple rectangular and/or cylindrical grid systems, P-Delta effects with static or dynamic analysis, Construction sequence loading analysis. So here I want to study the behavior of high rise structure due to wind effects, seismic effects and combination of two along with p-delta effects. Base shear, storey displacement, storey moments and axial force on column is calculated and compared between different zones with and without P-delta effects.
Key Words: High rise buildings, ETABS, lateral loads, Base shear, storey displacement, storey moments, axial force on column ,wind effects, seismic effects, P-delta effects, shear wall.

I. INTRODUCTION

In this modern era of 21st century, as urbanization increases the availability of land is becoming less due to high population and cost of land is becoming higher. To overcome this problem the only solution is to prefer high rise structures. A high rise structure is to designed to resist all lateral load. A high rise building is a structure whose architectural height is between. When it has a minimum of 14 to 45 floors whether or not the height is known it is classified as high rise structure. By the study of past earthquakes occurred in multistoried building shows that if they are not well designed and constructed with adequate strength it leads to the complete collapse of the structure. So to acquire safety against additional deformations there is need to study of detailed considerations to design earthquake resistance structures. Generally structural engineers traditionally use linear static analysis to compute design forces moments and displacements of a structure resulting from loads acting on it. In wind design the building is subjected to a pressure on its exposed surface area, where as in earthquake design the building is subject to random motion of the ground at its base. Design for wind forces and earthquake effects are different. My present work is to study the behavior of a multi storied R C building subjected to earthquake and wind effects with and without P-delta effects. The building models in the study has sixteen storeys , twenty four and thirty two stories with constant storey height of 3m.Three models are used to analyze with different zone factors and wind effects.

A. Literature review

T. K. Datta (2010) in "Seismic Analysis of Structures", have presented an overview of various dynamic analysis procedures for use in seismic design of structures. A discussion of the determination of the structural response to be used in association with the equivalent static force method and Response spectrum method is presented. Prashant Dhadve, Alok Rao in Assessment of "P-Delta Effect on High Rise Buildings". By increasing stiffness of building by providing suitable cross section or by increasing stiffness building can bring within acceptable limit. Richard dobs on has explained with a short introduction to the different methods of P-Delta analysis currently available in commercial software form. Donald G. Newman in "Civil engineering license review,14th edition" stated that the P-delta effects produce secondary moments augmenting the sway moments in that story. If the ratio of secondary to primary moments exceeds 0.1,the effects of the secondary moments should be included in the analysis. S.K. Duggal in

"Earthquake resistant design of structures" states that the moment induced by the P-delta effects is a secondary effect and may be ignored when it is less than 10 percent of the primary action of lateral loads.

B. Objectives of the study

The main objective of this project is to study the behavior of structures with wind effects, seismic effects and P-delta effects. To compare manually calculated lateral loads on G+16 building due to wind effects with ETABS calculated lateral loads. To compare manually calculated lateral loads on G+16 building due to seismic effects with ETABS calculated lateral loads. To compare various results of analysis under zone II, III and IV using ETABS software. Different values of zone factor and wind speeds are taken and their corresponding effects are interpreted in the results. To study the behavior of a building with and without consideration of P-delta effects.

C. P-Delta Effect

P-DELTA effect is said to be the effect of gravity on the lateral force resistance of structures. The concept of P-delta effects under static loading can be illustrated using the single degree of freedom structure. In this figure,2P represents the force due to gravity acting on the mass lumped at the top of the structure ,L is the structure height,2V is the lateral force on the mass, and Δ is the horizontal displacement of the mass.As the structure sways by Δ under the effect of the lateral force,the product of P by Δ produces an additional moment at the base of each column which can be obtained by considering static equilibrium in the deformed configuration.Therefore additional moment or secondary moment at the base is given by,

$$M=P*\Delta$$

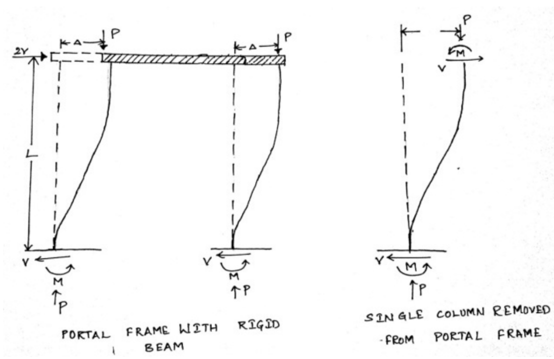

Figure: 1 Action of P-delta effect

II. MODELING

In this present project G+16, G+24 and G+32 buildings are modeled along with plinth story of 2m.

Type of structure	R.C.C frame structure
Number of storey	G+16,G+24,G+32
Floor to floor height	3m
Grade of concrete	M20 for Beam & slabs M25 for columns
Grade of steel	HYSD500
Beam size	Plinth beam 230mmx600mm Floor beam 230mmx715mm
Column size	300mmx900mm
Slab thickness	115mm

Table no.1:Modeling data

III. LOADING

A. Dead Load

For dead loads we need to follow the codal provision IS 875- part I 1987

Self weight of the structure

Wall load:

External wall weight =(1*0.23*2.4)*21.20

=11.7024 ≅ 12 KN/m

Internal wall weight=(1*0.115*2.4)*21.20

=5.8512 ≅ 6 KN/m

Parapet wall weight=(1*0.115*1)*21.20

=2.438 ≅ 3 KN/m

Floor finishing =2 KN/m^2

B. Live Load

For live loads we need to follow the codal provision IS 875- part II 1987

For rooms =2 KN/m^2

For corridors = 3 KN/m^2

For roofs =2 KN/m^2

C. Staircase Loads

1) Loads on going/flight

Self weight of steps =0.56 KN/m

Floor finishing =2 KN/m^2

Live load =3 KN/m^2

Floor Finishing =2 KN/m^2

Live load =3 KN/m^2

D. Wind Loads

For wind load calculation we need to follow the codal provision IS 875- part III 1987

<table>
<tr><th></th><th>Hyderabad</th><th>Vijayawada</th><th>New Delhi</th></tr>
<tr><td>Basic wind speed</td><td>44m/s</td><td>50m/s</td><td>47m/s</td></tr>
<tr><td>Risk coefficient factor(k_1)</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Terrain category</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td><table>
<tr><th></th><th>Hyderabad</th><th>Vijayawada</th><th>New Delhi</th></tr>
<tr><td>Zone</td><td>II</td><td>III</td><td>IV</td></tr>
<tr><td>Zone factor</td><td>0.10</td><td>0.16</td><td>0.24</td></tr>
<tr><td>Importance factor</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Time period</td><td>1.473</td><td>1.473</td><td>1.473</td></tr>
<tr><td>Soil site type</td><td>I</td><td>II</td><td>I</td></tr>
</table>Structure class</td><td>B</td><td>B</td><td>B</td></tr>
<tr><td>Topography factor(k_3)</td><td>1</td><td>1</td><td>1</td></tr>
</table>

Table no.2:Wind Loads

E. P-Delta Effects

To include P-delta effects in analysis we have to use P-delta options command. An automation method is programised for inclusion of P-delta effects in iterative based method .The load case may be the sum of a dead load case plus a fraction of a live load case.

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IV. RESULTS OF ANALYSIS AND DISCUSSION

A. *Lateral Forces Of G+16 Building in ZONE II*

1) *Lateral loads due to wind effects by calculating manually*

Story	Elevation m	Pz	In X-direction	In Y-direction
G+16	53	1380.10	131.28	100.22
G+15	50	1364.95	129.83	99.12
G+14	47	1342.37	127.69	97.48
G+13	44	1319.99	125.56	95.86
G+12	41	1297.80	123.45	94.24
G+11	38	1275.79	121.35	92.65
G+10	35	1253.97	119.28	91.06
G+9	32	1232.34	117.22	89.49
G+8	29	1196.71	113.83	86.90
G+7	26	1161.60	110.49	84.35
G+6	23	1127.01	107.20	81.84
G+5	20	1079.47	102.68	78.39
G+4	17	1026.39	97.63	74.53
G+3	14	949.28	90.30	68.93
G+2	11	899.54	85.57	65.32
G+1	8	899.54	85.57	65.32
G	5	899.54	85.57	65.32
PLINTH	2	0.00	0.00	0.00
Base	0	0.00	0.00	0.00

Table no.4:Lateral loads due to wind effects by calculating manually

2) *Lateral loads by using Etabs*

This calculation presents the automatically generated lateral wind loads for load pattern WIND-X according to Indian IS875:1987, as calculated by ETABS.

B. *Exposure Parameters*

Exposure From = Shell Objects

Structure Class = Class B
Terrain Category = Category 3
Top Story = G+16
Bottom Story = G
Include Parapet = No

C. *Factors and Coefficients*

Risk Coefficient, k_1 [IS 5.3.1]

$$k_1 = 1$$

Topography Factor, k_3 [IS 5.3.3]

$$k_3 = 1$$

D. *Lateral Loading*

Design Wind Speed, V_z [IS 5.3] $V_z = 38.72$

$$V_z = V_b k_1 k_2 k_3 V_z = 38.72$$

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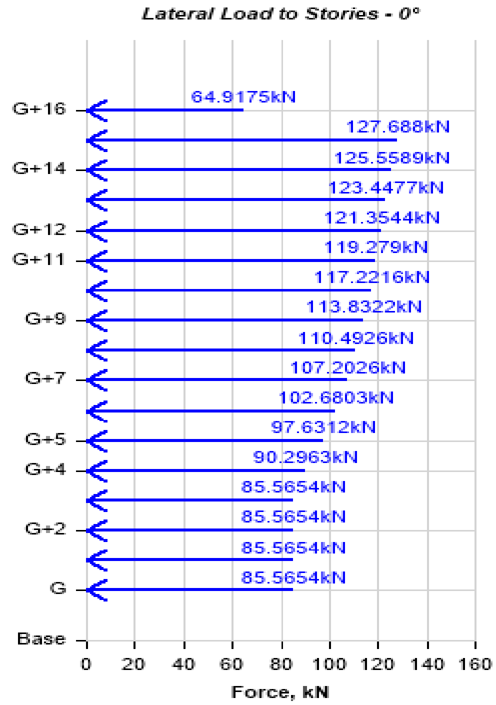
Design Wind Pressure, p_z [IS 5.4]

$$p_z = 0.6V_z^2$$

E. Applied Story Forces



F. Indian IS875:1987 Auto Wind Load Calculation

This calculation presents the automatically generated lateral wind loads for load pattern WIND-Y according to Indian IS875:1987, as calculated by ETABS.

G. Exposure Parameters

Exposure From = Shell Objects
Structure Class = Class B
Terrain Category = Category 3
Top Story = G+16
Bottom Story = G
Include Parapet = No

H. Factors and Coefficients

Risk Coefficient, k_1 [IS 5.3.1]

$$k_1 = 1$$

Topography Factor, k_3 [IS 5.3.3]

$$k_3 = 1$$

I. Lateral Loading

Design Wind Speed, V_z [IS 5.3]

$$V_z = V_b k_1 k_2 k_3$$

$$V_z = 38.72$$

Design Wind Pressure, p_z [IS 5.4]

$$p_z = 0.6V_z^2$$

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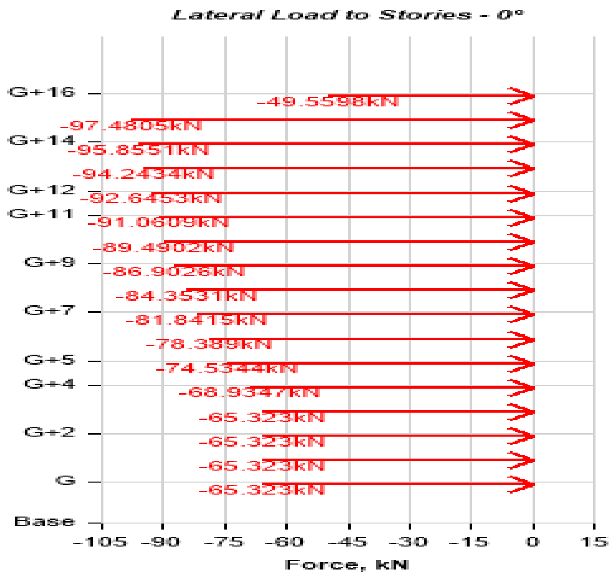
J. Applied Story Forces



K. Seismic lateral load calculation manually

Seismic weight =(1*DL)+ (0.25LL)
=(1*(57651.7097+14547.488+45767.33+58.3014))+(0.25*15667.9429)=121941.8148 KN

A_h=(ZIS_a/ 2Rg)=(0.10*1*0.679)/(2*3)=0.0113

V_B = A_h W=0.0113*121941.8148=1377.9425KN

$$Q_i = V_B \frac{W_i h_i^2}{\sum_{i=1}^{n} W_i h_i^2}$$

Story	Elevation m	Wi*hi2	Qi
G+16	53	342534558	107.6793
G+15	50	304854537	191.6684
G+14	47	269369469	169.3582
G+13	44	236079353	148.428
G+12	41	204984191	128.8778
G+11	38	176083981	110.7077
G+10	35	149378723	93.91752
G+9	32	124868418	78.50738
G+8	29	102553066	64.47725
G+7	26	82432666.8	51.82714
G+6	23	64507220	40.55703
G+5	20	48776725.9	30.66694
G+4	17	35241184.5	22.15687
G+3	14	23900595.7	15.0268
G+2	11	14754959.6	9.276751
G+1	8	7804276.15	4.906711
G	5	3048545.37	1.916684
PLINTH	2	487767.259	0.306669
Base	0	0	0

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Table no.4:Seismic lateral load calculation manually

L. *Maximum Story Displacements*

LOADCASE	ZONE –II		
	WITHOUT P-Δ EFFECT	WITH P-ΔEFFECT	Increase in percentage
WINDX	24.2	25.23	4.256
WIND-X	24.2	25.22	4.215
WINDY	18.05	18.84	4.354
WIND-Y	18.05	18.84	4.393
EQX	25.89	26.93	3.997
EQY	25.03	26.07	4.14

Table no.5:G+16 of ZONE –II

LOADCASE	ZONE –III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	31.27	32.58	4.181
WIND-X	31.27	32.57	4.181
WINDY	23.3	24.32	4.395
WIND-Y	23.31	24.33	4.389
EQX	56.34	58.6	3.999
EQY	54.48	56.73	4.139

Table no.6:G+16 of ZONE –III

LOADCASE	ZONE –IV		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	27.63	28.79	4.191
WIND-X	27.63	28.78	4.177
WINDY	20.59	21.49	4.401
WIND-Y	20.6	21.5	4.394
EQX	62.16	64.65	3.999
EQY	60.1	62.59	4.142

Table no.7:G+16 of ZONE –IG+24:

LOADCASE	ZONE –II		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	67.189	71.983	7.135
WIND-X	67.184	71.977	7.134
WINDY	47.009	50.306	7.014
WIND-Y	47.037	50.336	7.014
EQX	50.686	54.168	6.87
EQY	45.913	48.9616	6.64

Table no.8:G+24 of ZONE –II

LOADCASE	ZONE –III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	86.764	92.976	7.16
WIND-X	86.757	92.9696	7.161
WINDY	60.704	64.982	7.047
WIND-Y	60.74	65.02	7.046
EQX	110.683	118.315	6.895
EQY	100.333	107.023	6.668

Table no.9:G+24 of ZONE –III

LOADCASE	ZONE –IV		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	76.664	82.154	7.161
WIND-X	76.658	82.148	7.162
WINDY	53.638	57.4181	7.047
WIND-Y	53.669	57.451	7.047
EQX	122.078	130.494	6.894
EQY	110.661	118.04	6.668

Table no.10:G+24 of ZONE –IV

LOADCASE	ZONE –II		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	155.91	173.26	11.129
WIND-X	155.91	173.26	11.128
WINDY	101.97	112.22	10.056
WIND-Y	102	112.26	10.055
EQX	85.041	94.202	10.772
EQY	72.065	78.962	9.5705

Table no.11:G+32 of ZONE –II

LOADCASE	ZONE –III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	201.33	223.74	11.128
WIND-X	201.33	223.73	11.129
WINDY	131.67	144.91	10.057
WIND-Y	131.72	144.97	10.057
EQX	185.05	204.99	10.773
EQY	115.3	126.34	9.5712

Table no.12:G+32 of ZONE –III

LOADCASE	ZONE –IV		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	177.9	197.69	11.128
WIND-X	177.89	197.69	11.129
WINDY	116.34	128.05	10.057
WIND-Y	116.39	128.09	10.057
EQX	204.1	226.09	10.773
EQY	172.96	189.51	9.5712

Table no.13:G+32 of ZONE –IV

*M. Story Moments:*4.3.1 G+16:

LOADCASE	ZONE –II		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	49976.1	52077.2	4.204
WINDY	38153.2	39778.9	4.261
EQX	-52293	-54401	4.032
EQY	52292.5	54393	4.017

Table no.14:G+16 of ZONE –II

LOADCASE	ZONE –III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	64535.3	67248.5	4.204
WINDY	49268	51367.4	4.261
EQX	-113789	-118377	4.032
EQY	113789	118359	4.017

Table no.15:G+16 of ZONE –III

LOADCASE	ZONE –IV		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	57023.4	59421.6	4.206
WINDY	43533.2	45388.8	4.263
EQX	-125532	-130596	4.034
EQY	125532	130576	4.018

Table no.16:G+16 of ZONE –IV

4.3.2 G+24:

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LOADCASE	ZONE –II		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	118241	126705	7.158
WINDY	90268.3	96473	6.874
EQX	-85926	-91928	6.985
EQY	85926.1	91564	6.561

Table no.17:G+24 of ZONE –II

LOADCASE	ZONE –III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	152687	163617	7.158
WINDY	116565	124578	6.874
EQX	-186975	-200036	6.985
EQY	186975	199243	6.561

Table no.18:G+24 of ZONE –III

LOADCASE	ZONE –IV		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	134914	144572	7.158
WINDY	102997	110077	6.874
EQX	-206223	-220628	6.985
EQY	206222.59	219753.7	6.561

Table no.19:G+24 of ZONE –IV

LOADCASE	ZONE –II		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	235982.54	261998.6	11.025
WINDY	180155.59	197917.9	9.859
EQX	-122198	-135513	10.896
EQY	122198.4	133823.1	9.51

Table no.20:G+32 of ZONE –II

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LOADCASE	ZONE –III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	304729.5	338324.6	11.025
WINDY	232638.9	255575.8	9.859
EQX	-265904	-294876	10.895
EQY	195517.4	214117	9.513

Table no.21:G+32 of ZONE –III

LOADCASE	ZONE –IV		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
WINDX	269259	298943.6	11.025
WINDY	205559.76	225826.8	9.859
EQX	-293276	-325230	10.895
EQY	293276.17	321175.6	9.513

Table no.22:G+32 of ZONE –IV

4.4Axial Force:

LOAD CASE	ZONE –II		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	433.4755	451.3837	4.131
G+24	938.9645	1007.301	7.278
G+32	900.5808	1000.641	11.111

Table no.23:In ZONE –II

LOAD CASE	ZONE –III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	943.2426	982.21	4.131
G+24	1453.116	1557.1	7.159
G+32	1959.664	2177.39	11.111

Table no.24:InZONE –III

LOAD CASE	ZONE –IV		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	1040.585	1083.589	4.133
G+24	1602.702	1717.434	7.159
G+32	2161.394	2401.54	11.111

Table no.25:InZONE –IV

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N. Base Shear

Following are the maximum base shear values due to WINDX

MODEL	ZONE -II		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	1763.863	1763.863	61.288
G+24	2844.908	2844.908	
G+24	2844.908	2844.908	51.519
G+32	4310.572	4310.572	

Table no.26:In ZONE –II

MODEL	ZONE -III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	2277.717	2277.717	61.288
G+24	3673.693	3673.693	
G+24	3673.693	3673.693	51.519
G+32	5566.337	5566.337	

Table no.27:InZONE –III

MODEL	ZONE -IV		
	WITHOUT P-ΔEFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	2012.59	2012.59	61.288
G+24	3246.075	3246.075	
G+24	3246.075	3246.075	51.519
G+32	4918.416	4918.416	

Table no.28:InZONE –IV

Following are the maximum base shear values due to EQX

MODEL	ZONE –II		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	1376	1376	11.483
G+24	1534	1534	
G+24	1534	1534	7.627
G+32	1651	1651	

Table no.29:InZONE –II

MODEL	ZONE –III		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	2994	2994	11.49
G+24	3338	3338	
G+24	3338	3338	7.639
G+32	3593	3593	

Table no.30:In ZONE –III

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MODEL	ZONE –IV		
	WITHOUT P-Δ EFFECT	WITH P-Δ EFFECT	Increase in percentage
G+16	3303	3303	11.444
G+24	3681	3681	
G+24	3681	3681	7.634
G+32	3962	3962	

Table no.31:InZONE –IV

For G+16,G+24 and G+32 building models there is approximately 4%,7% and 11% of increase in displacements ,story moments and axial forces when we include P-delta effects in analysis respectively. Increase in percentage of displacements, moments and axial forces values of different zones with and without P-delta effects is approximately similar of same structure. There is no variation in base shear values with and without P-delta effects in analysis. Increase in percentage of base shear values between different models in different zones is similar.

O. Results With Shear Wall

1) Displacements: **G+16**

LOAD CASE	ZONE -II		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	25.23	17.027	32.5129
WIND-X	25.22	17.027	32.4869
WINDY	18.84	12.805	32.0185
WIND-Y	18.84	12.841	31.8543
EQX	26.93	19.461	27.7295
EQY	26.07	19.112	26.6925

Table no.32:G+16 of ZONE –II

LOAD CASE	ZONE –III		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	32.58	21.99	32.51
WIND-X	32.57	21.99	32.5
WINDY	24.32	16.54	32.01
WIND-Y	24.33	16.58	31.86
EQX	58.6	42.35	27.73
EQY	56.73	41.59	26.69

Table no.33:G+16 of ZONE –III

LOAD CASE	ZONE –IV		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	28.79	19.428	32.51
WIND-X	28.78	19.428	32.49
WINDY	21.49	14.611	32.02
WIND-Y	21.5	14.651	31.86
EQX	64.65	46.721	27.73
EQY	62.59	45.881	26.69

Table no.34:G+16 of ZONE –IVG+24:

LOAD CASE	ZONE –II		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	71.983	50.599	29.707
WIND-X	71.977	50.596	29.705
WINDY	50.306	36.859	26.73
WIND-Y	50.336	36.879	26.734
EQX	54.168	40.467	25.294
EQY	48.9616	38.436	21.498

Table no.35:G+24 of ZONE –II

LOAD CASE	ZONE –III		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	92.976	65.339	29.725
WIND-X	92.9696	65.336	29.723
WINDY	64.982	45.597	29.831
WIND-Y	65.02	45.622	29.834
EQX	118.315	88.057	25.574
EQY	107.023	83.637	21.851

Table no.36:G+24 of ZONE –III

LOAD CASE	ZONE –IV		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	82.154	57.734	29.725
WIND-X	82.148	57.731	29.723
WINDY	57.4181	42.057	26.753
WIND-Y	57.451	42.079	26.757
EQX	130.494	97.122	25.574
EQY	118.04	92.247	21.851

Table no.37:G+24 of ZONE –IVG+32:

LOAD CASE	ZONE –II		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	173.26	124.09	28.382
WIND-X	173.26	124.08	28.385
WINDY	112.22	85.124	24.145
WIND-Y	112.26	85.138	24.161
EQX	94.202	71.168	24.452
EQY	78.962	63.499	19.583

Table no.38:G+32 of ZONE –II

LOAD CASE	ZONE -III		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	223.74	160.22	28.388
WIND-X	223.73	160.22	28.385
WINDY	144.91	109.92	24.146
WIND-Y	144.97	109.94	24.162
EQX	204.99	154.81	24.479
EQY	126.34	105.6	16.418

Table no.39:G+32 of ZONE –III

LOAD CASE	ZONE -IV		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
WINDX	197.69	141.58	28.383
WIND-X	197.69	141.57	28.385
WINDY	128.05	97.128	24.145
WIND-Y	128.09	97.143	24.162
EQX	226.09	170.8	24.452
EQY	189.51	152.4	19.584

*Table no.40:*G+32 of ZONE –IV

O. Axial Forces:

LOAD CASE	ZONE -II		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
G+16	451.3837	305.8184	32.249
G+24	1007.301	535.0231	46.885
G+32	1000.642	788.5473	21.196

Table no.41:In ZONE –II

LOAD CASE	ZONE -III		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
G+16	982.2109	665.4609	32.249
G+24	1557.14	1554.255	0.185
G+32	2177.396	1715.879	21.196

Table no.42**:**In ZONE –III

LOAD CASE	ZONE –IV		
	WITHOUT SHEAR WALL	WITH SHEAR WALL	Decrease In Percentage
G+16	1083.589	734.1547	32.248
G+24	1717.434	1284.055	25.234
G+32	2401.54	1892.513	21.196

Table no.43**:**In ZONE –IV

For G+16,G+24 and G+32 building models there is decrease in displacement ,axial forces when we construct shear wall to the structure. Decrease in percentage of displacement values of different zones with and without shear wall is approximately similar of same structure. From above results we can observe that wind, seismic and P-delta effects can be resisted by constructing shear walls. Increase in stiffness of building depends upon shear wall position and height.

V. GRAPHICAL REPRESENTATION:

A. Graphs of Displacement Increment

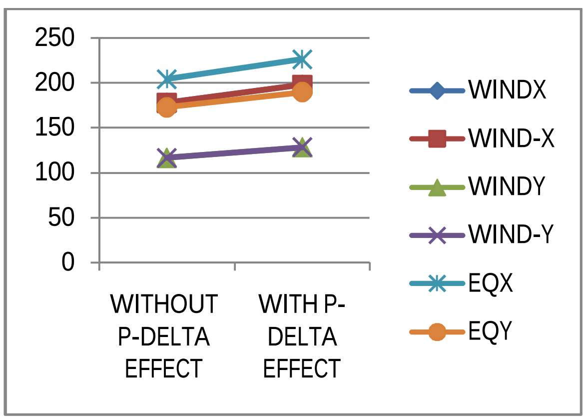

Figure:1Graph of G+32 ZONE-IV

B. Graphs Of Story Moments

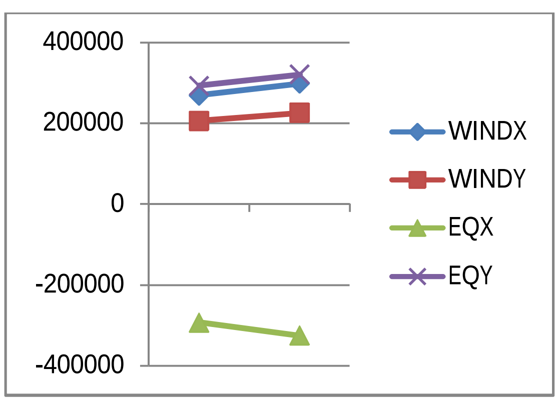

Figure:6 Graph of G+32 ZONE-IV

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C. Graphs of Axial Forces

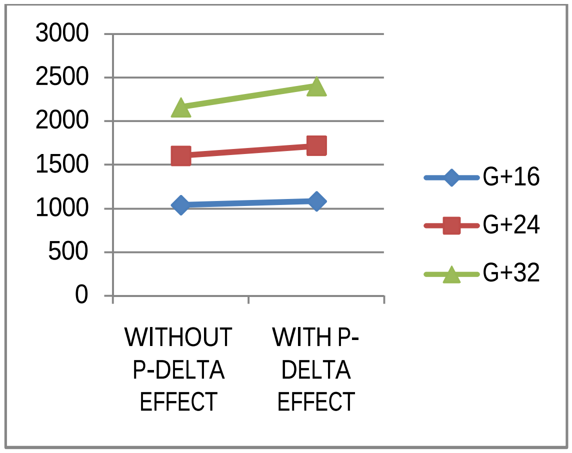

Figure:7Graph of ZONE-IV

D. Response Of Structure With Shear Wall

1) Graphs Of Displacements

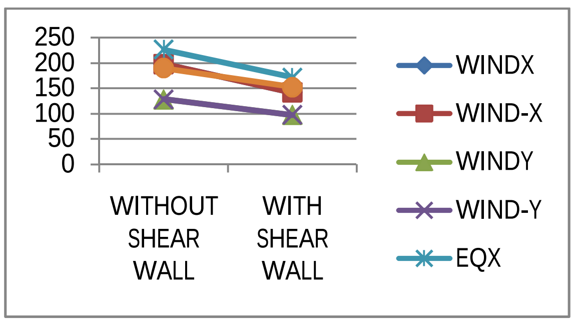

Figure:10Graph of G+32 ZONE-IV

2) Graphs of axial Forces

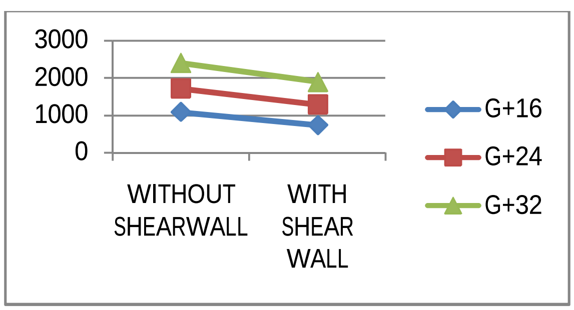

Figure: 11Graph of ZONE-IV

VI. CONCLUSION

A. Manually calculated lateral forces due to wind effects and Etabs calculated lateral forces due to wind effects are similar.
B. Calculation of seismic weight with manual analysis and software analysis approximately shows same result.
C. Calculation of base shear with manual analysis and software analysis approximately shows same result.
D. Lateral loads due to seismic effects obtained by software analysis are slightly higher than manual analysis.
E. Reinforcement percentage increases as we consider seismic and P-delta effects.
F. As the seismic zone increases displacement and moment of the structure increases.
G. As the height of the model increases displacement of storey increases.
H. As we go to higher seismic zones base shear of structures increases.

I. As the height of the model increases P-delta effect increases.
J. For a model, from G+32 and to above stories we have to consider P-delta effects in the analysis.
K. If P-delta effects are not considered in high rise buildings, the structure failure will occur in early stages.
L. If the change in bending moments, shear forces and displacements is more than 10%, P-delta effect should be considered in design.
M. Increase in percentage of displacement, moment and axial force values of different zones with and without P-delta effect is approximately similar of same structure.
N. These Wind effects, seismic effects and P-delta effects on the structure can be reduced by constructing a shear wall to the structure.
O. This conclusion is applicable for regular RCC residential buildings

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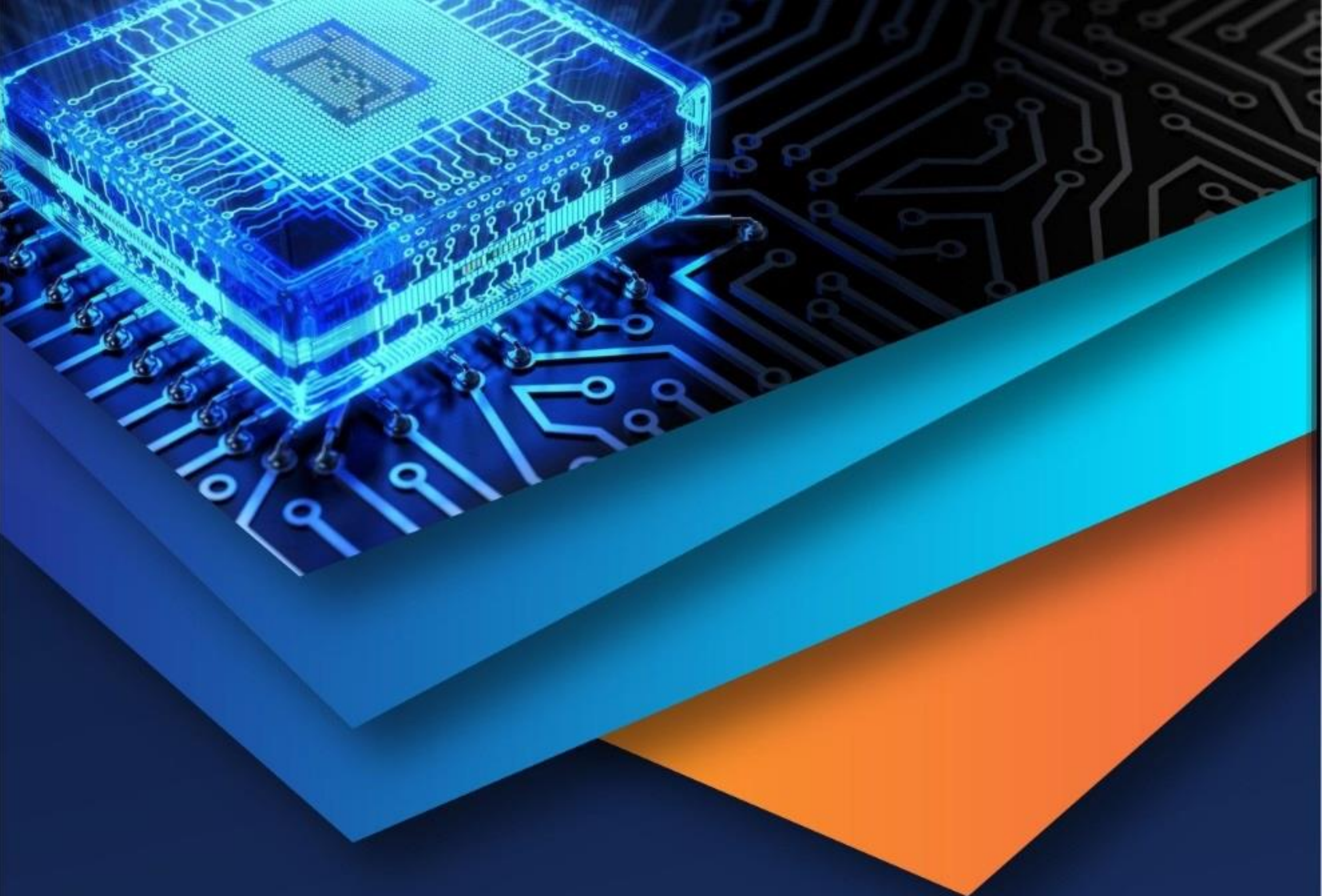

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