EFFECTS OF SHAPE ON THE WIND-INSTIGATE RESPONSE OF HIGH RISE BUILDINGS

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Abstract

A large number of structures that are being constructed at present tend to be wind-sensitive because of their slenderness, shapes, size, lightness and flexibility. With the ever increase in the vertical growth of urban cities, high rise buildings are being constructed in large numbers. In this study, analytical investigation of different shapes of buildings are taken as an example and various analytical approaches are performed on the building. These plans are modeled and wind loads are found out according to I.S 875(part 3)-1987 by taking gust factor and without taking gust factor. These models are compared in different aspects such as storey drift, storey displacement, storey shear, etc. for different shapes of buildings by using finite element software package ETAB's 13.1.1v. Among these results, which shape of building provide sound wind loading to the structure as well as the structural efficiency would be selected.

Key Words: *Storey displacement, Storey drift, Storey shear, Gust, Wind load*

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1. INTRODUCTION

A building having height more than 15 m as per National building code 2005 of India is called high rise building. Due to rapid growth of population, expensive land prices, to improve aesthetic view of city and restriction in horizontal development due to less space, vertical growth is the ultimate option available. Wind is the large scale horizontal movement of free air. It plays an important role in design of tall structures because it exerts loads on buildings. The response of structures to wind depends on the characteristics of wind. As the height of building increases, there is more danger against high velocity of wind force at high level.

1.1 Wind Effects on Structures

Wind is randomly varying dynamic phenomenon. Wind loading is complex live load that varies both in time and space. Wind effects on structures can be classified as static and dynamic. Static wind effects causes elastic bending and twisting of structure. Wind gusts are the major dynamic effects on the on the structures which induce large dynamic motions, including oscillations. Hence, dynamic analysis is essential for tall structures.

It is important to evaluate the characteristics of fluctuating wind forces and the dynamic characteristics of the building. The wind induced building response of tall buildings can be reduced by means of aerodynamic based design and modifications that change the flow pattern around the building or break up the wind affecting the building face. The use of aerodynamic building forms is an effective method of reducing the wind loads on buildings.

2. METHODOLOGY

In this study, the gust response factors and the equivalent static wind loads for various along wind response components at different shape of building as per I.S 875(part3)-1987 are calculated and analysed with the help of ETAB's 13.1.1v.

Table -1: Parameters considered for the study

No. of Storey	50
Bottom storey height	3m
Storey height	3m
Soil type	Medium
Wind zone	I
Shape of buildings	Rectangular, square, circular and elliptical
Thickness of slab	0.125m
Beam size	0.3m x 0.6 m
Column size	1m x 1m
Material Properties	
Grade of concrete	M40
Grade of steel	Fe500
Dead load intensities	
FF on floors	1.75 kN/m²
FF on roof	2 kN/m²
Live load intensities	
LL on floors	2 kN/m²
LL on roof	1 kN/m²

2.1 Building Models

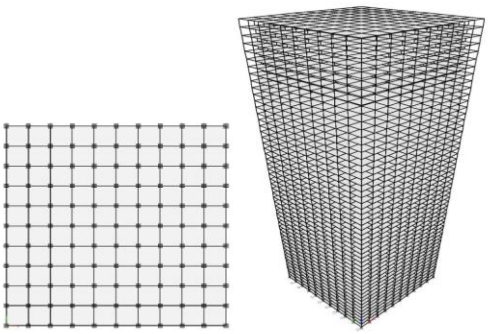

Fig-1: Plan and 3-D view of square building

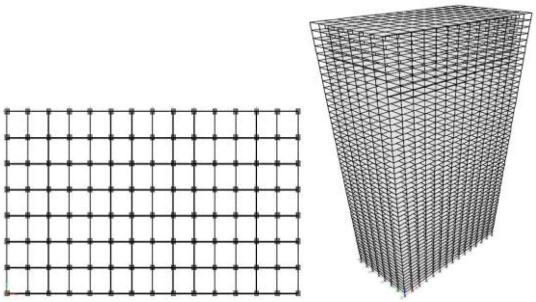

Fig-2: Plan and 3-D view of rectangular building

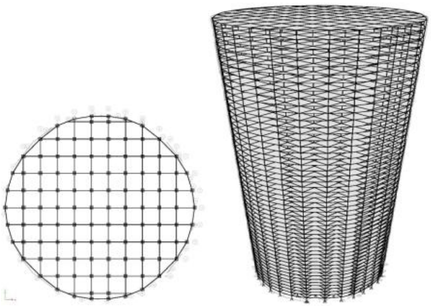

Fig-3: Plan and 3-D view of circular building

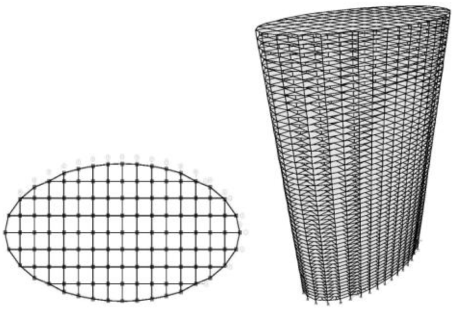

Fig-4: Plan and 3-D view of elliptical building

Table -2: Model Plan dimensions

Name of parameter	Square shape	Rectangular shape	Circular shape	Elliptical shape
Plan dimension in x-direction	50 m	70 m	28.20 m	38 m
Plan dimension in y-direction	50 m	35.714 m	28.20 m	20.95 m

2.2 Linear Analysis

2.1.1 Pressure coefficients

Pressure coefficients are applicable to structural elements like walls and roofs as well as to the design of cladding. The calculation process implies the algebraic addition of C_{pe} and C_{pi} obtain the final wind loading. External pressure coefficient depends on wind direction, structure configuration in plan, its height versus width ratio and, characteristics of roof and its shape. Internal pressure coefficients are largely dependent on the percentage of openings in the walls and their location with reference to wind direction.

2.1.2 Force coefficients

The value of force coefficients apply to a building or structure as a whole, and when multiplied by the effective frontal area A**,** of the building or structure and by design wind pressure, p_d gives the total wind load on that particular building or structure.

2.1.3 Parameters considered for linear analysis

Design wind speed: The basic wind speed (V_z) for any site shall be obtained from Fig.1 IS: (875(Part 3)-1987) and shall be modified to include the following effects to get design wind velocity at any height (V_z) for the chosen structure:

a) Risk level
b) Terrain roughness, height and size of structure; and
c) Local topography

$V_z = V_b.k_1.k_2.k_3$

V_z= hourly mean wind speed in m/s, at height z

V_b = regional basic wind speed in m/s

k_1 = probability factor (risk coefficient) (Clause 5.3.1 of IS: 875(Part 3)-1987)

k_2 = Terrain and height factor (Clause 5.3.2 of IS: 875(Part 3)-1987)

k_3 = topography factor (Clause 5.3.3 of IS: 875(Part 3)-1987)

Design Wind Pressure**:** The design wind pressure at any height above mean level shall be obtained by the Following relationship between wind pressure and wind velocity:

$P_z=0.6\ V_z^2$

Where, P_z= Design wind pressure in N/m2 at height 'z' m

V_z **=** design wind velocity in m/s at height „z‟ m

Wind Load on Individual Members**: (**IS: 875 (Part 3)

$F = (C_{pe} – C_{pi})\ AP_Z$

Where, C_{pe} = external pressure coefficient,

C_{pi} = internal pressure- coefficient,

A = surface area of structural or cladding unit and

P_z = design wind pressure.

Table -3: Parameters considered for linear analysis

Name of parameter	Square shape	Rectangular shape	Circular shape	Elliptical shape
(k_1)	1	1	1	1
(k_3)	1	1	1	1
Terrain category	II	II	II	II
Class of structure	B	C	C	C

Table -4: Linear Wind loads (KN)

Floo r no.	Squar e	Rectangular		Circular	Elliptical
		X	Y		
1	131.78	166.15	84.77	105.17	32.78
5	142.76	180.75	92.22	114.41	35.66
10	166.03	207.77	106.01	131.52	41.00
15	177.54	226.14	115.38	143.15	44.62
20	185.91	238.39	121.63	150.91	47.04
25	192.68	247.47	126.26	156.65	48.83
30	199.57	256.71	130.97	162.50	50.65
35	205.23	263.41	134.40	166.74	51.98
40	208.27	269.98	137.74	170.90	53.27
45	211.32	275.70	140.66	174.52	54.40
50	214.40	281.25	143.50	178.04	55.50

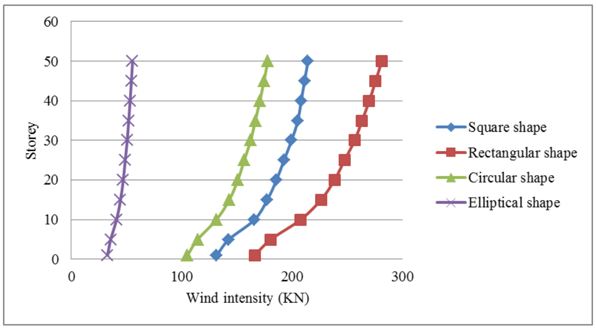

Chart -1: Wind intensity in X-direction

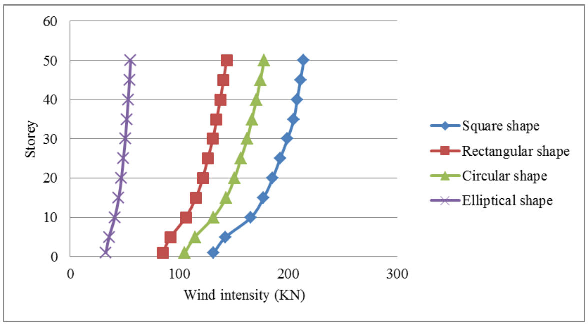

Chart -2: Wind intensity in Y-direction

From linear analysis, it was seen from table-4 that with the increase in the height of building the wind intensities were also increasing and wind intensities were decreasing with the variation of shapes from square to elliptical. The variation of wind intensity is shown in chart 1 and chart 2.

2.2 Gust Factor Method

A gust factor, defined as the ratio between a peak wind gust and mean wind speed over a period of time, can be used along with other statistics to examine the structure of the wind.

Constants and parameters used for gust factor analysis are:

i. T = Time period (pg.48, IS 875(part-3)-1987)

ii. C_f = Force coefficient for clad building (fig. 4 of IS 875(part-3)-1987)

iii. g_f = Peak Factor and Roughness Factor (fig. 8 of IS 875(part-3)-1987)

iv. B = Background factor (fig. 9 of IS 875(part-3)-1987)

v. S = Size reduction factor (fig. 10 of IS 875(part-3)-1987)

vi. Ø = Constant

vii. E = Gust energy factor (fig. 11 of IS 875(part-3)-1987)

viii. β = (pg.52, IS 875(part-3)-1987)

ix. G = Gust factor

$$G = 1 + gfr\sqrt{\left[B(1+\emptyset)^2 + \frac{SE}{\beta}\right]}$$

x. F_x = Along wind load on the structure on a strip area at any height

$$Fx = Cf.Ae.Pz.G$$

Table -5: Parameters considered for gust factor analysis

Name of parameter	Square model	Rectangular model	Circular model	Elliptical model
T_x	1.9	1.61	2.54	2.18
T_y	1.9	2.25	2.54	2.94
C_f	1.25	1.1	0.7	0.2
g_f	0.85	0.85	0.85	0.85
B	0.85	0.85	0.85	0.85
Ø	0	0	0	0
β	0.016	0.016	0.016	0.016

Table -6: Wind loads with gust factor (KN)

Floor no.	Square	Rectangular		Circular	Elliptical	
		X	Y		X	Y
1	96.46	116.57	67.26	94.77	30.17	29.22
5	111.76	134.82	78.52	109.81	35.17	33.85
10	136.45	162.67	95.85	132.90	42.91	40.80
15	153.23	181.94	107.96	149.22	48.41	45.84
20	165.27	194.96	116.17	160.49	52.06	49.17
25	175.29	204.68	122.30	168.74	54.74	51.67
30	183.98	214.61	128.60	177.10	57.98	54.23
35	191.70	223.33	134.15	184.53	60.85	56.44
40	197.03	229.23	137.91	189.55	62.69	57.96
45	203.04	235.21	141.72	194.60	64.47	59.52
50	209.79	241.27	145.57	200.41	66.31	61.10

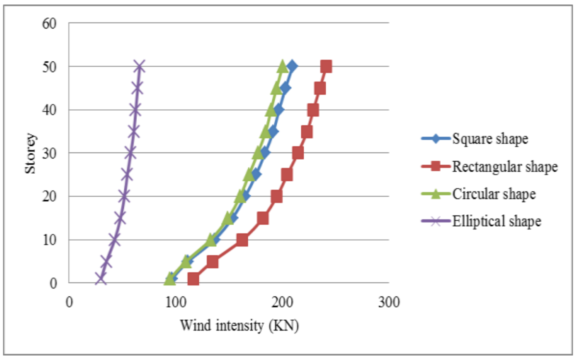

Chart -3: Wind intensity in X-direction

3. RESULTS AND DISCUSSION

In this section, behavior of different buildings when subjected to wind load have been discussed.

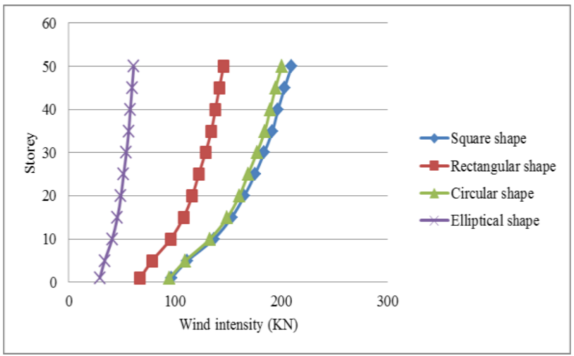

Chart -4: Wind intensity in Y-direction

3.1 Wind Intensity

It is the pressure exerted by the wind on the structure. The wind intensity for square, rectangular, circular and elliptical shape building are compared in table 7 and it is graphically represented in chart 5, 6, 7 and 8.

Table -7: Comparison of wind loads without gust factor (X-direction) (kN)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Wind intensity (kN)	Wind intensity (kN)	% Decrease	Wind intensity (kN)	% Decrease	Wind intensity (kN)	% Decrease
0	0	131.780	166.147	-26.079	105.172	20.191	32.784	75.123
10	30	166.029	207.775	-25.144	131.523	20.783	40.997	75.307
20	60	185.911	238.395	-28.231	150.906	18.829	47.039	74.698
30	90	199.569	256.710	-28.632	162.499	18.575	50.653	74.619
40	120	208.267	269.979	-29.631	170.899	17.942	53.271	74.422
50	150	214.397	281.253	-31.183	178.036	16.960	55.496	74.115

Table -8: Comparison of wind loads without gust factor (Y-direction) (kN)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Wind intensity (kN)	Wind intensity (kN)	% Decrease	Wind intensity (kN)	% Decrease	Wind intensity (kN)	% Decrease
0	0	131.780	84.769	35.674	105.172	20.191	32.784	75.123
10	30	166.029	106.008	36.151	131.523	20.783	40.997	75.307
20	60	185.911	121.630	34.576	150.906	18.829	47.039	74.698
30	90	199.569	130.974	34.371	162.499	18.575	50.653	74.619
40	120	208.267	137.744	33.862	170.899	17.942	53.271	74.422
50	150	214.397	143.496	33.070	178.036	16.960	55.496	74.115

Table -9: Comparison of wind loads with gust factor (X-direction) (kN)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Wind intensity (kN)	Wind intensity (kN)	% Decrease	Wind intensity (kN)	% Decrease	Wind intensity (kN)	% Decrease
0	0	96.457	116.566	-20.847	94.773	1.746	30.172	68.719
10	30	136.446	162.674	-19.223	132.902	2.597	42.915	68.548
20	60	165.272	194.964	-17.965	160.494	2.891	52.061	68.500
30	90	183.979	214.612	-16.651	177.101	3.738	57.981	68.485
40	120	197.028	229.230	-16.344	189.554	3.793	62.695	68.180
50	150	209.786	241.265	-15.006	200.406	4.471	66.310	68.392

Table -10: Comparison of wind loads with gust factor (Y-direction) (kN)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Wind intensity (kN)	Wind intensity (kN)	% Decrease	Wind intensity (kN)	% Decrease	Wind intensity (kN)	% Decrease
0	0	96.457	67.265	30.265	94.773	1.746	29.222	69.704
10	30	136.446	95.846	29.755	132.902	2.597	40.803	70.096
20	60	165.272	116.165	29.713	160.494	2.891	49.174	70.247
30	90	183.979	128.604	30.099	177.101	3.738	54.235	70.521
40	120	197.028	137.912	30.004	189.554	3.793	57.959	70.583
50	150	209.786	145.574	30.608	200.406	4.471	61.101	70.875

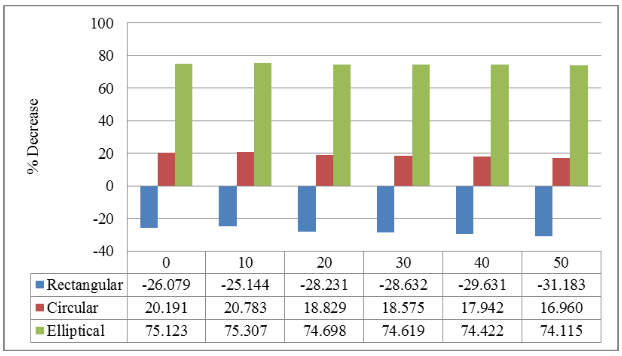

Chart -5: Wind intensity in X-direction (without gust)

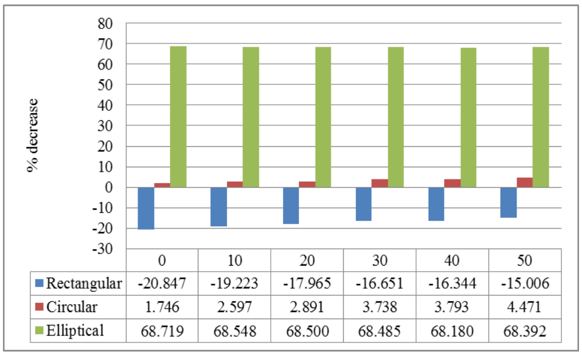

Chart -7: Wind intensity in X-direction (with gust)

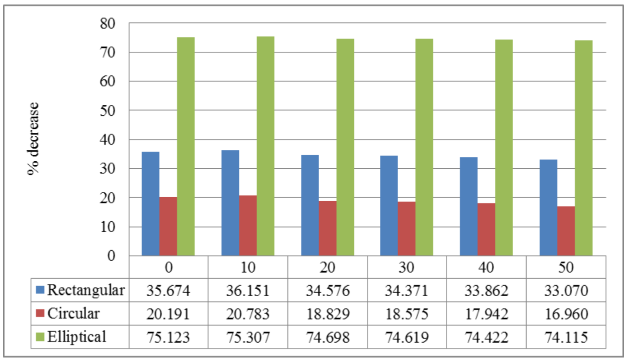

Chart -6: Wind intensity in Y-direction (without gust)

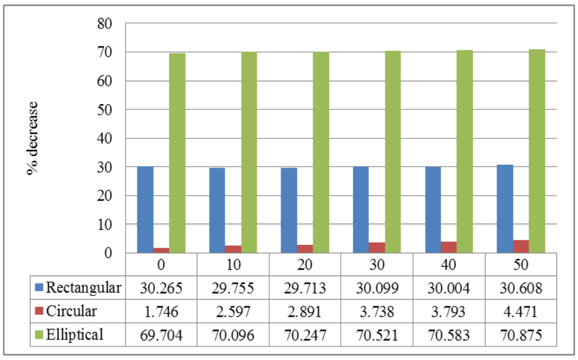

Chart -8: Wind intensity in Y-direction (with gust)

3.2 Storey Displacement

It is displacement caused by the lateral force on the each storey level of structure. The storey displacement for square, rectangular, circular and elliptical shape building are compared in table 11 and it is graphically represented in chart 9, 10, 11 and 12.

Table -11: Comparison of storey displacement without gust factor (X-direction) (mm)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey displacement (mm)	Storey displacement (mm)	% Decrease	Storey displacement (mm)	% Decrease	Storey displacement (mm)	% Decrease
0	0	0.8	0.5	37.500	0.7	12.500	0.2	75.000
10	30	27.6	17.7	35.870	24	13.043	6.5	76.449
20	60	52.7	33.7	36.053	46.1	12.524	12.4	76.471
30	90	72.5	46	36.552	63.7	12.138	17	76.552
40	120	85.9	54.2	36.903	75.7	11.874	20.1	76.601
50	150	92.9	58.3	37.244	82	11.733	21.6	76.749

Table -12: Comparison of storey displacement without gust factor (Y-direction) (mm)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey displacement (mm)	Storey displacement (mm)	% Decrease	Storey displacement (mm)	% Decrease	Storey displacement (mm)	% Decrease
0	0	0.8	1.1	-37.500	0.8	0.000	0.2	75.000
10	30	27.7	38.2	-37.906	26	6.137	7	74.729
20	60	53.1	74.1	-39.548	50.3	5.273	14	73.635
30	90	73.1	102.8	-40.629	69.3	5.198	19.7	73.051
40	120	86.9	123.1	-41.657	82.3	5.293	24	72.382
50	150	94.2	134.4	-42.675	89.1	5.414	26.6	71.762

Table -13: Comparison of storey displacement with gust factor (X-direction) (mm)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey displacement (mm)	Storey displacement (mm)	% Decrease	Storey displacement (mm)	% Decrease	Storey displacement (mm)	% Decrease
0	0	0.7	0.6	14.286	0.8	-14.286	0.2	71.429
10	30	25.2	21.7	13.889	26	-3.175	7.4	70.635
20	60	48.7	37.6	22.793	50.4	-3.491	14.2	70.842
30	90	67.5	49.9	26.074	69.7	-3.259	19.5	71.111
40	120	80.5	58.1	27.826	83	-3.106	23.1	71.304
50	150	87.4	62.1	28.947	90.1	-3.089	24.9	71.510

Table -14: Comparison of storey displacement with gust factor (Y-direction) (mm)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey displacement (mm)	Storey displacement (mm)	% Decrease	Storey displacement (mm)	% Decrease	Storey displacement (mm)	% Decrease
0	0	0.7	1.2	-71.429	0.8	-14.286	0.2	71.429
10	30	25.7	39.8	-54.864	28.3	-10.117	7.5	70.817
20	60	50.6	70	-38.340	55	-8.696	14.9	70.553
30	90	71.2	94.5	-32.725	76	-6.742	21.1	70.365
40	120	86.3	111.8	-29.548	90.4	-4.751	25.7	70.220
50	150	95.6	121.5	-27.092	97.9	-2.406	28.5	70.188

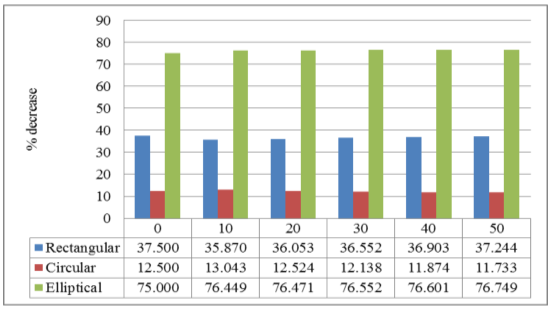

Chart -9: Storey displacement in X-direction (wog)

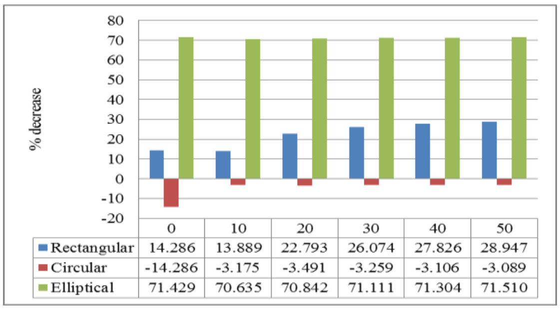

Chart -11: Storey displacement in X-direction (wg)

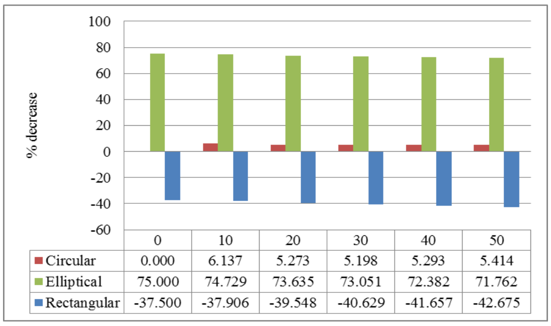

Chart -10: Storey displacement in Y-direction (wog)

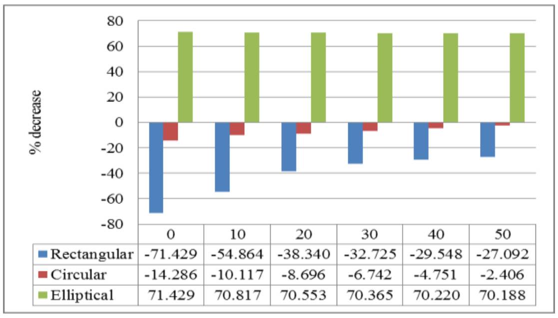

Chart -12: Storey displacement in Y-direction (wg)

3.3 Storey Drift

It is the displacement of one level relative of the other level above or below. The storey drift for square, rectangular, circular and elliptical shape building are compared and it is graphically represented in chart 13,14,15,16.

Table -15: Comparison of storey drift without gust factor (X-direction)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey drift	Storey drift	% Decrease	Storey drift	% Decrease	Storey drift	% Decrease
0	0	0.271	0.177	34.686	0.239	11.808	0.068	74.908
10	30	0.924	0.588	36.364	0.806	12.771	0.213	76.948
20	60	0.763	0.479	37.221	0.673	11.796	0.173	77.326
30	90	0.567	0.349	38.448	0.503	11.287	0.125	77.954
40	120	0.347	0.206	40.634	0.312	10.086	0.074	78.674
50	150	0.2	0.136	32.000	0.191	4.500	0.083	58.500

Table -16: Comparison of storey drift without gust factor (Y-direction)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey drift	Storey drift	% Decrease	Storey drift	% Decrease	Storey drift	% Decrease
0	0	0.271	0.366	-35.055	0.256	5.535	0.005	98.155
10	30	0.918	1.3	-41.612	0.883	3.813	0.002	99.782
20	60	0.751	1.099	-46.338	0.736	1.997	0.003	99.601
30	90	0.551	0.838	-52.087	0.547	0.726	0.003	99.456
40	120	0.329	0.539	-63.830	0.335	-1.824	0.004	98.784
50	150	0.179	0.297	-65.922	0.205	-14.525	0.061	65.922

Table -17: Comparison of storey drift with gust factor (X-direction)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey drift (mm)	Storey drift (mm)	% Decrease	Storey drift (mm)	% Decrease	Storey drift (mm)	% Decrease
0	0	0.246	0.173	29.675	0.258	-4.878	0.076	69.106
10	30	0.849	0.583	31.331	0.885	-4.240	0.243	71.378
20	60	0.71	0.482	32.113	0.741	-4.366	0.2	71.831
30	90	0.529	0.349	34.026	0.558	-5.482	0.147	72.212
40	120	0.323	0.207	35.913	0.348	-7.740	0.087	73.065
50	150	0.186	0.137	26.344	0.206	-10.753	0.088	52.688

Table -18: Comparison of storey drift with gust factor (Y-direction)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey drift (mm)	Storey drift (mm)	% Decrease	Storey drift (mm)	% Decrease	Storey drift (mm)	% Decrease
0	0	0.244	0.302	-23.770	0.276	-13.115	0.074	69.672
10	30	0.818	1.088	-33.007	0.969	-18.460	0.26	68.215
20	60	0.657	0.929	-41.400	0.81	-23.288	0.232	64.688
30	90	0.462	0.714	-54.545	0.606	-31.169	0.184	60.173
40	120	0.247	0.459	-85.830	0.373	-51.012	0.127	48.583
50	150	0.118	0.259	-119.492	0.221	-87.288	0.114	3.390

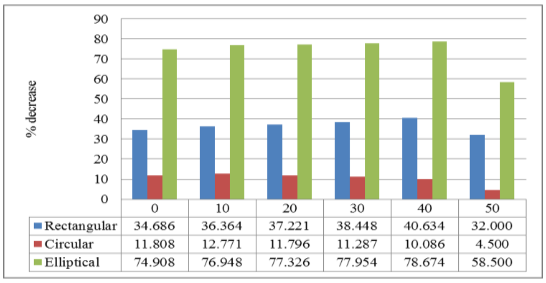

Chart -13: Storey drift in X-direction (wog)

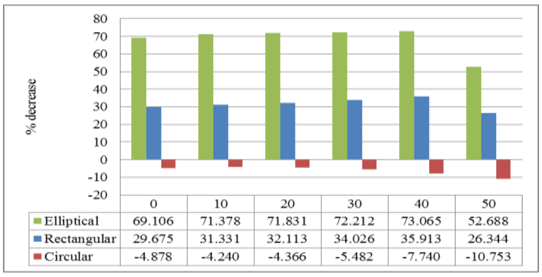

Chart -15: Storey drift in X-direction (wg)

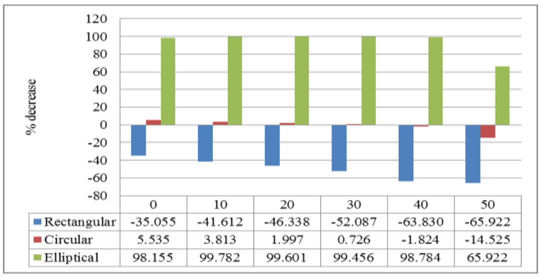

Chart -14: Storey drift in Y-direction (wog)

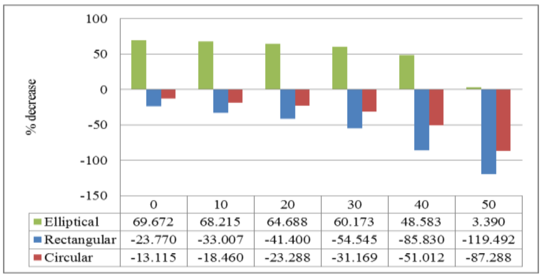

Chart -16: Storey drift in Y-direction (wg)

3.4 Storey Shear

The summation of design lateral forces at levels above the storey under consideration. The storey shear for square, rectangular, circular and elliptical shape building are compared and it is graphically represented in chart 17,18,19,20.

Table -19: Comparison of storey shear without gust factor (X-direction) (kN)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey shear (kN)	Storey shear (kN)	% Decrease	Storey shear (kN)	% Decrease	Storey shear (kN)	% Decrease
0	0	13980.735	9181.982	34.324	11393.930	18.503	3551.140	74.600
10	30	12041.085	7931.808	34.127	9842.439	18.260	3067.626	74.524
20	60	9401.61	6220.733	33.833	7718.960	17.897	2405.855	74.410
30	90	6550.215	4333.736	33.838	5377.159	17.909	1676.105	74.411
40	120	3485.775	2320.950	33.417	2879.251	17.400	897.645	74.248
50	150	321.465	215.245	33.043	267.123	16.904	83.248	74.104

Table -9: Comparison of storey shear without gust factor (Y-direction) (kN)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey shear (kN)	Storey shear (kN)	% Decrease	Storey shear (kN)	% Decrease	Storey shear (kN)	% Decrease
0	0	13975.845	17996.685	-28.770	12092.5306	13.475	3555.0198	74.563
10	30	12036.195	15546.344	-29.163	10429.4282	13.349	3071.5056	74.481
20	60	9396.72	12192.637	-29.754	8179.7516	12.951	2409.7343	74.356
30	90	6518.055	8494.122	-30.317	5698.7774	12.569	1676.1052	74.285
40	120	3453.615	4549.063	-31.719	3051.5243	11.643	897.6452	74.009
50	150	289.305	421.880	-45.825	282.998	2.180	83.2475	71.225

Table -9: Comparison of storey shear with gust factor (X-direction) (kN)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey shear (kN)	Storey shear (kN)	% Decrease	Storey shear (kN)	% Decrease	Storey shear (kN)	% Decrease
0	0	12573.615	8915.481	29.094	12282.829	2.313	3969.000	68.434
10	30	11068.875	7859.618	28.994	10806.057	2.374	3498.495	68.393
20	60	8805.45	6265.258	28.848	8487.108	3.615	2783.305	68.391
30	90	6210.885	4339.087	30.137	5967.661	3.916	1965.336	68.357
40	120	3352.275	2338.503	30.241	3214.616	4.106	1058.619	68.421
50	150	314.535	218.360	30.577	300.688	4.403	99.469	68.376

Table -9: Comparison of wind loads with gust factor (Y-direction) (kN)

Storey No.	Height m	Square	Rectangular		Circular		Elliptical	
		Storey shear (kN)	Storey shear (kN)	% Decrease	Storey shear (kN)	% Decrease	Storey shear (kN)	% Decrease
0	0	12587.025	14815.455	-17.704	13013.246	-3.386	3727.399	70.387
10	30	11081.385	13002.693	-17.338	11448.710	-3.315	3272.592	70.468
20	60	8817.96	10313.509	-16.960	8991.669	-1.970	2595.666	70.564
30	90	6210.885	7257.578	-16.853	6322.492	-1.797	1824.255	70.628
40	120	3352.275	3881.193	-15.778	3405.835	-1.598	982.173	70.701
50	150	314.535	361.898	-15.058	318.557	-1.279	91.655	70.860

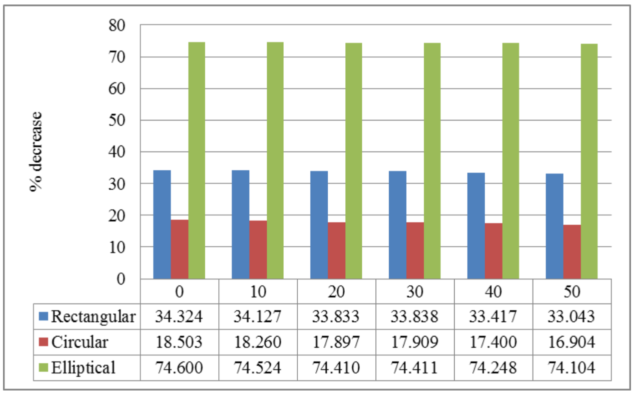

Chart- 17: Storey shear in X-direction (wog)

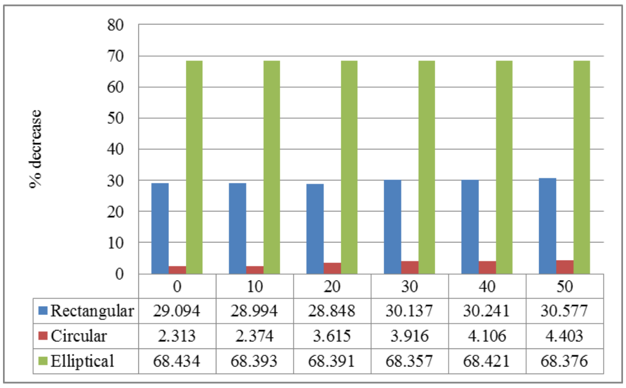

Chart- 19: Storey shear in X-direction (wg)

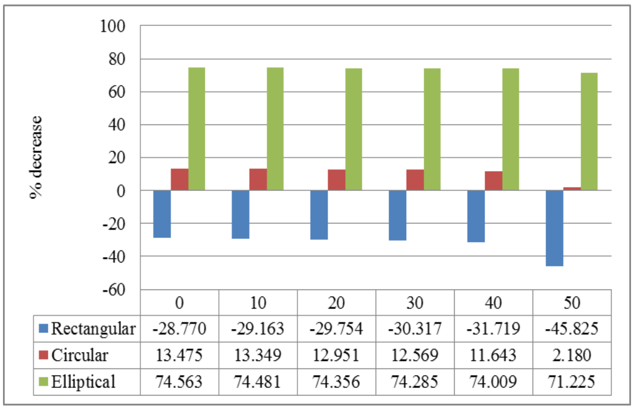

Chart- 18: Storey shear in Y-direction (wog)

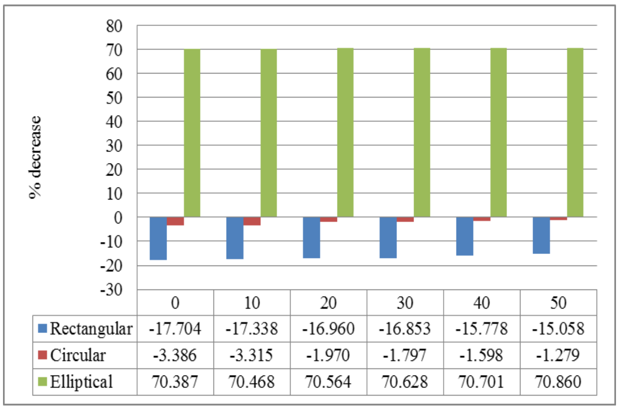

Chart- 20: Storey shear in Y-direction (wg)

4. CONCLUSION

1. The percentage reduction in peak wind intensity for circular building is 16.96 %, 74.115 % for elliptical building and it is more by 31.183 % for rectangular building when compared with square building without gust factor. The percentage reduction in peak wind intensity for circular building is 4.471 %, 68.392 % for elliptical building and it is more by 15 % for rectangular building when compared with square building with gust factor.
2. The percentage reduction in peak displacement in circular building is 11.73 %, 76.74 % in elliptical building ,31.18 % in rectangular building without gust factor and 28.94 % in rectangular building,71.51 % in elliptical building and it is more by 3.08 % in circular building with gust factor in longitudinal direction when compared with square building. The percentage reduction in peak displacement in circular building is 5.41 %, 71.76 % for elliptical building and it is more by 42.67 % for rectangular building without gust factor and it is 70.18 % in elliptical building, it is more by 27 % in rectangular, 2.40 % in circular building when compared with square building with gust factor in transverse direction.
3. The percentage reduction in peak drift in circular building is 4.50 %, 58.50 % in elliptical building , 32 % in rectangular building without gust factor and 26.44 % in rectangular building,52.68 % in elliptical building and it is more by 10.75 % in circular building with gust factor in longitudinal direction when compared with square building. The percentage reduction in peak drift in elliptical building is 65.92 % and it is more by 65.92 % for rectangular building and 14.52 % in circular building without gust factor and it decreased by 3.39 % in elliptical building, it is more by 119.49 % in rectangular, 87.28 % in circular building when compared with square building with gust factor in transverse direction.
4. The percentage reduction in peak storey shear in circular building is 16.90 %, 74.10 % in elliptical building , 33 % in rectangular building without gust factor and 30.57 % in rectangular building,4.40 % in elliptical building and 68.37 % in circular building with gust factor in longitudinal direction when compared with square building. The percentage reduction in peak drift in circular building is 2.18 %,71.22 % in elliptical building and it is more by 45.85 % for rectangular building without gust factor and it decreased by 70.86 % in elliptical building, it is more by 14 % in rectangular, 1.27 % in circular building when compared with square building with gust factor in transverse direction.
5. The gust factor method uses the statistical concepts of a stationary time series to calculate the response of structure to a gusty wind. Hence it is important for the estimation of wind loads on the flexible structures.
6. Buildings having circular or elliptical plan forms have a smaller surface perpendicular to the wind direction, the wind pressure is less than in prismatic buildings.
7. From the above results, with the change in shape of building from square to elliptical the wind intensity, storey drifts, the lateral displacements, storey shear of the building decreased. Hence it is conclude that wind load is reduced by maximum percentage with an elliptical plan.

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