A REVIEW ON DYNAMIC WIND ANALYSIS OF TALL BUILDING PROVIDED WITH STEEL BRACING AS PER PROPOSED DRAFT FOR INDIAN WIND CODE AND EFFECT OF SOFT STOREY

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ABSTRACT- For preliminary design including the proportioning of a structure, the variation of wind force on a structure with variation of site parameters and structural parameters should be known. The present study is an effort to achieve the same, primarily based on proposed draft for Indian wind code considering two different wind speed zones. RC framed buildings are generally designed without considering the structural action of masonry infill walls present. These walls are widely used as partitions and considered as non-structure elements. But they affect both structural and non-structural performance of the RC buildings with lateral loads.

KEYWORDS**:** proposed draft code, Indian wind code, Soft storey, Equivalent diagonal strut, Dynamic coefficient factor, Displacement, drift.

I.   INTRODUCTION

A. General

Codes and standards are the mainstream of information to the designers of civil engineering structure. The wind loading codes are primarily based on comprehensive data on wind speeds collected by the meteorological departments, and the results of the results of the research carried out understand wind characteristics and its effect on structure, based on these data and experiments made in wind tunnel.

As wind is a randomly varying dynamic phenomenon, it has significant dynamic effects on buildings and structures especially on high rise flexible structures. Codes and standards utilize the ''gust loading factor' (GLF) approach for estimating dynamic effect on high-rise structures. The concept of GLF was first introduced by davenport in 1967. Wind is air in motion relative to the surface of earth. The effect of wind on the structure as a whole is determined by the combined action of external & internal pressures acting upon it. Wind velocity consists of a mean plus a fluctuating component,

momentary deviation of the fluctuating component from the mean value is responsible for creation of gust.

Both the components of wind velocity vary with height & depend upon the approach terrain & topography.

II.   METHODOLOGY

The design wind velocity (Vz) is given by

$$Vz = Vb. K_1. K_2. K_3$$

The design wind pressure (Pa) is given by

$$Pz = 0.6Vz2$$

Where Vb = basic wind speed as per IS 875: PART -3, Vz is design wind pressure at height z in m/s, k1 is the probability factor given in IS 875 part 3 table 1 , k2 is the terrain roughness and height factor given in table 2, k3 is topographical factor and k4 is cyclonic factor.

DYNAMIC RESPONSE FACTOR: According dynamic response factor as per proposed wind code method the following equations are used.

Where Pz = Design wind pressure at height z in N/m^2 given by

C_{dyn} i

s dynamic response factor (total load / mean load) and is given by

$$C_{dyn} = \frac{1+2*Ih[gv^2*bs+\frac{Hsgr^2 SE]^{0.5}}{\beta}}{(1+2gvIh)}$$

Where I_h = turbulence intensity, obtained from table 31 of IS: 875 (part 3): proposed draft and commentary; gv = peak factor for the up wind velocity fluctuations, which shall be taken as

Bs is back ground factor, which is a measure of the slowly varying background component of the fluctuating response, caused by the low frequency wind speed variations given as follows.

$$Bs = \frac{1}{1+\frac{[36(h-s)^2+64b^2sh]^{0.5}}{2Lh}}$$

S is size reduction factor given by expression presented below

$$S = \frac{1}{[1+\frac{4foh(1+gvIh)}{Vh}][1+\frac{4foboh(1+gvIh)}{Vh}]}$$

E is $(\frac{\pi}{4})$ times the spectrum of turbulence in the approaching wind stream given by

$$E = \pi N/(1+70N^2)^{5/6}$$

And N = reduced frequency, and is given by

$$N = \frac{fo\ Lh\ [1+(gv*Ih)]}{Vh}$$

Where Vh = design wind speed at height h.

III.   DESCRIPTION OF STRUCTURAL MODEL

Twenty five storey building is considered having 8 bays in X and Y directions with plan dimension 40x40m and storey height 3.5m each in all the floors and spacing is 5m.the building is kept symmetric in both mutually perpendicular directions in plan to avoid torsional effects. The orientation and size of column is kept some throughout the height of the structure. The building is considered for wind speed zones 47 m/s and the response obtained. The building is considered as general building located in terrain category three i.e. has obstruction up to 10m height of building and surface is plain.

| Data	Values
Basic wind speed V_b	47 m/s
E for M30 concrete	27.386×10^6 KN/m^2
E of brick masonry	3500×10^3 KN/m^2
Density of brick masonry	20 KN/m^3
Density of reinforced concrete	25 KN/m^3
Grade of concrete	M30
Loads	
Floor finishes	1 KN/m^2
Imposed load	3 KN/m^2
Slab thickness	0.15m

Column size	0.23mX0.7m
Beam size	0.23mX0.45m
Thickness of wall	0.23m

Table 1: Description of structural model

IV.   MODELS FOR ANALYSIS

Following six models are analyzed as special moment resisting frame using equivalent static analysis and dynamic response spectrum analysis.

- Model 1: Bare frame model without bracings, however masses of infill walls are included in the model.
- Model 2: Bare frame model with V bracings.
- Model 3: Full Infill model without bracings.
- Model 4: Full Infill model with V bracings.
- Model 5: building has one full brick Infill masonry wall in all storeys without bracing with ground soft storey.
- Model 6: building has one full brick Infill masonry wall in all storeys with V bracing with ground soft storey.
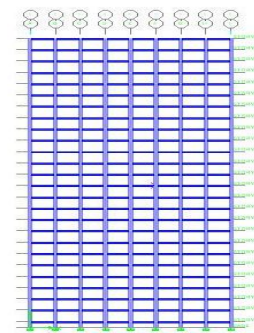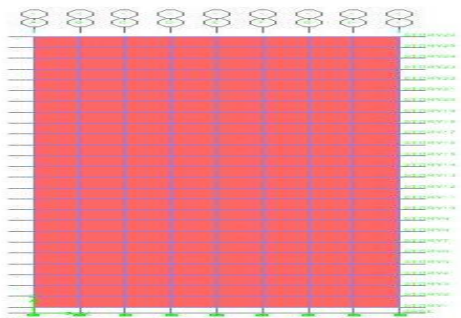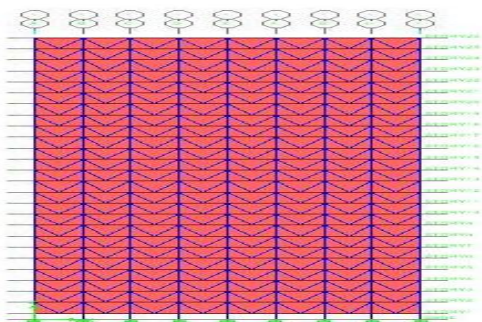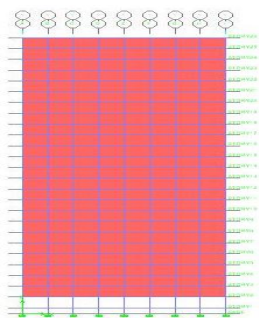

Model 1
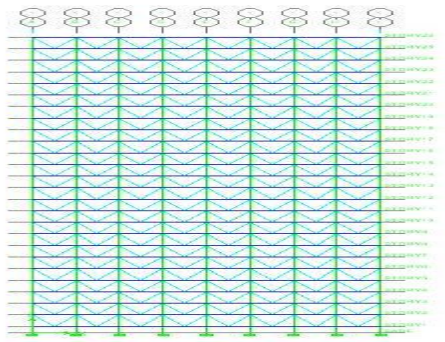
Model 2
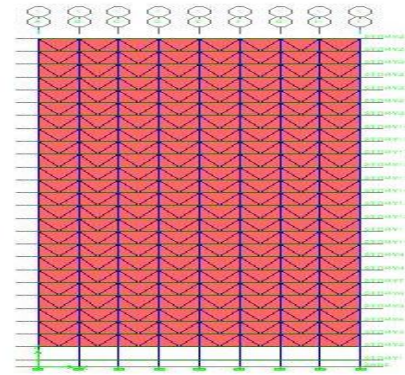
Model 3

Model 4

Model 5

Model

V.   *RESULT AND DISSCSSION*

Table 2: Lateral displacement and storey drifts for bare frame model with V bracing for wind speed zones 47 m/s.

STOREY NO	DISP X	DISP Y	DRIFT X	DRIFT Y
26	35.66	35.66	0.00009	0.00009
25	35.33	35.33	0.00011	0.00011
24	34.92	34.92	0.00014	0.00014
23	34.41	34.41	0.00017	0.00017
22	33.79	33.79	0.00020	0.00020
21	33.06	33.06	0.00024	0.00024
20	32.22	32.22	0.00027	0.00027
19	31.27	31.27	0.00030	0.00030
18	30.22	30.22	0.00033	0.00033
17	29.06	29.07	0.00035	0.00035
16	27.81	27.81	0.00038	0.00038
15	26.45	26.45	0.00041	0.00041
14	25.00	25.00	0.00044	0.00044
13	23.46	23.46	0.00046	0.00046
12	21.83	21.8	0.0004	0.0004

		3	9	9
11	20.11	20.11	0.00051	0.00051
10	18.32	18.32	0.00053	0.00053
09	16.44	16.44	0.00055	0.00055
08	14.50	14.50	0.00057	0.00057
07	12.49	12.49	0.00059	0.00059
06	10.42	10.42	0.00060	0.00060
05	8.303	8.303	0.00061	0.00061
04	6.152	6.152	0.00061	0.00061
03	4.007	4.007	0.00058	0.00058
02	1.970	1.970	0.00044	0.00044
01	0.424	0.425	0.00021	0.00021

Table 3: Lateral displacement and storey drifts for infilled frame model for V bracing wind speed zone 47 m/s.

STORE Y NO	DISP X	DISP Y	DRIFT X	DRIFT Y
26	3.5866	3.3267	0.000027	0.000023
25	3.4933	3.2450	0.000028	0.000025
24	3.3943	3.1578	0.000030	0.000027
23	3.2895	3.0646	0.000032	0.000028
22	3.1788	2.9656	0.000033	0.000030
21	3.0625	2.8608	0.000035	0.000032
20	2.9407	2.7505	0.000036	0.000033
19	2.8136	2.6349	0.000038	0.000034
18	2.6816	2.5142	0.000039	0.000036
17	2.5449	2.3887	0.000040	0.000037
16	2.4038	2.2586	0.000041	0.000038

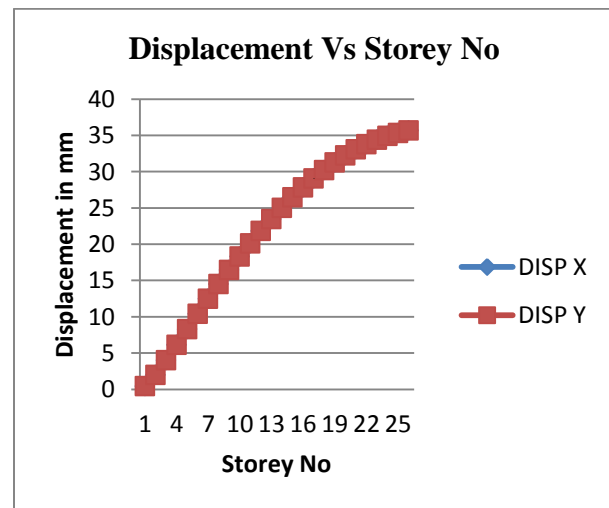| 15	2.2587	2.1245	0.000042	0.000039
14	2.1100	1.9865	0.000043	0.000040
13	1.9582	1.8453	0.000044	0.000041
12	1.8038	1.7013	0.000045	0.000042
11	1.6474	1.5550	0.000045	0.000042
10	1.4894	1.4070	0.000045	0.000043
09	1.3306	1.2579	0.000045	0.000043
08	1.1716	1.1083	0.000045	0.000043
07	1.0131	0.9589	0.000045	0.000042
06	0.8560	0.8106	0.000044	0.000042
05	0.7010	0.6642	0.000043	0.000041
04	0.5493	0.5206	0.000042	0.000040
03	0.4017	0.3809	0.000040	0.000038
02	0.2604	0.2469	0.000045	0.000043
01	0.1012	0.0959	0.000051	0.000048

Fig 1: Comparison of Lateral displacement Vs Storey No for bare frame model for wind speed zone 47m/s.
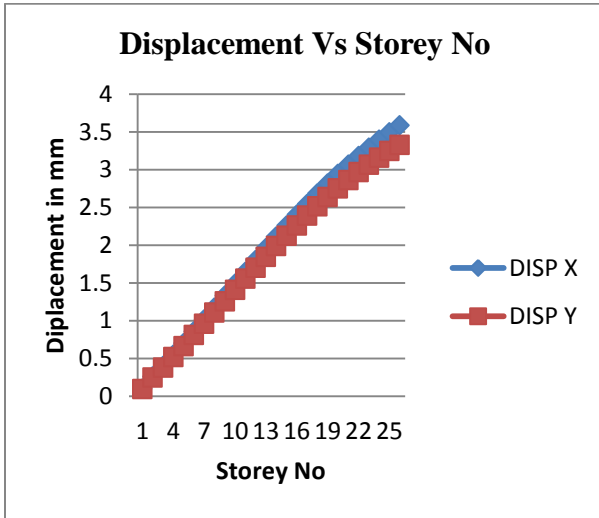
Fig 2: Comparison of Lateral displacement Vs Storey No for infilled frame model for wind speed zone 47m/s.
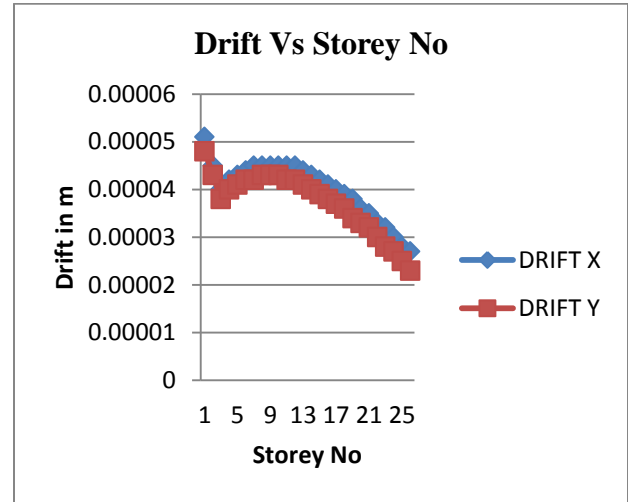

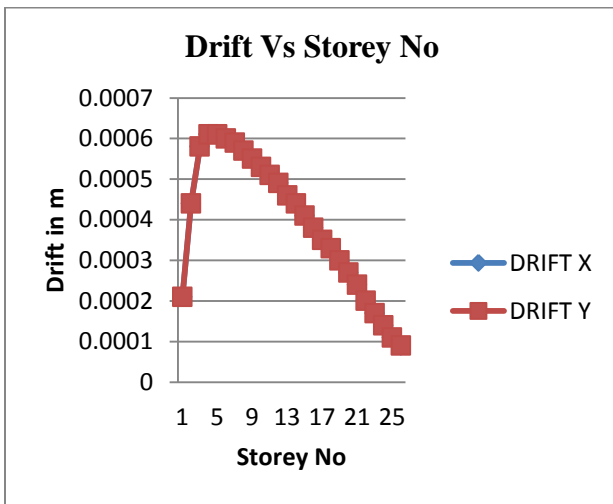Fig 4: Comparison of Drift Vs Storey No for bare frame model for wind speed zone 47m/s.

Fig 3: Comparison of Drift Vs Storey No for bare frame model for wind speed zone 47m/s.

VI.   CONCLUSIONS

1) Dynamic coefficient factor not only varies with the height of the structure but is also influenced by wind speed zones.
2) Dynamic wind load increases with increase in height of structure
3) Dimension of the column should be increased to increase the lateral resistance.
4) Infill model effectively braces the RC frame structure and increases the lateral resistance to wind loads. Hence the effect of infill has to taken in consideration during the design of structure.
5) Wind forces remains constant up to 3 stories and increases linearly over the height of the building for wind speed zones 47m/s
6) Effect of soft storey increases with increase in position of soft storey as the lateral resistance goes on decreases.
7) Displacements limits are exceeding wind speed zones for bare framed model. Though practically such system do not exit it is very vulnerable.
8) Maximum displacements are within the limits for wind speed zones for infilled model and displacement decreased by 77.84% compared with displacements of bare frame model indicates the huge increase in lateral resisting system by considering the effect of infill.
9) Maximum displacement exceeded limits for model1 3, model 1 4, model 15 in Y direction for 47 m/s wind speed zones maximum displacement

in either direction were within limits. This clearly suggests that the influence of soft stories is predominant in 47 m/s wind speed zone and hence the lateral stiffness has to be increased.

10) .Maximum storey drift is found a ground stories for model 1 3, model 1 4, model 1 5and abrupt increase in drifts were found for soft stories indicating large decrease in stiffness. So the stiffness has to be increased by provision of infill, increasing dimension of column or by some other lateral resisting system to increase the lateral resistance against wind loads and reduce soft storey effects.

11) Soft storey exhibits very poor performance in case of 47 m/s wind speed zones.

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