Wind Load Analysis of Steel Frame Building with Angle Sections

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Abstract— For high rise tall buildings of buildings more than 20 storeys, wind loads become prominent. Steel buildings are characterized by light weight in addition to their strength, hence wind load become even more critical for them. The prominence of this wind load on high rise building of G+28 storey is checked in this paper. The building is a steel structure composed of angle section. The response under wind load and load combination is compared with that under seismic loads.

Key words: Displacement, Drift, Steel Building, Wind Load

I. Introduction

The analysis and design of tall buildings of steel as well as concrete require the wind and earthquake loads to be considered in it. Governing criteria for carrying out dynamic analyses for earthquake loads are different from wind loads. Various other consideration for height of structure, seismic, geometric irregularities, dynamic analysis etc. [1]

Various loads exerted on the building are given to the structural system into the ground, the magnitude of the wind pressure is a function of exposed basic wind speed, topography, building height, internal pressure, and building shape [1,2].

In general, for style of tall buildings each wind furthermore as earthquake loads ought to be thought-about. Governing criteria for winding up dynamic analyses for earthquake loads are different from wind loads [3,4].

According to the provisions of Bureau of Indian Standards for earthquake load, IS 1893(Part 1):2002, height of the structure, unstable zone, vertical and horizontal irregularities, soft and weak structure necessitates dynamic analysis for earthquake load.

The contribution of the upper mode effects are enclosed in incoming at the distribution of lateral forces on the height of the building. As per IS 875(Part 3):1987, when wind interacts with a building, each positive and negative pressures occur at the same time, the building should have sufficient strength to resist the applied loads from these pressures to prevent wind evoked building failure [5].

Load exerted on the building envelope are transferred to the structural system and they in flip should be transferred through the foundation into the ground, the magnitude of the wind pressure is a perform of exposed basic wind speed, topography, building height, internal pressure, and building form [6].

First, the sensitivity of base shear of the building with respect to the location of the building at completely different wind zones in India is investigated. The wind loads and earthquake loads on the building are calculated forward the building to be set at urban center. The member forces are calculated with load combinations for Limit State methodology given in IS 456: 2000 and also the members are designed for the most important member forces among them. The building is subjected to self weight, dead load, live load as per IS 875(Part one, half 2):1987. Safety of the structure is checked against allowable limits prescribed for base shear, roof displacements, inter-storey drifts and accelerations in codes of apply and different references in literature on effects of earthquake and wind loads on buildings[5,7].

The objective of study is to analyse G+28 building of multi stored residential type under earthquake and wind loads. The analysis is as per Indian standard codes of practice IS 1893(Part 1):2002 and IS 875(Part 3):1987. The building is assumed to be located at Bhopal, India. The structure response is given in terms of storey displacement, inter-storey drifts bending moments.

The analysis is performed through structural analysis software Etabs of Computers and Structures software [8].

II. Details of Building Model

The building model is steel angle section building having 29 storeys and 3 bay each. The height of the storey is kept 3 m and width of bay is 8 m in each direction. The plan is shown in Fig. 1. The three dimensional model of building is shown in Fig. 2.

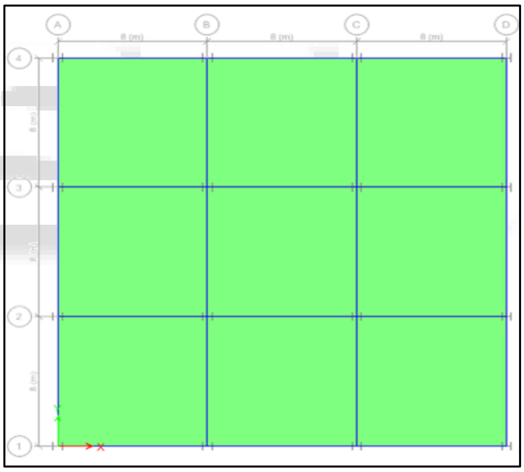

Fig. 1: Plan showing geometric details of 29 storey building

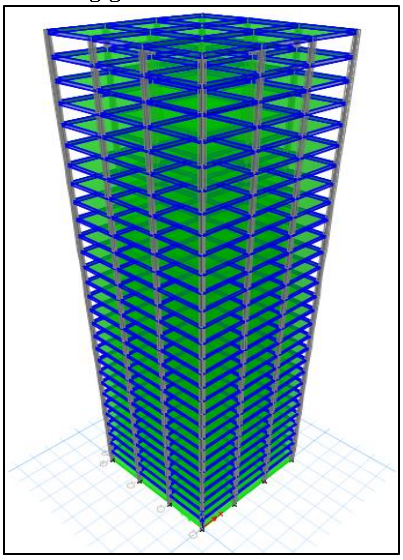

Fig. 2: 3D rendered model of building taken in study

The building model is analysed for various load combinations. The details of these are shown in Table 1.

Designation	Description
WL	Wind load
EQL	Earthquake load
1.2 (DL+LL +WL)	Load combination with dead load, live load and wind load
1.2 (DL+LL +EQL)	Load combination with dead load, live load and earthquake load

Table 1: Details of openings for concentric type

III. Methodology of Analysis

The method of analysis adopted in present study is linear static analysis for wind as well as seismic analysis. The procedure is as given in IS 1893:2002, the Indian Standard Seismic code. The static lateral load are calculated based on wind and seismic coefficients.

The whole modelling and analysis procedure is performed in CSI Etabs software [7].

IV. Results and Discussions

A. *Storey Displacement*

The storey displacement results is shown in Table 2 which shows roof displacement of each storey. This is helpful in assessing the performance of building under lateral loads.

Fig. 3 shows storey displacement contour of whole building and finally Fig. 4 shows storey displacement plot on graph for comparison.

Storey	WL	EQL	1.2(DL+LL+WL)	1.2(DL+LL+EQL)
29	43.53453	34.41615	82.1	64.90454
28	43.13927	34.41076	81.5	64.42839
27	42.90581	34.11173	80.8	64.33708
26	41.92846	33.54052	80	62.81313
25	41.83847	33.16258	79.1	62.66887
24	41.10317	32.73536	77.9	60.97019
23	41.08046	32.16683	76.6	60.15306
22	40.42999	31.73156	75.2	58.84197
21	39.8805	31.4429	73.6	58.2385
20	37.175	30.3451	71.8	56.55991
19	36.68524	29.98559	69.8	55.54933
18	35.6537	29.54804	67.7	54.99854
17	34.1712	27.40172	65.5	52.41067
16	33.23531	26.93388	63	50.53875
15	33.16437	25.97985	60.4	48.52315
14	31.49623	25.57717	57.7	46.99998
13	29.76262	23.26609	54.7	44.2651
12	27.71622	22.39043	51.7	40.22574
11	27.21852	21.6174	48.4	38.70993
10	24.79922	18.13772	45	36.77918
9	22.8971	17.35903	41.5	33.08036
8	21.83194	17.23843	37.8	30.97353
7	19.19538	15.04449	33.9	28.85837
6	17.98411	12.84509	29.9	23.19182
5	15.2122	11.91425	25.7	21.25304
4	13.04722	9.573269	21.4	18.53036
3	10.38283	8.394602	16.8	13.80676
2	7.918663	6.963425	11.9	11.90385
1	5.674523	4.415541	6.5	6.429597
0	0	0	0	0

Table 2: Storey displacement results for G+28 building

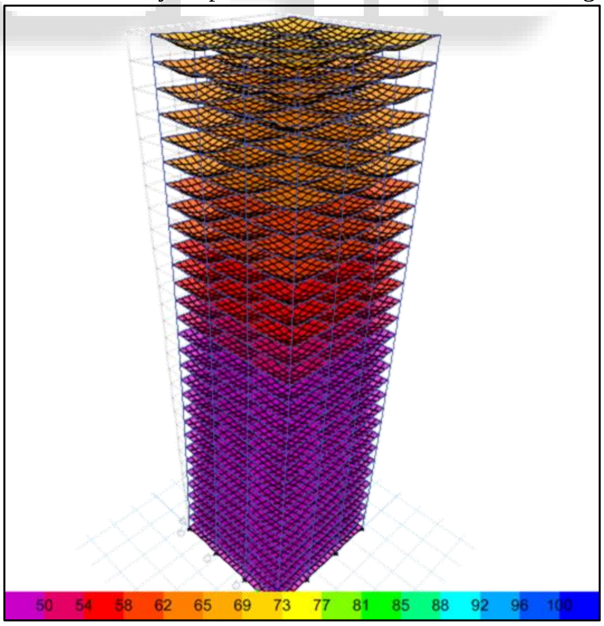

Fig. 3: Storey displacement of whole building

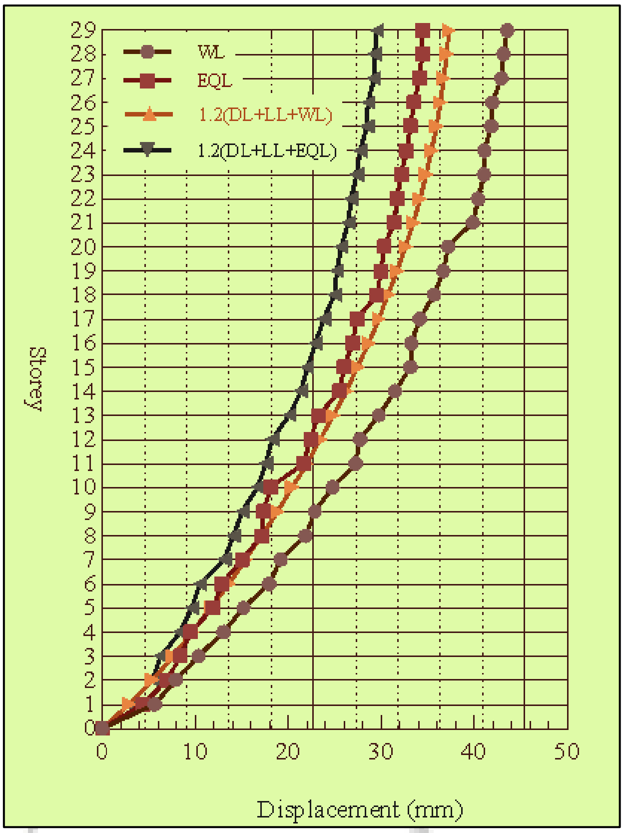

Fig. 4: Storey displacement plot

B. *Interstorey Drift*

The interstorey drift is as shown in Table 3 and Fig. 5

Storey	WL	EQL	1.2(DL+LL+WL)	1.2(DL+LL+EQL)
29	0.014512	0.011472	0.027367	0.021635
28	0.01438	0.01147	0.027167	0.021476
27	0.014302	0.011371	0.026933	0.021446
26	0.013976	0.01118	0.026667	0.020938
25	0.013946	0.011054	0.026367	0.02089
24	0.013701	0.010912	0.025967	0.020323
23	0.013693	0.010722	0.025533	0.020051
22	0.013477	0.010577	0.025067	0.019614
21	0.013294	0.010481	0.024533	0.019413
20	0.012392	0.010115	0.023933	0.018853
19	0.012228	0.009995	0.023267	0.018516
18	0.011885	0.009849	0.022567	0.018333
17	0.01139	0.009134	0.021833	0.01747
16	0.011078	0.008978	0.021	0.016846
15	0.011055	0.00866	0.020133	0.016174
14	0.010499	0.008526	0.019233	0.015667
13	0.009921	0.007755	0.018233	0.014755
12	0.009239	0.007463	0.017233	0.013409
11	0.009073	0.007206	0.016133	0.012903
10	0.008266	0.006046	0.015	0.01226
9	0.007632	0.005786	0.013833	0.011027
8	0.007277	0.005746	0.0126	0.010325
7	0.006398	0.005015	0.0113	0.009619
6	0.005995	0.004282	0.009967	0.007731
5	0.005071	0.003971	0.008567	0.007084
4	0.004349	0.003191	0.007133	0.006177
3	0.003461	0.002798	0.0056	0.004602
2	0.00264	0.002321	0.003967	0.003968
1	0.001892	0.001472	0.002167	0.002143
0	0	0	0	0

Table 3: Storey drift result

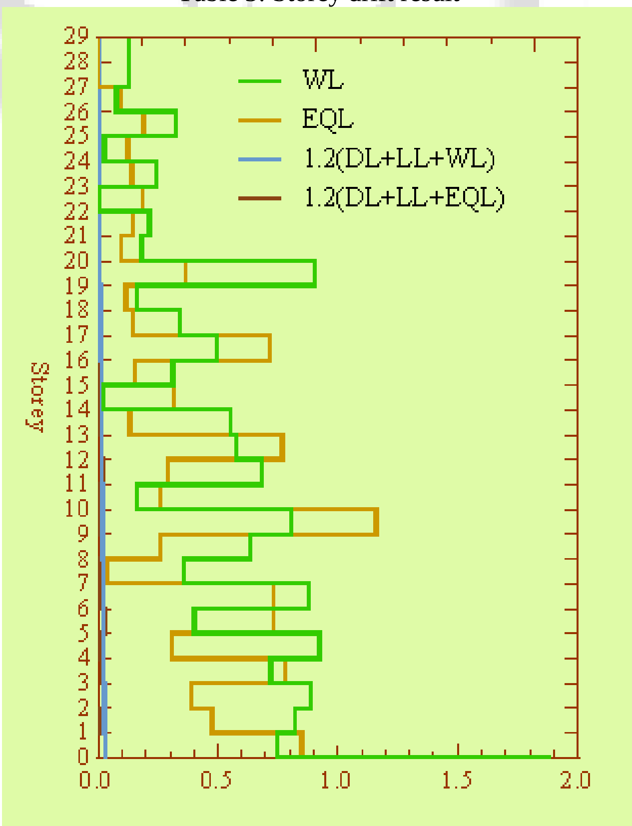

Fig. 5: Storey drift demand plot

C. Bending Moments

The bending moment diagram for conceptual purpose for combination of load is as shown in Fig. 6.

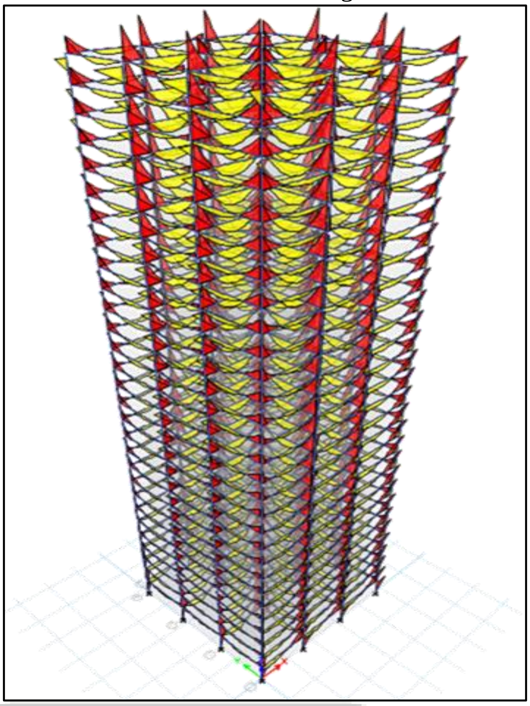

Fig. 6: Bending moment diagram

V. CONCLUSION

The wind load analysis of G+28 storey building is performed and is compared with earthquake load results. The results are reported in terms of storey displacemen, storey drift and bending moment.

It is found that wind load is more prominent for high rise buildings than seismic loads.

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