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Comparison Between Wind and Earthquake Resistance Structure

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ABSTRACT

It is very essential to consider the effects of lateral loads induced from wind and earthquakes in the design of reinforced concrete structures, especially for high-rise buildings. In some cases effects of earthquake are found to be dominant and more critical than wind effects and in some cases the opposite happens. As per as earthquake force as considered zone factor, height of building and type of sub-soil are relevant in estimation of earthquake force. For wind load base dimensions, height, basic wind speed, terrains category and many more factors include permeability are required for estimation of forces due to wind. By using STADD pro the results presented here are focused on calculation of parameters such as deflection, shear force and bending moment for earthquake and wind load on the different configuration buildings.

Keywords: high-rise buildings; wind pressure; equivalent static loads; zone factor; structural factor; importance factor

I. INTRODUCTION

The focus of this study, in the field of wind and earthquake engineering, is on the comparison of the dynamic behaviour of a multi-story reinforced steel structure building & how they respond to wind and earthquake induced excitations.

All structures especially high rise structures are design for dynamic loads which include loads due to earthquake and wind. Major consideration is given to earthquake loads in earthquake prone areas and that to wind loads in cyclones prone areas. For very tall structure wind is considered as predominant load. Earthquake forces are estimated as per the provision of IS 1893(Part 1):2002 while the wind forces are estimated by IS 875(Part 3):1987. As per the historical wind velocity data India is divided into no. of zones and designed wind velocity is considered according to wind map of India.Class-B Structure and their component such as cladding, glazing, roofing, etc. having greatest vertical or horizontal dimensions between 20 and 50m.

The focus of this study, in the field of wind and earthquake engineering, is on the comparison of the dynamic behaviour of a multi-story reinforced concrete building and steel structure building & how they respond to wind and earthquake induced excitations.

- **Objectives**

1. To critically study the codal provisions for Wind and Earthquake Loads.
2. To analyse structural frames with different base dimension and heights for wind and earthquake loads considering provisions of relevant codes
3. To understand development of displacements and forces in selected columns.

II. METHODOLOGY

- Calculation of loads as per Indian Standards.
- Step by Step process of Methodology.
- Analysis using Staad pro on residential buiding.
- Design using Staad. Pro on residential building.

Calculation of loads as per Indian Standards There are different types of loads acting on the structure

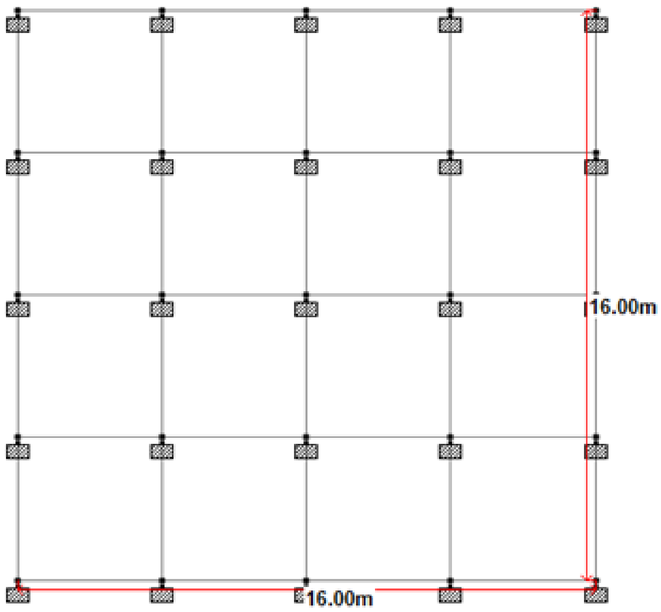
- Dead loads: - All permanent constructions of the structure form the dead loads. The dead load comprises of the weights of walls, partitions floor finishes, false ceilings, false floors and the other permanent constructions in the buildings. The dead load loads is calculated from the dimensions of various members and their unit weights. the unit weights of plain concrete and reinforced concrete made with sand and gravel or crushed natural stone aggregate may be taken respectively.
- Live loads: - Live load is produced by the intended use or occupancy of a building including the weight of movable partitions, distributed and concentrated loads, load due to impact and vibration and dust loads. Imposed loads do not include loads due to wind, seismic activity, snow, and loads imposed due to temperature changes to which the structure will be subjected to, creep and shrinkage of the structure, the differential settlements to which the structure may undergo.
- Wind loads: - Wind is air in the motion relative to the surface of the earth. The primary cause of wind is traced to earth's rotation and differences in the terrestrial radiation. The radiation effects are primarily responsible for the convection either upwards or downwards. The wind generally blows from the horizontal to the ground at high wind speeds. Since vertical components of the atmospheric motion are relatively small, the term 'wind' denotes almost exclusively the horizontal wind, vertical winds are always identified as such. The wind speeds are to be assessed with the aid of anemometers or anemographs which are installed at meteorological observatories at heights generally varying from 10 to 30 meters above the ground.

Project details:-

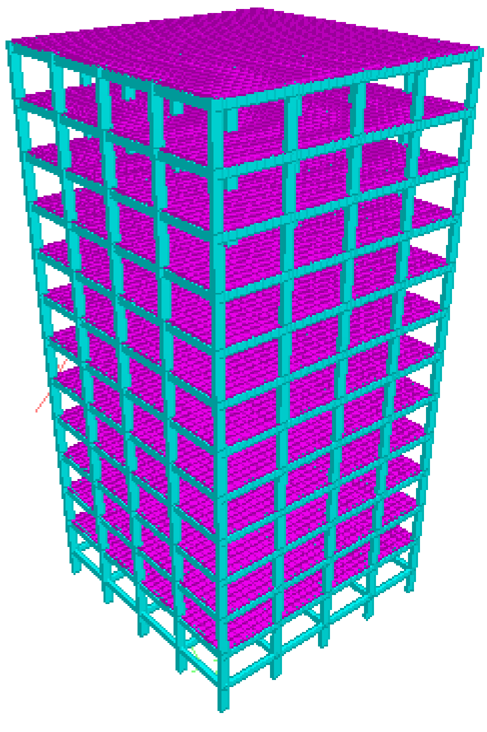
- City :- Nagpur
- Basic wind speed :- 44 m/s
- Permeability :- 5-20%
- Building type :- General
- Size of building :- 16m X 16m X 36m
- Floor :- G+11

III. RESULTS AND DISCUSSION [Page Style]

Modeling of Class-B structure :-



Plan- Base dimensions 16-16



3D View 16-16-36

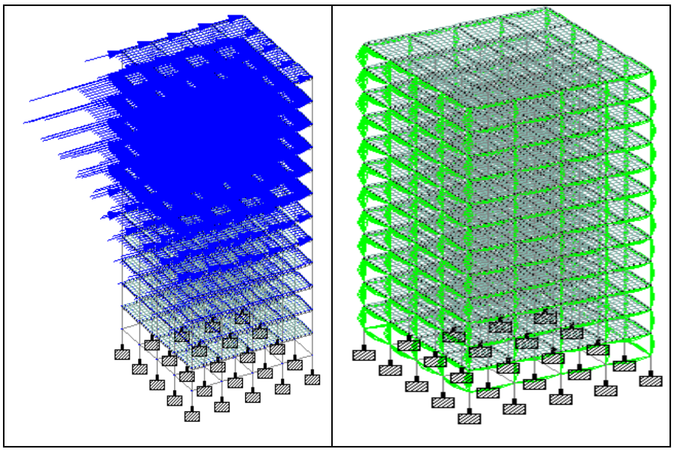


Figure 1. Application of earthquake and wind load on the structures.

Design wind speed and Wind pressure coefficient for Class B structure.

Floor level	Vz= Design wind speed				Pz= Wind pressure coefficient			
	TC 1	TC 2	TC 3	TC 4	TC 1	TC 2	TC 3	TC 4
11	50.38	49.06	46.11	42.5	1.52	1.44	1.28	1.08
10	50.07	48.75	45.72	41.72	1.5	1.43	1.25	1.04
9	49.72	48.4	45.32	40.92	1.48	1.41	1.23	1
8	49.32	47.74	44.66	38.676	1.46	1.37	1.2	0.9
7	48.93	47.08	44	36.43	1.44	1.33	1.16	0.8
6	48.53	46.42	43.34	34.19	1.41	1.29	1.13	0.7
5	47.87	45.67	42.42	33.44	1.38	1.25	1.08	0.67
4	47.08	44.88	41.36	33.44	1.33	1.21	1.03	0.67
3	46.02	43.82	39.78	33.44	1.27	1.15	0.95	0.67
2	45.32	43.12	38.72	33.44	1.23	1.12	0.9	0.67
1	45.32	43.12	38.72	33.44	1.23	1.12	0.9	0.67
0	45.32	43.12	38.72	33.44	1.23	1.12	0.9	0.67

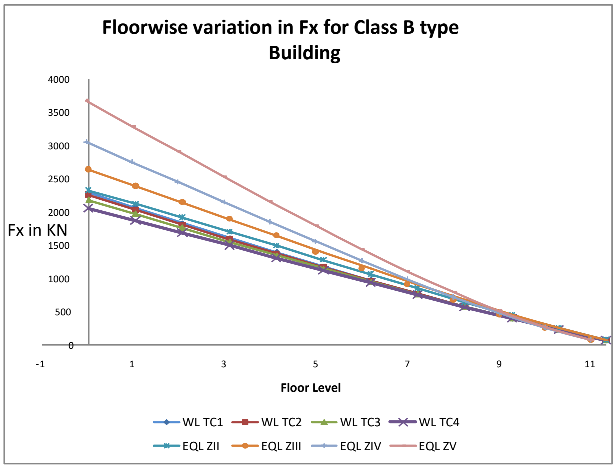


Figure 2. (Variation of Axial force of class B structure with diff Terrain Category and Zones)

1) For B class type of structures the difference in axial force developed in column due to EQ and WIND loading is relatively less in case of structure with lower lateral dimensions.
2) For the structure having height 36m the axial forces in EQ Zone-II are very close to the forces developed due to wind. However the difference is significantly higher with increase in base dimensions and the EQ forces are found to be predominant in class B type of structure with higher base dimensions.

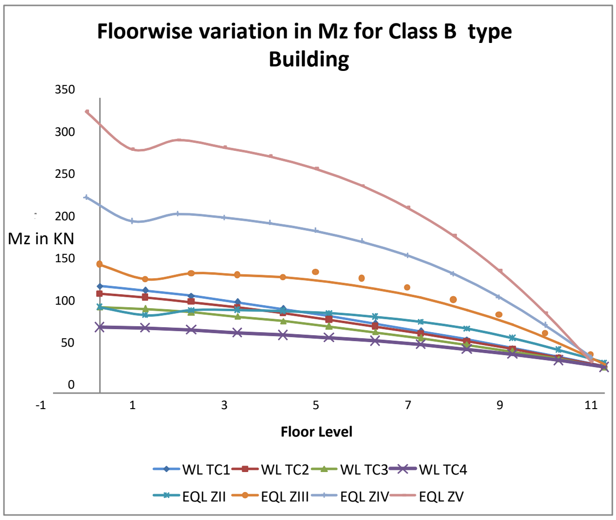


Figure 3. (Variation of Mz of class B structure with diff Terrain category and Zones)

In case of moment in Z direction the Mz due to EQ force is more than that of wind loading.

IV. CONCLUSION

[1] In case of earthquake the axial force, shear force, torsion, bending moment and displacements developed in the column increase as zone factor increases,

[2] In case of wind force the axial force, shear force, torsion, bending moment and displacements developed in the columns decrease as terrain category is changed from 1 to 4.

[3] In case of shear in Z direction for class B If the height of structure increase wind loading in TC 1,2,3 are more than the EQ forces in Zone II.

[4] In class B type of structure the X-Translation due to wind in terrain categories 1, 2 and 3 is greater than due to earthquake in zone II and III, and X-Translation due to wind in terrain category 4 is greater than due to earthquake in zone II.

V. REFERENCES

[1]. Dr. Suchita Hirde, Mr. Vinay Magadum, "Severity of Earthquake Forces against Wind Forces for Multistorey RCC Building" Professor, Applied Mechanics Department, Govt. College of Engineering, Karad 415 124, India 2PG Student, Civil-Structures, Govt. College of Engineering, Karad 415 124, India

[2]. Kosta talaganov, Mihail garevski, Danilo ristic and Vlado micov, "comparative dynamic stability study of a high –rise structure exposed to seismic and wind effects – case" STUDY 13th World Conference on Earthquake Engineering Vancouver, B.C., Canada August 1-6, 2004 Paper No. 778

[3]. Khaled M. Heiza and Magdy A. Tayel, "Comparative Study of The Effects of Wind and Earthquake Loads on High-rise Buildings" Civil Engineering Department, Faculty of Engieering, Menoufiya University, EGYPT

[4]. Gana A.J, "Wind effects on structures a case study of buildings in irepodun local government area of kwara state" Civil Engineering Department College of Sciences and Engineering Landmark University, Omu-Aran, Kwara State

[5]. Xinzhong Chen and Ahsan Kareem, Evaluation of Equivalent Static Wind Loads on Buildings, Assistant Professor of Civil Engineering, Texas Tech University, Texas, USA, xinzhong.chen@ttu.edu, and Professor of Engineering, University of Notre Dame, Indiana, USA, kareem@nd.edu

[6]. Bimala Pillai, Priyabrata Guha, "Comparison between RCC and steel structure with wind and earthquake effect using Staad pro"

[7]. Baldev D. Prajapati and D. R. Panchal, "Study of seismic and wind effect on multi storey r.c.c., steel and composite building" M.E. Research Scholar & Assistant Professor, Applied Mechanics & Structural Engg. Deptt., Faculty of Techno. & Engineering, M. S. University of Baroda, Vadodara – 390001, Gujarat, India.

[8]. P. Mendis, T. Ngo, N. Haritos, A. Hira and B. Samali Wind Loading on Tall Buildings, The University of Melbourne, Australia, and University of Technology Sydney, Australia, J. Cheung Monash University, Australia

[9]. Umakant Arya, Aslam Hussain and Waseem Khan, "Wind Analysis of Building Frames on Sloping Ground" Rura Engineering Services, M .P , India, Civil, UIT R.G.P.V Bhopal, M.P,India

[10]. Swati D.Ambadkar and Vipul S. Bawner, "Behaviour of multistoried building under the effect of wind load" Assistant Professor, Department of Civil Engineering, P.R.M.I.T.&R, Badnera, Amravati. Post Graduate Student, Department of Civil Engineering, P.R.M.I.T&R ,Badnera, Amravati

[11]. D. Boggs and J. Dragovich, "The Nature of Wind Loads and Dynamic Response" IS : 1893 (Part1) : 2002 IS : 875 (Part 3) : 1987