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Literature Review on Wind Analysis

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Abstract— Recently modern architecture meanssomething regularity and irregularity in geometry.Everyone wants to win the race of designing beautiful andcomplex structures and with issue of scarcity of land it istoday's necessity to go higher and higher vertical andconstruct high rise structures. But as we go higher windexcitation becomes one of the most precarious forceacting on the surface of the structure and if the plangeometry is irregular it can induce torsion which can belife-threatening to the structure, so it is essential toanalyze and understand such forces during designing. This paper presents an overview of research work done regarding wind analysis of multistoried buildings with different plan shapes, chimney, transmission tower, comparison of different code standards with the Indian code and the lateral load on the building.

1. Introduction

Wind is the term used for air in motion and is usually applied to the natural horizontal motion of the atmosphere. Motion in a vertical or nearly vertical direction is called a current. Movement of air near the surface of the earth is three-dimensional, with horizontal motion much greater than the vertical motion. Vertical air motion is of importance in meteorology but is of less importance near the ground surface. On the other hand, the horizontal motion of air, particularly the gradual retardation of wind speed and the high turbulence that occurs near the ground surface, are of importance in building engineering. The height of the tallest building changes year by year because skyscrapers are constructed constantly worldwide. With this development that buildings are rising, there will be a larger awareness of occupants comfort due to wind induced acceleration in the top floors of a high rise structure. So when the height of structure increases then the consideration of lateral load and other factors are very much important. For that the lateral load resisting system becomes more important than the structural system that only resists the gravitational loads. Wind effects on structures can be classified as "static" and "dynamic". Static wind effect primarily causes elastic bending and twisting of structure. For tall, long span and slender structures dynamic analysis of the structure is essential, Wind gusts cause fluctuating forces on the structure which induce large dynamic motions, including oscillations.

2. Effect of Plan Shapes in RC and composite building :

B. S. Mashalkar (2017)reported I shaped building has lesser storey drifts, lesser lateral displacements at the points as compared to T, L and C shaped building. It has been observed that displacement and storey drift in T, C and L shaped buildings is more than I shaped building. This may due to asymmetry of T, C and L type buildings. This is due to the distance of extreme point of building from CG is more in case of T, C and L type plan than I type plan.**Shaikh Muffassir (2016)** reported The result of different shape of composite buildings suggests that the rectangular shape building is more preferable in wind prone zone compare to other shape buildings. U-shape building is not preferable in wind prone zone due to large displacement and less stiffness.**MeghaKalra, Purnima Bajpai and Dilpreet Singh (2016)** reported L-shape and U-shape are the least stable of all the shapes. Plus shape and Non uniform are the most stable. In case of Plus shape and Non uniform shape the stiffness was high as compared to the other cases, that is why there values were near to that of the rectangular shaped building.**U.Dhiyaanesh (2018)** reported It can be concluded by saying that if one needs stability plus shape can be chosen, if economy is the priority C shape can be chosen. Rectangle shape stays back in both efficiency and economy.**AlkeshBhalerao (2016)** reportedgenerally symmetrical structure is preferred for high rise structure but in this case square shape found to be less stiff compare to rectangular structure in wind load consideration. U-shape structure is not preferred as it gives the maximum displacement and maximum drift due to its geometric shape most susceptible for wind load. The effective shape for to resist wind lateral load is rectangular shape structure for G+ 25 considerations.

3. Comparison of standard code:

MdAhesanMd Hameed (2018) reportedIndian and Australian standards having same terrain categories. Indian and Australian standards gives variation in forces as the terrain category are changed, whereas in American standard does not give any variation in forces. Indian code has prescribed class of structure, based on largest dimension; other codes have not defined class of structures. Australian standard gives lower value of bending moment along Y-direction and displacement along X&Y direction whereas American standards give higher values as per Indian load combination and loading combinations prescribed in various codes. **Shams Ahmed (2017)** reported a conclusion after comparing Indian code, ASCE 7 and Eurocode 1-4 (1993) i.e. the final values of dynamic response factor vary greatly from code to code so the values of 0.965 and 1.01 are deemed to be rightly representing the prediction of dynamic response factor as per IS 875 (part 3)2015. The scatter in values obtained from different codes is mainly due to variation in definition of wind characteristics parameters and different averaging times involved. To achieve uniformity in codes and standards it is necessary to arrive at unified and common definition of all the wind characteristics parameters such as size reduction factor, peak factor, background factor etc, including the averaging times.

4.Tall Reinforced Concrete Chimneys:

VijayaSimha Reddy, J. Prashanth Kumar , A.Vijay Kumar, S.Sreevastav Reddy (2018) Reported From above table results, it is clear that shear force and bending moment increases with increase in zone factor values. The effect of wind force is quite significant as compared with the earth quake forces over 100m RCC Chimney. The geometry of chimney has to be chosen in order that the deflection produced at the top of chimney is well within the permissible limits. On comparison of loads acting on an industrial RCC chimney, the wind loads are the governing loads for design of chimney shell.**M. G. Shaikh, Mie** The effect of wind forces is quite significant as compare to earthquake forces over 220 m height R.C.C chimney. The geometry of chimney has to be so chosen that the deflection of chimney at the top is within permissible limits. The presence of gust wind over a considerable height of chimney plays important role as the forces obtained by gust factor method are quite high along the sections considered except the top four sections where the forces obtained in seismic analysis are higher. Elsewhere, the effect of earthquake forces seems comparatively lesser along the height of the chimney. The cross wind analysis is taken care of by considering first mode of oscillation as the critical wind speed is well within the design wind speed for the first two modes. Having known this, a given tall reinforced concrete chimney can now be designed for respective wind and seismic forces obviating the need for empirical formulae.

5. Effect of lateral load:

P. Mendis, T. Ngo, N. Haritos, A. Hira (2007) "Wind Loading on Tall Buildings"reported **:**Serviceability with respect to occupier perception of lateral vibration response can become the governing design issue necessitating the introduction of purpose-designed damping systems in order to reduce these vibrations to acceptable levels. **RavindraJori ,OmkarKamble, EklavyaSarnaik, Pooja Niphade (2018) "**Gust analysis of tall building by is 875(part3)-1987 and by ETABS software**"** reported the gust pressures computed by gust effectiveness factor method increase with the height of the building and they are more critical than static pressures and as such gust effectiveness factor method gives critical wind pressures to be considered in the design of tall multistoried frames. The results obtained by Analytical method are less than the results obtained by software.**Srikanth and B Vamsi Krishna (2014) "**Study on the effect of gust loads on tall buildings", reported For the design of columns both axial loads moments critical for design when wind effects are included. The values of beam moments increase by 20 to 35% bottom to top for different multistoried frames from 20 to 80 stories for dead load and live load combination. Large criticality is being caused in the design of beams in multi-storied frame when wind effects are included.**Abhishek Soni (2017)**"Wind Analysis of Tall Building with Floor Diaphragm".wind analyses of three-dimensional (3-D) G+20 tall buildings with and without rigid floor diaphragm is considered. The effect of diaphragm on three different geometrical plans hexagonal, pentagonal and square is also studied. The buildings are considered with different elevation floors that are 5 floors, 10 floors, 15 floors and 20 floors for all the geometrical plan buildings. The buildings are analyzed as per IS 875-1987 part 3 for wind zone II. In this way total 24 buildings are analyzed with 27 load combinations**Vikrant Trivedi, SumitPahwa (2018)** "Wind Analysis and Design of G+11 Storied Building Using STAAD-Pro" reported the wind loads increases with height of structure. Wind loads are more critical for tall structures than the earthquake loads. Structures should be designed for loads obtained in both directions independently for critical forces of wind.

6.Transmission tower:

Jingbo Yang, Fengli Yang, Qinghua Li, Dongjie Fu and Zifu Shang (2010) "Dynamic responses analysis and disaster prevent of transmission line under strong wind" reported For the constructed transmission lines, the transmission tower should be strengthened by adding secondary members or pasting associate main members, which can enhance the reliability and safety of the transmission lines.**GopiSudamPunse** "Analysis and design of transmission tower"Narrow based steel lattice transmission tower structure plays a vital role in its performance especially while considering eccentric loading conditions for high altitude as compared to other normal tower. Narrow based steel lattice transmission tower considered in this paper can safely withstand the design wind load and actually load acting on tower. The bottom tier members have more role in performance of the tower in taking axial forces and the members supporting the cables are likely to have localized role. The vertical members are more prominent in taking the loads of the tower than the horizontal and diagonal members, the members supporting the cables at higher elevations are likely to have larger influence on the behavior of the tower structure. The effect of twisting moment of the intact structure is not significant. The Geometry parameters of the tower can efficiently be treated as design Variables and considerable weight reduction can often be achieved as a result of geometry changes. The tower with angle section and X-bracing has the greater reduction in weight after optimization. Tube section is not economic to use in this type of transmission tower. Total weight of tower considering weight of nut bolts, anchor bolts, hardware etc works out to 30 to 35 Tone.**Srikanth L., Neelima Satyam D.(2014)** "Dynamic Analysis of Transmission Line Towers" the analysis is carried out consideringall the different loads such as vertical loads, lateral loads andlongitudinal loads with the combinations specified as perIndian standards, resulting breaking load as the criticalcombination among the forces developed in the structure.Studies on the transmission tower also stated that the failure ofleg members makes the structure more susceptible to damage.So, from this analysis it observed that the maximum axialforce in the leg members is 1600kN considering the breakingload combination and the axial force is reduced to 522.382kNwithout considering breaking load. As the tower is assumed tobe in the central span of equal distances between the adjacenttowers, the breaking load will not be the major criteria fordesign of elements. Though dynamic analysis is performed,wind is the predominant load on these tall structures

7. CONCLUSION:

- For RCC high rise building I shape and rectangular shape building is more preferable in wind prone zone compare to other shape buildings because of due to symmetry and centre of mass and center of rigidity will acts at center.
- Plus shape is chosen when one needs stability.
- C shape is chosen when economy is priority.
- For composite structure rectangular shape building is more preferable.
- By comparing Indian code with Australian and American standards code, the terrain category is same in Indian and Australian code. Indian code has prescribed class of structure, based on largest dimension; other codes have not defined class of structures.
- The geometry of chimney has to be so chosen that the deflection of chimney at the top is within permissible limits.
- To reduce the lateral vibration response necessary to introduce the damping system, however, it is beneficial, as damping reduces motion, making the building feel more stable.
- Provide the rigid diaphragms to the building which is more efficient in reducing bending moment, shear force and displacement.
- Increase the safety of the transmission lines in transmission tower by adding secondary members to the main members.
- In transmission tower X-bracing has the greater reduction in weight. Tube section is not economic to use in this type of transmission tower.
- To reduce the leg failure of transmission tower as the tower is assumed to be in the central span of equal distances between the adjacent towers, the breaking load will not be the major criteria for design of elements

8. REFFERENCE:

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