International Journal of Research
eISSN: 2348-6848 & pISSN: 2348-795X Vol-5 Special Issue-13
International Conference on Innovation and Research in Engineering, Science & Technology
Held on 23rd & 24th February 2018, Organized by Tulsiramji Gaikwad Patil College of Engineering & Technology, Nagpur, 441108, Maharastra, India.

Analysis Of Multi-Storieyed Irregular RC Building Under Influence Of Wind Load

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Abstract:

In this paper a detailed study on the behavior of structural irregularities in high rise building. Now a days , In designing the multi-storied buildings irregularities in structures are inevitable due to functional requirements of the building. It is very essential to consider the effect of lateral loads induced from wind pressure. The present study describes the effect of wind speed 55 m/s on three buildings of G+20 multi storied frame structure for different irregularities. The three structure considered as regular building, stiffness irregular & vertical irregular. The results were tabulated by performing analysis by using STAAD Pro in the form of Bending Moment, Shear Force, Axial Force in the irregular buildings.

Keywords
Lateral Load, Wind pressure, STAAD Pro, Bending Moment, Shear Force, Axial Force.

1. Introduction

In modern world the new materials and construction techniques resulted in structures. In this modern world the different types of structure are use most important structures like; high rise structures like; towers, chimney, buildings etc, . Because of the height of structure is greater than 6 m therefore the intensity of wind load is acting on the structure. Due to this load the swaying effect are taken into structure. The structure height is more than 12 m the intensity of wind load is more. The recent world the population in cities are increase. Therefore we need a tall buildings to establish a peoples living. The height of the building are increases therefore building become more flexible, low in damping and light in weight. Such structure is highly influence under the wind pressure. Wind forms the predominant source of loads, in tall free standing structures. The structure experiences aerodynamic forces due to wind on tall structure are divided into two categories as shown in the Fig 1.:

1. Along-wind effect : The drag force acting in the direction of the mean wind.
2. Across-wind effect : The lift force acting perpendicular to the direction.

The wind load is the most important factor that determined design of all building over 10 storey's. The building taller than 10 stories would generally require additional steel and lateral system. Under the action of natural wind, gusts and other aerodynamic forces will act continuously affect a tall building. The structure will deflect about a mean position and will oscillate continuously.

Buildings should have a two types of building structures according their use. They are following

1. Regular Structure: It has all the load, mass, stiffness, etc, distributed equally along column, beam, slab. The chances of collapse of regular building is less.
2. Irregular Structure: The multi storey building having some structural irregularities like horizontal, vertical, stiffness and mass. The chances of collapse is more than regular building.

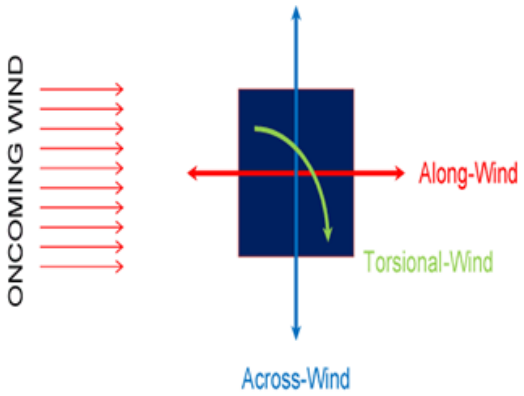

Fig. 1. Along & Across wind effect

2. Method Of Analysis

Based on electrical-mechanical transformation, piez Code-based procedure for wind analysis:

Basic wind speed can be obtained by IS 875 (Part III) : 2015 ANNEX A (Clause 6.2) & shall be modified by including the effect of following factors to get design wind velocity at any height for the chosen structure:

a) Risk level
b) Terrain roughness & height of structure
c) Local topography

Wind Speed = Vz = Vb X K1 X K2 X K3
Wind Pressure = Pz = 0.6 Vz
Where;
V = Design wind speed at any height z in m/s
K1 = Probability Factor (Risk Coefficient)
K2 = terrain, height & structure size factor
K3 = Topography factor
Pz = Design wind speed in N/m2 at any height z

NOTE: Design wind speed up to 10 m height from mean ground level shall be consider constant.

3. MODELING & ANALYSIS

An RCC framed structure is basically an assembly of slabs, beams, columns & foundation inter-connected to each other as a unit. The load transfer mechanism in these structures is from slabs to beams, from beams to columns, and then ultimately from columns to the foundation, which is turn passes the load to the soil. In this analysis we adopted 4 case by considering different irregularities for the same structure, as explained below.

1. Regular
2. Stiffness Irregularity
3. Vertical Irregularity

Design characteristic : The following design characteristic are consider for the analysis of multi-storied RC frames.

Table 1. Design Data

Sr. No.	Particulars	Dimensions/Size
1	Model	G+20
2	Wind Speed	55 m/s
3	Floor Height	3 m
4	Plan Size	30 X 30 m
5	Size of Column	0.5 X 0.23 m
6	Size of Beams	0.45 X 0.23 m
7	Wall	1. External wall = 0.23 m 2. Internal wall = 0.15 m
8	Thickness of Slab	150 mm
9	Material used	M 20 & Fe 415
10	Place	Darbhanga
11	Software used	STAAD pro

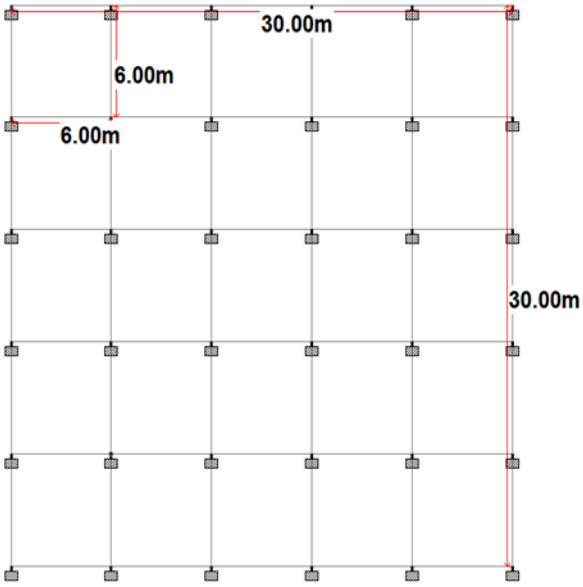

Fig. 2. Model Plan

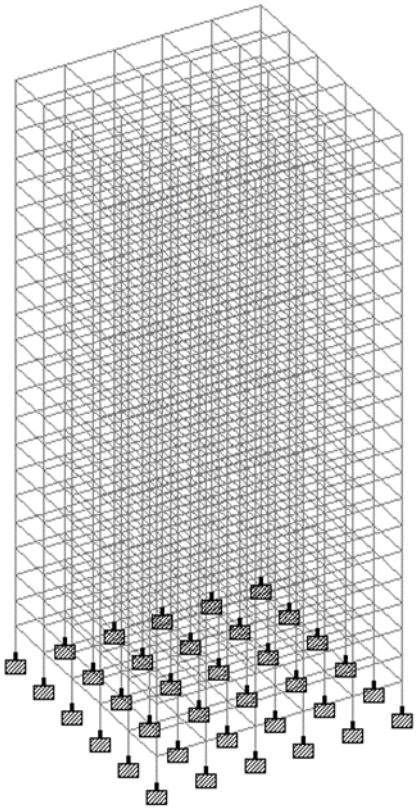

Fig. 3. Regular Building

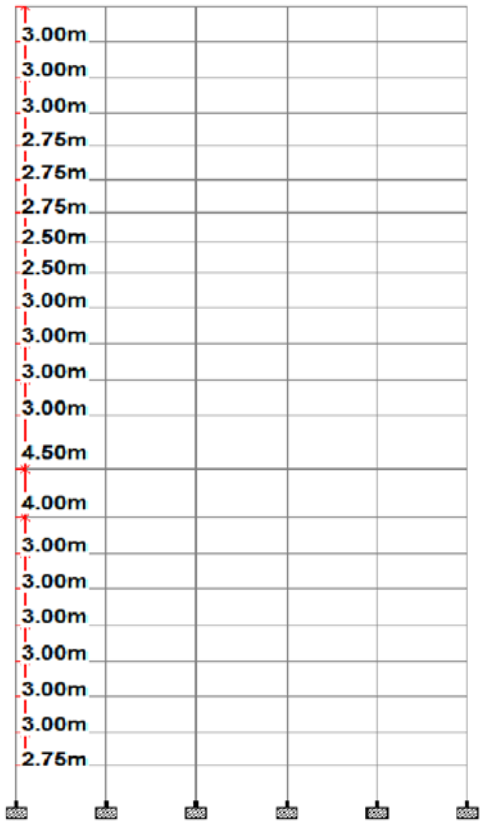

Fig. 4. Stiffness Irregular Building

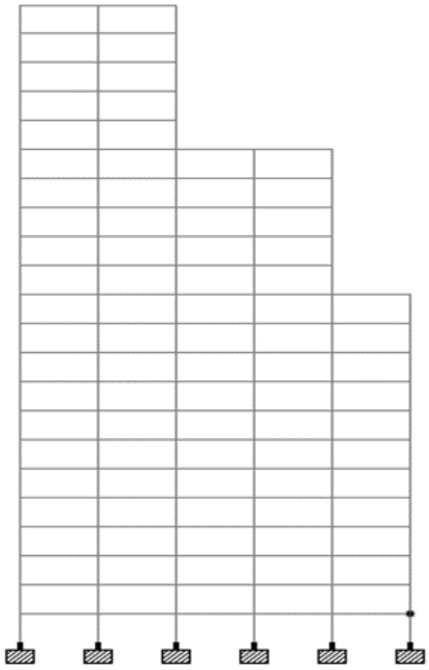

Fig. 5. Vertical Irregular Building

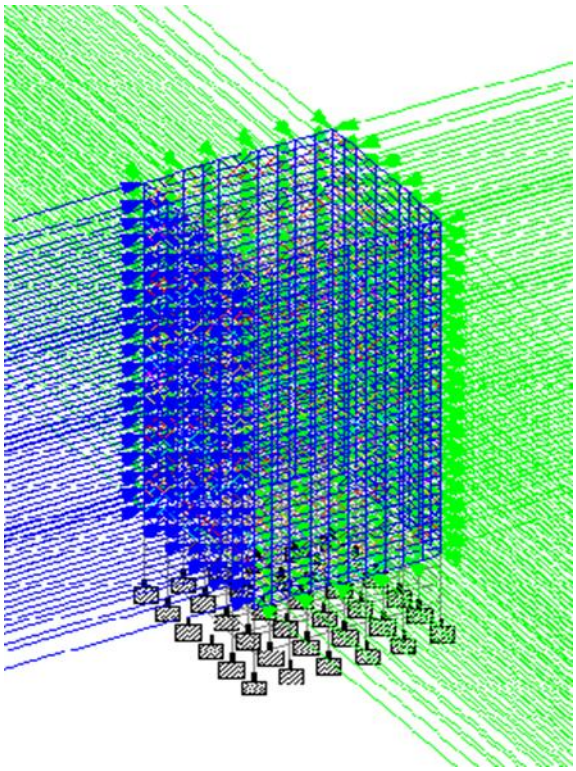

Fig. 6. Wind Loading in X-direction for Regular Building

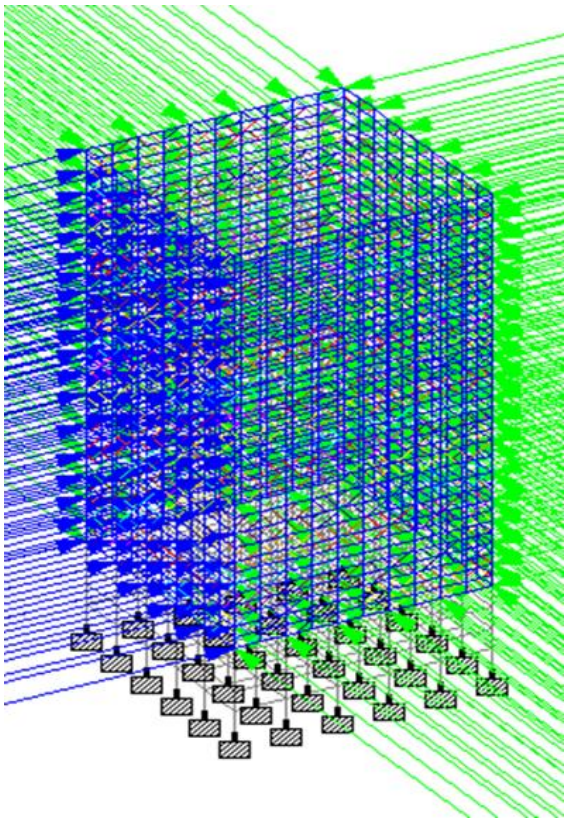

Fig. 9. Wind Loading in X-direction for Stiffness Irregular Building

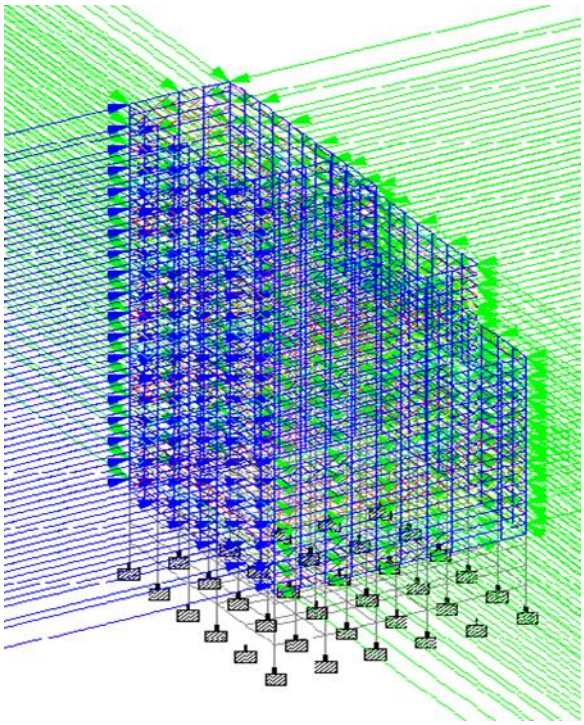

Fig. 8. Wind Loading in X-direction for Vertical Irregular Building

3. Results

Bending Moment: 1.2(DL+LL+WL)

Table 2. Maximum Bending Moment (KN-m) of Beams at different Floors

Storey No.	Regular Structure	Stiffness Irregular Structure	Vertical Irregular Structure
G	21	19.50	26.1
1	96	95.90	96.1
5	99.10	98.60	102
10	107	107	115
15	112	112	119
20	116	115	105

Shear Force: 1.2(DL+LL+WL)

Table 3. Maximum Shear Force (KN) of Beams at different Floors

Storey No.	Regular Structure	Stiffness Irregular Structure	Vertical Irregular Structure
G	14.8	13.9	13
1	73.5	74	72.8
5	113	112	122
10	138	145	158
15	153	155	163
20	161	160	121

Axial Force: 1.2(DL+LL+WL)

Table 6. Maximum Axial Force (KN) of Column at different Floors

Storey No.	Regular Structure	Stiffness Irregular Structure	Vertical Irregular Structure
G	7999	8082	7992
1	7842	7929	7835
5	6428	6519	6407
10	4564	5420	4500
15	2633	5617	2523
20	667	666	630

4. Conclusion

1. Bending Moment & Shear Force in beams increases as the height of the structure increase in regular & stiffness irregular structure due to the wind load as well as due to the floor load.
2. In vertical irregular structure the bending moment & shear force increase in certain limit & after that it decreases.
3. Axial force in the column increases as the height of the structure is decreases.
4. Axial force is maximum in stiffness irregular structure as compare to regular & vertical irregular structure.
5. Shear force in column is more in stiffness irregular building.

6. Bending moment, shear force & axial force is maximum in loading combination 1.2(DL+LL+WL).

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