G+10 RESIDENTIAL STRUCTURE DESIGN WITH COMPUTER-ASSISTED WIND ANALYSIS AND STAADPRO

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ABSTRACT:

The current research examines the impact of wind on a multi-story structure. It uses Staad-pro to analyse a G+10 multi-story framed structure for various wind speeds such as 33m/sec, 39m/sec, 44m/sec, 47m/sec, 50m/sec, and 55m/sec.

Two frames in the longitudinal direction and two in the transverse direction are considered. According to IS:875 part-1, part-2, and part-3, they are analysed for gravity and wind loading with various load combinations.

These frames are examined at various wind speeds, and members from one storey are compared to members from another storey at a given wind speed, with corresponding results drawn for key load combinations.

To draw conclusions, all of the above results will be thoroughly examined. For a collection of columns chosen at random, sample design calculations were performed**.** The current project is an attempt to use STAAD to study a multistory building subjected to wind stress. Professional software. The behaviour of tall buildings must be determined by taking into account site-specific lateral wind loads as well as vertical gravity stresses.

The amount of structural material required to resist lateral loads grows dramatically as a building's height increases. STAAD was used to generate the wind load values. Pro analysed the critical case situation to the given wind intensities at different heights while strictly adhering to the IS 875 requirements.

The investigation of multistory buildings is carried out in a normal manner in this study. As a result, it aids in the examination of the structure's behaviour under various loading conditions, as well as its load deflection behaviour.

INTRODUCTION:

Because of their forms, slenderness, flexibility, size, and lightness, a substantial number of structures now under construction are wind-sensitive. Add to that the usage of materials that are stressed at a substantially higher proportion of their ultimate strength than in the past due to improved material quality assurance. The ancient notion of tolerating recurring tragedies caused by wind by "fate" and gods is giving way to demands for cost-effective wind resistance in today's social environment.

Over the previous two decades, various international codes of practise, particularly the British, Australian, Canadian, American, and French, have been updated often, and the current versions contain most of the improvements gained in understanding wind characteristics and their effect on structures. The new discoveries have made it evident that simply amending the earlier code IS 875:1964 will not be sufficient.

The newly issued wind code of practise for design loads (other than earthquake) for buildings and structures IS875 (part 3):1987 differs in many ways from the previouscode, which was first issued in 1964, and attempts to correct not only the 1964 code's shortcomings, but also to incorporate recent knowledge of wind effect on structures.

LOADS CONSIDERED:

DEAD LOAD:

The structure's permanent constructions create dead loads. The dead load is made up of the weights of walls, partitions, floor finishes, artificial ceilings, false floors, and other permanent structures in buildings.

IMPOSED LOAD:

The weight of moveable partitions, scattered and concentrated loads, impact and vibration loads, and dust loads are all examples of imposed loads created by a building's intended use or occupancy.

Wind, seismic activity, snow, and stresses exerted on the structure as a result of temperature changes, creep and shrinkage, and differential settlements are not included in applied loads.

WIND LOAD:

Wind is the movement of air in relation to the earth's surface. The fundamental causes of wind are the earth's rotation and changes in terrestrial radiation. Radiation impacts are the primary cause of convection, whether it is uphill or downward.

The wind normally blows horizontally to the ground at high wind speeds. Because the vertical components of atmospheric motion are minor, the term "wind" nearly always refers to the horizontal wind; thus, vertical winds are always identified as such.

CONCEPT OF WIND ANALYSIS:

Theory of Wind Pressure and Forces on Buildings:

Wind generates a random time-dependent load that can be regarded as a mean plus a fluctuating component. Due to the fluctuating component (gustiness) of wind, all constructions will undergo dynamic oscillations. These oscillations are small in short rigid structures, therefore they can be viewed as having an equivalent static pressure. Most rules and standards use this approach, which is also the case in this thesis. If the natural time period of a structure is less than one second, it is considered short and rigid. The more flexible systems, such as towering structures, respond dynamically to the wind's gustiness.

Parameters of response

The wind-induced reaction of a tall building is dependent on a number of factors. These include the building's geometric and dynamic properties, as well as the approach flow's turbulence characteristics. There are a number analytical methodologies available for estimating the wind-induced response of tall buildings in both directions. The structure is subjected to aerodynamic forces caused by wind flow, which provide drag and lift forces. The drag (along-wind) force acts in the mean wind's direction, while the lift (across-wind) force acts in the opposite direction. The pressure variations in the windward and leeward faces, which normally flow the oscillations in the approach flow at least in the low frequency region, cause the along-wind motion.

Pressure variations caused by vortex shielding in the separated shear layers and wake flow field cause across wind motion. The following factors influence wind pressure:

1) Period of Average

2) Return Time

3)Roughness of the Ground

4)Height

5)Topography

Structure Dimensions:

Building:

A somewhat permanent enclosed structure over a parcel of ground with a roof, usually windows, and often more than one floor, used for a number of purposes such as dwelling, entertainment, or manufacturing.

Attack Direction:

The attack is the angle formed by the direction of the wind and the reference axis; angle " is the angle formed by the direction of the wind and the reference axis (horizontal line).

Horizontal dimension of the building measured normal to the structure's breadth.

WIND PRESSURE DESIGN:

The following expression yields the design wind pressure at any given height above ground level.

$P_z = 0.6 V_z^2$

Where,

P_z = design wind pressure (N/m) at a given height

V_z = design wind speed (m/sec) at a given height

WIND LOAD CALCULATIONS (3.2.3.3)

RCC building G+10 kind of structure

1st category of terrain

Class: B

Visakhapatnam, India

V_b (basic wind speed) = 55 m/sec

Coefficient of Risk (K_1): 1

Interpolation is used to obtain values for terrain and height factor (K_2).

Factor of topography (K_3): 1

K_4 importance factor: 1,Wind speed design (V_z) = $V_b K_1 K_2 K_3 K_4$,0.6 V_z^2 design wind pressure (P_z)

METHODOLOGY:

Note on Multistory Building Design

1) 1.5" foundation depth

2) Supports = They're all fixed. Supports

3) G+10 = number of stores

4) Each storey is 2.5 metres tall.

5) The building's total height is 25 metres.

6) The beam's cross section is 300 mm x 450 mm.

7) The column's diameter is 600mm.

8) The parapet wall's height is 1.2 metres.

9) The wall thickness is 160 mm.

10) The brick's density is 20 KN/m3.

11) Concrete density in members other than walls =25KN/m3

12) 1 KN/m floor finish

13) 0.15 mm slab thickness

14) 1 KN/m3 floor finish

For each zone, here are some examples:

Bangalore, Mysore, Zone I

ADVANTAGES:

In the measurement of shear force and bending moment,

STAAD Pro provides precise results.

STAAD Pro eliminates the need for manual calculations, saving time and increasing efficiency.

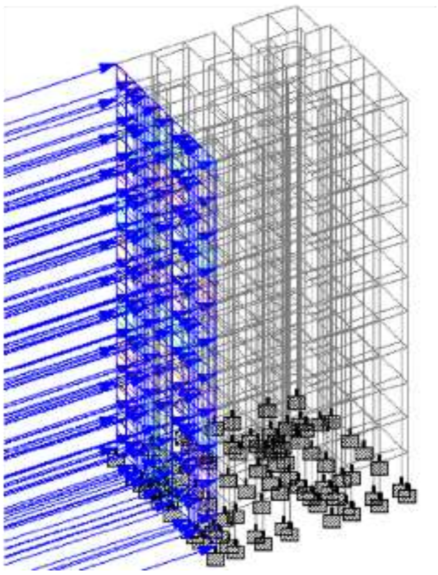
Engineers can use STAAD Pro to improve the structure, section, and dimensions.

TABLES & RESULTS:

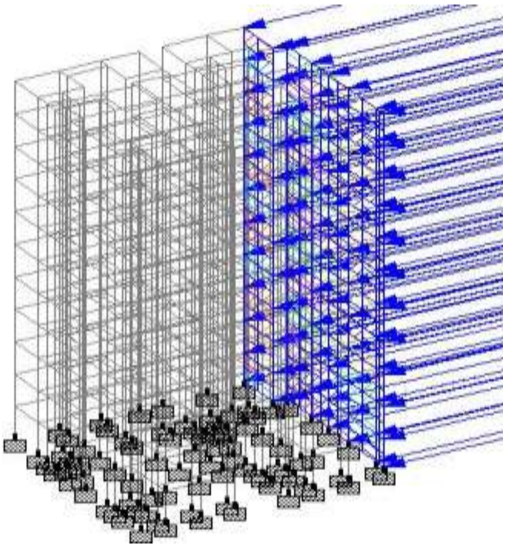
1.Wind speed and wind pressure values for various building heights

S.NO	HEIGHT(m)	Vb	K1	K2	K3	K4	Vz	Pz
1	3.5	55	1	0.98	1	1	58.8	2074.46
2	7	55	1	0.98	1	1	58.8	2053.35
3	10.5	55	1	0.98	1	1	59.04	2091.43
4	14	55	1	1.02	1	1	60.72	2212.15
5	17.5	55	1	1.035	1	1	62.1	2313.84
6	21	55	1	1.055	1	1	63.3	2404.14
7	24.5	55	1	1.07	1	1	64.2	2472.98
8	28	55	1	1.09	1	1	65.4	2566.29
9	31.5	55	1	1.104	1	1	66.24	2632.64
10	35	55	1	1.112	1	1	66.72	2670.9
11	38.5	55	1	1.121	1	1	67.26	2714.3
12	42	55	1	1.13	1	1	67.8	2758.1

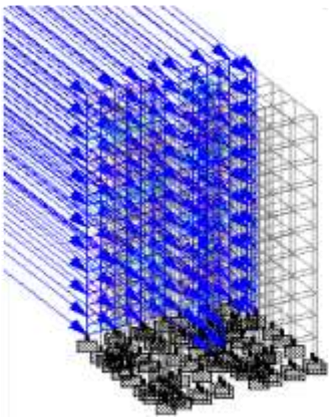
2. Wind load in the direction of +ve X



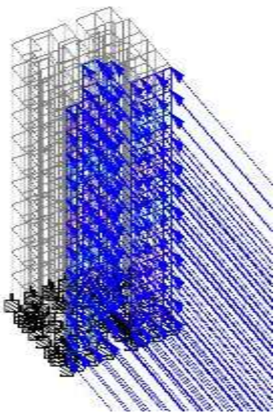
3.-ve X direction wind load



4. Wind load in the direction of +ve Z



5. Wind force in the negative Z direction



CONCLUSION :

1. In terms of bending moment and shear force, wind load combinations outnumber earthquake load combinations.

2. STAAD was used to gather the details of each and every member. Pro. The deflections are all within their parameters

All members have a deflection of less than 20mm.

As a result, it is risk-free.

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