iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** V **Month of publication:** May 2023

DOI: https://doi.org/10.22214/ijraset.2023.51523

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

Effect of Wind on Building Frame Resting on Sloping Ground and Analysis using ETABS

Rizwan Khan[1], Dr. Samyak Parekar[2]
[1]P.G. Student M-Tech Structural Engineering, of G. H. Raisoni University, Saikheda, India.
[2]Professor, G. H. Raisoni University, Saikheda, India.

***Abstract:** Today, the primary responsibility of a structural or civil engineer is structural design. As of right now, a variety of factors are taken into account while constructing a structure, and these factors have an impact on the longevity, quality, and functionality of the building. In the modern world, structures are designed using software. Staad pro and Etabs are two examples of modern software that is utilized on a daily basis. So, in this project, we'll plan, design, and use Etabs to analyze a residential G+8 building.*

The major consideration of this project is depending on the wind criteria on the sloping ground there were three structures we have considered, and all these three structures is resting on 4 slopes. The four slopes which we are considered are 0, 5, 10, 15 degrees respectively. And we are going to analyze the structure that which structure is going to give us the best possible result.

***Keywords:** Analysis, Designing, Planning, Etabs, Loading calculations, Wind loads.*

I. INTRODUCTION

The primary area of civil engineering is structural analysis and design. The key portion of the process is the designing and analyzing, and if we were to solve these portions manually, it would take a lot of time and increase the likelihood of error. As a result, in the modern world, software is employed for planning, design, and analysis purposes. Today, AutoCAD is frequently used for planning, and Excel is frequently used for calculations, but it can be difficult to finish calculations in Excel, so we will design our G+8 Residential building on Etabs. Due to its use in the "Burj Khalifa" Dubai, the world's tallest structure, Etabs software is more popular today.

Generally, in hilly areas the wind load and earthquake load effects a structure more than any other loads. Hence it is important to analyze that at which slope we are getting satisfactory result and in which we didn't get the acceptable results.

The major issue which is comes under the designing are storey drift and storey displacement let now focus on these two terms. That what are they?

1) *Storey Drift:* The storey drift is defined as the displacement of particular floor to the height from the ground and sometimes in this case time period is very essential for studies of earthquake engineering.
2) *Storey Drift:* It's miles general relocation of its Story with appreciate to floor and there's most extreme admissible confine endorsed in IS codes for homes. Storey relocation is totally the expense of uprooting of the Story beneath development of the horizontal powers. The absolute removals ought to be controlled to alleviate the outcomes of optional PDELTA results and normal equilibrium of the building.

II. PROBLEM STATEMENT

1) Multistory building structures with sloping floors are rapidly emerging in modern times. Urbanization and the growing need for housing are pushing developers into sloped land.
2) The main factor affecting a building resting on sloped terrain is wind, which creates waft and oscillations.
3) Construction on a sloped floor must overcome this wind effect and provide a more functional and efficient design. Structural engineers must constantly strive for the most efficient and logical designs possible.

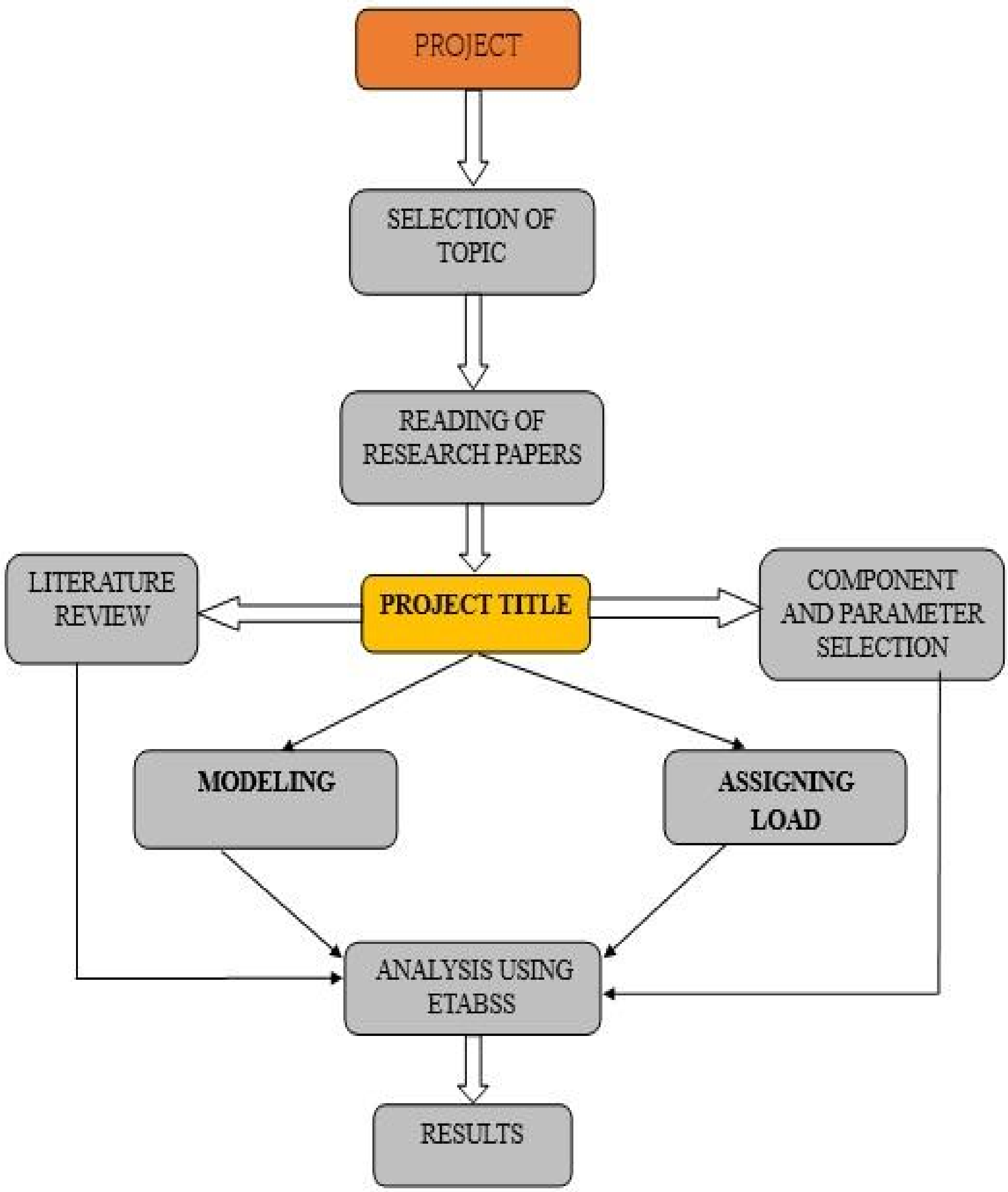
III. AIM

1) To investigate the effects of slope and wind on building frames so that, despite projected wind deflection, the structure can endure excessive wind loads throughout its duration.
2) To investigate the effects of Storey displacement and Storey drift on a building frame lying on sloping ground.
3) Wind's effect on building rests on flat and sloping ground is compared.
4) To investigate a structural engineering approach

IV. OBJECTIVES

1) To compare the Wind's effect on building rests on flat and sloping ground
2) To study the effect of wind velocity on a building with a 0-degree sloped footing level.
3) To study the impact of wind speed on a building with a 5°, 10° or 15° sloping footing level.
4) In the discipline of structural engineering, there is a method for professional practice.
5) To study the impact of wind on three various building frame heights on sloping ground. As per IS 875 (part 3):1987.

V. METHODOLOGY



The Details of the structure:

Three frames (8 storey, 10 storey and 12 storey) with 5 bays in x and y direction is considered.

1) The properties of the material which is provided in our structure.
   a) *Beam and column size = 350*350 mm*
   b) *Slab thickness= 150 mm*
   c) *Density of RCC = 25 kN/m³*
   d) *Density of Masonry =20 kN/m³*
   e) *Grade of concrete = M30*
   f) *Grade of steel = Fe415*
2) Dead load due to exterior wall, interior wall, partition wall, floor, parapet walls are calculated and assigned. Live load of 3 kN/m² is assigned on each floor.
3) Calculation and assigning of wind load are done as per is-code 875 (part-III):1987

$$V_z = \mathbf{V_b\ k_1\ k_2\ k_3}$$

4) *Vb =design wind speed at any height* z in m/s = (39 m/s, 44 m/s, 49 m/s)
5) *kl= risk coefficient* (see 5.3.2.2) = 0.83 (for 24m) & 0.93 (for 30m)
6) *k2 = terrain, height and structure size* factor (see 5.3.2) = (1)
7) k3 = topography factor (see 5.3.3) = (1)
8) Terrain category = 4
9) Structure class = B
10) Wind load is assigned as per clause 6.2.2.1, table number 4.

Analysis of 24 cases of 8 storey and 10 storey building frame resting on 0°, 5°, 10°, 15° for wind speed 39m/s, 44m/s, 47m/s is done respectively. Maximum storey displacement and drift are analyzed for a WLx, WLy and load combination of 1.2 (DL+ LL+ WL)

A. Loading Combination

The shape has been analyzed for load mixtures thinking about all the preceding masses in proper ratio. Combination of self-weight, lifeless load, live load and seismic load changed into taken into consideration in line with IS-code 875(Part 5).

VI. WORK DONE

A. Storey Building Frames

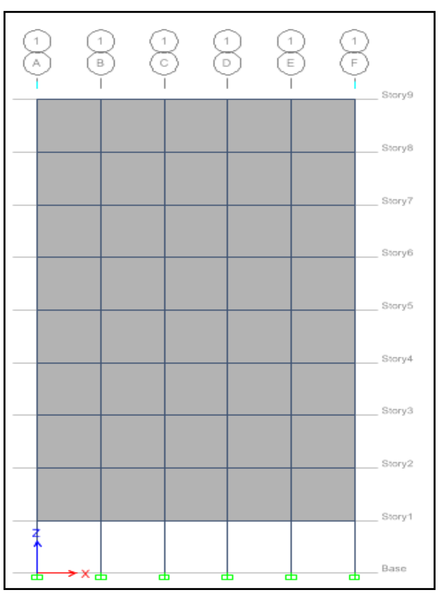


Fig. 2 Storey Building Frame at 0°

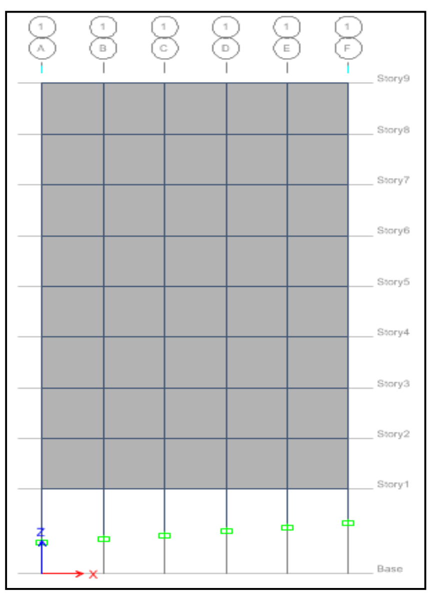


Fig.3 Storey Building Frame at 0°

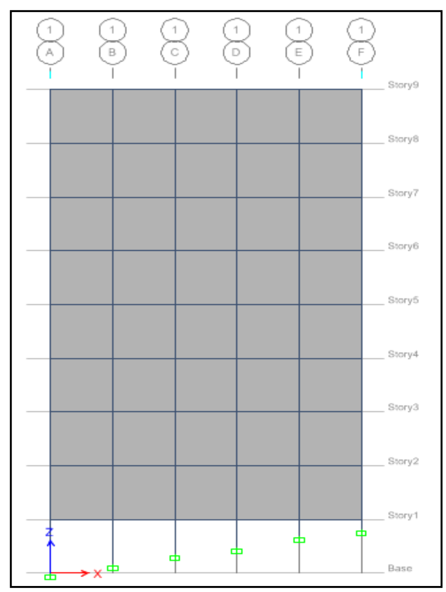


Fig.4 Storey Building Frame at 0°

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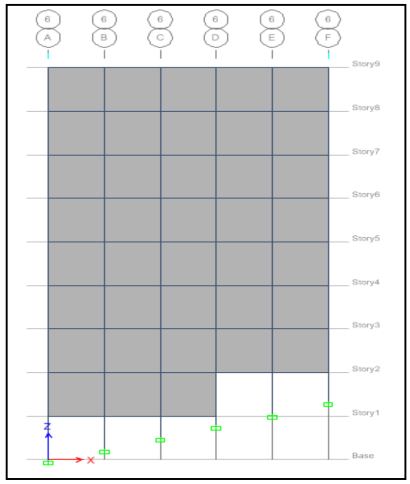
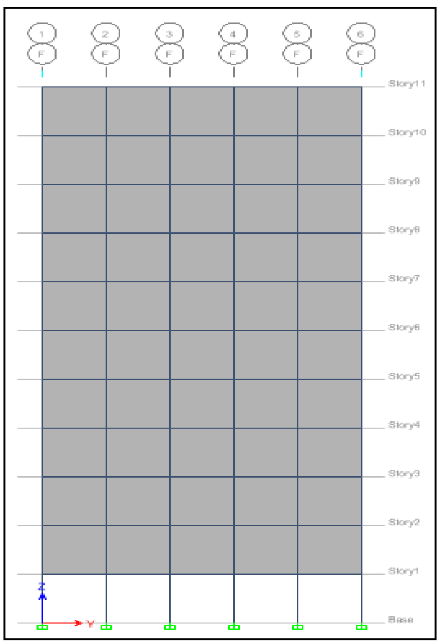
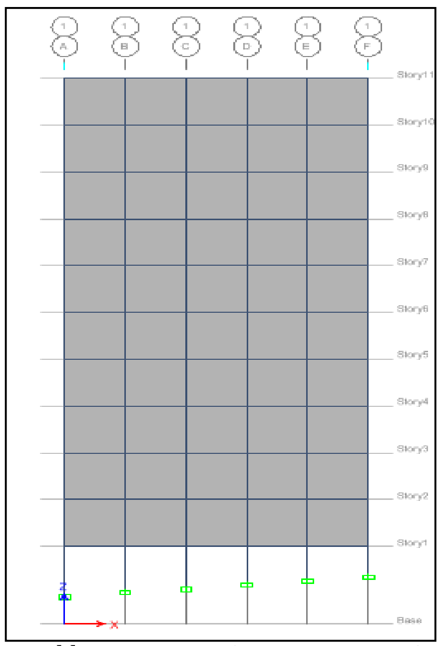


Fig.5 Storey Building Frame at 15°

B. Storey Building Frames





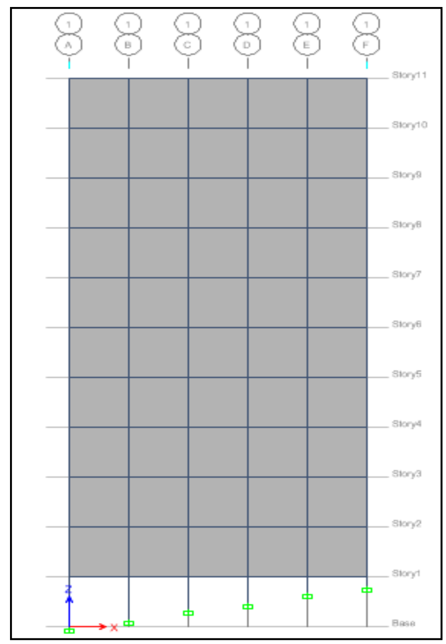
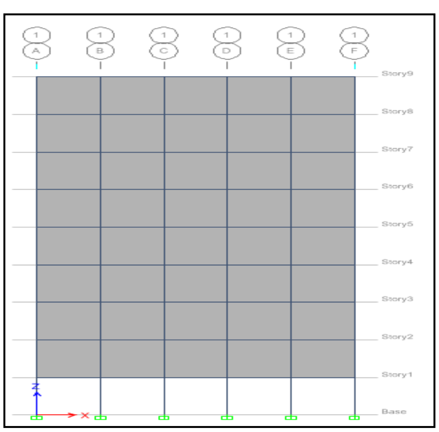


Fig.6 Storey Building Frame at 0° Fig.7 Storey Building Frame at 5° Fig.8 Storey Building Frame at 10°



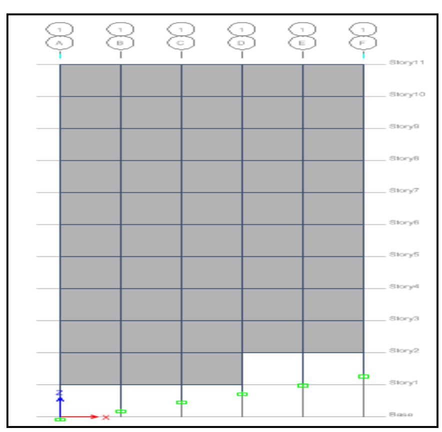


Fig.9 Storey Building Frame at 15°

C. Storey Building Frames

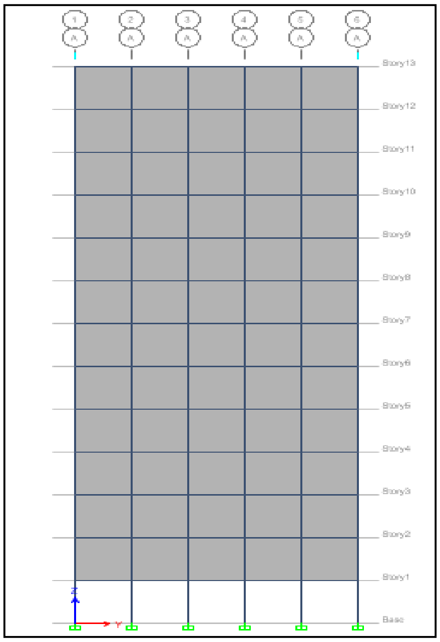


Fig.10 Storey Building Frame at 0°

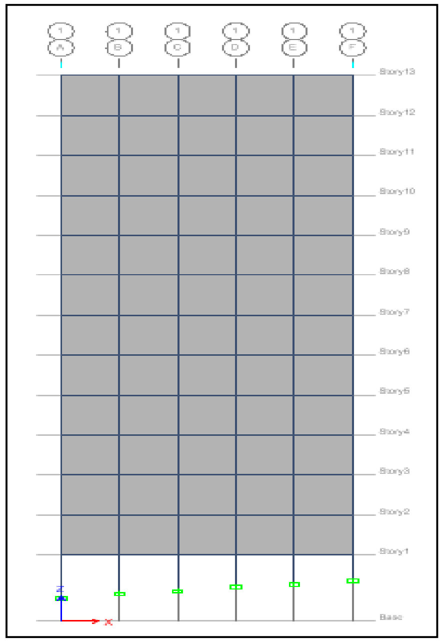


Fig.11 Storey Building Frame at 5°

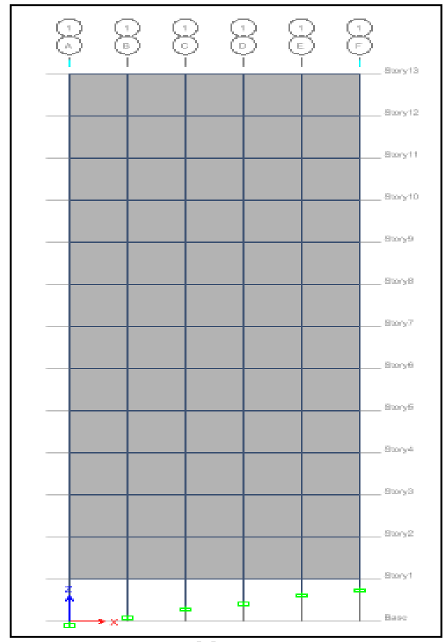


Fig.12 Storey Building Frame at 10°

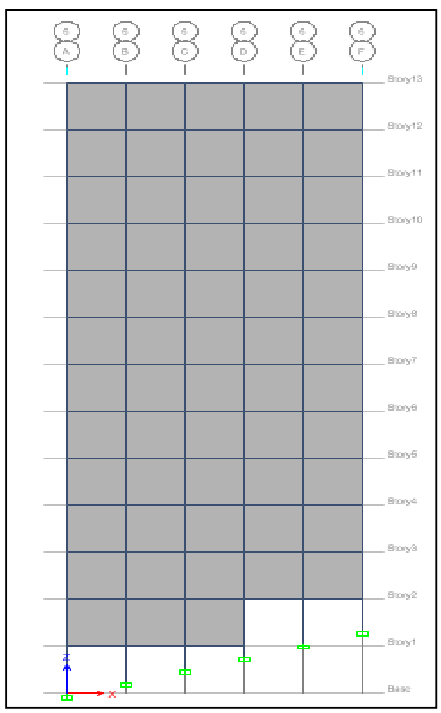


Fig.13 Storey Building Frame at 15°

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D. Models On E-Tabs

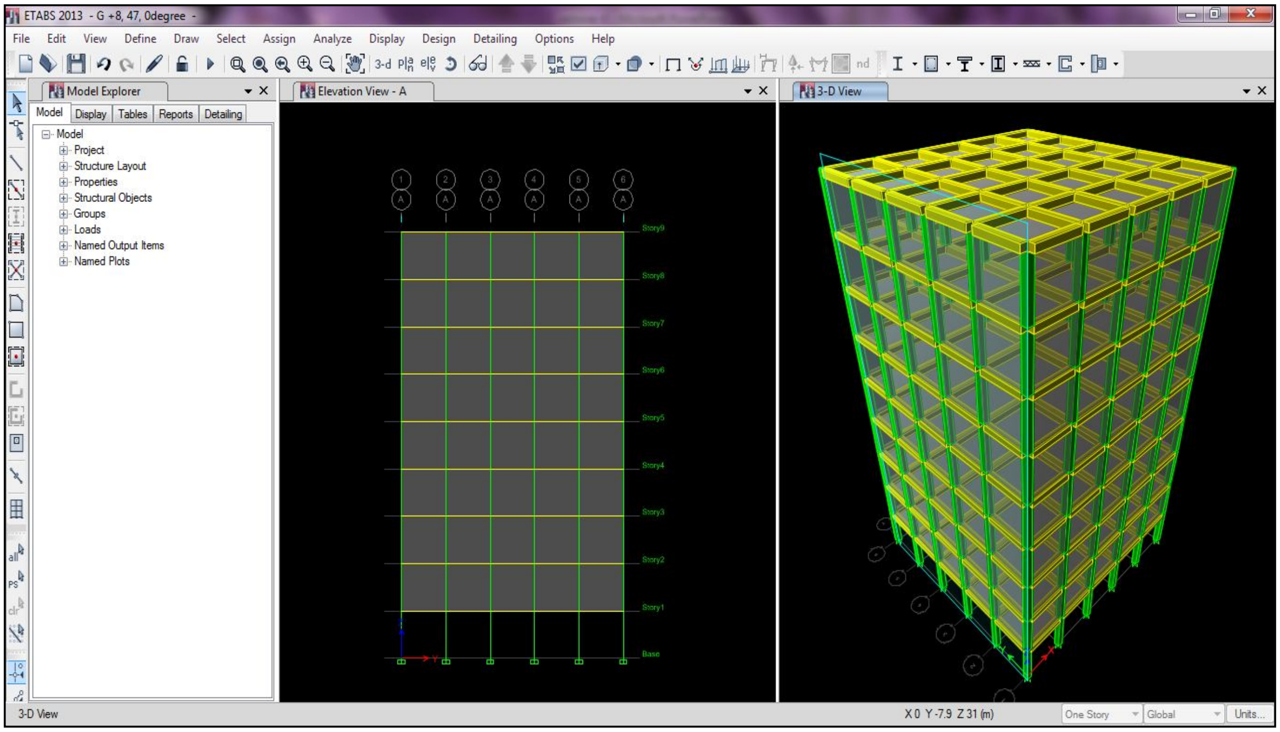


Fig.14 G+8 Storey Building

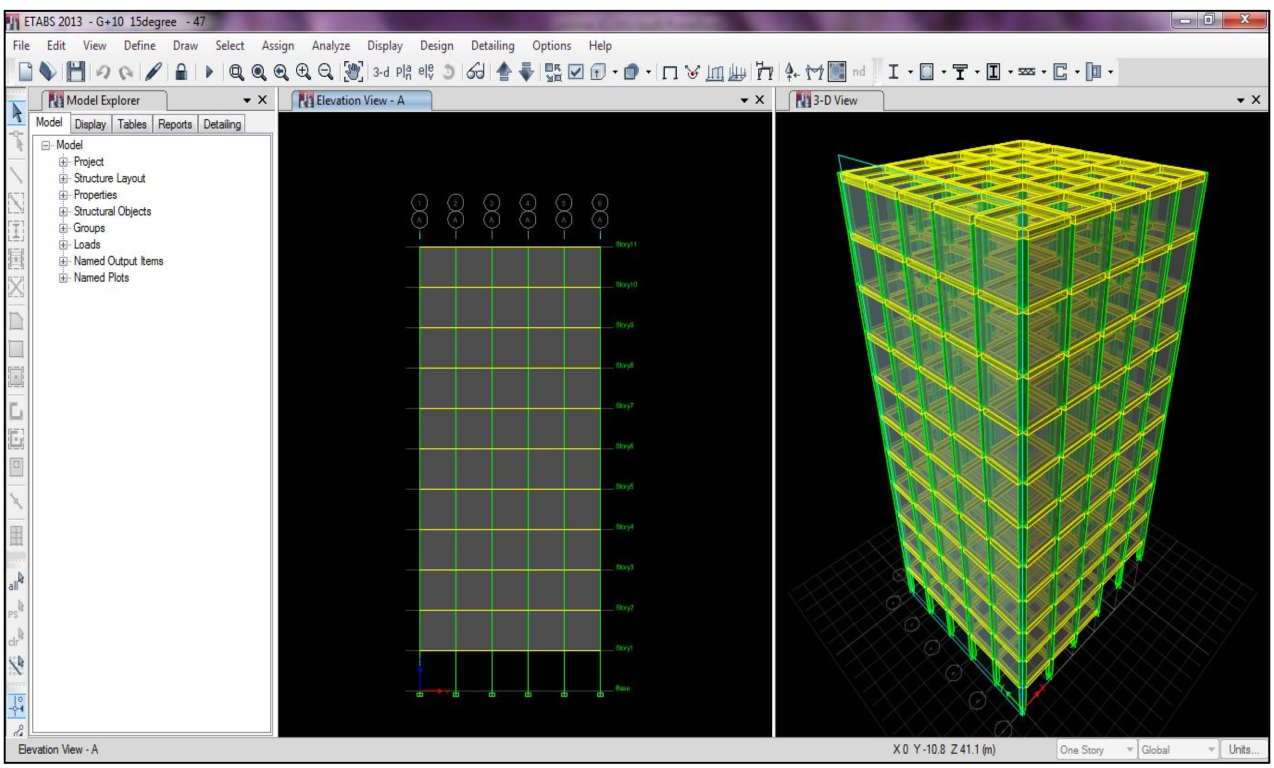


Fig.15 G+10 Storey Building

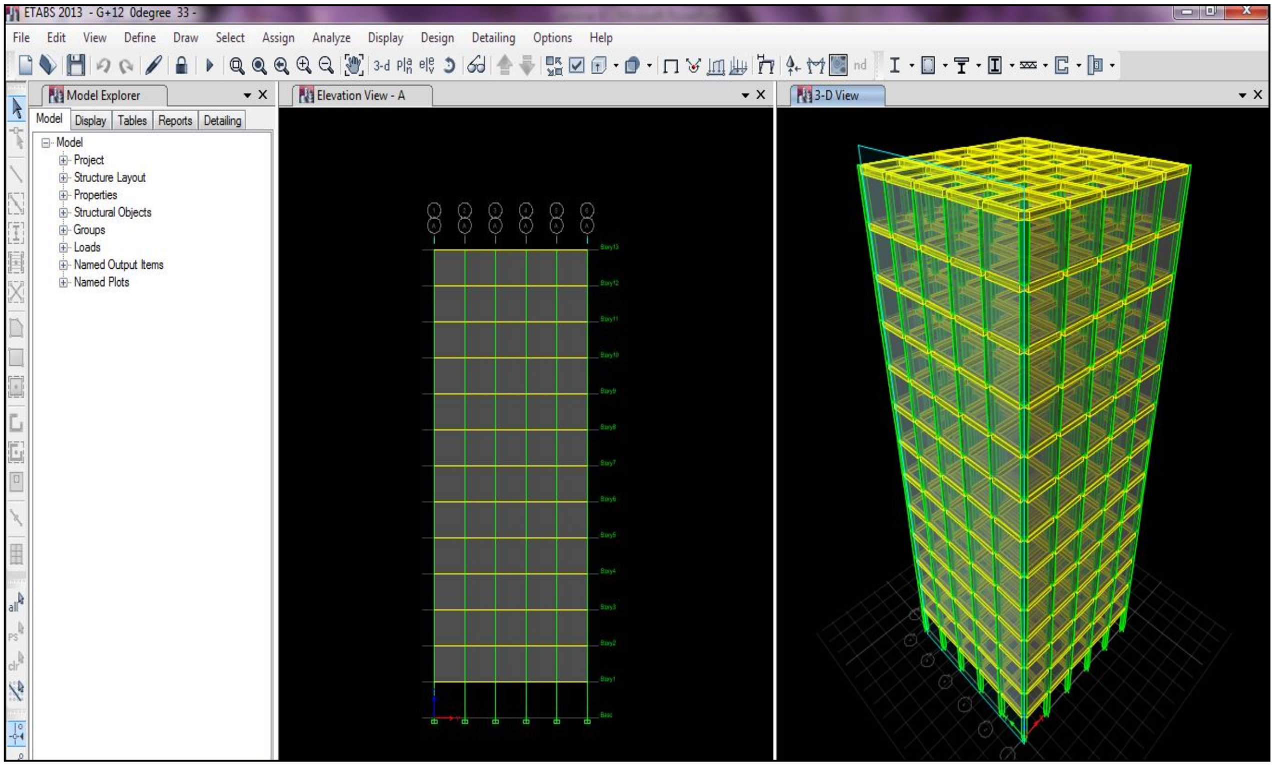


Fig.16 G+12 Storey Building

E. Earthquake Loads

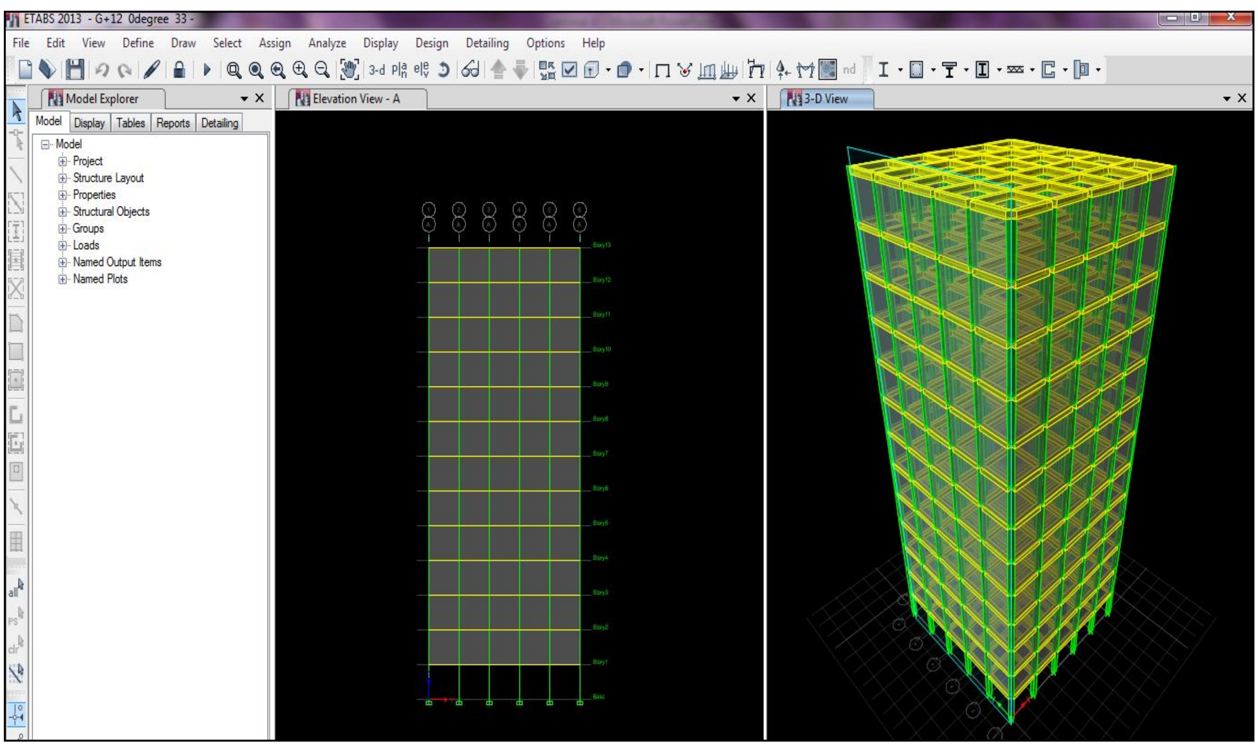


Fig.17 Wind Load WLx

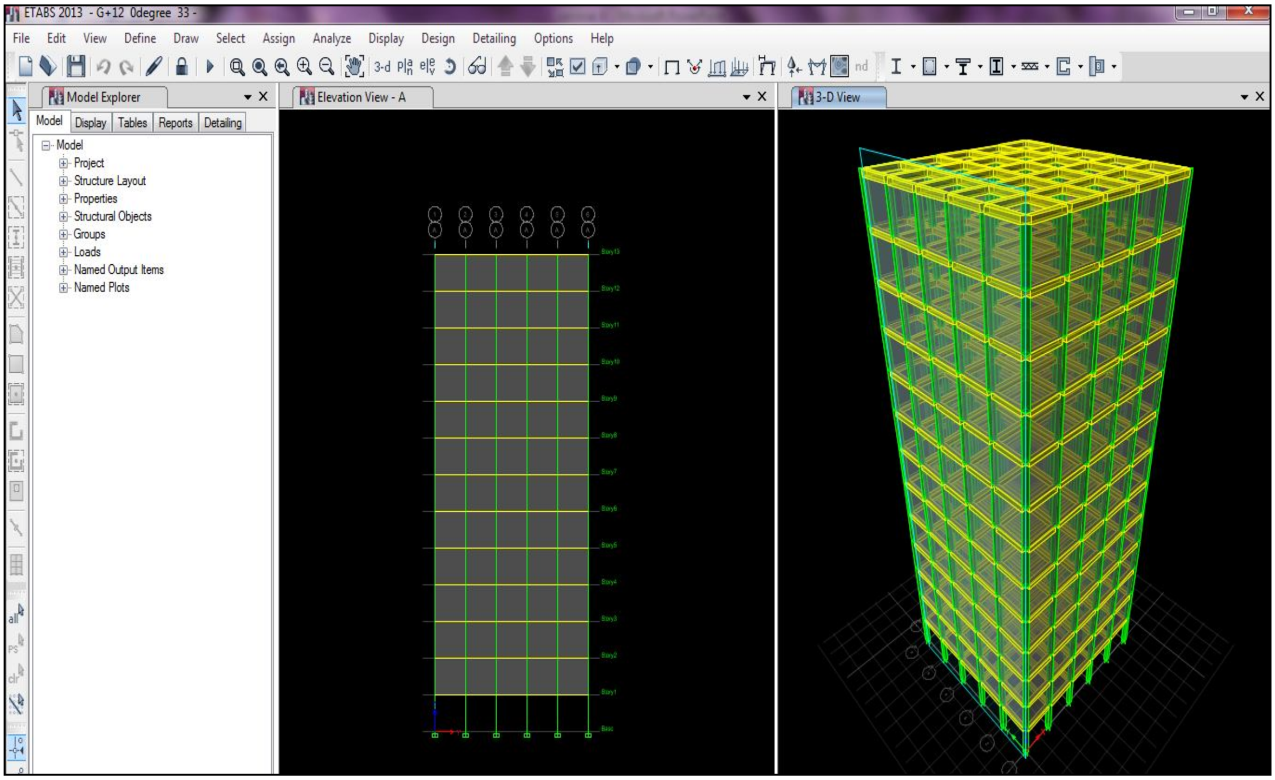
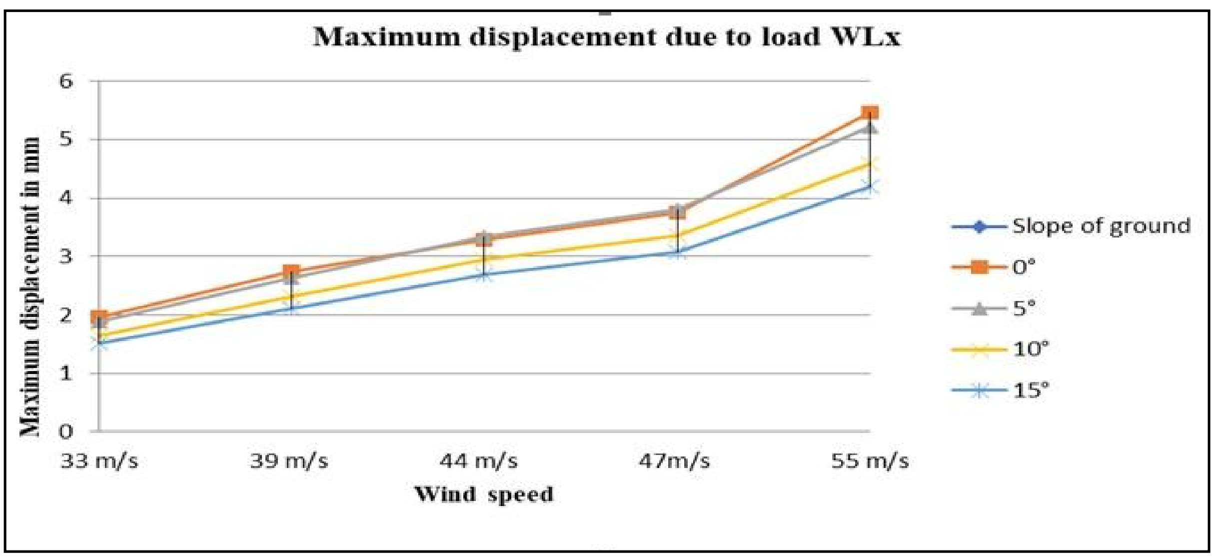


Fig.18 Wind Load WLy

VII. RESULTS

A. Maximum Displacement

Maximum Displacement in 8 storey building frame due to Load WLx



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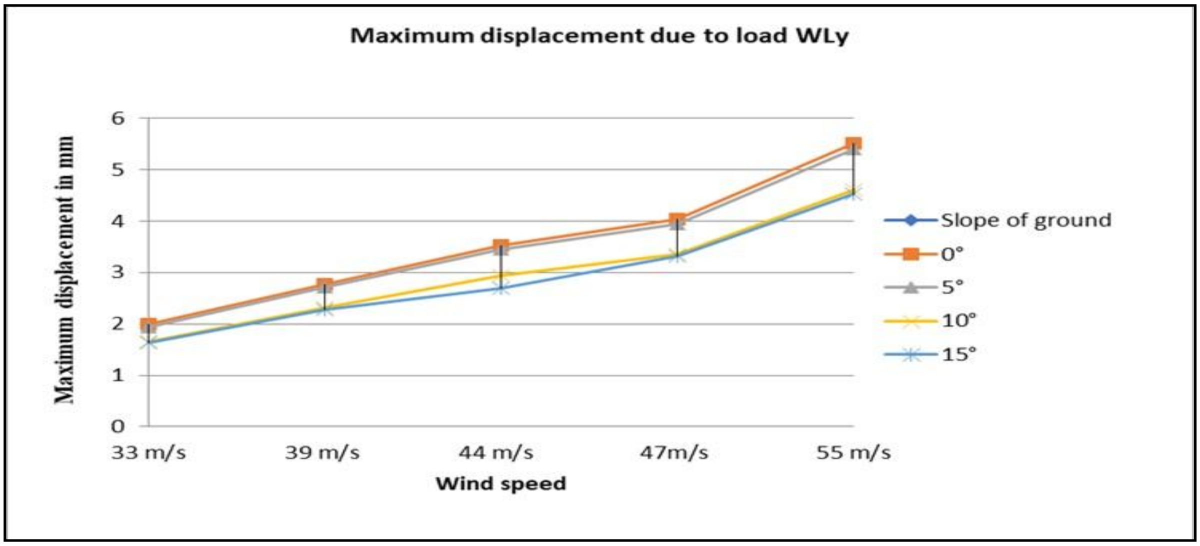
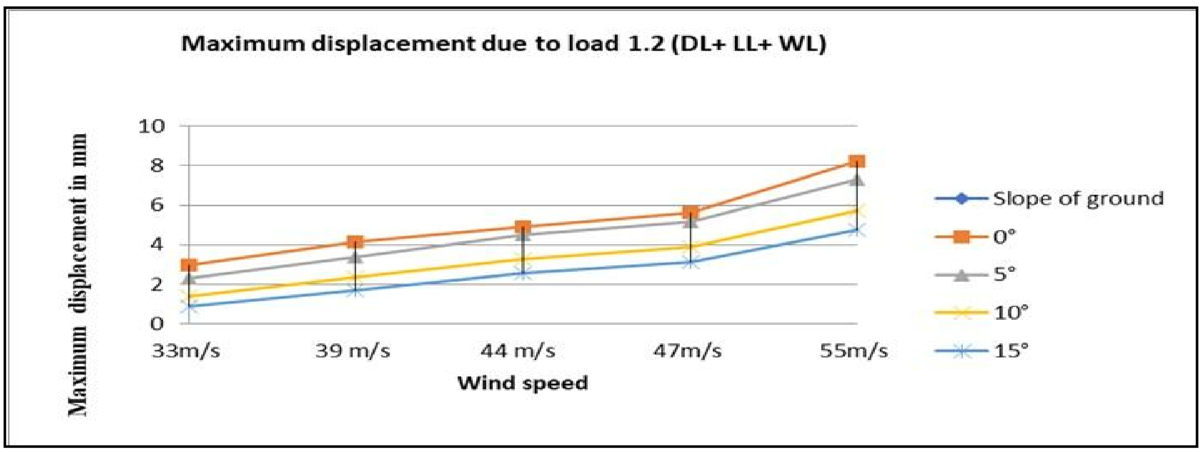
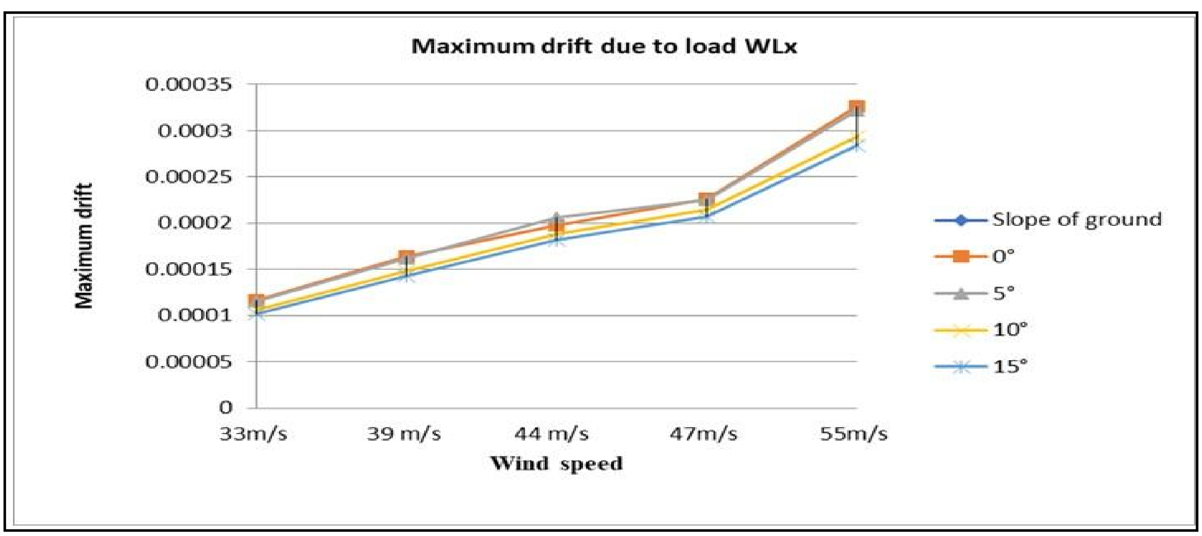
Maximum Displacement in 8 storey building frame due to Load WLy



Maximum Displacement in 8 storey building frame due to load combination of 1.2(DL+LL+WL)



Maximum Displacement in 8 storey building frame due to load combination of 1.2(DL+LL+WL)



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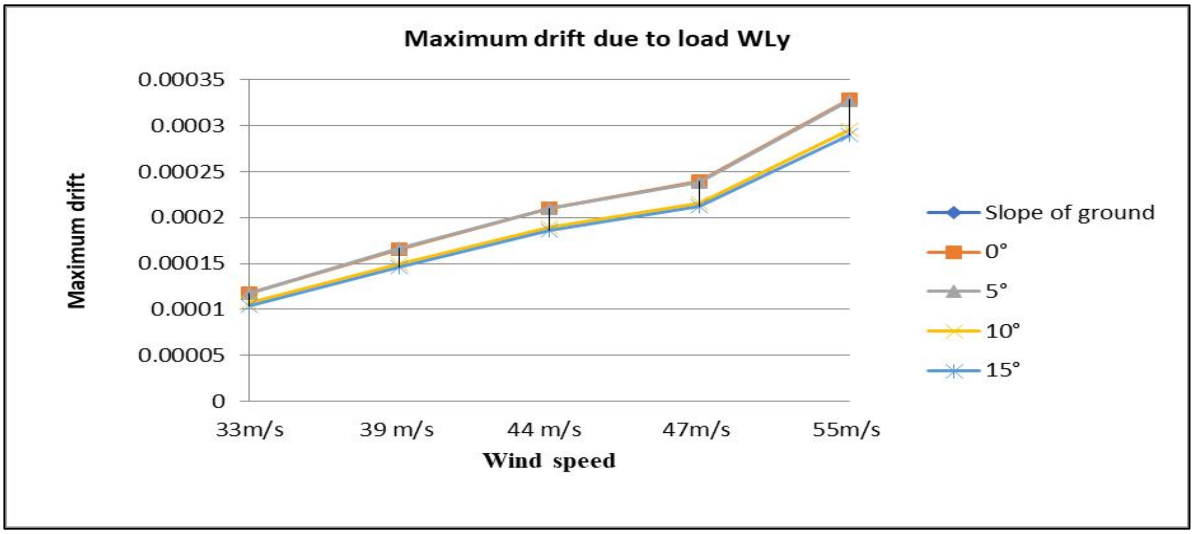
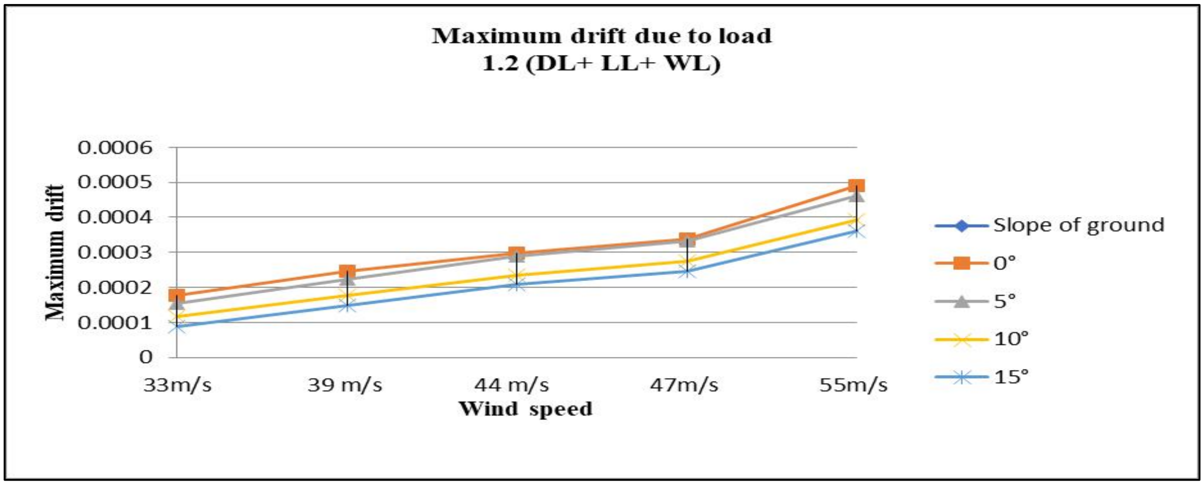
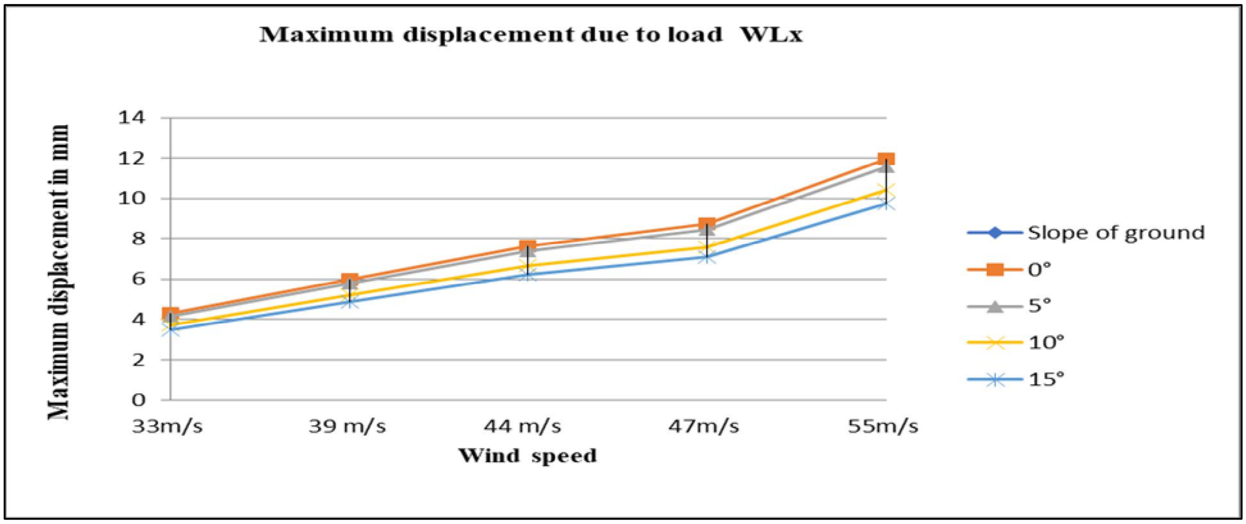
Maximum drift in 8 Storey Building frame due to load WLy



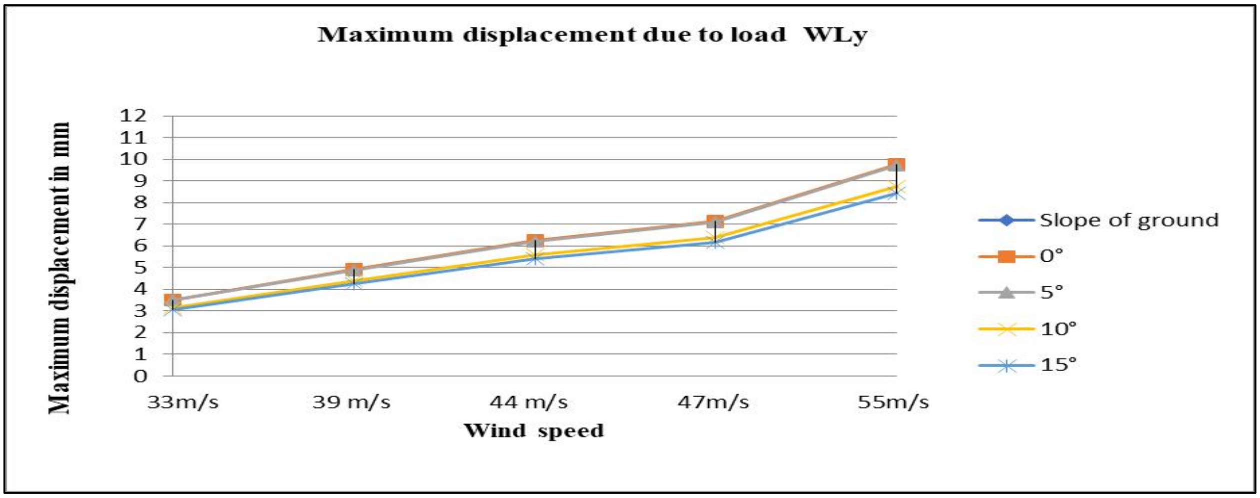
Maximum drift in 8 storey building frame due to load combination of 1.2 (DL+ LL+ WL)



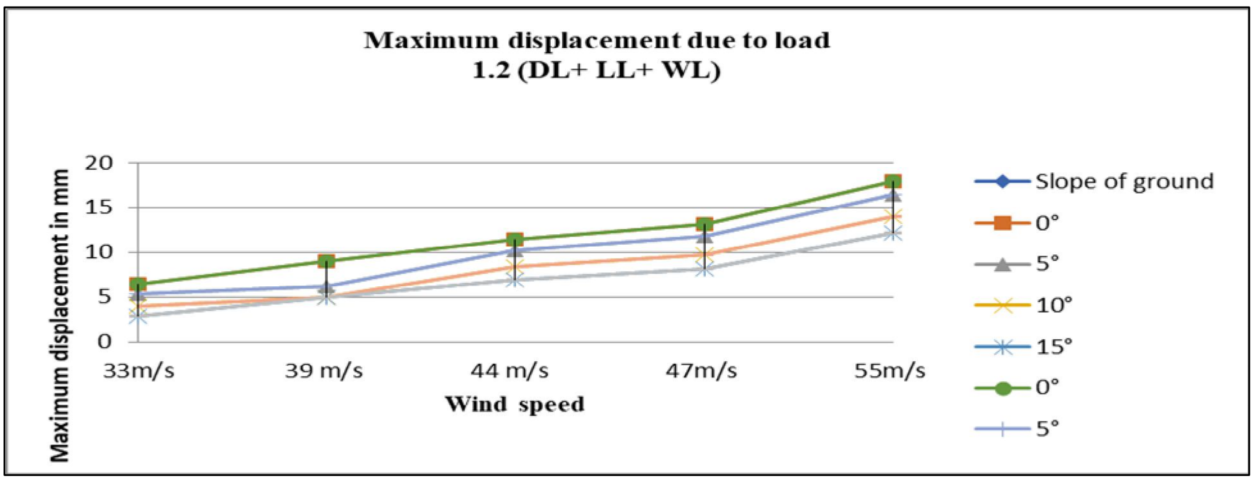
Maximum displacement in 10 Storey Building frame due to load WLx



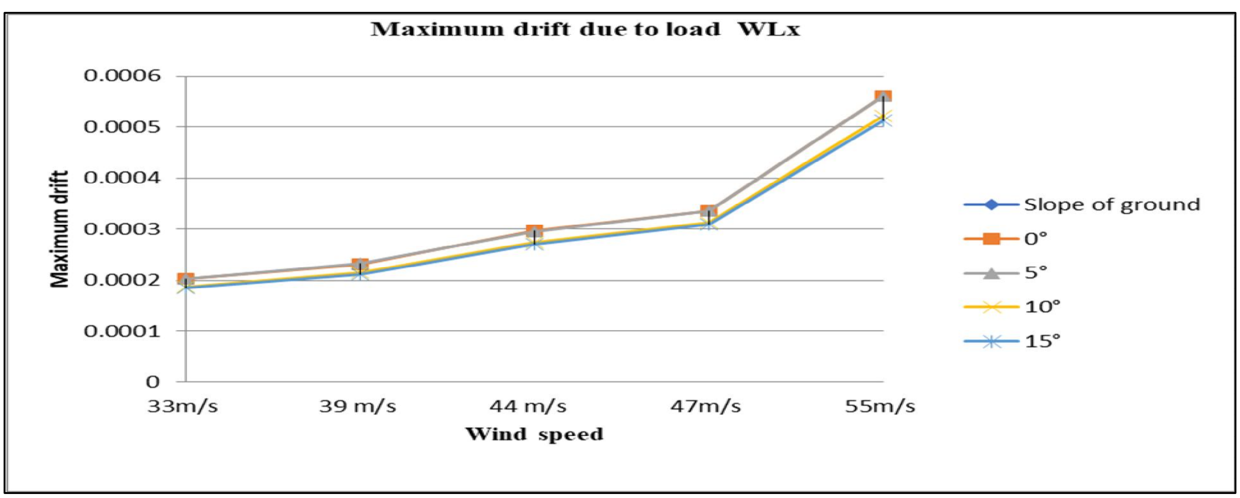
Maximum displacement in 10 Storey Building frame due to load WLy



Maximum displacement in 10 storey building frame due to load combination of 1.2 (DL+ LL+ WL)



Maximum drift in 10 Storey Building frame due to load WLx



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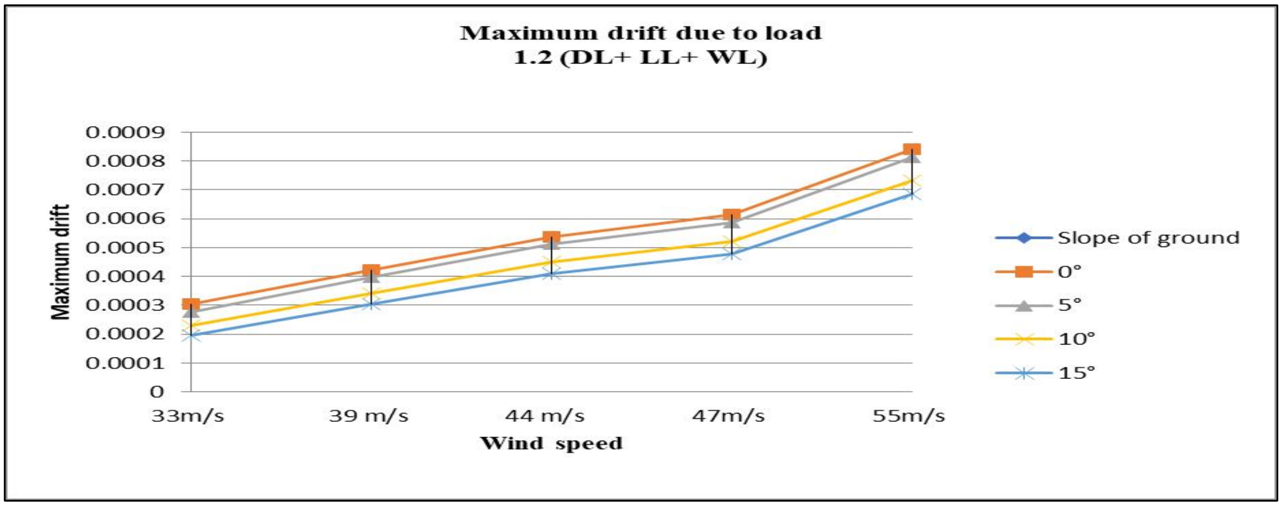
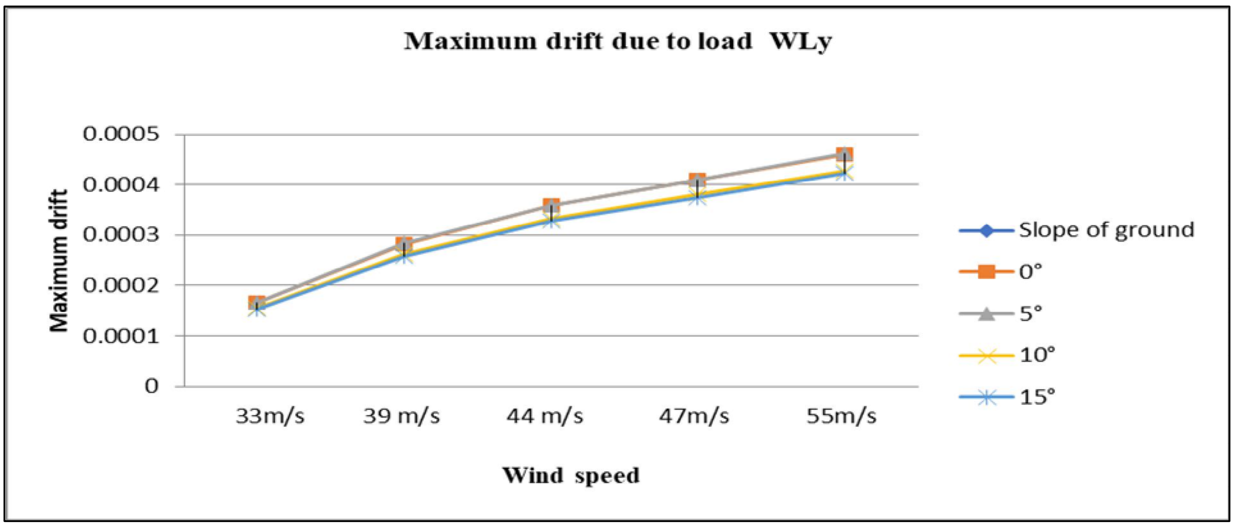
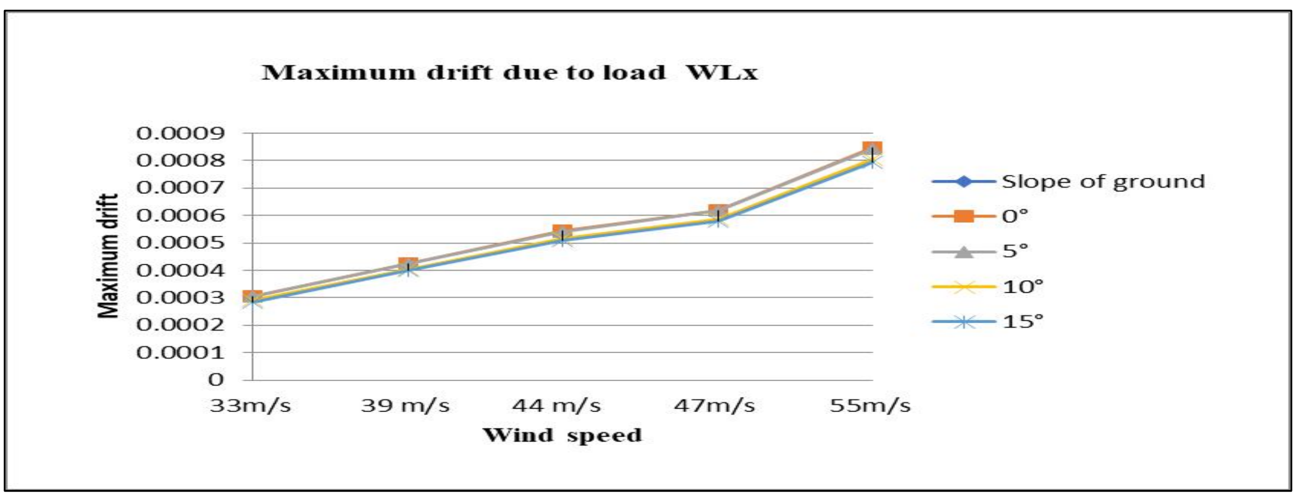
Maximum drift in 10 Storey Building frame due to load WLy



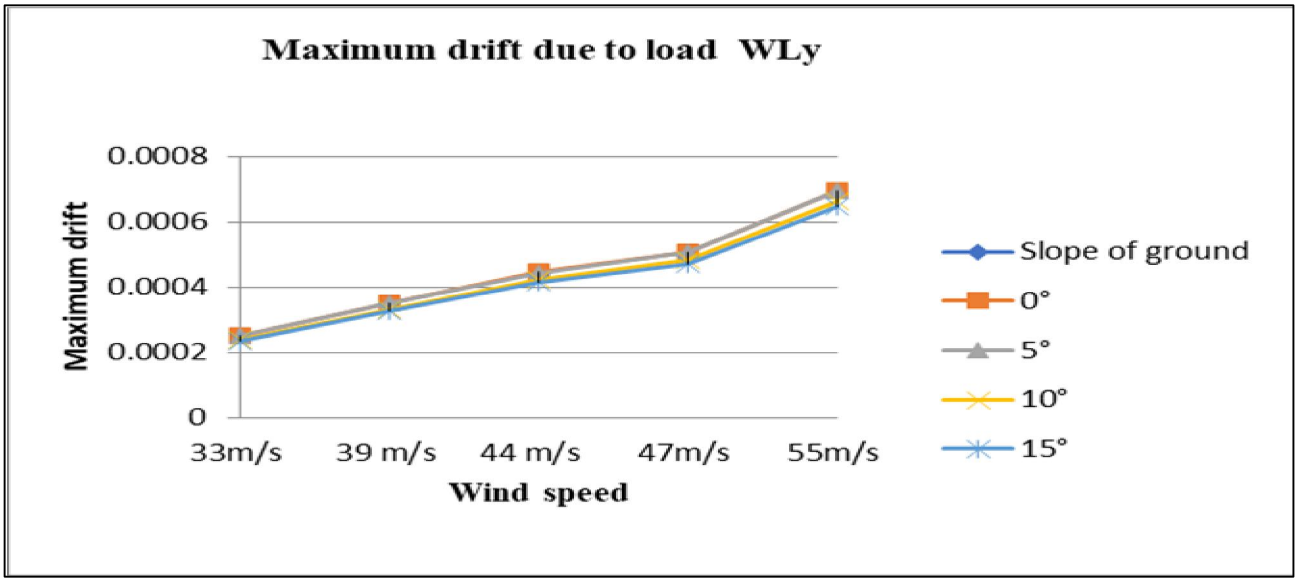
Maximum drift in 10 storey building frame due to load combination of 1.2 (DL+ LL+ WL)



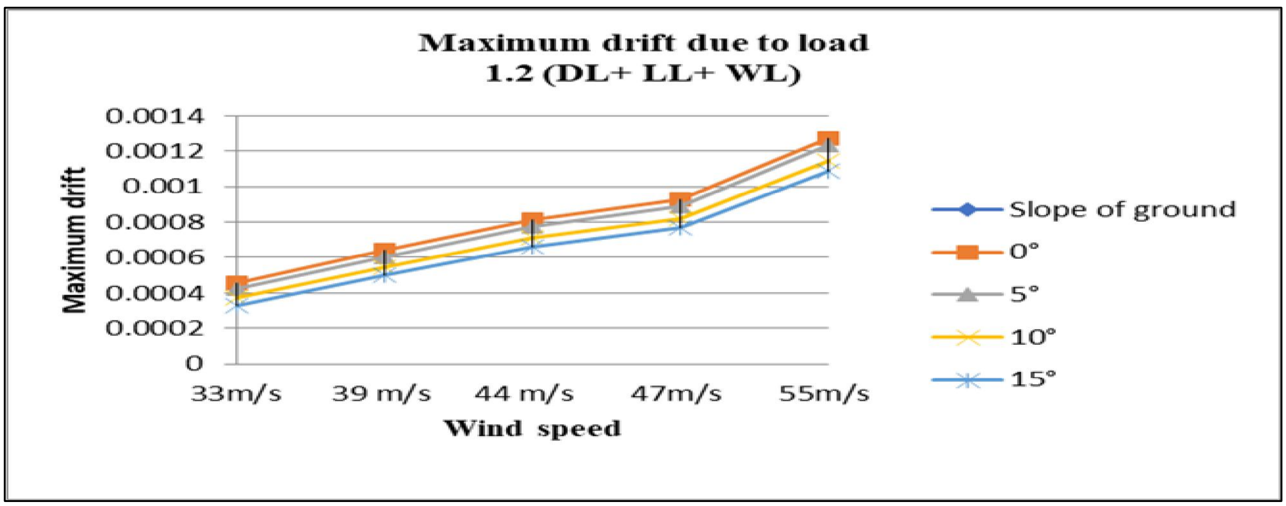
Maximum drift in 12 Storey Building frame due to load WLx



Maximum drift in 12 Storey Building frame due to load WLy



Maximum drift in 12 storey building frame due to load combination of 1.2 (DL+ LL+ WL)



VIII. CONCLUSION

Conclusion of the project is that:

1) When we growth the wind velocity it's far discovered that the most Storey displacement values increase with that of wind velocity for wind load WLx, WLy and load mixture 1.2(DL+LL+WL).
2) It is observed that the most Storey displacement value decreases with increase in slope.
3) Maximum Storey displacement increases with growth in top of building due to wind load WLx, WLy and load mixture 1.2(DL+LL+WL) for 8 Storey, 10 Storey and 12 Storey constructing frames.
4) Similarly, when we boom the wind velocity its miles observed that the maximum Storey drift values growth with that of wind speed for wind load WLx, WLy and load mixture 1.2(DL+LL+WL).
5) It is located that through changing slope most Storey drift has most effective a small change it does no longer show a slow growth or decrease.
6) Maximum Storey drift increases with boom in top of building due to wind load WLx, WLy and load mixture 1.2(DL+LL+WL) for 8 Storey, 10 Storey and 12 Storey constructing frames.

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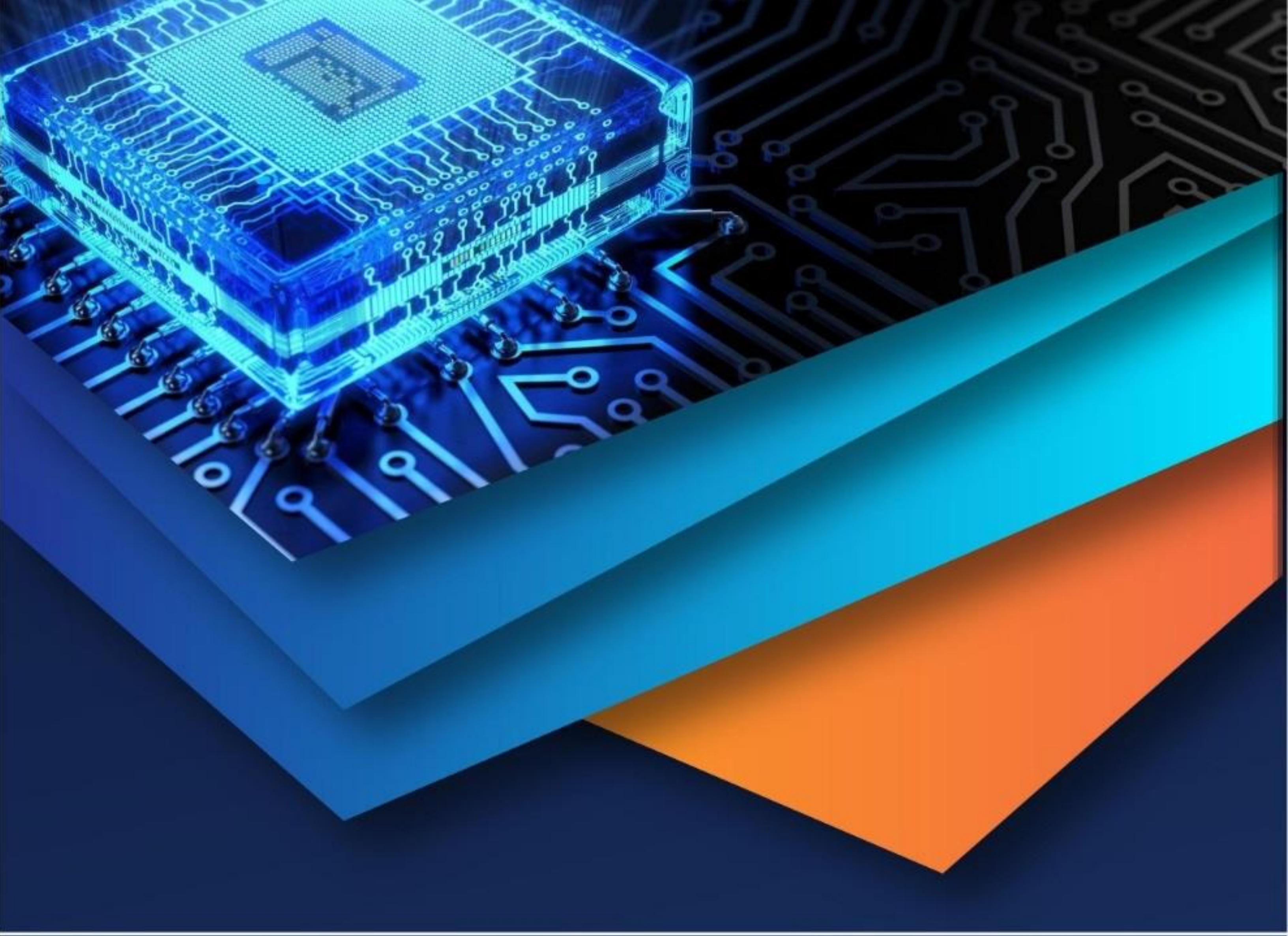

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