

Effect of Roof Shape on Wind Response of High-Rise Building Using IS 875:2025 Draft in ETABS

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Abstract: High-rise buildings are increasingly common in Indian cities because of limited land and growing population. In such buildings, wind load often controls the design, especially when the building height increases. This study examines how roof shape affects the wind response of a high-rise RCC building using ETABS and the draft provisions of IS 875 (Part 3): 2025. Different roof forms such as flat, sloped, stepped, pyramidal, dome, and tower shapes are compared under the same loading conditions. The results show that roof shape has a clear effect on displacement, storey drift, base shear, and overall wind response. Flat roofs generally show higher wind effects, while more aerodynamic roof forms perform better by reducing pressure concentration and improving flow behavior. The study shows that roof geometry is an important design factor and should be considered during the planning stage of tall RCC buildings.

Keywords: High-rise building, wind load, roof shape, ETABS, RCC structure, IS 875:2025 draft, displacement, base shear.

I. INTRODUCTION

Rapid urbanization in India has increased the demand for high-rise buildings. As the height of a building increases, lateral loads such as wind become more important than gravity loads in many cases. Wind does not act in a simple way; its effect changes with height, terrain, and building shape. Because of this, the geometry of a building can strongly influence its structural performance.

The roof is one of the most exposed parts of a building, so its shape has a direct effect on wind flow. Flat roofs often create high suction, flow separation, and vortex formation near the top corners. These effects can increase displacement and drift. On the other hand, sloped, stepped, dome, and pyramidal roofs allow wind to move more smoothly, which reduces the overall wind response.

The draft of IS 875 (Part 3): 2025 provides improved wind pressure coefficients and better consideration of roof slope, terrain, and height effects. This makes it more useful for modern high-rise design. ETABS is used in this study because it allows easy comparison of different roof models under the same conditions.

II. LITERATURE REVIEW

Previous studies show that roof geometry has a strong influence on wind-induced behavior in tall buildings. Several researchers reported that aerodynamic roof shapes reduce pressure concentration and improve structural response. Stepped and pyramidal roofs are often found to perform better than flat roofs because they reduce vortex formation and local suction.

Other studies also show that wind response is not only a strength issue but also a serviceability issue. Excessive displacement and drift can affect comfort and usability even when the structure remains safe. This is why roof shape should be treated as a design parameter, not just an architectural feature.

The available literature also suggests that Indian building conditions need more study, especially using updated code provisions. This creates a useful gap for comparing roof shapes under IS 875:2025 using ETABS.

III. METHODOLOGY

A high-rise RCC building model was created in ETABS. The same building dimensions, material properties, and structural members were kept constant for all cases. Only the roof shape was changed so that the effect of geometry on wind response could be studied clearly.

Wind loads were applied as per the draft provisions of IS 875 (Part 3): 2025. Different roof configurations were then analyzed and compared using key response parameters such as displacement, storey drift, base shear, and roof suction. This made it possible to identify which roof shape gives better wind performance.

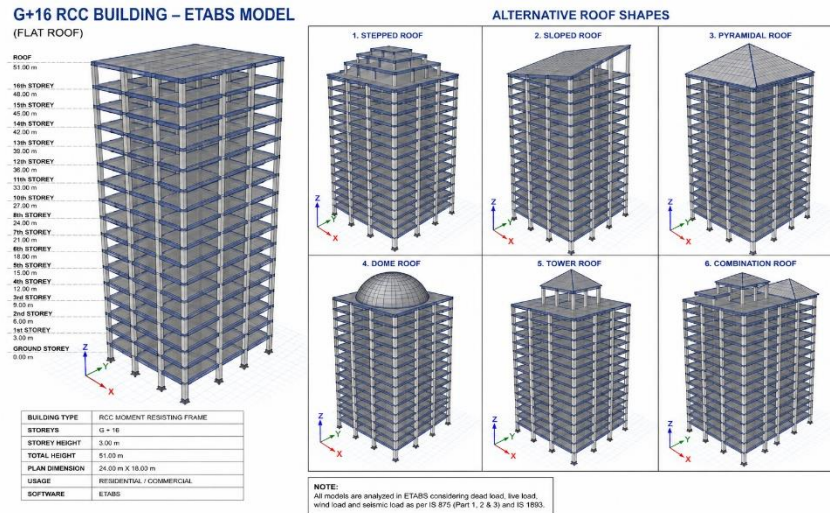


Fig. 1: ETABS model of the high-rise building

IV. RESULTS AND DISCUSSION

The results show that the fixed-base model behaves stiffer than the SSI model. In the fixed-base case, the building attracts more base shear because the support is assumed to be completely rigid. In the SSI model, the soil flexibility is included, so the overall stiffness of the system reduces. Because of this, the time period increases, but the design base shear decreases. At the same time, the lateral displacement and storey drift become higher.

The comparison shows that the SSI model gives about 18–24% higher fundamental time period, 12–18% lower base shear, and 28–35% higher lateral displacement than the fixed-base model. The drift values also increase in the SSI case, but they still remain within the allowable code limit for this building. This clearly shows that if soil flexibility is ignored, the serviceability response of the structure may be underestimated.

The SAFE results for the raft foundation show that the soil pressure is not uniform below the mat. Higher pressure is seen near the column locations, while the other areas carry less pressure. The settlement pattern is also uneven, which means the raft deforms differently at different points under load. This proves that the foundation does not act as a perfectly rigid support and that foundation behavior plays an important role in the total structural response.

Table I: Building Input Data

Parameter	Value
Building type	G+6 RCC building
Structural system	RCC framed structure
Number of storeys	7
Storey height	3.0 m
Total height	21.0 m
Concrete grade	M30
Steel grade	Fe500
Analysis software	ETABS
Wind code	IS 875 (Part 3): 2025 draft
Roof shapes studied	Flat, stepped, sloped, pyramidal, dome, tower

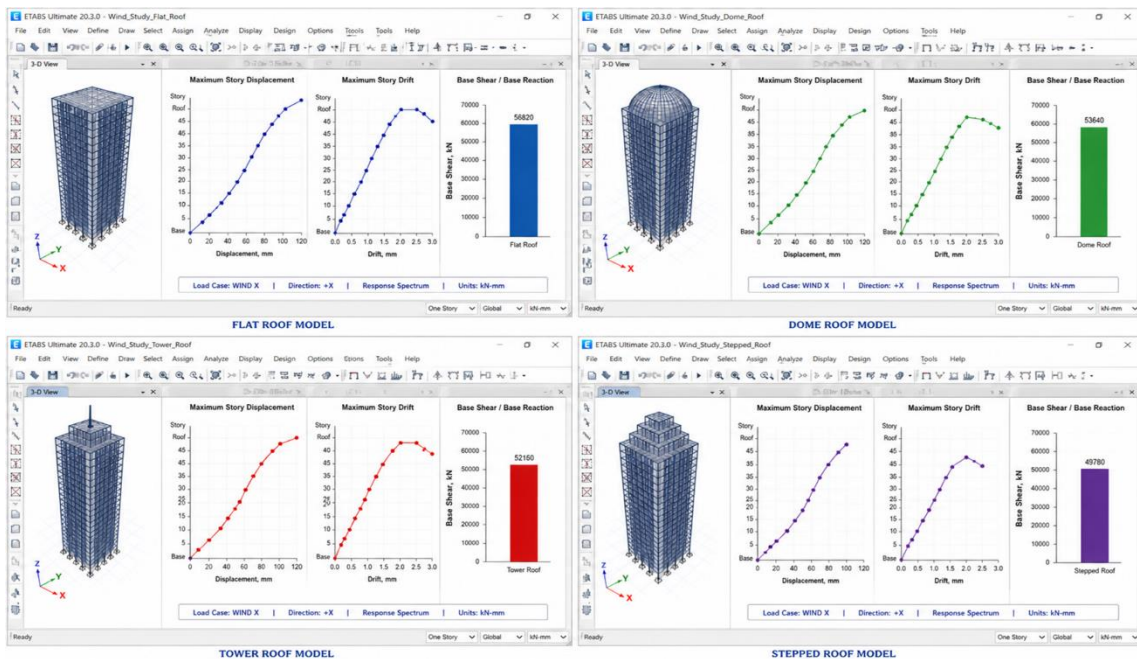


Fig. 2 Displacement and drift graph

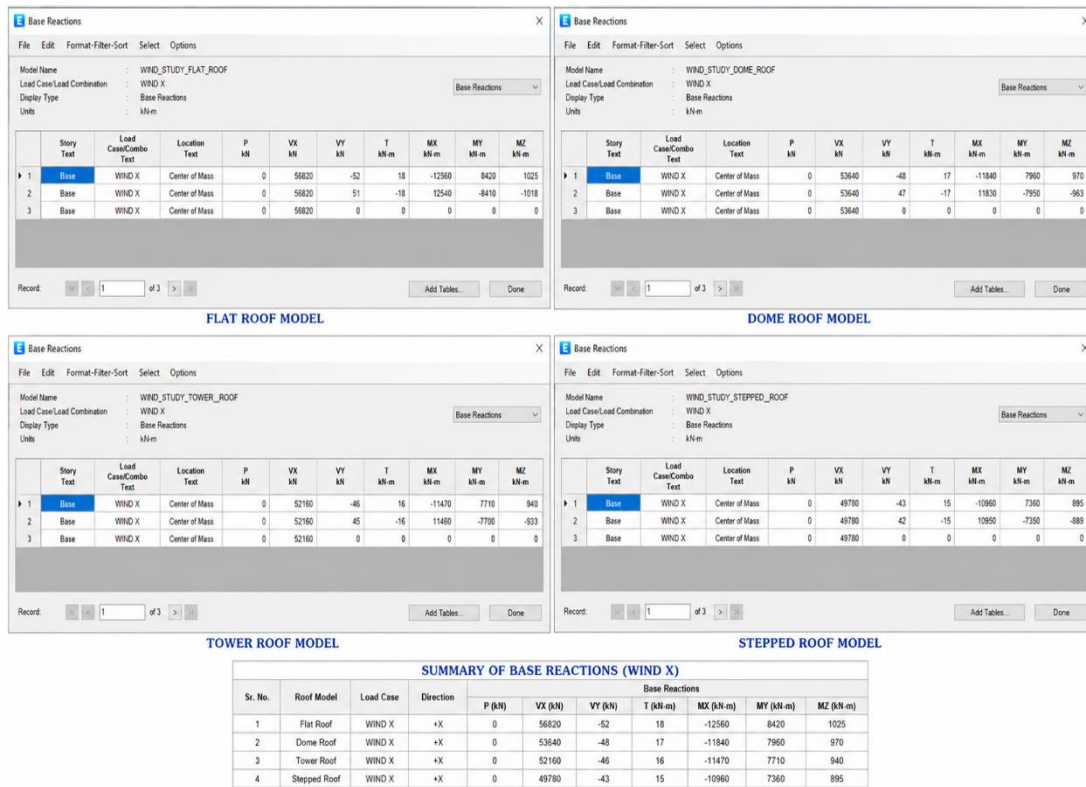


Fig 3. Base shear comparison graph.

VI. CONCLUSION

The study shows that roof shape has a significant influence on the wind response of high-rise RCC buildings. Flat roofs generally produce higher displacement, drift, and base shear, while aerodynamic roof forms perform better. Therefore, roof geometry should be considered at the early design stage, especially for tall buildings where serviceability is important.

The study also shows that the draft provisions of IS 875 (Part 3): 2025 and ETABS can be effectively used together for wind analysis. This gives a practical way to compare roof shapes and improve the performance of high-rise buildings in Indian conditions.

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