ANALYSIS OF G+10 BUILDING WITH AND WITHOUT INFILL WALLS OF EARTHQUAKE EXCITATION BY USING ESTABS

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Introduction:

1. Masonry infill walls are commonly used in reinforced concrete (RC) structures for architectural partitioning and space division.
2. During seismic events, infill walls interact with RC frames, contributing to stiffness, strength, and energy dissipation.
3. It evaluates and compares the seismic performance of bare RC frames and infilled frames using ETABS, in accordance with IS 1893:2016.
4. The outcomes will help in assessing whether modeling infills can lead to safer, more economical, and realistic design practices in earthquake-prone areas.

Objectives:

1. Structural Modeling:
    a. To generate a 3D structural model of a G+10 Reinforced Concrete (RC) building using ETABS software under two distinct conditions:
    b. Case A: Bare Frame Model (where the mass of the infill is considered, but its stiffness is neglected).
    c. Case B: Infilled Frame Model (where both the mass and the stiffness of the infill walls are considered).
2. Infill Wall Simulation:
    a. To calculate the width of the equivalent diagonal strut for the masonry infill panels based on established guidelines (such as FEMA-356 or IS 1893) and model them appropriately as compression-only members in ETABS.
3. Dynamic Analysis:
    a. To perform a Response Spectrum Analysis on both models in accordance with the Indian Standard IS 1893 (Part 1): 2016 for the specified Seismic Zone.
4. Comparative Assessment:
    a. To evaluate and compare the seismic performance of both the Bare Frame and the Infilled Frame models based on critical parameters, including:

* Fundamental Natural Time Period
* Base Shear
* Maximum Storey Displacement
* Inter-Storey Drift

Methodology:
The project utilizes ETABS for modeling and analysis. Two primary models are developed for comparison:

Model A: Bare Frame

1. Only beams, columns, and slabs are modelled as structural elements.
2. Infill walls are considered only as distributed dead loads on beams. Model B: Infilled Frame (Diagonal Strut Method)
3. The stiffness of the masonry is accounted for using the Equivalent Diagonal Strut method (as per IS 1893:2016 or FEMA 356).
4. The infill wall is replaced by a pin-jointed diagonal member that resists compression, effectively turning the frame into a "truss-like" system.

Result and Conclusion:

Result

1. Storey shear and overturning moment are higher in the infilled frame, meaning the structure attracts more lateral force because of increased stiffness.
2. Storey displacement and drift are much lower with infill, so the building sways less and is more likely to satisfy codal drift limits.
3. The natural time period reduces from 0.75 s to 0.45 s with infill walls, which is consistent with the general principle that stiffer buildings have shorter periods

Parameter	**Bare frame (without infill walls)**	**Infilled frame (with infill walls)**
Storey shear	4352.671 kN	6771.694 kN
Storey displacement	40.783507 mm	13.956952 mm
Storey drift	0.001748	0.000754
Storey overturning moment	5206844 kN·m	582661 kN·m
Natural time period	0.75 s	0.45 s

Conclusion

The analysis focuses on the comparison of the following parameters:

1. Natural Time Period: Infill walls significantly increase stiffness, which decreases the natural time period of the building compared to the bare frame.
2. Storey Displacement: The lateral displacement at the top of the building is drastically reduced in the infilled model due to the bracing effect of the masonry.

3. Storey Drift: Infilled frames show lower inter-story drift, helping to meet the safety limits prescribed by seismic codes (usually $0.004 \times h$).
4. Base Shear: Because the infilled building is stiffer and has a shorter period, the Base Shear (V_b) is typically higher than that of the bare frame.
5. Member Forces: The presence of infills reduces the bending moments in beams and columns but increases the axial forces in columns.

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Future Scope:

1. This study was based on a linear elastic analysis of a regular building
2. For a more comprehensive understanding, future studies could explore:
3. Non-linear analysis to capture the post-cracking behaviour of the infill walls.
4. The effect of openings in the infill walls on the seismic response.
5. The influence of irregular distribution of infill walls in plan and elevation.
6. The out-of-plane behaviour of the infill walls.