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Comparative analysis of multi storey building with Seismic Static and Dynamic (Response Spectrum) actions

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ABSTRACT

Due to a paucity of available space, residential and commercial structures in metropolitan areas need sizable vacant spaces for parking, auditoriums, banquet halls, and other commercial uses. In order to address this issue, high rise buildings were introduced. The 2B+G+14 reinforced concrete building structure is examined in this study utilizing ETABS software along with static and dynamic (Response Spectrum) seismic activities for seismic analysis methods like the equivalent method and modal analysis method in Zone IV. Using the IS code Standard Specification and national building laws, analysis and design have been developed. After analysis it is observed that building with Dynamic (Response Spectrum) seismic actions shown safer results in terms of analysis and design parameters such as base shear, storey drift, storey displacements, overturning moments compared to building with Seismic Static and Dynamic (Response Spectrum) actions.

OBJECTIVE:

The main objectives of the project are:

- The protection of people within and outside of buildings during and after seismic events is the main goal. In order to reduce the risk of collapse or substantial damage, this involves analyzing the possible damage that structures may sustain after an earthquake and constructing them accordingly.
- Create a 2B+G+14 Structure software model using the ETABS program. Assess the structure's resistance to seismic and wind loads.
- To determine the distinction between Base shear, Storey drift, and displacement as seismic parameters.
- To compare the RCC building's performance outcomes with seismic static and dynamic (Response Spectrum) actions.
- Engineers try to forecast how varying amounts of seismic shaking may affect a structure's behavior. They can optimize the design to reach the intended performance levels, such as preventing structural failure or retaining functionality after a seismic event, by knowing how a building or structure will respond to seismic pressures.

- Seismic analysis aids in determining how susceptible existing structures are to earthquakes. Engineers can prioritize upgrades and renovations to lower the danger to life and property by assessing the potential damage and retrofitting requirements.

METHODOLOGY:

- Prepare software models on ETABS Software.
- Analyse reinforced concrete building structure with Equivalent and Response spectrum methods respectively.
- Analyse the above-mentioned models with seismic zones IV.
- Compare the obtained analytical results from ETABS

MODELLING:

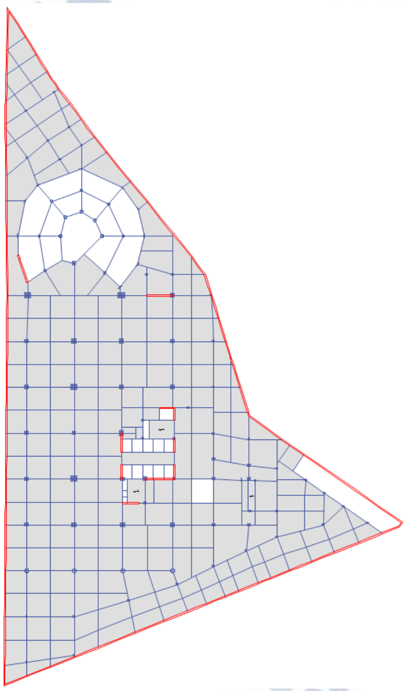

FIG-1: STRUCTURAL PLAN

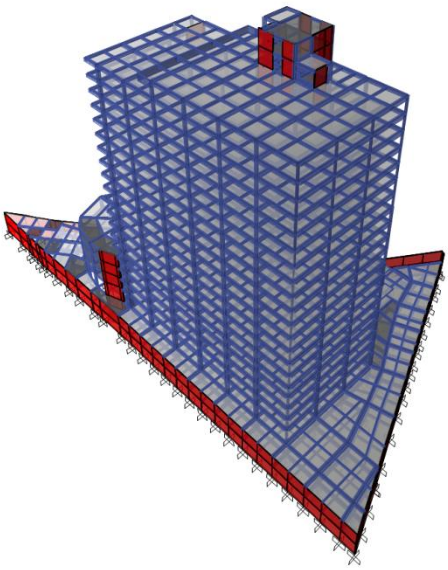

FIG-2: STRUCTURAL 3D VIEW

Load Cases:

- Dead Load (Self weight): 25 kN/³ as per (IS-875:1987 Part-1)
- Floor Finish: 1.5 kN/m² as per (IS-875:1987 Part-1)
- Live Load: 2 kN/m² & 4 kN/m² as per (IS-875:1987 Part-2)
- Wind Loads as per (IS-875:2015 Part-3)
- Seismic Load as per (IS-1893:2016 Part-1)

Seismic Zone: IV

Zone factor Z = 0.24

Importance factor I = 1.5

Soil type = Medium-2

RESULTS:

Storey Shear:The diagram shows the value of base shear.

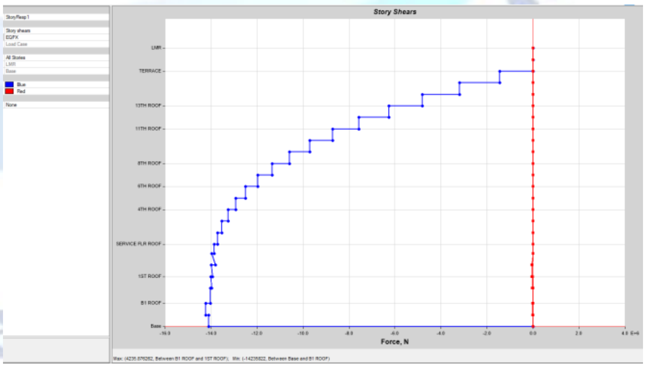

FIG-3: Base Shear Static X-direction

14235.82 kN

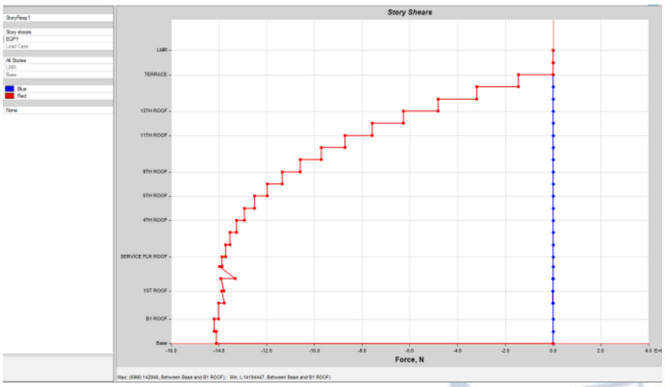

FIG-4: Base Shear Static Y-direction
14194.45 kN

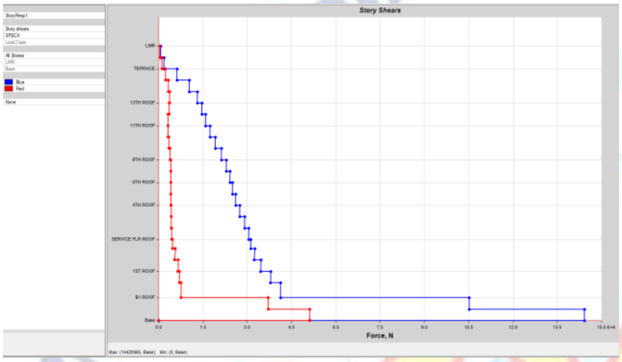

FIG-3: Base Shear Dynamic X-direction
14420.96 kN

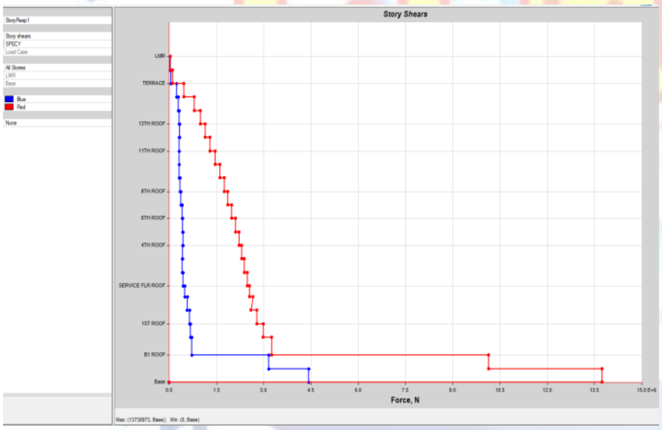

FIG-4: Base Shear Dynamic Y-direction
13738.97 kN

Maximum Storey Displacement: The diagram shows the value of Storey Displacement.

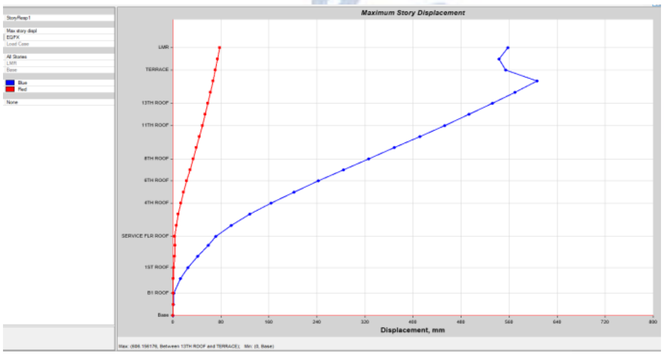

FIG-5: Storey Displacement Static X-directio
606.15 kN

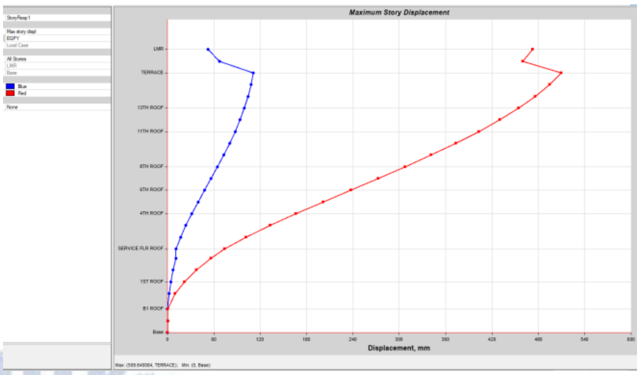

FIG-6: Storey Displacement Static Y-direction
509.64 kN

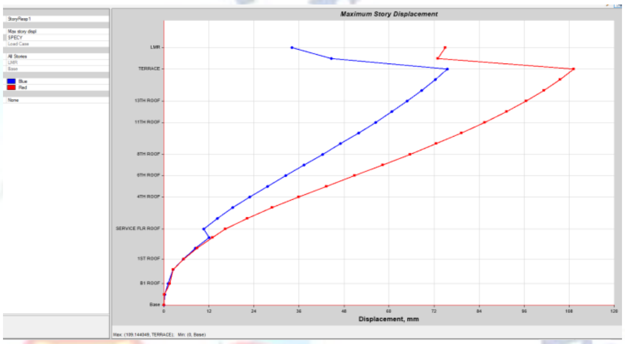

FIG-7: Storey Displacement Dynamic X-direction
129.23 kN

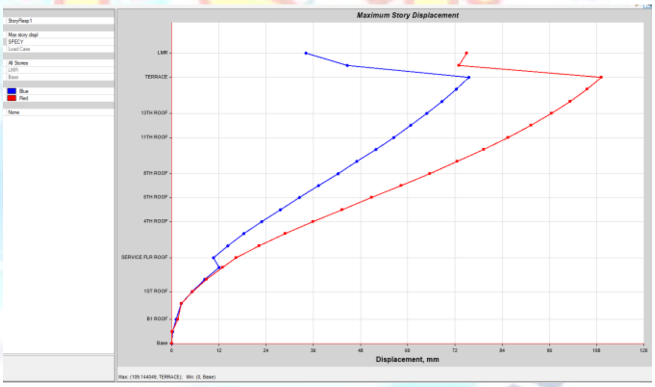

FIG-8: Storey Displacement Dynamic Y-direction
109.144 kN

Maximum Storey Drift: The diagram shows the value of Storey Drift.

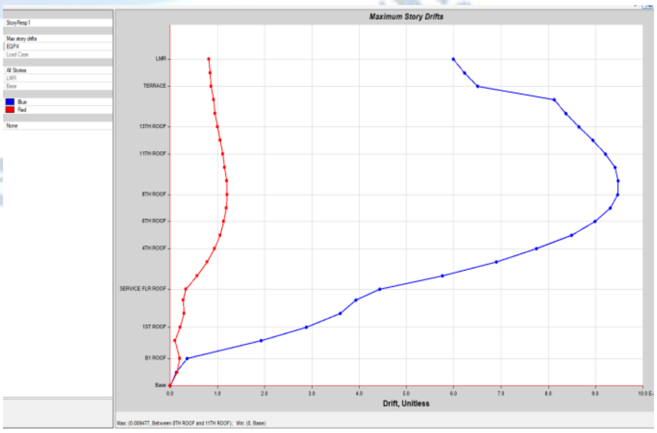

FIG-7: Storey Drift Static X-direction
0.009477

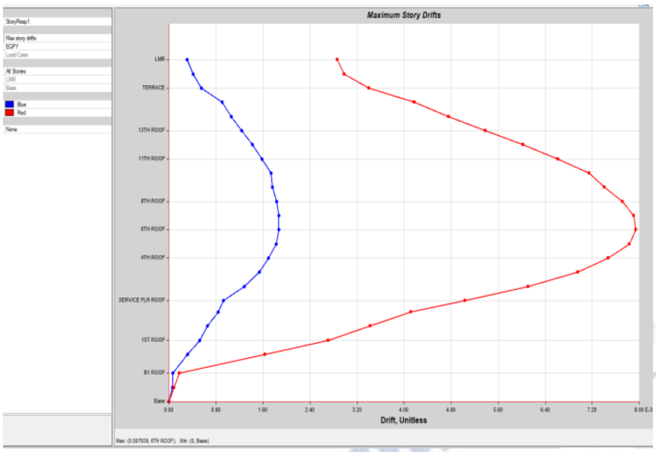

FIG-8: Storey Drift Static Y-direction
0.007939 kN

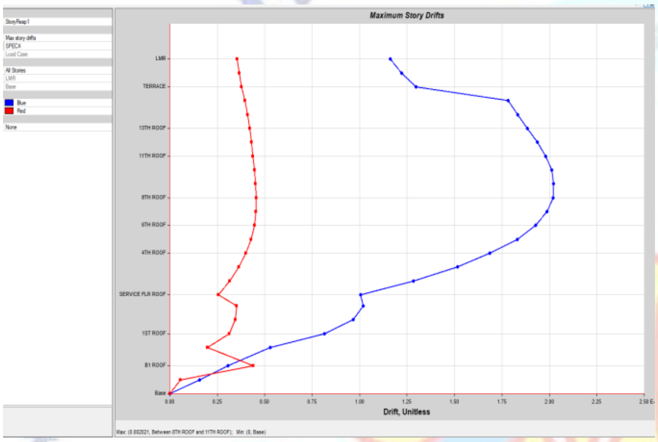

FIG-9: Storey Drift Dynamic X-direction
0.002021

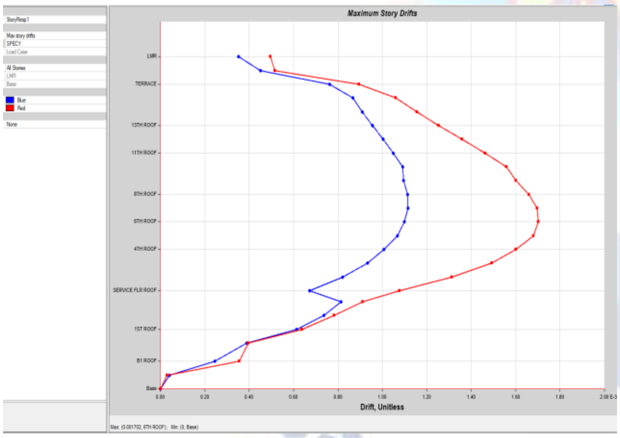

FIG-10: Storey Drift Dynamic Y-direction
0.001702 kN

Maximum Overturning Moment: The diagram shows the value of Overturning Moment.

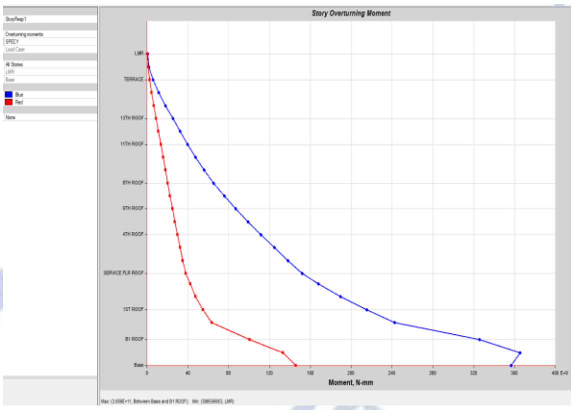

FIG-9: Overturning Moment Static X-direction
5711553 N-mm

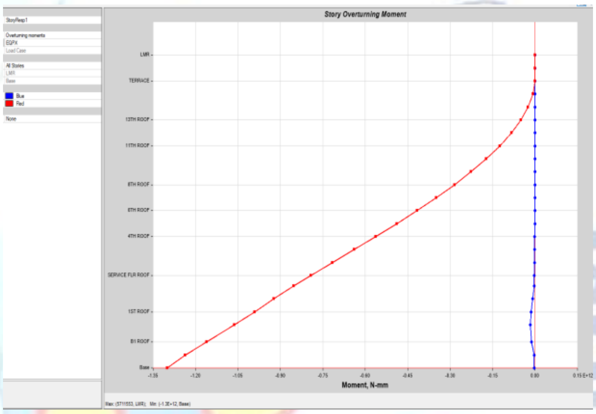

FIG-10: Overturning Moment Static Y-direction
58148262420 N-mm

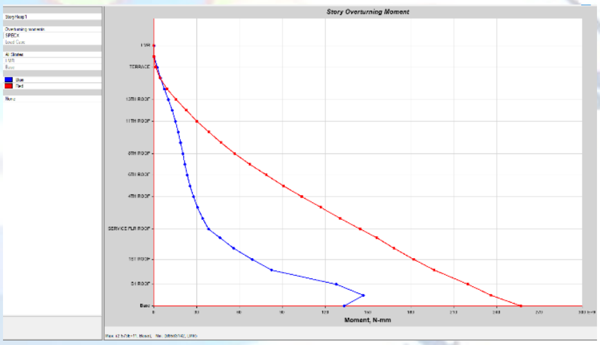

FIG-11: Overturning Moment Dynamic X-direction
89583142 N-mm

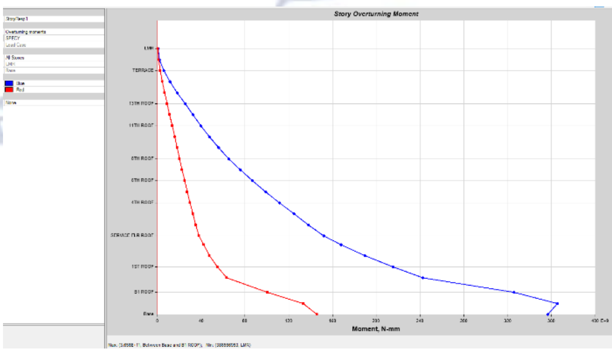

FIG-12: Overturning Moment Dynamic Y-direction
386556953 N-mm

CONCLUSION:

- Building frame with dynamic analysis method gives better performance and shows greater values of above mentioned terms as compared to building static analysis method.
- Majorly dynamic analysis effects the model in shorter lateral direction.
- Lateral Displacement has been increased 21.31% from dynamic to static analysis.
- Base shear has been increased2% from static to dynamic analysis.
- Lateral Drift has been increased 21.32% from dynamic to static analysis.
- Overturning Moment has been increased 6.37% from static to dynamic analysis.
- From obtained results dynamic analysis gives more stability and stiffness to the building, and to opt for future designs.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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