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COMPARISON OF SEISMIC ANALYSIS ON G+10 BUILDING WITH CONVENTIONAL SLAB AND GRID SLAB

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Abstract –In the prevailing era, earthquakes play a maximum probably position internal factor the evaluation and designing of systems. Therefore, it is far crucial to research the seismic conduct of buildings. Inmodern day creation, RC systems are normally used for creation. Here evaluation and layout of a Conventional Slab and Waffle Slab is carried out using ETABS. The analysis and design of structures are influenced by earthquake ground motion. The objective of this work is to analyze a commercial building with two different slab configurations, including conventional slabs and grid/waffle slabs. The modelling and analysis have been carried out using ETABS 2018 software, and for analysis Response Spectrum Analysis has been done. After analyzing the models, the effect of slab types are compared for the results of parameters like story displacement, story drift, and base shear in both Zone V & Zone IV.

Keywords:Horizontal irregularity, Shear wall, Openings, Seismic performance, Response Spectrum Analysis, ETABS, Story drift, Story displacement, Base shear.

1.INTRODUCTION

Earthquake has always been a threat to human civilization from the day of its existence, devastating human lives, property and man-made structures. The very recent earthquake that we faced in Turkey and Syria has again shown nature's fury, causing such a massive destruction to the country and its people.Earthquake causes random ground motions, in all possible directions emanating from the epicenter.Vertical ground motions are rare, but an earthquake is always accompanied with horizontal ground shaking. The ground vibration causes the structures resting on the ground to vibrate, developing inertial forces in the structure.As the earthquake changes directions, it can cause reversal of stresses in the structural components, that is, tension may change to compression and compression may change to tension.

A Grid slab, also known as a flat grid/ waffle, is a type of building material used in wood, metal, and concrete construction.It is a flat slab on top with a grid-like surface on the bottom, formed by the removal of molds after the concrete sets. Grid slab is most popularly used as the structural layout which is constructed in the hotel's porch, entrances of the airports' terminals, larger banquet hall, Convention or public Centre and car parking spaces.

Grid slabs can bear a larger amount of load compared to conventional slabs.They provide low floor deflections and have good finishes and robustness.They have a greater load capacity than traditional one-way slabs.They are suitable

for larger spans with less number of columns.They have excellent vibration control capacity.They are lightweight and use 30% less concrete and 20% less steel than a raft slab.They have afairly slim floor depth and are fire-resistant.They provide an attractive soffit appearance when exposed.They can be used for both construction of the floor slab and ceiling slabs.

Grid slabs are commonly used in buildings that require minimal vibration and large open spaces, such as laboratories, manufacturing facilities, airports, hospitals, commercial and industrial buildings, and train stations. Here are some common applications for grid/Grid slabs.Grid slabs are often used in industrial and commercial buildings because they can bear a larger amount of load compared to conventional slabs. They provide low floor deflections and have good finishes and robustness.

2.LITERATURE REVIEW

The following literatures are referred for the present work:

Shivani Singh, Vinayak Mishra, Singh R.P et al. (2023) [1], used the ETABS software to do a time history analysis on a G+4 RCC building with a waffle slab and an X-type bracing system.Conclusions for the structural framework of a G+4 construction in India with different types of soil in earthquake zone IV have been established based on a time history analysis. As per the results discussed the structure without bracing system is unstable and prone to damage due to which installation of bracing becomes necessary. Bracings enhance the stiffness and strength of the RC structure as well as reduce deformation by increasing the structure's stiffness and reducing displacements, drifts, etc.Waffle slabs can be adopted for large span high-rise structures and exhibits good vibration control capacity.

P.B. More, Y.P. Pawar et al. (2023) [2], In this study, slab system design and analysis for low rise, medium and high rise building for different seismic zones and having medium soil condition by using Stadd pro.Analysis of flat slab, grid slab and conventional slab is done by using response spectrum method. The analysis and design of different slab systems is done as per IS 456-2000 and IS 1893- 2000.

Sourabh Ram Ingole, Ansari Fatima Uz Zehra et al. (2022) [3], Study of a G+5 Residential multistoried building having flat slab, Grid Slab and conventional slab has been analyzed for the parameters like story drift, quantity of concrete and steel, and story displacement. Design of the slab system is done for different spacing/ grid size of column to find out which grid size of the column or plan area which slab is economical.Flat slab structures are the best solution for high rise structures as compared to conventional slab

structures and Grid Slab. Whereas the Conventional slab is more suitable for Residential and small span structures, while Grid Slab is more suitable for bigger span structures.

Maulin Patel, Abbas Jamani et al. (2022) [4],Analyzes of multistory building with wonderful slab arrangements the use of Etabs like as conventional slab, flat slab and waffle slab.Modelled a 10-story building in ETABS software program application. Total 12 Models have been prepared with wonderful shape of slabs in wonderful earthquake zone. Design of the slab system is done for different spacing/ grid size of column to find out which grid size of the column or plan area which slab is economical. For the same span/grid size, the amount of concrete required for a Waffle slab multi-story building is minimum and for a flat slab multi-story building is maximum. Waffle Slab is more suitable for bigger span structures like big malls, halls, and auditoriums for the better elegant view of building.

Neeraj Kumar Sahu, Neeraj Kumar Sahu et al. (2022) [5],A comparative analysis of ribs and waffle plates is presented to determine maximum stability and distribution with in the evaluation. To validate the results, selected instances are compared using finite detail analysis, and force, second, displacement, and flow results are compared for each trace. Ribbed slab structure is capable of maintaining the structure stable and more resistible in earthquake load.

3. OBJECTIVE

With this research Igot to know about latest technologies and compared some results how much difference is being acquired and how much accurate is the result given by technologies used in our field. The points which are taken into consideration while going through the research are listed below:

- To model two separate G+10 buildings with grid slab and conventional slab.
- To analyze the building with different earthquake zones.
- To perform dynamic analysis of building using response spectrum analysis.
- To compare the effect of seismic parameters for conventional & grid slabs in different zones.

4. METHODOLOGY & MODELLING

- For analysis, a G+10 story building is modeled in ETABS.
- The building does not represent any real existing building. The building has been analyzed by Response Spectrum Analysis, which is a linear dynamic analysis.
- Dynamic Analysis is adopted since it gives better results than static analysis.
- The buildings are modelled, and the effect of both the type of slabs are presented in the study.
- Various zones have been performed and investigation the optimum results of model has been studied.
- The nomenclature used for the model ID is CONVrepresents the conventional slab building, and GRID represents the grid slab building.

Table 1: Building Description

SPECIFICATIONS	CONV	GRID
Plan Dimension	40mx40m	40mx40m
Length of Grid in x-direction	5m	5m
Length of Grid in y-direction	5m	5m
Floor to Floor height	3m	3m
No. of Stories	G+10	G+10
Slab Thickness	175mm	175mm
Column Size	630mm x 630mm	630mm x 630mm
Beam Size	200mm x 250mm	-
Grid size	-	150mmx150mm
Spacing of Grid	-	1m
Grade of Concrete	M30	M30
Grade of Steel	Fe 500	Fe 500
Loads		
Live Load	3 KN/m2	3 KN/m2
Floor Finish Load	1 KN/m2	1 KN/m2
Wall Load	13 KN/m	13 KN/m
Seismic Load	As per IS1893:2016	As per IS1893:2016
Seismic Parameters		
Seismic Zone Factor	0.36 (Zone-V) & 0.24 (Zone-IV)	0.36 (Zone-V) & 0.24 (Zone-IV)
Response Reduction Factor	5	5
Importance Factor	1	1
Type of Soil	Medium (II)	Medium (II)
Damping Ratio	5%	5%

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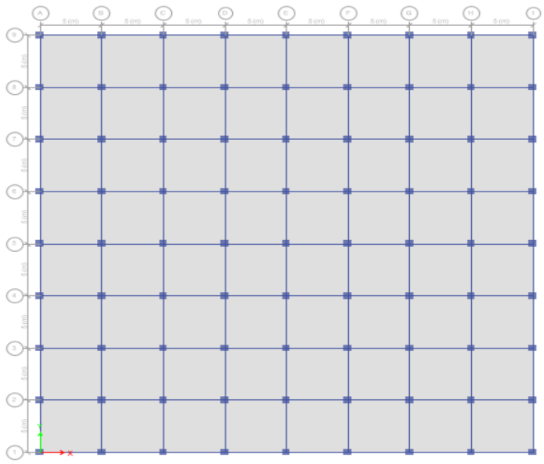

Fig. 1. Plan view of building with Conventional Slab(CONV) model

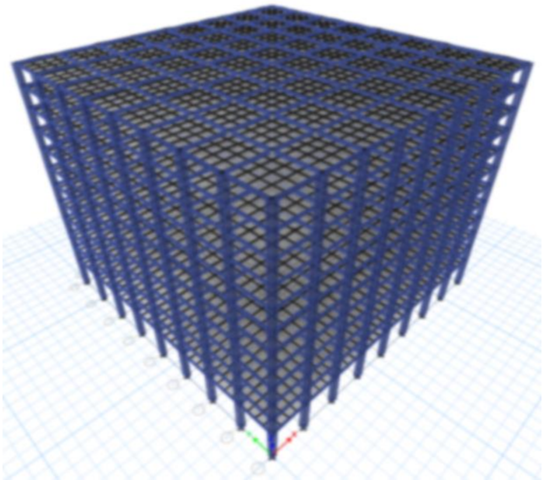

Fig. 2. 3D view of building with Conventional Slab(CONV) model

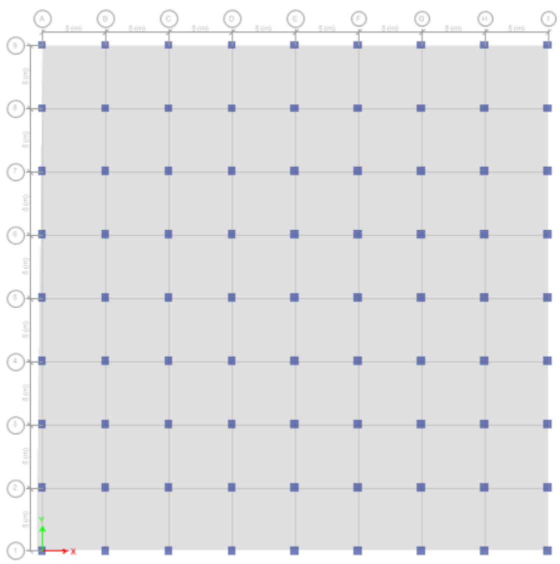

Fig. 3. Plan view of building with Grid Slab (GRID) model

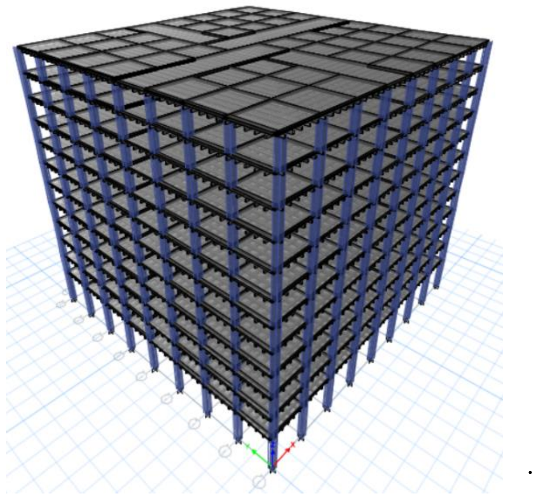

Fig. 4. 3D view of building with Grid Slab (GRID) model

V. RESULTS & DISCUSSION

The results of seismic parameters for conventional and grid slab building models with various earthquake zones (Zone IV & Zone V) by Response Spectrum Analysis using ETABS software are presented in this chapter. The seismic parameters that are considered in the present study are as follows:

1.Base Shear:

It is the total design lateral force at the base of a structure.

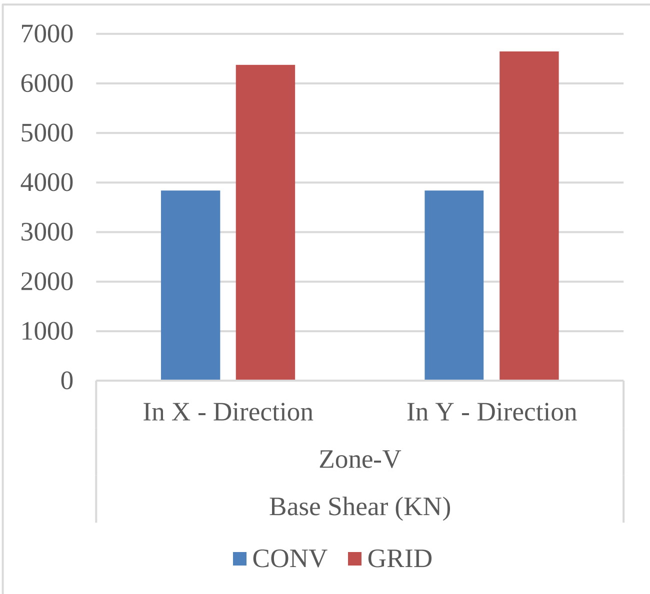

Fig. 5. Base Shear for conventional and grid slab buildings with Zone V

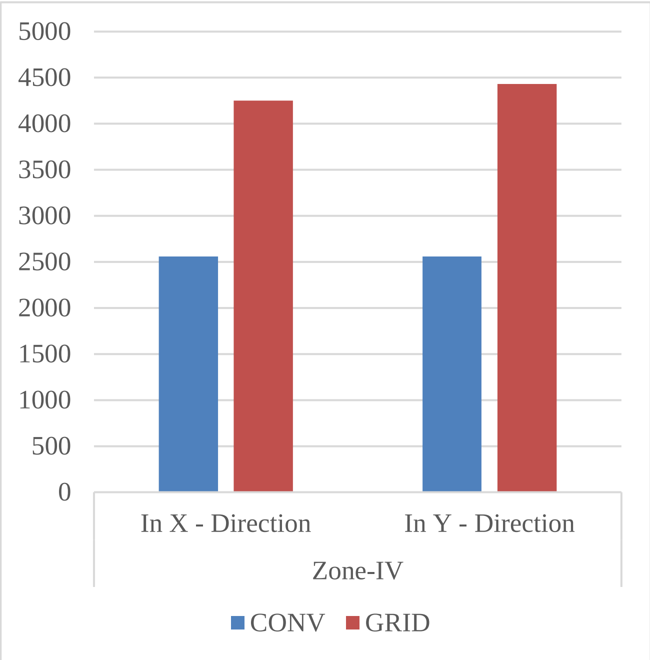

Fig. 6. Base Shear for conventional and grid slab buildings with Zone IV

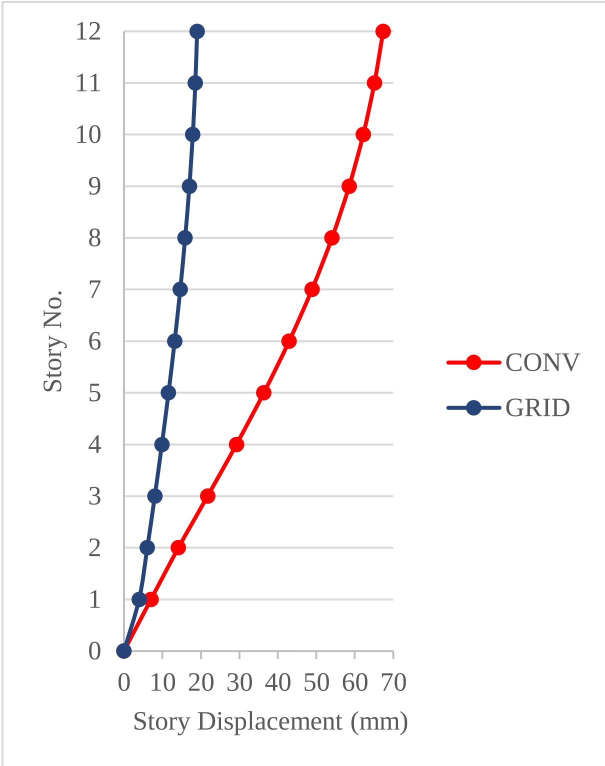

Fig. 8. Story Displacement for conventional and grid slab buildings with Zone V in Y-direction

2.Story Displacement

Story displacement is the lateral displacement of the story with respect to the base. The lateral force-resisting system can limit the excessive lateral displacement of the building.

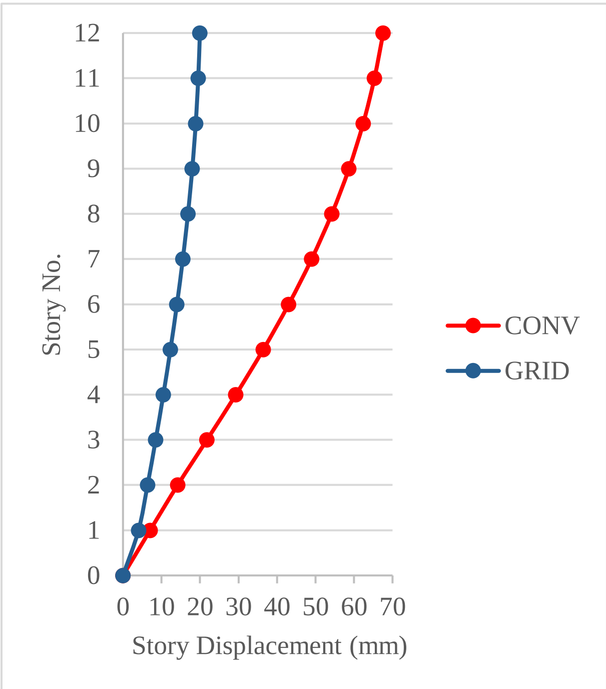

Fig. 7. Story Displacement for conventional and grid slab buildings with Zone V in X-direction

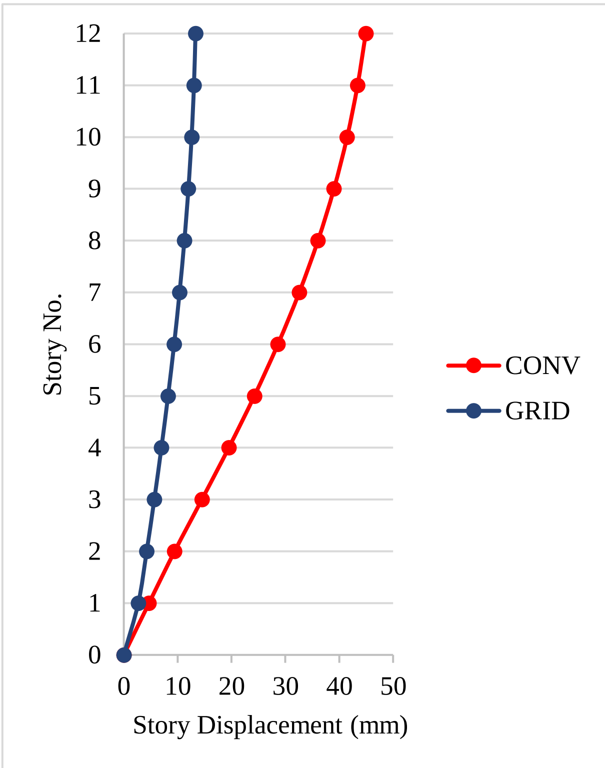

Fig. 9. Story Displacement for conventional and grid slab buildings with Zone IV in X-direction

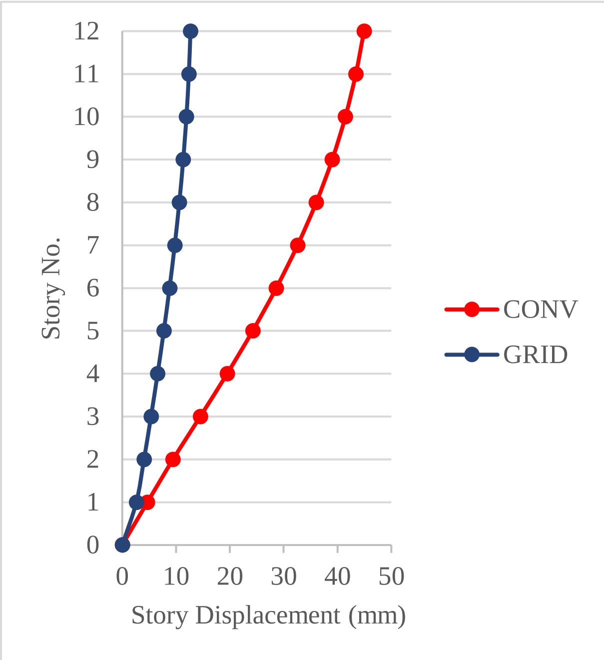

Fig. 10. Story Displacement for conventional and grid slab buildings with Zone IV in Y-direction

3.Story Drift

Story drift is the lateral displacement of one-story levelwith respect to the level above or below. Story drift ratiothe story drift divided by the story height.

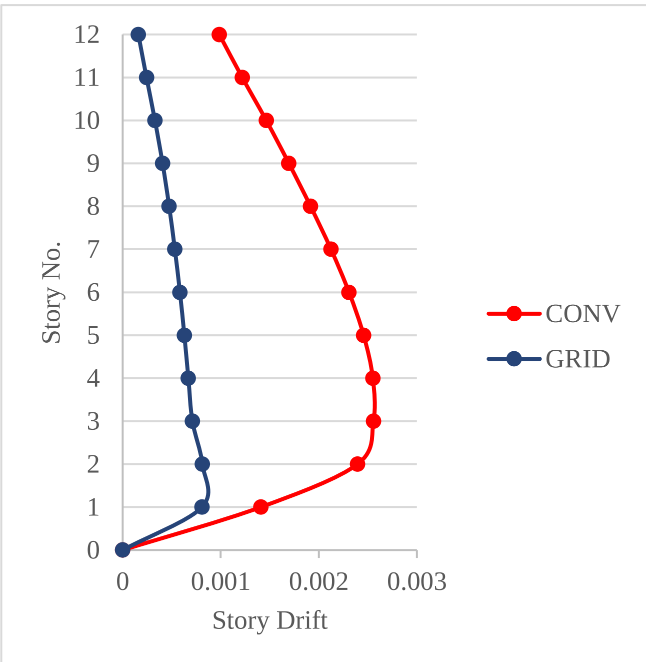

Fig. 11. Story Drift for conventional and grid slab buildings with Zone V in X-direction

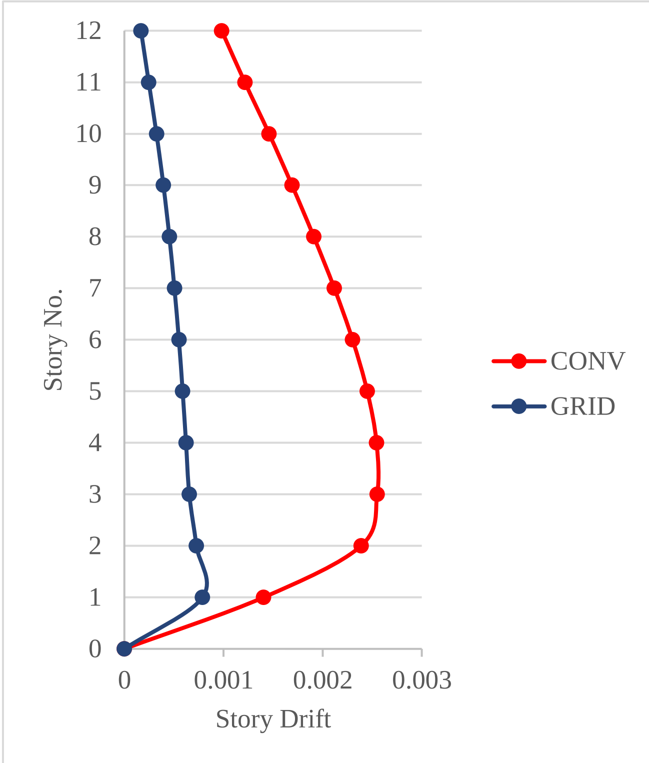

Fig. 12. Story Drift for conventional and grid slab buildings with Zone V in Y-direction

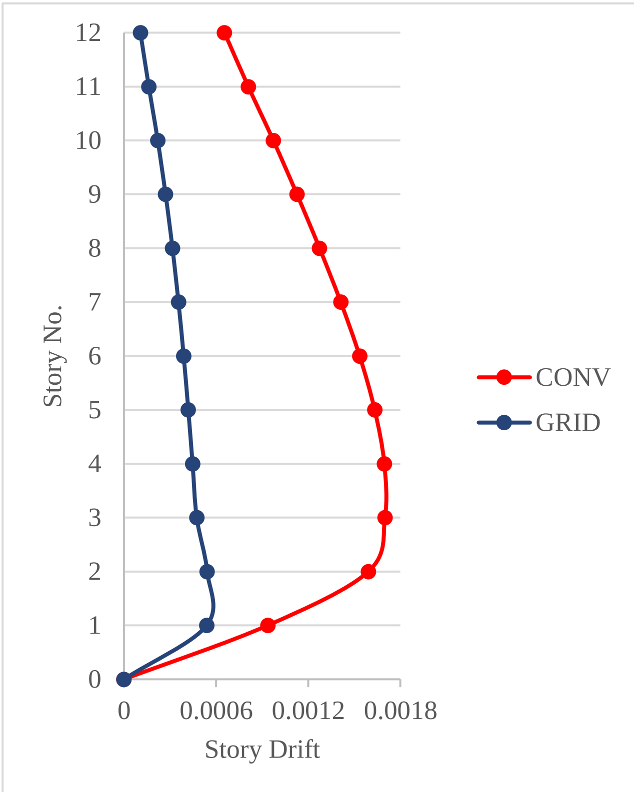

Fig. 13. Story Drift for conventional and grid slab buildings with Zone IV in X-direction

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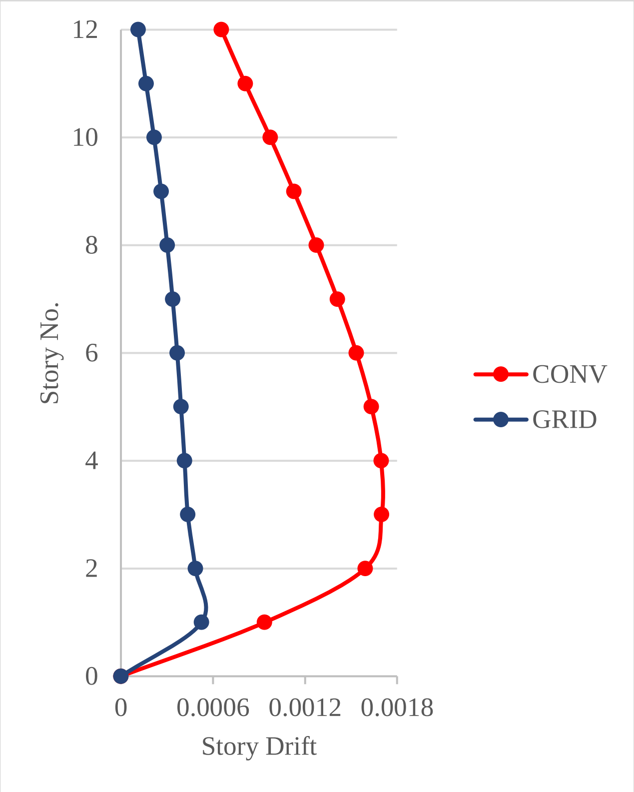

Fig. 14. Story Drift for conventional and grid slab buildings with Zone IV in Y-direction

5.CONCLUSIONS

Based on the analysis results for conventional and grid slab buildings in Zones V & IV i.e., on four models considered for this study, the following conclusions can be drawn:

1. The values of Base Shear concludes that waffle slab shows higher i.e., approx. 66.2% in X-direction & 73.3 % in Y-direction higher than conventional slab base shear values for both earthquake zones.
2. The values of Story displacement concludes that waffle slab shows lower story displacement i.e., approx. 30% than conventional slab in both directions for both earthquake zones.
3. The values of Story drift concludes that waffle slab shows lower story drift i.e., approx. 28% than conventional slab in both directions for both earthquake zones.
4. Waffle Slab perform better in every aspect during earthquake as compared to conventional slab.
5. Waffle Slab is more suitable for bigger span structures like big malls, halls, and auditoriums for the better elegant view of building. Whereas the Conventional slab is more suitable for Residential and small span structures.

REFERENCES

[1] Shivani Singh, Vinayak Mishra, Singh R.P (2023), Seismic response evaluation of waffle slab with and without bracing system using time history analysis, National Conference on Structural and Geotechnical Engineering.

[2] P.B. More, Y.P. Pawar (2023), A Review on Comparative Analysis and Design of Flat Slab and Grid Slab with Conventional Slab System, International Research Journal of Modernization in Engineering Technology and Science.

[3] Sourabh Ram Ingole, Ansari Fatima Uz Zehra (2022), Comparative Analysis and Design of Flat and Grid Slab System with Conventional Slab System by Etabs, International Research Journal of Modernization in Engineering Technology and Science.

[4] Maulin Patel, Abbas Jamani (2022), Analysis and Design of Multistory Building with Different Slab Arrangements Using Etabs, International Research Journal of Engineering and Technology (IRJET).

[5] Neeraj Kumar Sahu, Neeraj Kumar Sahu (2022), A Comparative Study of Waffle Slab, Mathematical Statistician and Engineering Applications.

[6] Anurag Kumar Pandey, Anjali Rai (2021), Seismic Analysis of Commercial Building with Grid/Waffle slab using ETABS, International Journal for Research in Applied Science & Engineering Technology (IJRASET).

[7] Shubham Rathi, Sameer Chitnis (2021), An Analytic Study on the Behavior of Types of Grid Slab subjected to Seismic Loading, International Research Journal of Engineering and Technology (IRJET).

[8] Ayush Rai, Vikash Kumar Singh (2020), Comparison of Beam Shear Analysis between Flat Slab and Grid Slab of High-Rise Buildings with Varying Geometry under Seismic and Wind Loading Condition, International Journal of Innovative Research in Technology and Management.

[9] Lalit Balhar (2019), Review Paper on Comparative Analysis of Flat Slab & Conventional RC Slabs With and Without Shear Wall, International Research Journal of Engineering and Technology (IRJET).

[10] Sudhir Singh Bhaduria, Nitin Chhugani et al. (2017), Comparative Analysis and Design of Flat and Grid Slab System with Conventional Slab System, International Research Journal of Engineering and Technology (IRJET).

[11] IS: 456-2000, Code of Practice Plain and Reinforced concrete.

[12] IS: 875 (Part 2), “Indian Standard Code of Practice for design loads (Other than earthquake) for building and structures, Imposed Loads”, Bureau of Indian Standards, New Delhi.

[13] IS: 1893:2016, Part 1, "Criteria for Earthquake Resistant Design of Structures - General Provisions for Buildings", Bureau of Indian Standards, New Delhi.