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Seismic Analysis of a Tall Structure Considering Conventional and Diagrid Structures with Dampers Using Structural Software

[1]Manish Kumar Gupta, [2]Abhay Kumar Jha, [2]Rajeev Singh Parihar, [3]Rajesh Misra, Ashutosh Udeniyan

[1]M. Tech Sscholar, Lakshmi Narain College of Technology, Bhopal
[2]Professor, Lakshmi Narain College of Technology, Bhopal
[3]Assistant Professor, Lakshmi Narain College of Technology, Bhopal

ABSTRACT:

Contrasted with firmly dispersed vertical segments in outlined cylinders, the diagrid structure comprise slanted segments on the outside surface. Because of slanted sections, horizontal burdens are opposed by hub activity of the inclining contrasted with bowing of vertical segments in outlined cylinder structure. Diagrid structures by and large don't need a centre since parallel shear can be conveyed by the diagonals on the outskirts of a structure. Examination and plan of aG+19 story diagrid steel building are introduced. A standard floor plan of 45 m × 45 m size is thought of. ETABS programming is utilized for demonstrating and investigating structure rigidity.

Keywords: Diagrid, Structural System, High rise buildings, Structural design, Structural Analysis, Tuned Dampers, displacement.

I. INTRODUCTION

The diagrid framework's fundamental effectiveness also aids in preventing inside and corner segments, which allows for a great deal of floor design flexibility. Comparing edge "diagrid" framework to a standard second edge structure, approximately 20% less primary steel weight is used. Because of their arranged location, the diagonal membrane in diagrid main frameworks can transport gravity stacks in the same way as horizontal powers. Since diagrid structures transmit sidelong shear through the crucial activity of slanting individuals, they are more effective in preventing shear twisting. Since the inclined individuals on the periphery can transport parallel shear, diagrid systems often do not require significant shear inflexibility cores. As such, the diagrid has brought back interest from compositional and underlying fashioners of tall structures due to its fundamental feasibility and feel.

2. OBJECTIVES OF THE PRESENT STUDY

● To ascertain the seismic characteristics, which include the story displacement, story drift, story stiffness, base shear, time period, and vibration modes.

● To assess the reaction of a conventional and diagrid system configuration with dampers .

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3. LITERATURE REVIEW

In this chapter we are reviewing the literatures and research publications of authors related to analysis of tall structure with lateral loadings and different lateral load resisting elements.

- **Barbosa and Ramadhan (2014)** In this paper they worked more than, a72-story model structure was used as an example to show how the plan and diagrid framework investigation were carried out. To relieve the conceivable huge relocation and base shear requests that these constructions may go through under seismic occasions, two new plan arrangements comprising of a couple of grinding tuned mass damper (TMD) units are investigated. In the principal arrangement, a TMD was put on the best four account soft he structure and was tuned to decrease the commitment of the major method of vibration of the construction, in both level bearings. In the subsequent arrangement, a twofold TMD framework was added at the mid-stature of the structure, in which a second TMD unit is tuned to the second time of the design.
- **Shah et al. (2016)**, In this examination, seven steel structures of the in distinguishable base region and loadings with various statures were intended forideal are as for both underlying frameworksdiagridandtraditionalcasingsinETABS.Differentboundarieslikebasictime-

frame,greatestpopularnarrativesidelongremoval, most extreme base shear, steel weight, rate contrasts in difference in steelweight, greatest story relocation and most extreme story float are considered in this examination. A Diagrid structure performs well than traditional edge constructions and expansions in steelweightwithanincrementintallnessofthestructurewasextensivelylessin diagrid structures.

Results inferred that the diagrid underlying frame work that arose was a superior answer for horizontal burden opposing frame work as far as parallel removals, steel weight and solidness. It is sufficiently hardened to oppose wrap powers up to higher statures. Thediagrid structure gives high effectiveness as far as steel weight alongside the stylishappearance.For24storystructures,theheavinessofthecustomaryedgewas100% more than the diagrid building. Relocations on every story and story floats were seen to be less in diagrid frame works when contrasted with the ordinary edges.

- **Isaac and Ipe (2017)**The goal of this paper was to study and think about the presentation of Diagrid, Octagrid and Hexagrid structures with fluctuated as kew point sand shifted module thickness under unique stacking and further more to track down the underlying framework that shows the most un-popularnarrativeuprootingandfloat,theidealscopeofthecornertocornerpointhavingbettersolidness and relationship of the time-frame to parallel firmness. Think about theunderlying weight and material expense of all structure models to decide the mostconservative alternativeamongthe models.
- **ShankarandPriyanka(2018)**,The concrete diagrid building and an ordinary structure with a comparable arrangement size of 15 by 15 meters were the subjects of a recent investigation evaluation. The investigation also examined the response of the construction when the story range was changed from G+5 to G+15. Another examination was completed fordiagrid and traditional constructions of comparative arrangement size (18x18)m withsame story stature G+15, and the impact of point of diagrid and length of diagrid wascontemplatedand was contrasted and the customaryframework.
- **Khan and Shinde (2019)** This paper presents the investigation of the 20- storey diagrid structure in examination with the outside propped outline structure. Examination results and plan of both the models are introduced as far as story shear, removal, float and synopsis of sidelong and gravity powers and in the diagrid structures, the upward segments from the outskirts are killed and this builds the principle contrast among diagrids and outside supported edges. Having located arrangement, the diagrids had the option to convey the gravity and parallel burdens. They likewise adequately limit shear misshapen as the diagonals convey the heaps pivotally. The diagrid underlying framework was embraced these days for tall structures due to its firmness and adaptability in compositional arranging.
- **Yadav and Bajpai (2020)** In this paper, they learned about the 30mX 30m arrangement of diagrid design and damper construction of the distinctive game plan. Seismiczone III, soiltype II, investigation done by there action range strategy on ETAB'S. Result as far as the time span, story float, storyrelocation,storyfirmnessandbaseshear.Afterinvestigationdiagridstructureperformsbettercomparedtothedamper. To examine seismic conduct of working for the normal arrangement underseismic loads and burden mixes according to IS 1893:2016. To assess the reaction of diagrid and damper framework distinctive plan. To decide seismic boundaries that aretime-frame, methods of vibration, base shear, story relocation, story float and story solidness.
- **Sadeghi and Rofooei (2020)** The paper explored that respect, the impacts of BRBs on the seismic execution qualities of diagrids, for example, reactional teration factor, R, over strength factor, Ω0, pliability proportion, μ, and middle break down limit, ^SCT, areassessed. To this end, 6th ree dimensional diagridstructureswithdifferentstaturesandincliningpointsaredisplayedutilizingtheOpen Sees program and are furnished.
- **Tandon and Singhai (2021)** Buildings with many stories are being constructed more often these days all around the world. This is a result of improvements in design tools, materials, analysis, and construction methods. "DIAGRID" It appears that the most creative and adaptable approach to fundamental structure in a millennium is the diagonalized grid structure. Diagrid is a border system made up of a series of positioned support systems. The corners of the diagrid are crossed, and the portions are level. Through key activity in support, the corner-to-corner persons from diagrid are able to transfer both sidelong and gravity load. Modelers are always trying to create new, intricate structures. The diagrid architecture has elegant potential and offers a broad range of primary productivity. The module that is located may also have a diamond-shaped decoration. Development innovations, materials, main frameworks, and on figuration advances all contributed to the creation of elevated structures.
- **Singh et al. (2023)** It is now crucial to address the issues of height and stiffness because of the increasing development of tall buildings brought about by modernization and an increase in land use. A number of structural systems, including as diagrid, outrigger, and framed systems, have been created to withstand different loading scenarios. The current study uses E-tabs software to perform dynamic evaluations for each structural system on a sixteen-story, G+ RCC structure. The variables that were looked at included base shear values, storey shear force values, maximum displacement values, maximum storey drift values, stiffness of storey levels, and time periods. The primary objective was to identify the best system out of all those that were looked at. This research can broaden our understanding of building dynamics and aid in the development of knowledgeable opinions regarding potential high-rise developments and their underlying structures. Once the study was completed, it was shown that the diagrid structural system, which worked similarly to the shear-walled model, was the most effective at controlling lateral forces for a wide range of response parameters. The effectiveness of the diagrid structural system in maximizing resistance to dynamic loads and stability shows that it has the potential to enhance both the performance and safety of these structures. In conclusion, the diagrid system presents itself as a viable option for high-rise construction, offering a productive and successful solution to the problems associated with urbanization-induced vertical growth.

- **Yashwanth et al. (2024)**There is not enough space between buildings when they collide laterally, which results in pounding. Massive force or deformation demand is induced at individual floors or entire buildings, resulting in damage or occasionally collapses. Code requirements typically provide the boundary lines a maximum limit to contain their negative consequences. A constant value (e.g., BCP of Egypt and Peru) or inelastic displacement obtained by modifying the displacement obtained from elastic analysis using a response reduction factor or displacement amplification factor (e.g., BCP of ASCE 7–16, Canada, Eurocode, India, Iran, Peru, and so on) are two possible limits for the separation gap (Sg). Another option is to limit it to a specified percentage of height (e.g., Building Code Provisions (BCP) of Australia, Iran, Peru, and so on).By altering the number of storeys (3, 5, and 10) and response reduction factors designed and described in accordance with IS 456, IS 1893-1, and IS 13920, a range of 2D building layouts are taken into consideration. Using Perform 3D, nonlinear static analysis (NLPoA) and nonlinear time history analysis (NLTHA) are used to examine the inelastic behavior of these buildings. Estimated from the maximum considered earthquake (MCE) and compared to the Sg given in different building code regulations are the performance point and maximum displacement. Only a few combinations of medium-rise buildings, such as three- and five-story structures, are covered by the Sg specified in building code rules; other combinations of short-, medium-, or high-rise buildings, such as three-, five-, and ten-story buildings, are not covered. With two 3D buildings modelled (R = 5) with and without similar struts to account for the infill increases without including diagonal struts, the findings are mathematically confirmed. The situation may get worse as the structures knock against one another. As a result, the Sg mentioned in the building code rules might not include the negative consequences of pounding. The code's requirements for pounding inside buildings must be revised to take into account (i) the Sg between structures and (ii) the maximum Sg determined by drift limitations. It is suggested that the building code restrictions be revised.

4. METHODOLOGY

The goal of this study is to analyze a structure that was on level ground when the earthquake occurred. Consideration is given to a typical moment-resisting G+19-story building situated over medium soil. A comparison between the response of a diagrid structure with and without dampers and a conventional construction with and without dampers is shown. Six bays in each direction, each measuring 4 meters in length and 3 meters in height, will be maintained. ETABS 2021 software will be used to analyze the building with consideration to zone III by the static equilibrium method. The models' specifics are provided below.

Plan dimension-20mx20mNumber of stories-G+19Floortofloorheight-3m

Number of bays in X-direction-9Number of bays in Y-direction-9Depthof slab-150mm.

MODELLING

Step1: ETABS provideaneco-systemtomodelstructureusingdifferentgridsasperplan.

Step2: This step includes defining material and section properties of beams and column as per the geo me try of the structure which was previously described in chapter above.

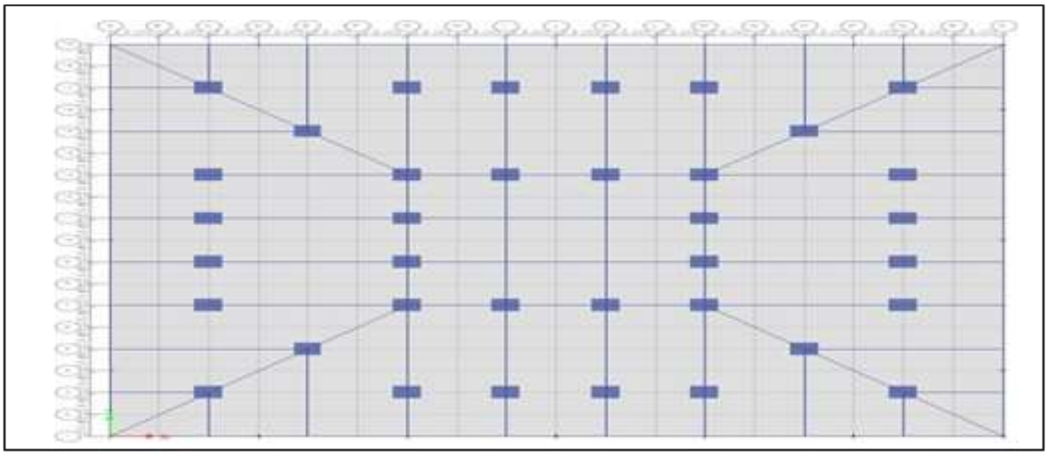


Fig 1Grid Designing of the different cases.

Step3: Fixed support are provided at the bottom of the structure.

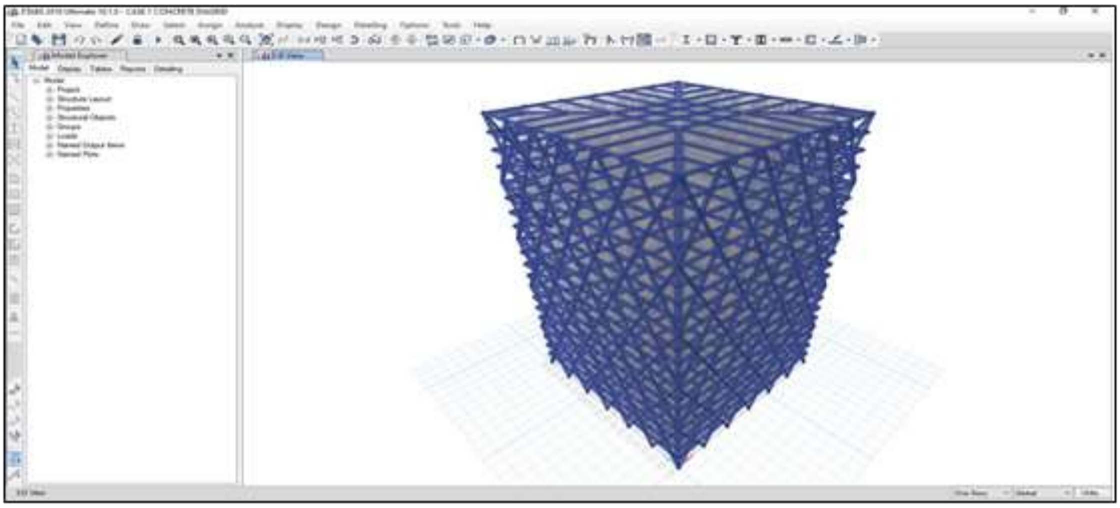
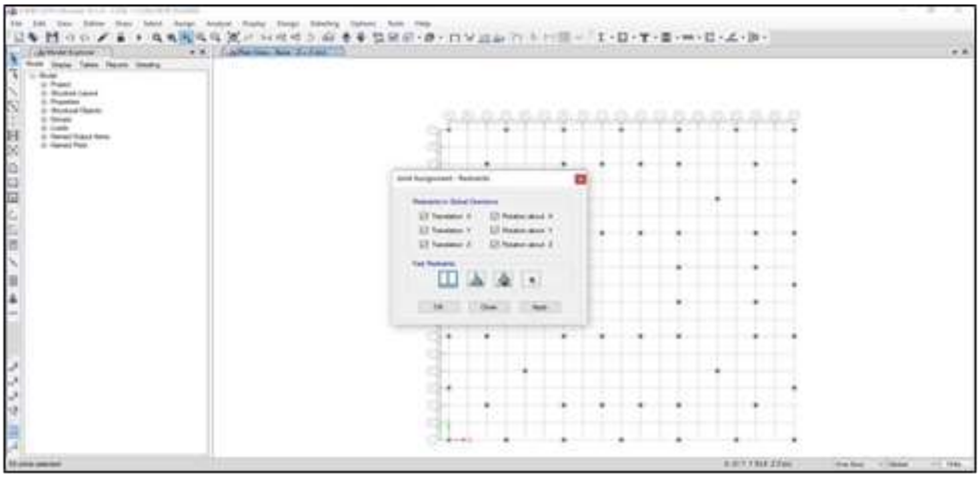


Fig 2 Assigning Fixed Support in X, Y and Z direction.



MODELLINGOF STRUCTURE USINGETABS (2021)

Step1. Choosing the Building Geometry.
↓
Step2. Grid Definition.
↓
Step3. Story Definition.
↓
Step4. Modelling of Selected geometry.
↓
Step5. Defining the Material and their property.
↓

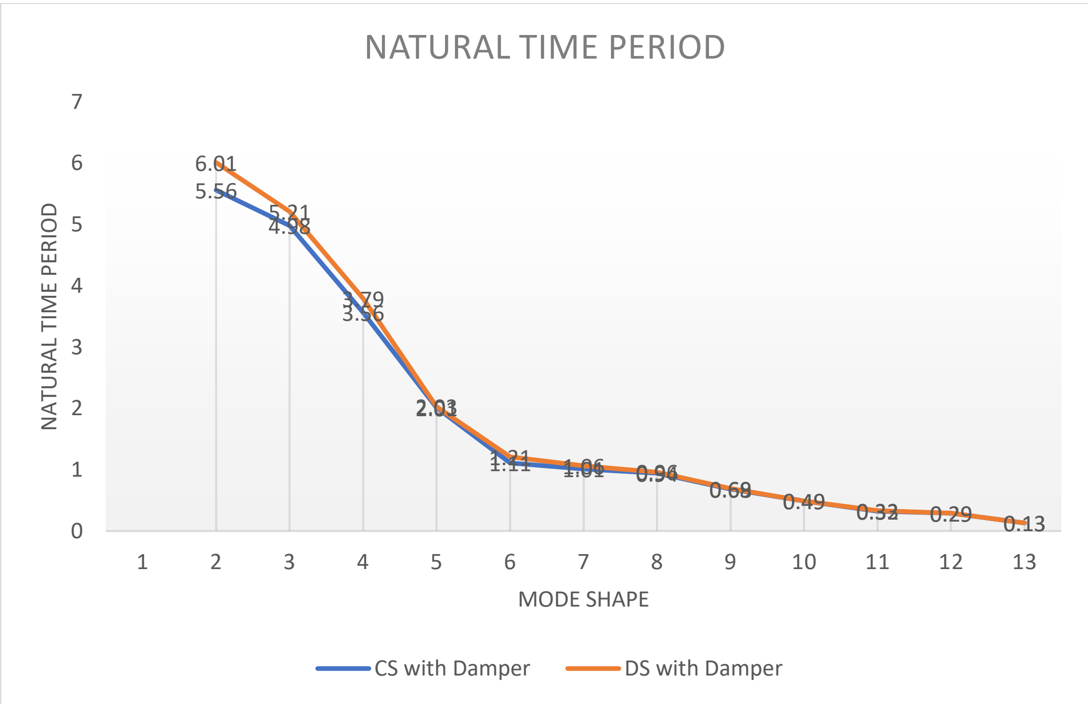
Step6. Frame/ Slab x- Section Definition.
Step7. Load Case/ Pattern/ Combination Definition.
Step8. Load Assignments/ Support Assignments.
Step9. Analysis.
Step10. Extract Result/Study.

5. DISCUSSION ON RESULTS:

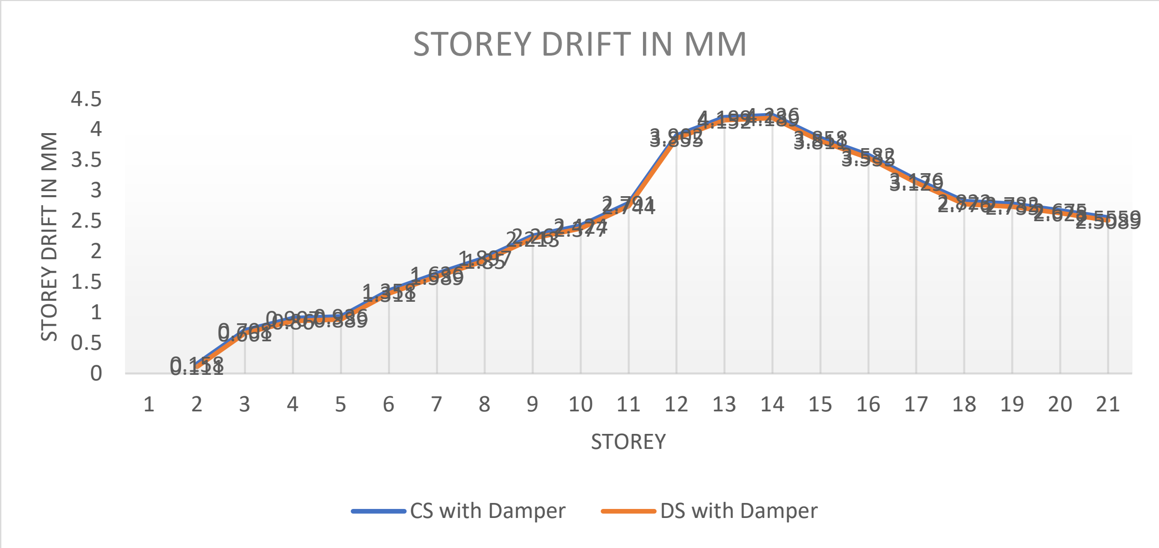
TIMEPERIOD

The natural period (Tn) of a building is the time it takes to go through a complete vibration cycle. This is the inherent nature of the building controlled by its mass “m” and stiffness “k”. These three astrological signs are interconnected.

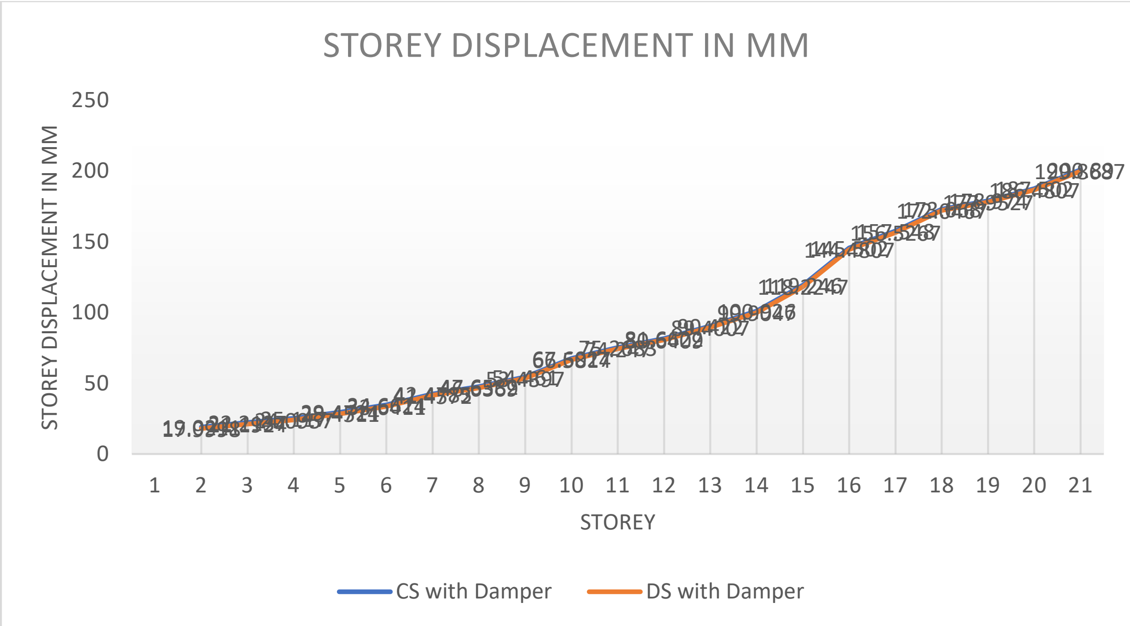
Tn =2$\boldsymbol{\pi}$√m/k



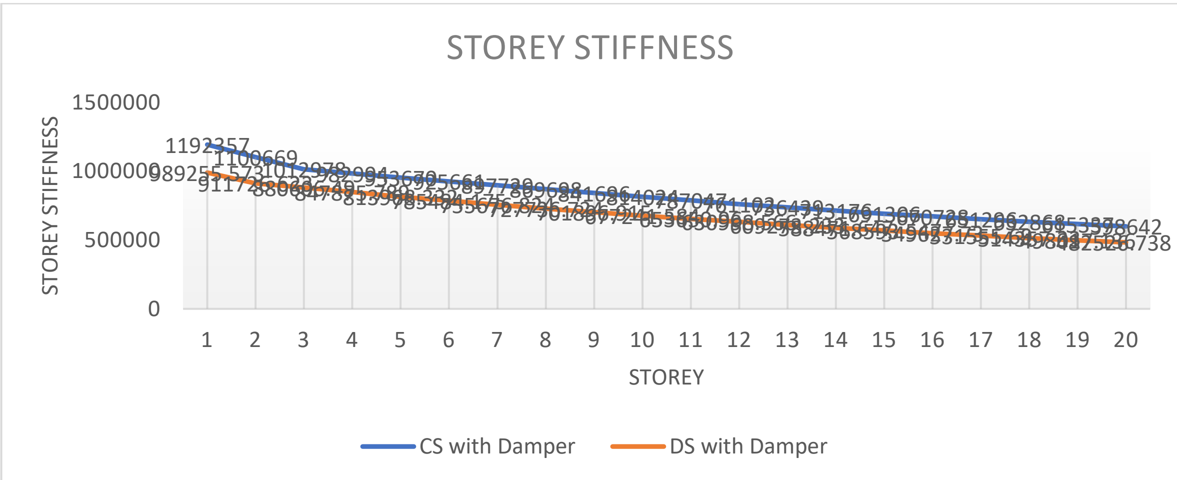
Graph 1 Natural Time Period



Graph 2StoreyDriftinmm



Graph 3StoreyDisplacement in mm



Graph 4 Storey Stiffness in mm

6. CONCLUSION

Based on results following conclusions are drawn from the study:

1. Natural Time Period:

while in diagrid structure with damper and conventional structure with damper the % increment 3.2 %**.**

2.Storey Drift:

while in diagrid structure with damper and conventional structure with damper the % increment 4.4 % .

3. Storey Displacement:

while in diagrid structure with damper and conventional structure with damper the % increment 1.9 % .

4. Storey Stiffness:

while in diagrid structure with damper and conventional structure with damper the % increment 20 % .

7. SCOPE FOR FURTHER STUDY

In this study following future scopes can be consider as:

1. In this study we consider viscous dampers in future frictional dampers can also be used.
2. InthisstudyETABSsoftwareisusedwhereasinfutureSAP2000orteklastructurecan be proffered.

REFERENCES

1. Abhra Tandon, Praveen Singhai Seismic Analysis of a Tall Structure Considering Diagrid and Tuned Dampers using ETABS A Review Article Info Volume 5, Issue 6 Page Number : 139-148 Publication Issue :November-December-2021 Article History Accepted : 02 Dec 2021 Published : 12 Dec 2021 International Journal of Scientific Research in Civil Engineering © 2021 | IJSRCE | Volume 5 | Issue 6 | ISSN : 2456-6667.
2. Bhavani Shankar And Priyanka M V, [Comparative Study Of Concrete Diagrid Building And Conventional Frame Building Subjected To SeismicForce], International Research Journal Of Engineering And Technology (Irjet)June-2018.
3. Harpreet Singh, Aditya Kumar Tiwary, Sandeep Thakur, Gaurav Thakur, Performance evaluation of high-rise reinforced concrete buildings under dynamic loading considering different structural systems, Materials Today: Proceedings,2023,,ISSN2214-7853,https://doi.org/10.1016/j.matpr.2023.08.251.
4. IS:875(Part2)-1987,“CodeofPracticeforDesignLoads(OtherthanEarthquake)forBuildingsandStructuresPart2ImposedLoads(Secondrevision)”,Bureau ofIndianStandard, NewDelhi.
5. Jayesh AkhandAndJ.NVyas,[ComparativeStudyOfDifferentShapesOfDiagrid Structure System With Conventional System Using Response SpectrumAnalysis],InternationalResearchJournalOfEngineeringAndTechnology(Irjet),Apr2019.
6. Meman Suraiyabanu Mohamed Salim,[Comparative Study Of Diagrid System,HexagridSystemAndShearWallSystemInTallTube-TypeBuilding],MultidisciplinaryInternationalResearchJournalOfGujaratTechnological UniversityJuly2020.
7. SunilGurdekarAndMayur Singi, [DynamicAnalysisOfFlatSlabDiagridStructureWith Response SpectrumMethod],Mukt Shabd Journal 2020.
8. Vikash Yadav And Anurag Bajpai, [Seismic Study Of Diagrid Structure WithDamperOf Different Arrangement], 2020.
9. Yashwanth, B., Tamizharasi, G. Limiting Drift to Mitigate Pounding Effects on RC Buildings Under Earthquake Shaking. Iran J Sci Technol Trans Civ Eng (2024). https://doi.org/10.1007/s40996-024-01348-2.