International Journal of Scientific Research in Civil Engineering
© 2023 | IJSRCE | Volume 7 | Issue 2 | ISSN : 2456-6667

Dynamic Analysis of A Circular Tall Structure Considering Outriggers Using ETABS

Sanjeev Shrivastava, Afzal Khan
Department of Civil Engineering, MITS, Bhopal, Madhya Pradesh, India

ARTICLEINFO

Article History:

Accepted: 15 Feb 2023
Published: 05 March 2023

Publication Issue
Volume 7, Issue 2
March-April-2023

Page Number
41-46

ABSTRACT

As the demand for unique structural solutions such as core and outrigger structural systems grows in today's modern world, it necessitates unique structural solutions such as core and outrigger structural systems. This system is constructed in such a way that greater forces are drawn to the building's centre core and less forces are carried by the building's periphery. This approach was also used for a building of medium height, in addition to tall structures. The goal of this study is to look at the seismic variation in circular buildings by placing the Outrigger system at the inner wall in the reinforced concrete structure. In this study, there are two models: one is a traditional circular building, and the other is a building with an outrigger system built into the inner wall. Dynamic analysis and rotational seismic analysis are the methods used to analyse these models, and Etabs is the software used to do so. I.S. (Indian Standard) 1893 part-1: 2016 was the code used for this dynamic study. After assessing all models, the models are compared on the seismic parameter values (lateral storey force, storey displacement, periods and frequency, storey stiffness) for each model to see which model is the most stable.

Keywords : Core and Outrigger structural system, Connection design, Dynamic analysis, time history, Rotational Seismic Analysis and Etabs.

I. INTRODUCTION

In the history of structures, efforts have been aggressive towards the human goal to make progressively tall structures. Different social and financial factors, for example, migration of people from country side to urban areas looking for better way of life and openings for work, the increment in land values in urban regions and higher population density, have prompted an incredible increase in the number of tall structures all over the world. As the tall structure is best to land use strategy in present

time it can spare a ton of land, hence the horizons of the world's urban areas are ceaselessly being punctured by particular and recognizable tall structures as great as mountain ranges, and achieving more height keeps on being the challenge and goal. However, there are some incredible challenges which are to be looked by the designer every day to make these structures a reality. Out of many challenges, one is that of lateral loads i.e. seismic load and wind load. So there is a need to stabilize the tall buildings against these lateral loads and to provide comfort to the occupants.

In this paper we are presenting review of literatures related to analysis and design of structures considering lateral load resisting techniques, considering analysis tools. This review will shows the present state of condition of structures and technique to resist displacement and heavy cost.

II. LITERATURE REVIEW

Bayati et al. (2008) this research paper displays an examination on reduction in drift in uniform belted structures with unbending outriggers, through the investigation of an example structure were operated in Tehran's Vanak Park. Results displayed that utilizing the upgraded multi-outriggers framework can successfully decrease the seismic reaction of the structure. Also, the outcomes show that a multi-outriggers framework can diminish components and establishment measurements. with a similar outrigger segment sizes and areas, virtual outriggers will be less viable than ordinary direct outriggers due to the diminished solidness of the circuitous forces move component. In numerous applications, the diminished viability or proficiency of the outrigger framework will be more than redressed. The conclusion expressed when there were no brackets in the space between the centre and the structure outside, there are fewer requirements on the area of outside segments. The need to find enormous outside segments where they can be legitimately connected by outrigger supports stretching out from the centre is disposed of. Every outside segment (not simply certain assigned outrigger sections) take an interest in opposing upsetting moment.

Sindhu et al. (2021) In this paper author studied the utilization of two different lateral load resisting technique considering hexa-grid and diagrid technique to determine the most prominent technique to resist lateral forces. Adopted a regular square floor plan of 48×48 m and irregular floor plan like C and L type base plan of diagrid and hexa-grid are studied. All structural steel members are designed as per IS 800:2007. The design earthquake load is computed based on the zone factor and their soil types, importance factor and response reduction factor as per IS:1893-2016. All models considered have same 40 storey height and author comparison is based on the parameters like displacement, maximum storey drift, storey shear, maximum base shear and steel consumed are considered in this study. Author concluded that diagrid and hexagrid structural systems shows less lateral displacement and drift compared with conventional frame structural system.

Suriya and Bushra (2021) Here author studied the efficiency and architectural potential of hexa-grid system in tall structures and skyscrapers. In this study author assigned hexagrid technique in three different directions i.e. vertical, horizontal and diagonal direction. Hexagrid encloses intersection of diagonal and horizontal or vertical members. This system is very similar to that of diagrid system and is configured by locating hexagons along the periphery of the building. Author aims to compare between hexagrid structural systems with different patterns and to find the optimal pattern which resists the lateral loads in hexagrid structural system. The use of hexagrids in a skyscraper is a relatively new idea. As such, more is yet to be explored in such a system. Concluded that the displacement values decrease as module size increases in both vertical and horizontal hexagrids. It is observed that as the angle decreases, displacement values increases in both vertical and horizontal hexagrids. and drift values decrease in both vertical and horizontal hexagrid as module size increases. As the angle decreases, it is observed that the drift values increases in both vertical and horizontal hexagrid.

III. OBJECTIVES

- To develop, planning and analysis model of the circular structure G+10 in ETabs software.
- To assess rotational seismic performances of circular structure with outrigger system at inner wall and without outrigger system .
- To Determine the maximum storey displacement, storey shear, storey drift, overturning moment, storey stiffness and Time period of circular structure for circular configuration subject to seismic load.
- To determine the utilization of etabs software in analysis of a circular tall structures.

IV. PROBLEM IDENTIFICATION

Step 1: Numerous research papers were reviewed from authors all around the globe who have particularly worked on research based on rotational seismic analysis to define structure behaviour in such condition.

Step 2: The primary step is model initialization so as to define the codes and units for measurement. Here the display units are defined as per Metric SI and steel design code and concrete design code is defined as per IS 800:2007 and IS 456:2000.

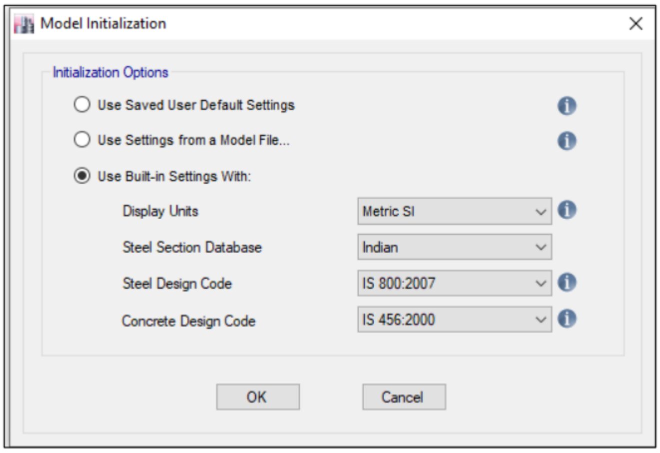


FIG 1: Unit Initiation

Step 3: Defining storey data as in this case, G+10 storey structure is considered with storey height of 3m and total elevation of 27m.

Step 4: The modelling of the structure using storey data

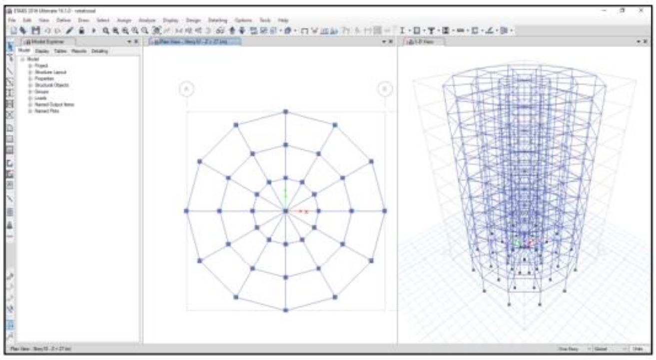


Fig 2: Plan

Step 4 Defining the material and section properties for the case study

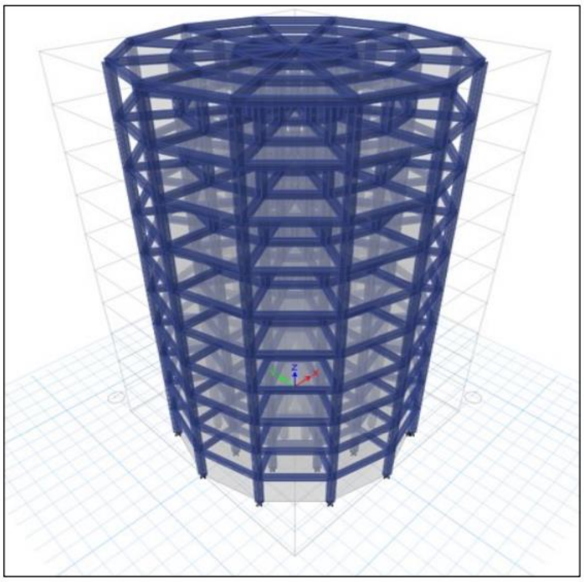
Step 5: Defining Loading conditions for the structure

Step 6: Analyzing results on the parameters of storey displacement, shear force, bending moment.

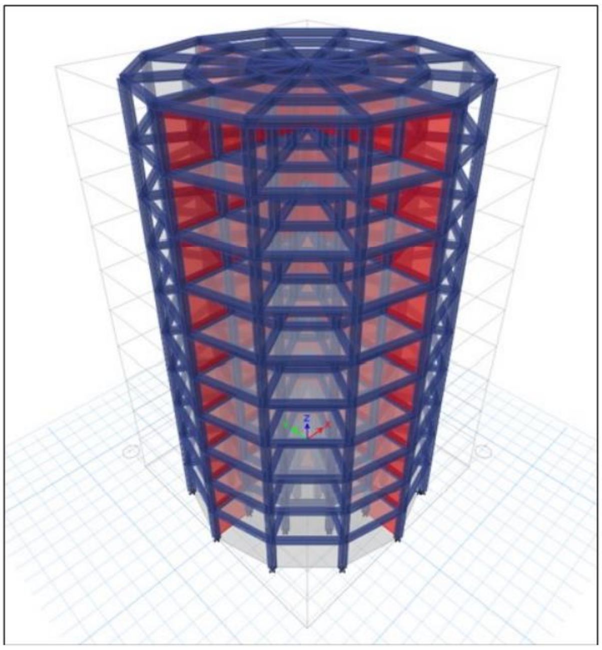
Table 1: Geometrical Data

Beam	250 mmX400 mm
Column	400 mm diameter
Slab	200 mm
Span of Beam	4.0 m
Height of building	27 m
Floor height	3.0m
Ground storey	3.0m
External Diameter	72.0m
Internal Diameter	32.0m
Area	430 m2
Outrigger Thickness	200 mm

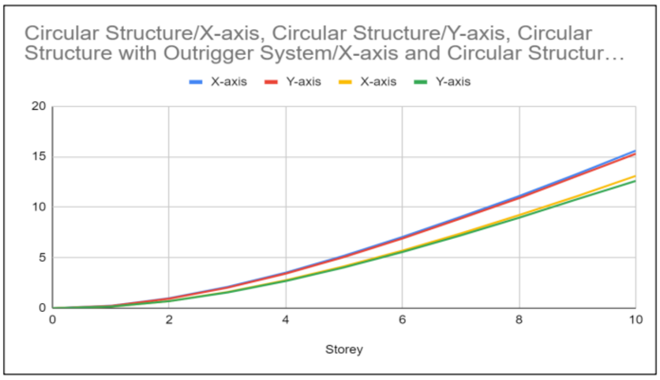
Case I: G+10 Circular conventional structure

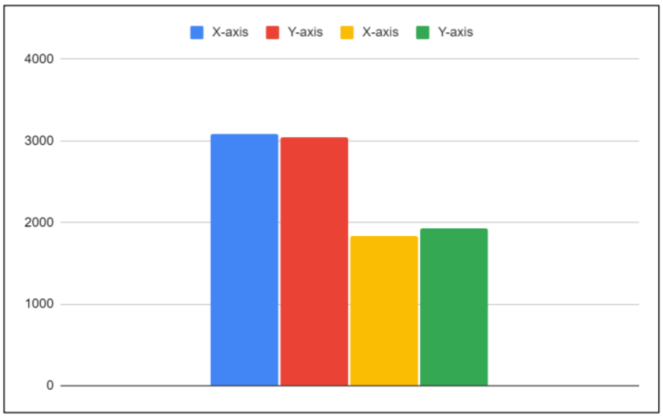


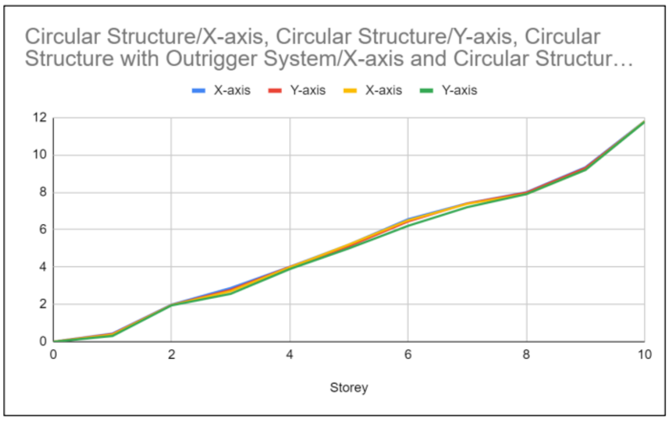
Case II G+10 circular Structure with Outrigger System



V. ANALYSIS RESULT







VI. CONCLUSION

- Storey Displacement Discussion: The lateral displacement of the storey in relation to the basis is known as storey displacement. The building's excessive lateral displacement can be limited by the lateral force-resisting system.Storey displacement was found maximum in circular structure whereas the circular structure with outrigger system was able to retain the displacement and acted stable.
- Base Shear Discussion: The maximum expected lateral stress on the base of the structure owing to seismic activity is called base shear. It's estimated using the seismic zone, soil material, and lateral force formulae from the building code. Here in this case base shear was more than 3000 kN in both X and Y direction in Case I and less than 2000 kN in X and Y direction for Case II.

- Deflection Discussion: In engineering, deflection is the degree to which a part of a structural element is displaced under a load (because it deforms). It may refer to an angle or a distance. Deflection was 4% more in Case I when compared to case II.

VII. REFERENCES

[1]. Anandh,, Mohamed Anas A and Sindhu Nachiar S [A Comparative Study on Seismic Analysis of Diagrid and Hexagrid Structural Systems], "IOP Conf. Series: Materials Science and Engineering", doi:10.1088/1757-899X/1130/1/012006, 2020.

[2]. Divya M. S. And B. Saraswathy, [Comparative Analysis Of High Rise Steel Building With Hexagrid, Diagrid And Conventional Structural System], International Research Journal Of Engineering And Technology (Irjet), Volume: 04 Issue: 04 | Apr-2017.

[3]. Diya Susan Ebinand D. Arul Prakash, [Study On Structural Behaviour Of Hexagrid Structural Systems In Multi Storey Buildings], Int. J. Chem. Sci.: 14(S1), 2016, 330- 340, Issn 0972-768x.

[4]. D. R Shambale And A.A Hamane, [Comparative Study Of Wind Analysis Of High Rise Building With Diagrid And Outrigger Structural System Using Gust Factor Method], International Journal Of Novel Research And Development, Volume 3, Issue 7 July 2018 | Issn: 2456-4184.

[5]. Deepak Laata And Mayankmehandiratta, [Results And Analysis Of Hexagrid And Diagrid Systems In Multi Storey Buildings], International Journal Of Science, Engineering And Technology, Issn (2348-4098), 2019.

[6]. IS:875 (Part 1)-1987 , "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 1 Dead Loads (Second revision)", Bureau of indian Standard, New Delhi

[7]. IS:875 (Part 2)-1987 , "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 2 Imposed Loads (Second revision)", Bureau of Indian Standard, New Delhi.

[8]. IS:1893 (Part 1)-2016, "Criteria for Earthquake Resistant Design of Structures Part General Provisions and Buildings (Sixth Revision)", Bureau of Indian Standard, New Delhi

[9]. Jateen M. Kachchhi, Snehal V. Mevada& Vishal B. Patel, [Comparative Study Of Diagrid Structure With Other Structural Systems For Tall Structures], Global Journal Of Engineering Science And Researches, Issn 2348 – 8034, Impact Factor- 5.070, April 2019.

[10]. Mathew Thomas And Alice Mathai, [Seismic Analysis Of Hexagrid Structure With Various Patterns], International Research Journal Of Engineering And Technology (Irjet), Volume: 05 Issue: 04 | Apr-2018.

[11]. Mathew Thomas And Alice Mathai, [Seismic Analysis Of Hexagrid Structure With Various Patterns], International Research Journal Of Engineering And Technology (Irjet), Volume: 05 Issue: 04 | Apr-2018.

[12]. Mohsen Rostami, Fatemehgorjisinaki And Abdolrezas.Moghadam, [Evaluation Of New Hexagrid Structural System In Bionic High-Rise Buildings], 5th International Conference Of Research In Science And Technology, 15th November 2016.

[13]. Pooja Liz Isaac And Bennetaipe, [Comparative Study Of Performance Of High Rise Buildings With Diagrid, Hexagrid And Octagrid Systems Under Dynamic Loading], International Research Journal Of Engineering And Technology, Volume: 04 Issue: 05 | May -2017.

[14]. Sooriya P and Bushra M A, [Performance assessment of hexagrid structural system] "IOP

Conf. Series: Materials Science and Engineering", doi:10.1088/1757-899X/989/1/012019, 2021.

[15]. Safiyadaliyaahammed And Shahla C. P, [Seismic Behaviour Of Hexagrid Type Structural System], International Journal Of Engineering Research & Technology (Ijert), Issn: 2278-0181, Vol. 8 Issue 02, February-2019.

[16]. Sayyed Kamran Altaf, Sandipatupat And Rahuk M Jadhav, [Parametric Study Of Diagrid, Pentagrid And Hexagrid Structural System], International Journal Of Technical Innovation In Modern Engineering & Science (Ijtimes), Impact Factor: 5.22 (Sjif-2017), E-Issn: 2455-2585, Volume 4, Issue 8, August-2018.

[17]. Snehal S. Mali, D. M. Joshi And Roshni John, [Response Of High Rise Building With Different Diagrid Structural System], International Journal Of Science Technology & Engineering | Volume 4 | Issue 5 | November 2017, Issn : 2349-784x

[18]. Tausif J. Shaikh, Swapnil B. Cholekar, Hemant L. Sonawadekar, [Comparative Study Of Wind Analysis Of High Rise Building With Diagrid And Outrigger Structural Systems Using Gust Factor Approach], International Research Journal Of Engineering And Technology (Irjet), Volume: 04 Issue: 06 | June -2017.

[19]. Taranath S. D, Mahantesh. N.B, M. B. Patil, [Comparative Study Of Pentagrid And Hexagrid Structural System For Tall Building], Journal Of Civil Engineering And Environmental Technology, Volume 1, Number 2; August, 2014 Pp. 10-15.

[20]. T.Subramani And K.Murali, [Analytical Study Of Tall Building With Outtrigger System With Respect To Seismic And Wind Analysis Using Etabs], International Journal Of Engineering And Technology, 7 (3.01)(2018) 77-82.

[21]. Zahidmanzoor And Gurpreet Singh, [Analytical Study On Outrigger And Hexagrid System In High-Rise Buildings], International Journal Of Innovative Technology And Exploring Engineering (Ijitee), Issn: 2278-3075, Volume-8 Issue-7 May, 2019.

[22]. Z. Bayati, M. Mahdikhani And A. Rahaei, [Optimized Use Of Multi-Outriggers System To Stiffen Tall Buildings], The 14th World Conference On Earthquake Engineering October 12-17, 2008, Beijing, China.

Cite this article as :

Sanjeev Shrivastava, Afzal Khan, "Dynamic Analysis of A Circular Tall Structure Considering Outriggers Using ETABS", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 7, Issue 2, pp.41-46, March-April.2023
URL : https://ijsrce.com/IJSRCE23726