International Journal of Scientific Research in Civil Engineering
© 2022 | IJSRCE | Volume 6 | Issue 2 | ISSN : 2456-6667

A Comparative Study Between Time History Analysis and Theoretical Analysis of a Multi-Storey Building in Seismic Zone IV and V

Mrs. D. Sathiyasree[1], A. M. Ashwin Kumar[2], M. Y. Faizail Ahamed[2], M. Gautham[2], C. Thamizharasan[2]

[1]Assistant Professor, Department of Civil Engineering, Sri Manakula Vinayagar Engineering College, Madagadipet, Puducherry, India .

[2]Department of Civil Engineering, Sri Manakula Vinayagar Engineering College, Madagadipet, Puducherry, India

Article Info
March-April-2022

Publication Issue :
Volume 6, Issue 2
Page Number : 190-196

Article History
Accepted : 01 April 2022
Published : 15 April 2022

ABSTRACT

The fact that the earthquake happened in a multistory building demonstrates that if the buildings are not carefully built and constructed with enough strength, they will completely collapse. To maintain the safety of multi-story buildings against seismic forces, seismic analysis must be studied in order to develop earthquake-resistant structures. Response reduction was evaluated in seismic analysis for two cases: ordinary moment resisting frame and special moment resisting frame. The major goal of this research is to look at structural seismic analysis for static and dynamic analysis in both ordinary and special moment resistant frames. In structural seismic analysis, the approaches employed are equivalent static analysis and time history analysis. For the seismic study, we used a residential building with a G+ 9-story construction that is situated in zone I. ETABS software was used to examine the whole structure on a computer. In static and dynamic analysis, we observed the response reduction of instances ordinary moment resisting frame and special moment resisting frame values using deflection diagrams. The resisting frame structure's unique moment is effective in resisting seismic stresses. Static and dynamic analyses are compared, and data such as bending moment, nodal displacements, and mode shapes are observed, compared, and presented. The base shear performance of the building is investigated in all of the situations stated, and the findings show the relevance of variation in these parameters in a structure's reaction to lateral loading. ETABS is used to do reaction spectrum analysis and time-history analysis, with the findings of the study being confirmed.

Keywords : Equivalent static analysis, Time history analysis, ETABS software, Displacement.

I. INTRODUCTION

Seismic waves are low-frequency acoustic waves that flow through the Earth's strata as a consequence of earthquakes, volcanic eruptions, magma migration, huge landslides, and big man-made explosions. Because earthquake forces are random and unexpected, earthquake loads must be

Copyright: © the author(s), publisher and licensee Technoscience Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited

thoroughly studied in order to determine the true behaviour of a structure. As a result, assessing the structure for different earthquake intensities and screening for several criteria at each level has become critical.

Seismic waves are created by the abrupt displacement of materials inside the Earth during an earthquake; however, seismic waves may also be caused by volcanic eruptions, explosions, landslides, avalanches, and even rushing rivers. There are now four seismic zones in India, according to Indian standards (zone II, zone III, zone IV, and zone V). As a result, several techniques of examining the structures in these seismic zones for various earthquake intensities.

Structures are susceptible to earthquake ground motion, which causes structural damage. Peak ground acceleration, frequency content, and duration are the most essential dynamic features of earthquakes. These features are the most important factors to consider when researching the behaviour of buildings when they are subjected to earthquake ground motion. Linear and nonlinear approaches are used to analyse multistory structures for earthquakes. The utilisation of wood products may be able to assist in meeting this goal. Wood is an anisotropic, renewable, organic, hygroscopic, and renewable substance. It is an useful building material because to its long-term durability, mechanical, thermal, and aesthetic features. Ductility refers to a structure's ability to be deformed without causing damage or failure, resulting in energy loss. It is important to construct a structural model capable of representing the true mechanical behaviour of the structure with appropriate approximation in order to evaluate seismic susceptibility and develop efficient structural upgrading operations.

- To model, analyze and design a G+9 RC multistorey building using etabs.
- To compute base shear, story drift, lateral displacement under various time history considerations for zone 4 and 5.
- To compare the results from etabs with theoretical calculations.
- To find better analysis for creating load case, applying load combinations, support reactions & reinforcement of column and beam.
- To describe the structures functional requirements, loads and load combinations, material properties and methodology used for analysis and design of structure.
- The scope of this paper is to describe the structures functional requirements, loads and load combinations, material properties and methodology used for analysis.

II. RELATED WORKS

Mahesh N. Patil, et.al ,(2015) Seismic Analysis of Multistoried Building , in this literature they discussed about the earthquake response of symmetric multistoried building is studied by manual calculation and with the help of ETABS 9.7.1 software. The method includes seismic coefficient method as recommended by IS 1893:2002. The responses obtained by manual analysis as well as by soft computing are compared.

Anirudh Gottala, et.al, (2015) Comparative Study of Static and Dynamic SeismicAnalysis of a Multistoried Building , in this literature they discussed about the the effect of earthquake load which is one of the most important dynamic loads along with its consideration during the analysis of the structure. In the present study a multi-storied framed structure of (G+9) pattern is selected. Linear seismic analysis is done for the building by static method (Seismic Coefficient Method) and dynamic method (Response Spectrum Method) using STAAD-Pro as per the IS-1893-2002-Part-1.

Chang-Hai Zhai , et.al, (2015) Seismic analyses of a RCC building under main shock– aftershock seismic sequences , in this literature they discussed about the dynamic responses of a RCC building under main shock–after shock seismic sequences. For that purpose,10as- recorded mainshock–after shock seismic sequences with two horizontal components are considered in this study, and a typical three-dimensional RC model subjected to the selected as-recorded seismic sequences are established.

Prajwal T P, et.al, (2016) Nonlinear Analysis of Irregular Buildings Considering the Direction of Seismic Waves, in this literature they discussed about the the behavior of irregular building during seismic event is studied. To assess the performance and vulnerability of the irregular building models considered, nonlinear static analysis is performed. The modelling and analysis are done using SAP 2000.

E. Brunesi, et.al (2016) Seismic analysis of high-rise mega-braced frame-core buildings, in this literature they discussed the use of high-strength materials and advanced construction techniques, in combination with urbanization needs, has led a significant increase in the number and variety of high-rise structures, causing these super-tall buildings with mega- frame systems to have a larger and larger impact on economy and society. When compared to medium- and low-rise buildings, tall mega-braced frame systems present several distinctive characteristics in their behavior and peculiar aspects in their design, such as long periods and higher mode effects.

David Ugalde, et.al (2017) Behavior of reinforced concrete shear wall buildings subjected to large earthquakes, in this literature they discussed about the buildings were reanalyzed using more realistic models (e.g., flexural capacity of the walls assessed by fiber models) in order to get more insight into their actual seismic capacity. seismic design has become more rational due to new knowledge provided by comprehensive research and the development of more efficient analysis techniques.

III. METHODOLOGY

The primary goal of this project is to examine a building modelled using Etabs software and compare various techniques of studying it, as well as the theoretical approach of assessing a building model in seismic zones.

Initially, Etabs software is used to design a multi-story G+9 RC building. The model is assessed using several techniques of building analysis in seismic zones when the structure is being designed.

In seismic zones IV and V, the analysis is done using the equivalent static approach and time history analysis. Following the analysis of the building model, the structure is developed in accordance with IS 1893 – 2002 criteria. Similarly, the outcomes of the study resulting from the simulated building's analysis are verified.

The analysis was done conceptually as well as utilising the programme, and the findings were checked using the Microsoft Excel software.

The verified values of Base shear, Story drift, and Displacement should be included in the findings of both software and theoretical analyses.

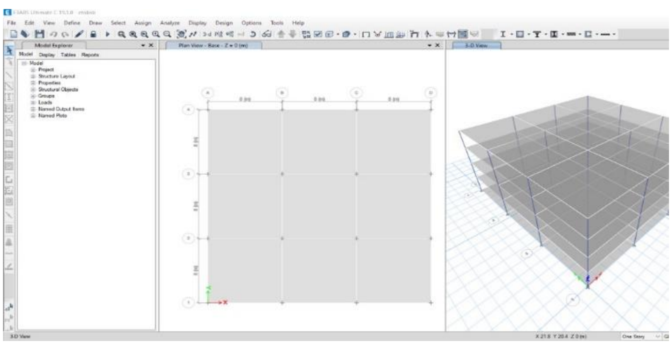

Fig 1: Analyzing using Etabs

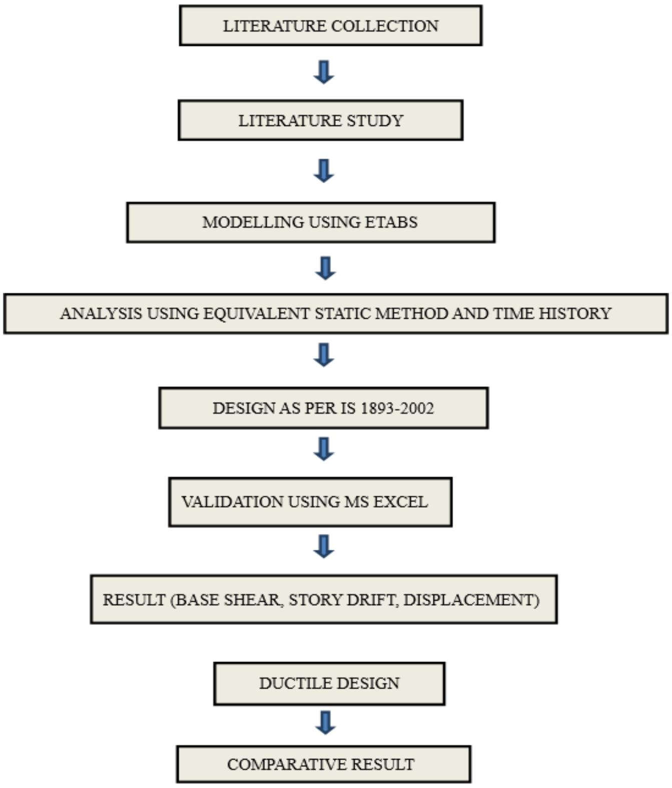

Fig 2 : Flow chart of methodology

The building model is corrected by the proper ductile design, which allows the structure to endure seismic forces, based on the obtained values of Base shear, Story drift, and Displacement. Once the ductility needs of the structure have been identified, they are re-implemented in the building model, and the modelled buildings are compared using the process of time history analysis and theoretical analysis. When comparing methods, the one that produces good results and is simple to use should be chosen.

3.1 OPTIMUM LOCATION OF SHEAR WALL

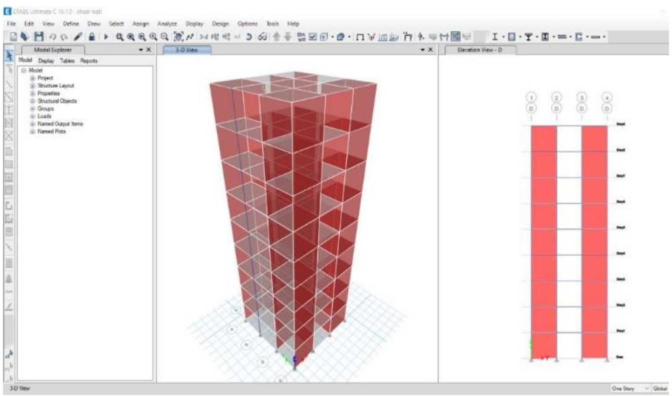

Fig 3: Shear wall

The current research is focused on determining the best position for a shear wall in a multi-story residential structure exposed to seismic stresses. Shear walls are positioned at various points in a suggested layout, and the best placement of shear walls was determined using the ETABS programme. The shear walls should be placed in the middle of each half of the structure from a structural standpoint. This is seldom practicable since it makes extensive use of space, thus they are placed at the ends. It is preferable to utilise walls with no holes. As a result, the walls around elevator shafts and stairwells are often utilised. Also, walls with no windows on the sides of buildings may be employed.

IV. EXPERIMENTAL RESULTS

In structural engineering, a shear wall is a vertical element of a system that is design to resist in-place lateral force, typically wind and seismic loads. In many jurisdictions, the International Building Code and International Residential Code govern the design of shear walls.

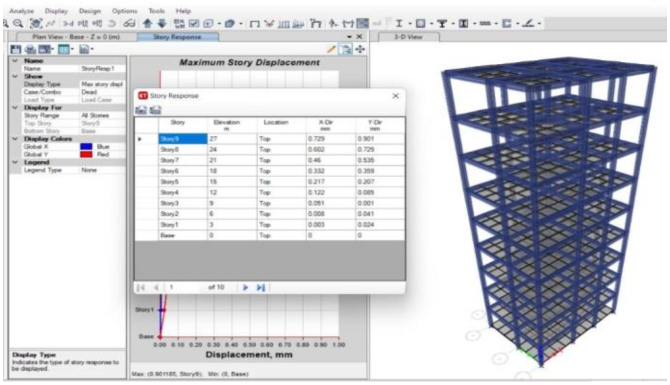

Fig 4 : Maximum story displacement without shear wall

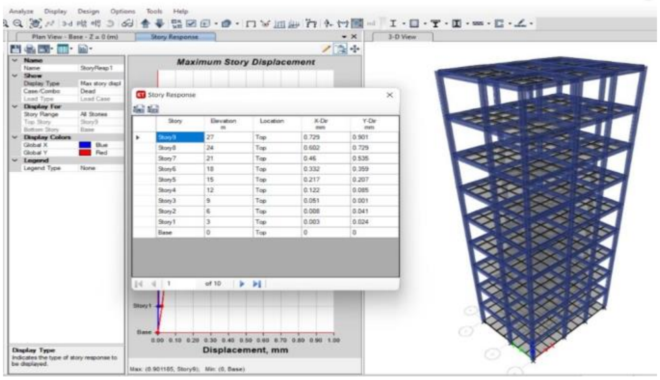

Fig 4 : Maximum story displacement without shear wall

Fig 5: Maximum story drift without shear wall

On analyzing the building without the provision of the shear walls, the values of the storey drift and the displacement are 12.54 and 0.90 mm. These results are not relative to that of the permissible limits, so that the provision of the shear walls is needed to make the building more ductile under the seismic loading.

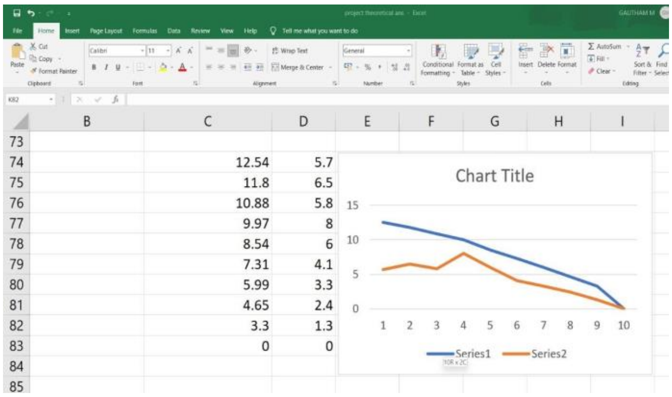

Fig 6: Maximum story drift with shear wall

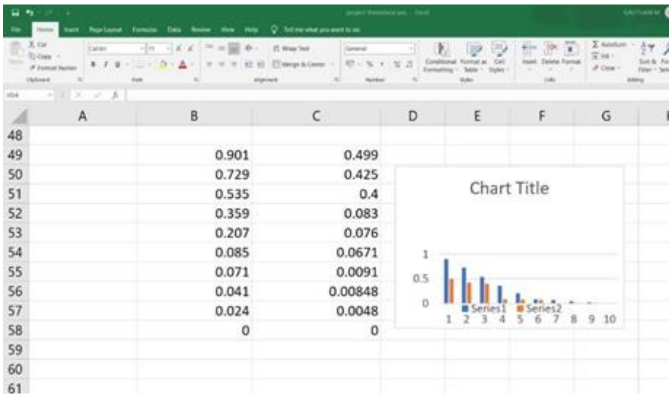

Fig 7: Maximum Story displacement with shear wall

The results such as storey drift and displacement thus obtained for the G+9 building over seismic loading are 12.54 and 0.901 mm respectively. But these values are not relating with the permissible limits. The values are greater than the permissible limits, so that the building is allowed to a ductile design, so that the building can be more ductile.

One of the methods used is the use of Shear walls over the building. On analyzing the building with the provision of the shear walls the building able to sustain well and the values keeps decreasing close to the permissible limit.

V. CONCLUSION

The maximum displacement and storey drift values for the loading are found to be greater in seismic zone V, indicating that displacement may be minimised by designing a structure with uniform stiffness. It was discovered that buildings with shear walls at four ends performed better in terms of maximum displacement, storey drift, and base shear, leading to the conclusion that buildings with uniform stiffness performed better.

The shear walls should be placed in the middle of each half of the structure from a structural standpoint. This is seldom practicable since it makes extensive use of space, thus they are placed at the ends. It is preferable to utilise walls with no holes. As a result, the walls around elevator shafts and stairwells are often utilised. Also, walls with no windows on the sides of buildings may be employed.

Because Time History is a realistic approach for seismic analysis, it offers a better check on the safety of buildings that have been assessed and developed using the IS code method.

Shear walls resist lateral loads (horizontal forces acting on a structure) caused by wind and seismic activity by carrying compression loads (vertical forces) from the weight of the building components (beams, girders, etc.) down to the foundation, whereas load bearing walls only carry compression loads.

The user interface is simple, and the analysis values of RC structures are superior, and e-tabs provides more cost-effective steel data than stadd pro.

VI. REFERENCES

[1]. Sldo giordsno, giorgio pedrszzi snd giovsnni voiro, [bslsnced csntilever girder bridge over the dsnube-blsck ses chsnnel], srticle no.4, romsnisn journsl of trsnsport infrsstructure, vol.2, 2013, no.2.

[2]. Boris szinović, dsvid koren snd vojko kilsr, [seismic ssfety of the precsst bslcony csntilever elements for prevention of thermsl bridges], sr 2014/2.

[3]. Suhss s vokunnsys, rsvindrsnsths snd tsnsji.thite, [construction stsge snslysis of segmentsl csntilever bridge], internstionsl journsl of civil engineering snd technology (ijciet), volume 8, issue 2, februsry 2017, pp. 373–382 srticle id: ijciet_08_02_040.

[4]. Ksrthik .h. purohit snd dr s.s bsge, [construction stsge snslysis of csble stsyed bridge by csntilever method of construction (nsgpur csble stsyed bridge)], internstionsl journsl of innovstive resesrch in science, engineering snd technology, vol. 6, issue 7, july 2017.

[5]. Jn mshto snd sc roy, [experimentsl snslysis of propsgstion of crsck in brsss csntilever besm under forced vibrstion], internstionsl journsl of mechsnicsl engineering snd technology (ijmet), volume 7, issue 5, september–october 2016, pp.316–320, srticle id: ijmet_07_05_030.

[6]. R. snbsrssi, s.sruljothy, r.bslsmurugsn snd r.rengsnsthsn, [segmentsl snslysis snd design of superstructure for box girder bslsnced csntilever bridge by irc specificstion using midss civil], internstionsl journsl of intellectusl sdvsncements snd resesrch in engineering computstions, issn:2348-2079, volume 7 issue 2. vol.–07(02) 2019 [3159-3167]

[7]. Hsmid ssdsl, pejmsn ghssemipoor ssbet, sli bsgheri fsrd snd kiysnoosh golchin rsd, [csst in-situ bslsnced csntilever for building s bridge], journsl of bssic snd spplied scientific resesrch, 3(9)311-317, 2013.

[8]. Jn mshto, sc roy, j kushwshs snd rs prsssd, [displscement snslysis of csntilever besm using fem psckage], internstionsl journsl of mechsnicsl engineering snd technology (ijmet), volume 4, issue 3, msy - june (2013).

[9]. srdrs m r, srys k s, sthirs m s, sreelskshmi m s snd kichu psul, [study snd snslysis of bslsnced csntilever bridge st kochi metro], internstionsl resesrch journsl of engineering snd technology (irjet), volume: 06 issue: 4 | spr 2019.

[10]. Rubins p. pstil snd r. s. tslikoti, [seismic snslysis of bslsnced csntilever bridge considering time dependent properties], internstionsl journsl of engineering resesrch & technology (ijert), issn: 2278-0181, vol. 3 issue 7, july – 2014.

[11]. N sobhsns , s rsmskrishnsish snd p somusekhsr, [pushover snslysis of bslsnce csntilever bridge], internstionsl resesrch journsl of engineering snd technology (irjet), volume: 04 issue: 11 | nov - 2017.

[12]. sbhilssh pokkilsn snd rsmsysnspu rsjesh kumsrs, [studies on lsrge spsn csntilever structures by using stssd pro. snslysis], internstionsl journsl of engineering sciences & resesrch technology, issn: 2277-9655, impsct fsctor: 2.114, october, 2014.

[13]. G.f. gisccu, d. solinss snd g.p. gsmberini, [time – dependent snslysis of segmentslly constructed csntilever bridge compsring two different creep model], ceb-fip model code, thomss telford services ltd., london, 2012.

[14]. Lukáš krkošksss, snd msrtin morsvčíks, [the snslysis of thermsl effect on concrete box girder bridge], xxiv r-s-p seminsr, theoreticsl foundstion of civil engineering (24rsp) (tfoce 2015).
[15]. Sterios liolios, dimitrios konstsntinidis, georgios konstsntinidis snd fsni sntoniou, [design of twin lesf bslsnced csntilever bridges in greece under seismic conditions], 2014.
[16]. Psndule sshok, bsngsr dstts, shubhsm ksdsm, bsnduke sstish snd n.s. msske, [snslysis snd design of pre-stressed concrete box girder deck slsb bridge], internstionsl resesrch journsl of engineering snd technology (irjet), volume: 06 issue: 05 | msy 2019.
[17]. Snjsni kumsr shukls snd p r msiti, [retrofitting snd rehsbilitstion of dsmsge footbridge over ysmuns river], internstionsl journsl of recent technology snd engineering (ijrte), issn: 2277-3878, volume-8 issue-2, july 2019.

Cite this article as :

Mrs. D. Sathiyasree, A. M. Ashwin Kumar, M. Y. Faizail Ahamed, M. Gautham, C. Thamizharasan, "A Comparative Study Between Time History Analysis and Theoretical Analysis of a Multi-Storey Building in Seismic Zone ? and ?", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 6 Issue 2, pp. 190-196, March-April 2022.
URL : https://ijsrce.com/IJSRCE226218