iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VII **Month of publication:** July 2022

DOI: https://doi.org/10.22214/ijraset.2022.45254

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VII July 2022- Available at www.ijraset.com

Design and Analysis of (G+4) Residential Building Using ETABS

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Abstract: ***Structural analysis is a branch that involves determining the behaviour of a structure to predict the response of different structural components due to loading effects. Every structure will be subjected to a load or set of loads, the various loads usually considered are dead load, live load, seismic load and wind load. In our project, we use ETABS software to analyse various loads such as dead load, live load, seismic load. The main objective of the project is to acquire sufficient knowledge of architectural planning, analysis and design. Practical knowledge is an important and essential skill that every engineer needs. For the analysis and design of multi-story buildings, concepts of structural engineering are required, as well a basic concept of theoretical and practical knowledge of planning and design. In this project, we mainly deal with (G+4) residential building using ETABS, and attempt to analyse and design multi-storey building using ETABS. The analysis is performed by static methods and the design is carried out according to IS 456:2000 guidelines. Drawings of plans, elevation, section, site plan, service plan, etc.. are done using AutoCAD software.***

Keywords: Multi-storied Residential building, ETABS software, Dead load analysis, Live load analysis, seismic load analysis.

I. INTRODUCTION

Every structural engineer need to design a building with the most efficient planning, economically and considering safety. The structural engineer should ensure that it is serviceable, habitable in healthy environment for its occupants and for longer design period. In this present day, ETABS software is one of the leading design software available in the market. ETABS software is very helpful for analysing very complex building structures. So in this project, the paper mainly deals with a comparative study between the result of analysis from ETABS and result from manual analysis. We mainly doing seismic load analysis in addition with dead load and live load analysis.

The action of earthquake load on a building depends on the duration and frequency of the existing ground motion, intensity and dynamic characteristics of the building structure. The analysis of various loads in the ETABS software helps to determine the safety of the building. As per geographical statics of India, it shows that around 54% of the land is vulnerable to earthquakes. It is important to construct a earthquake resistant structures in all over the world.

This paper mainly deals with analysis of a (G+4) storied residential building by using the ETABS software. Full form of ETABS is referred as Extended three dimensional analysis of building structure. In our project we mainly use INDIAN STANDARD CODE BOOKS such as IS 456:2000, SP-16, IS 875-1987 (PART 1), IS 875-1987 (PART 2), IS 1893-2002 (PART 1). IS 456:2000 code book is used for design of R.C.C structures, SP-16 is used for design of column, IS 875-1987 (PART 1) uses of calculating dead load, IS 875-1987 (PART 2) is used for calculating live load and IS 1893- 2002 (PART 1) is used for calculation of seismic load. This project is carried out by considering soil condition as type-II soil.

In our project, we referred Kerala municipal building rule (KMBR) for finding occupancy, allowable staircase size, measurements of offsets of the building, allowable ramp measures, etc…in this project, we considered the seismic zone as zone-III and seismic zone factor as 0.16 and importance factor as 1.2, and response reduction factor as 5. As per KMBR rule height of each story is 3.3m and in this project we provided height of each story as 3.3m and the total height of the building is 20.35m. In this project, after analyzing dead load, live load and seismic load in ETABS software, we manually done the design of beams, columns, staircase, water tank and septic tank.

II. LITERATURE REVIEW

1) *Sayyed Feeoz Sikander et.al (2017):* In this article sayyed feeoz sikandar selected a building with (G+10) storied having a car parking facility provided at basement. In this the design method involves load calculation manually and analysing the whole structure in ETBAS.

2) *C.V.S Lavanya et.al (2017):* In this paper, the author selected a (G+4) residential building and analysed the building using ETABS software. And they designed the structure most economically in an economic way by reducing the sizes in the sections. In this paper, from the plinth to the certain height of the building, the column size may differ that is it would be more when compared to upper columns because to reduce the failure in the structure.
3) *V. Mounusha et.al (2017):* They are analysed the residential building using ETABS. Design was enhanced architectural developments in the construction of arches and roof domes. Arches improved the efficiency and capability of bridges and aqueducts (fewer supports columns were needed to support the structure), while domed roofs not only permitted the building of larger open areas undercover, but also lent the exterior an impressive.
4) *S. Abhishek et.al (2018):* This project presents multi-storied residential building analysed and designed with lateral loading effect of earthquake using ETABS. This project is designed as per IS 1893-Part2: 2002, IS 456:2000. This paper discusses the analysis of a commercial building (G+1) located at Hyderabad under effect of seismic forces. Shear forces and bending moments or beams and columns are observed and concluded that larger span have more shear forces and bending moments. Stages in structural design includes drawing study, load combinations, analysis of structures, structural design.
5) *Melvin Ronaldo Dsouza et.al (2019):* They took a residential building consisting of G+12 floors for the analysis of multistorey building, reductive of deflection using bracing system and optimization of beams and columns. Their exposure condition is taken to be moderate. They discussed about the types of plan in detail, also about the ETAB software to be used. They also described about AutoCAD. Introduction to bracing system were also discussed. The types of bracing systems; X bracing, V bracing, inverted V, diagonal were explained in detail. From the project they concluded that in RCC frame building the displacement and storey drift decreases for different types of bracing system used to compared to RCC frame building without bracings and the base shear increases for different types of bracing system used compared to unbraced frame structure. Different load cases and their calculations are explained.
6) *Ramesh Bharagan et.al (2020) :* Any structure is made up of structural elements (load carrying, such as slabs, beams and columns) and non-structural elements (such as partitions, false ceilings, doors). The structural elements, put together, constitute the 'structural system'. Its function is to resist effectively the action of gravitational and environmental loads, and to transmit the resulting forces to the supporting ground, without significantly disturbing the geometry, integrity and serviceability of the structure. A creative sense, imagination, understanding and keen observation of structures in nature, scientific knowledge of various aspects of structures, understanding of the various structural phenomenon on basis of statistical and experimental data, and finally, the backing of vast experience from the past, are some of the qualities, required for a structural engineer.

III. DETAILS OF STUDY MODEL

A. *Details of Project*

1) Purpose of the building: residential
2) Shape of the building: Rectangular shape
3) Total number of stories: 5
4) Number of staircases: 2
5) Total number of lift: 1
6) Type of wall of building: brick wall
7) Type of construction: R.C.C framed structure
8) Height of stories: 3.3m

B. *Condition of Area of Construction*

1) Place: kurukathani, kottakkal, Malappuram district
2) Plot area = 680.85 m^2
3) Plinth area = 1152.40 m^2
4) Floor area ratio: 230.48
5) Soil type: type-II
6) Seismic zone: zone-III
7) Seismic zone factor: 0.16
8) Importance factor: 1.2
9) Response reduction factor: 5
10) Damping: 5%

C. Materials Used

Grade of concrete: M_{20}
Grade of steel: Fe_{415}
Brick masonry: first class
Beam size: 200 x 400 mm

Column size: 1) 200 x 200 mm
2) 200 x 400 mm
Slab: 100 mm thick

D. Loads On the Building: -
Self-weight of slab = 2.5 KN/m^2
Floor finish of slab = 1 KN/m^2
Total load on slab = 3.5 KN/m^2
Wall load (20 c.m thick wall) = 13.2 KN/m^2
Live load on floor = 1 KN/m^2
Floor finish on floor = 1 KN/m^2

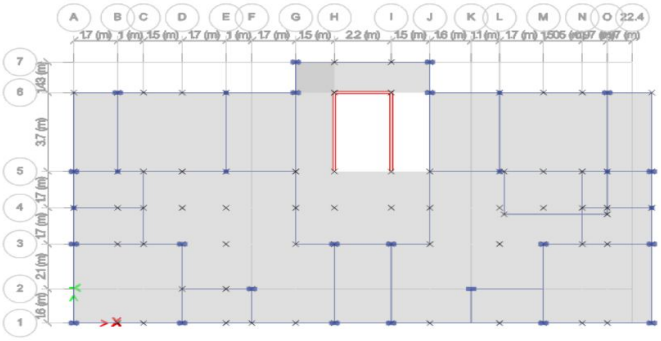

Fig. 1 Typical floor plan in ETABS

IV. RESULT AND DISCUSSION

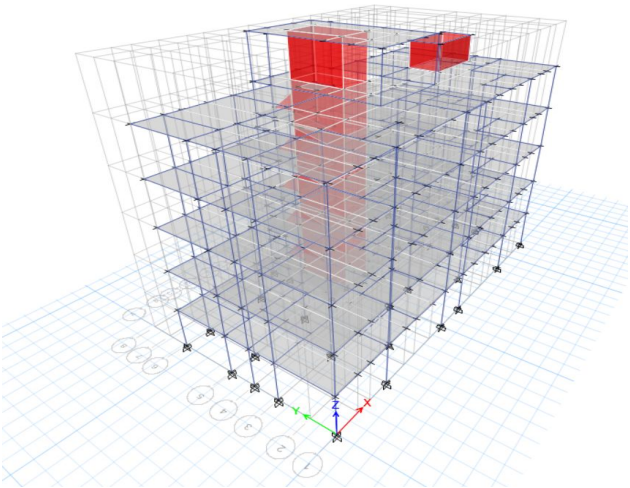

Fig. 2 3-D model view of the model

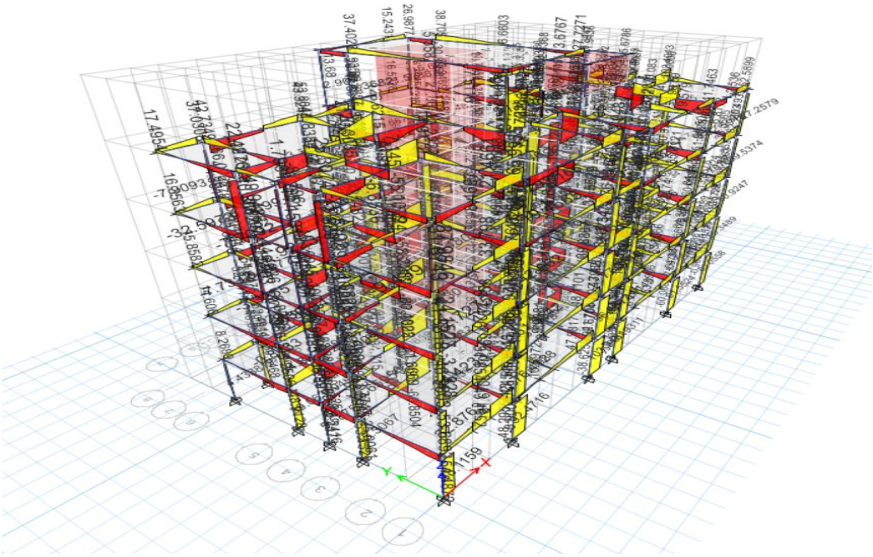

Fig 3 Shear force diagram

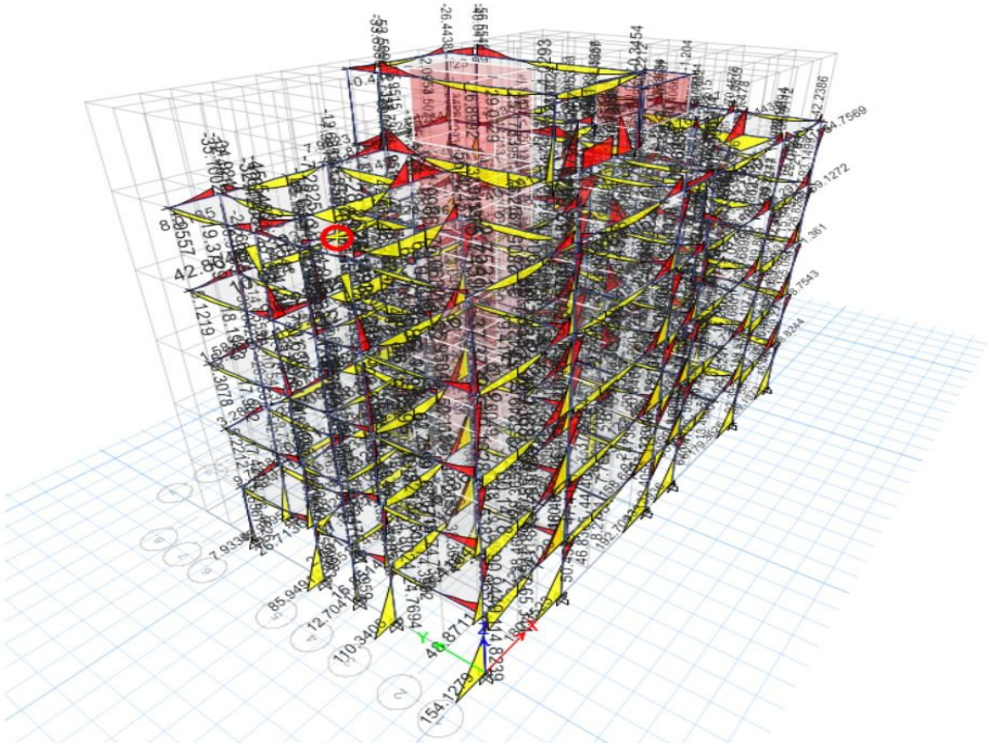

Fig. 4 Bending moment diagram

V. CONCLUSION

In this project, we have worked to design and analysis of a (G+4) residential building in kurukathani, kottakkal, Malappuram district. Throughout this project, we learned how to use AutoCAD software and how to do analysis in ETABS software. All the structural members are designed using the limit state method of design. By using the ETABS software, it minimizes the time required for analysis and design. We provided an additional column of size 200 x 200 mm in addition to the column of size 200 x 400 mm to carry more loads and making the building free from the failure due to column failure. seismic load analysis was done by using ETABS software and successfully verified by manually as per the IS 1893-2002 (PART 1). ETABS is a perfect software for analysis and design of building.

VI. ACKNOWLEDGMENT

We would remember with grateful appreciation, the encouragement and support rendered by Dr Vince Paul, Principal eranad knowledge city Technical Campus, Manjeri.

We express our deepest sense of gratitude to Mr Shyam P, Professor and head of department of civil engineering and Ms. Karthika M.R, assistant professor, project co Ordinator and guide, department of civil engineering for their valuable advice and guidance.

We would always oblige for the helping hands of all other staff members of the department and all our friends and well-wishers, who directly or indirectly contributed in this venture.

Last but not least, we are indebted to God almighty for being the guiding light throughout this project and helped us to complete the same within the stipulated time.

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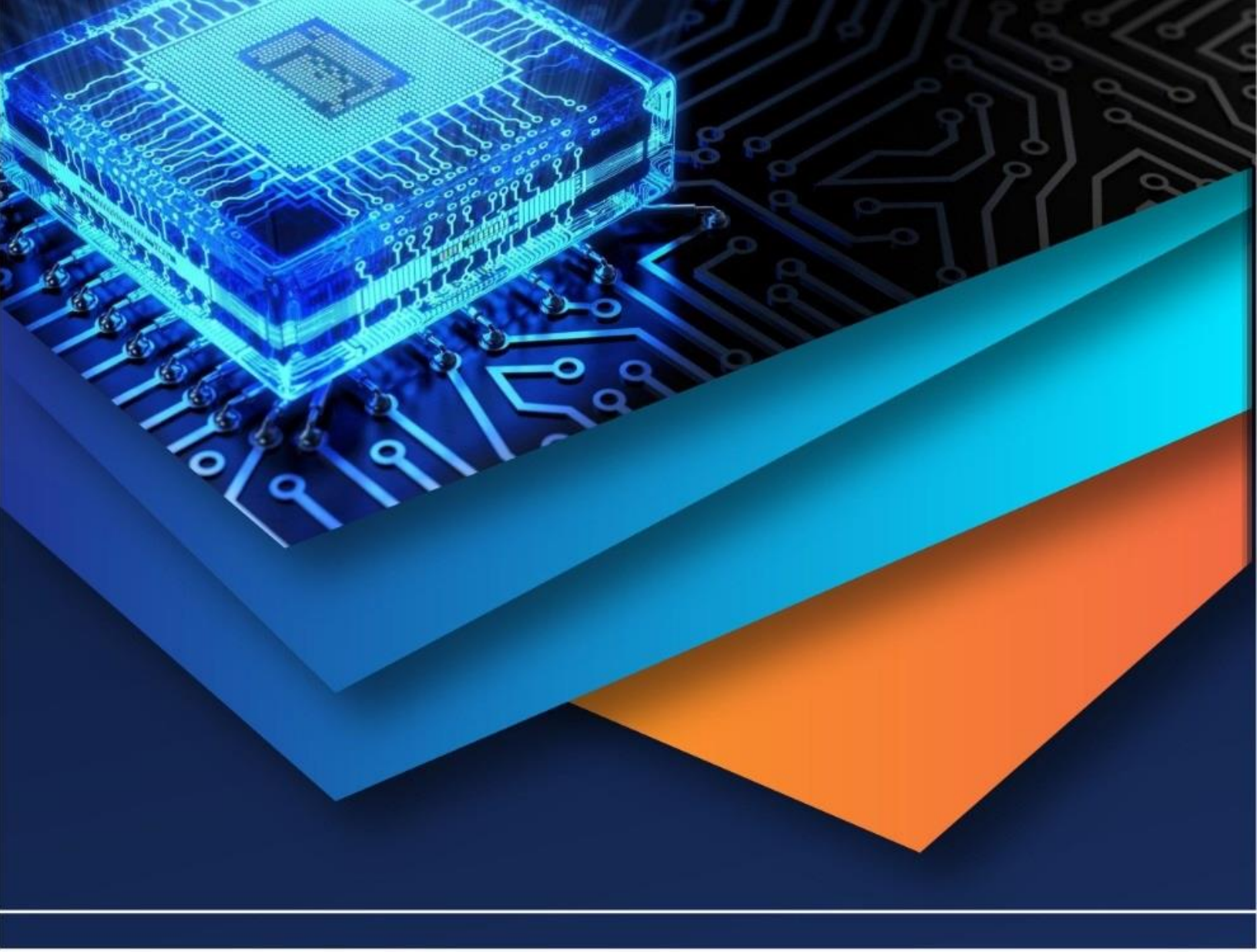

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