IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363

DESIGN AND DETAILING OF G+7 COMMERCIAL BUILDING USING ETABS

S Narasimha, G Nikhil, B Rakesh, M Pavan Kumar, Manapadu Gayathri, Mohammed Abdul Aleem, Mr. Syed Sabeel Pasha

Dept. of Civil Engineering, SVITS, Mahbubnagar, Telangana, India.

Abstract: *ETABS is the leading design software in today's market. Not only it is being used in many design and consultant companies for designing purposes but also it is also being taught at different study levels. For these reasons, a good knowledge of software is necessary. This report mainly deals with the design and detailing of a Multi-storey commercial structure (G+7) using ETABS. This would include the designing of complete R.C.C structure and the results will be compared in the end. A structure is an assembly of members, each of which is subjected to bending or direct force (either tensile or compressive) or to a combination of bending and direct forces.These primary influences may be accompanied by shearing forces and sometimes by torsion. Effects due to changes in temperature, shrinkage and creep of the concrete, the possibility of damage resulting from overloading, abrasion, local damage, vibration frost, chemical attack and similar causes may also have to consider. Design includes the calculations of, or other means of accessing and providing resistance against the moments, forces and other effects on the members. An efficiently design structure is one in which the members are arranged in such a way that the weight, load and forces are transmitted to the foundation by the cheapest means consistent with the intended use of structure of the site. Efficient design means more than providing suitable sizes for the concrete members and the provisions of the calculated amount of reinforcement in the economical manners.*

I- INTRODUCTION

Building construction is the engineering deals with the construction of building such as residential houses. In a simple building can be define as an enclose space by walls with roof, food, cloth and the basic needs of human beings. In the early ancient times humans lived in caves, over trees or under trees, to protect themselves from wild animals, rain, sun, etc. as the times passed as humans being started living in huts made of timber branches. The shelters of those old have been developed nowadays into beautiful houses. Rich people live in sophisticated condition houses. Buildings are the important indicator of social progress of the county. Every human has desire to own comfortable homes on an average generally one spends his two-third life times in the houses. The security civic sense of the responsibility. These are the few reasons which are responsible that the person do utmost effort and spend hard earned saving in owning houses.

In this project, an effort made on planning, analysis and design of residential building. For analysis and design of building, the plan draft by AUTO-CAD software which plan import in Etabs.

The development of the multistory building has followed the growth of the city closely. The process of urbanization that started with the age of industrialization is still in progress in developing countries like India. Industrialization causes migration of people to urban centres where job opportunities are significant. The land available for buildings to accommodate this migration is becoming scarce, resulting in rapid increase in the cost of land. Thus, developers have looked to the sky to make their profits. The result is multistoried buildings, as they provide a large floor area in a relatively small area of land in urban centres.

The construction of multi-storeyed buildings is dependent on available materials, the level of construction technology and the availability of

services such as elevators necessary for the use in the building.

1.2 EARLY MODERN AND THE INDUSTRIAL AGE:

With the emerging knowledge in scientific fields and the rise of new materials and technology, architecture engineering began to separate, and the architect began to concentrate on aesthetics and the humanist aspects, often at the expense of technical aspects of building design. Meanwhile, the industrial revolution laid open the door for mass production and consumption. Aesthetics became a criterion for the middle class as ornamental products, once within the province of expensive craftsmanship, became cheaper under machine production.

Vernacular architecture became increasingly ornamental. House builders could use current architectural design in their work by combining features found in pattern books and architectural journals.

1.3 METHODOLOGY

A multistory building frame is a three-dimensional structure or a space structure. It is idealized as a system of interconnected two-dimensional vertical frames along the two mutually perpendicular horizontal axes for analysis. These frames are analyzed independently of each other. In frames where the columns are arranged on a rectangular grid, loading patterns giving biaxial bending need not be considered except for corner columns.

The degree of sophistication to which a structural analysis is carried out depends on the importance of the structure. A wide range of approaches have been used for buildings of varying heights and importance, from simple. Approximate methods which can be carried out manually, or with the aid of a pocket calculator, to more refined techniques involving computer solutions. Till a few years ago most of the multistory buildings were analyzed by approximate methods such as substitute frame, moment distribution, portal and cantilever methods.

1.4 OBJECTIVES OF THE PROJECT

The main objective of the project is to design and analyze a multi-storey building using ETABS. Because of the growing population and less availability of land, construction of multi-storey buildings is coming into play to serve commercial spaces in limited area.

1.5 SCOPE OF WORK

The analysis is implemented for Analysis and Design of Multi Storeyed l Building using ETABS. The structure is analyzed for the loading systems as per the IS 456- 2000 codal provisions.

II - LITERATURE REVIEW

Ibrahim, et.al (April 2019): Design and Analysis of Residential Building(G+4): After analyzing the G+4 story residential building structure, conducted that the structure is rate in loading like dead load, live load, wind load and seismic loads. Member dimensions (Beam, column, and slab) are assigned by calculating the load type and its quantity applied on it. Auto CAD gives detailed information at the structure members length, height, depth, size and numbers, etc. Etabs. has a capability to calculate the program contains number of parameters which are designed as per IS 456: 2000. Beams were designed for flexure, shear and tension and it gives the detail number, position and spacing brief.

Dunnala Lakshmi Anuja, et.al (2019): Planning, Analysis and Design of Residential Building (G+5) By using Etabs: Frame analysis was by Etabs. Slab, Beams, Footing and stair-case were design as per the IS Code 456-2000 by LSM. The properties such as share deflection torsion, development length is with the IS code provisions. Design of column and footing were done as per the IS 456-2000 along with the SP-16 design charts. The check like one way shear or two-way shear within IS Code provision. Design of slab, beam, column, rectangular footing and staircase are done with limit state method. On comparison with drawing, manual design and the geometrical model using Etabs.

Mr K. Prabin Kumar, et.al (2018): A Study on Design of Multi-Storey Residential Building:

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363

They used Etabs. To analysis and designing all structure member and calculate quantity of reinforcement needed for concrete section. Various structure action is considered as members such as axial, flexure, shear and tension. Pillars are delineated for axial forces and biaxial ends at the ends. The building was planned as per IS: 456- 2000.

Deevi Krishna Chaitanya, et.al (January, 2017): Analysis and Design of a (G+6) Multi-Storey Building Using Etabs.: They used static indeterminacy methods to calculate numbers of unknown forces. Distributing known fixed and moments to satisfy the condition of compatibility by Iteration method. Kani's method was used to distribute moments at successive joints in frame and continues beam for stability of members of building structure. They used the designing software Etabs. Which reduced lot of time in design, gives accuracy.

R. D. Deshpande, et.al (June, 2017): Analysis, Design and Estimation of Basement+G+2 Residential Building: They found that check for deflection was safe. They carried design and analysis of G+2 residential building by using E-Tabs software with the estimation of building by method of center line. They safely designed column using SP-16 checked with interaction formula.

Sreeshna K.S (2016) this paper deals with structural analysis and design of B+G+4 storied apartment building. The work was completed in three stages. The first stage was three dimensional models and scrutiny of building and the second stage was to design the structural elements and the final was to detail the structural elements. In this project STAAD.Pro software is used for analyzing the building. The IS:875 (Part 1) and (Part 2) were referred for dead load and live load. Design of structural elements like beam, column, slab, staircase, shear wall, retaining wall, pile foundation is done according to IS Codes.

1. Allows Graphic user input and other related modifications- Bang on! Try this new feature and create fantastic structures.

2. Offering different view options in 3D for all side checks.

3. Easy editing and navigation- with the help of the tools, you can move your object from any place simultaneously keeping it subjected to constant changes. Edit your model with a real-time view.

4. Exporting capability and automatic consideration of self-weight of material- This is something again you need not run here and therefore.

5. Integration with SAP2000 thus letting you constructs furthermore structures.

6. Connection with EC-Praxis 3J allows creating a steel model.

These are some of the outstanding benefits provided by ETABS that won't even let you think of any other software.

III - LAYOUT OF G+7 STRUCTURE USING AUTOCAD

3.1 General

AutoCAD or Computer Aided Design is a very helpful tool in drafting and designing any structure. AutoCAD uses a Graphical User Interface for the purpose of drafting and designing any structure. The software has various inbuilt tools for complex drafting. Also AutoCAD can be used for 2D, 3D and for perspective design.
With the help of AutoCAD all the drafting for the project has been done.

3.2 Details of the Project:

The plot size for the project was 25x20 mts accordingly the building has been laid in the centre of the plot leaving ample space on all the sides for landscaping and pathways for cars and for visitors parking.

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363

The complete structure is of 600 sqyards and the numbers of floors are G+7 with column orientation, beam placements and slabs as per different floors.

3.3 Layout Using AutoCAD

The layout has been mostly completed using the Line command. The unit for the layout is metres with accuracy of "0.000". Below is a screen shot of the line diagram showing the centre line for beam and column layout.

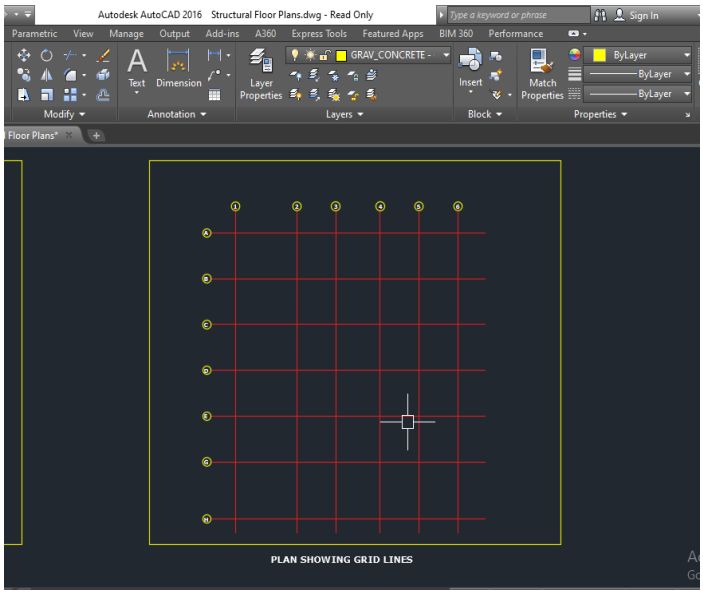


Fig 1 Shows grid lines of the building

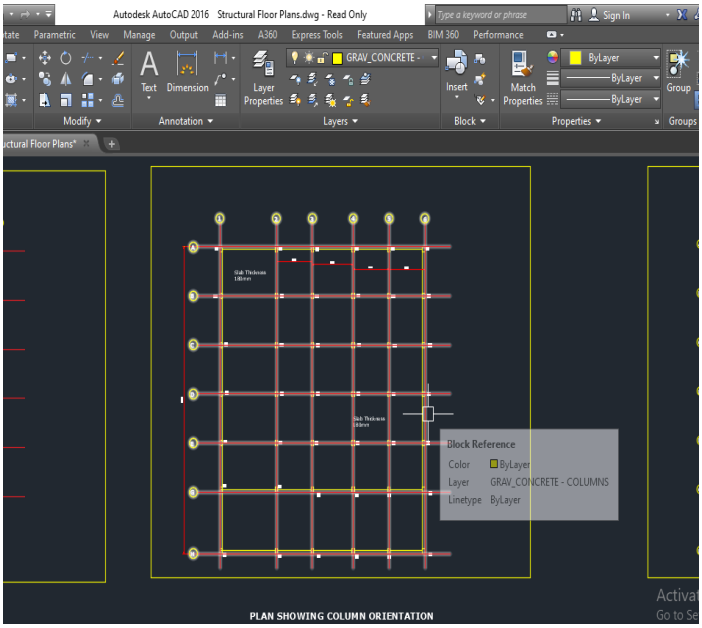


Fig 2 shows the column orientation of the building

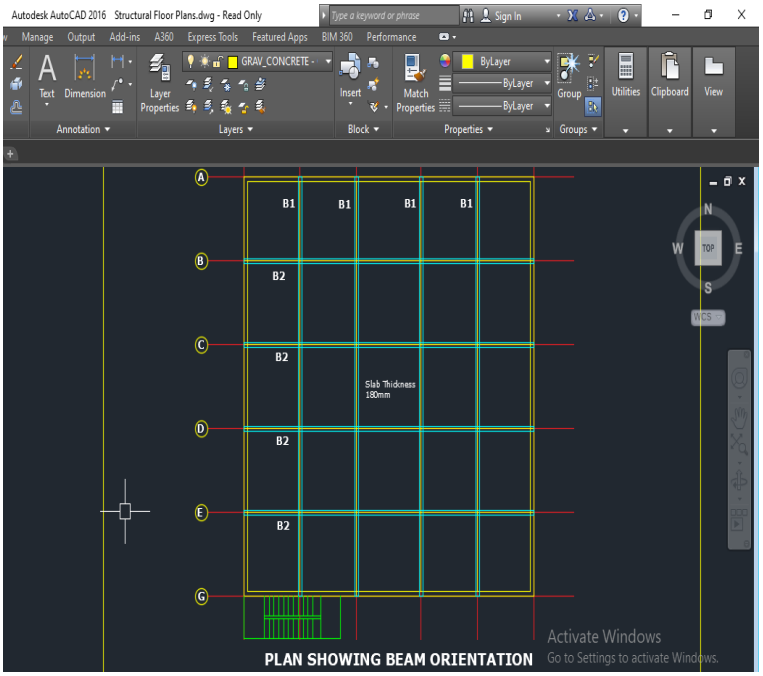


Fig 3 shows the beam orientation of the structure.

IV - DESIGN PARAMETERS

4.1 Etabs Inputs statement

Concrete Grade = M25
Clear Cover = 25mm
Fc = 25 mpa

Fy main = 500mpa
Fy Section/ Stirrups = 500mpa
Density of Concrete = 23.5Kn/m^3

Loading Considerations for elements

Consider Finishes of 75mm with 20 Kn/m^3 Density of concrete
Brick wall/Partition walls Moderate Grade = 20 Kn/m^3
Live Load = 2.0Kn/m^2 & 2.50Kn/m^2 for commercial

4.2 Properties of elements

a). Beam Sizes

300 mm × 400 mm C to 2nd Floor
250 mm × 350 mm 3rd to 5th Floor
225 mm × 300 mm Roof Beam Size

b). Column Sizes

250 mm × 400 mm C to 2nd Floor
230 mm × 400 mm 3rd to 5th Floor
230 mm × 350 mm Secondary Columns

c). Slabs Thickness

Floors C to 1st = 200mm
Floors 2nd to 5th Slab = 150mm
Roof Slab = 125mm

d). Wall Thickness

Partition wall = 115mm
Outer Main wall = 230mm
Parapet wall = 75mm thick / Height= 1.2m

V - ANALYSIS OF STRUCTURE

5.1 Modelling of structure

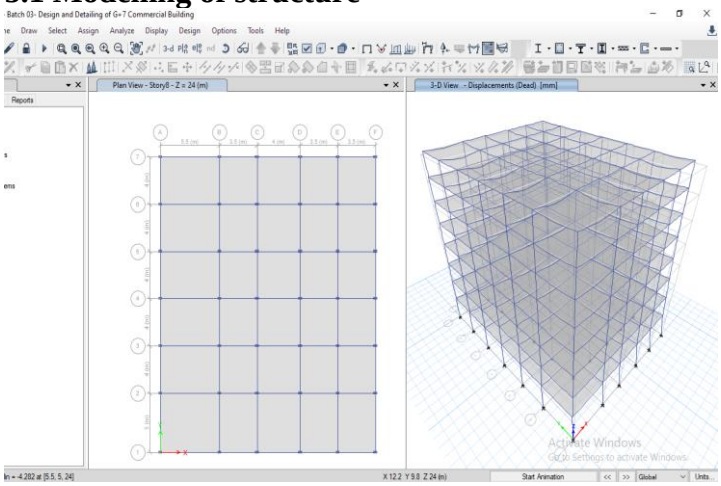


Fig 5 shows the geometry of the structure.

5.2 Member property assigning to the structural elements

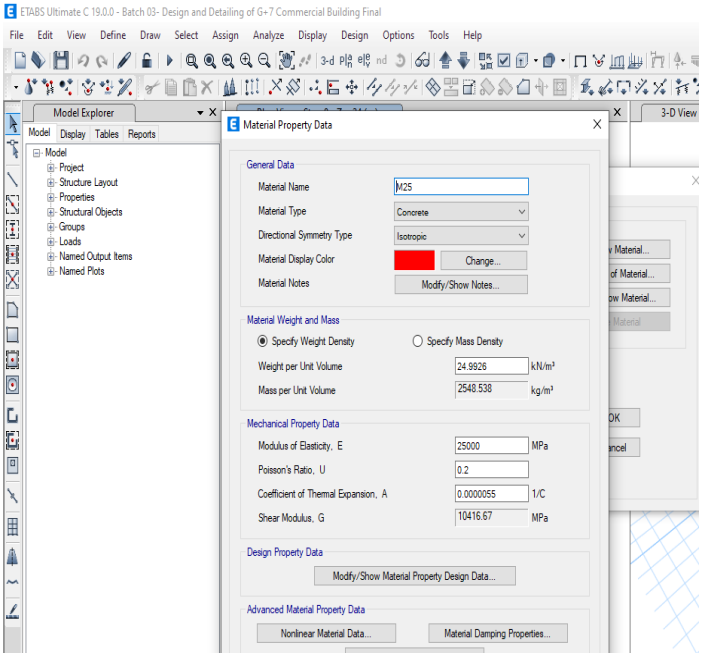


Fig 6 shows the member property of the elements.

a) Slab Properties

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363

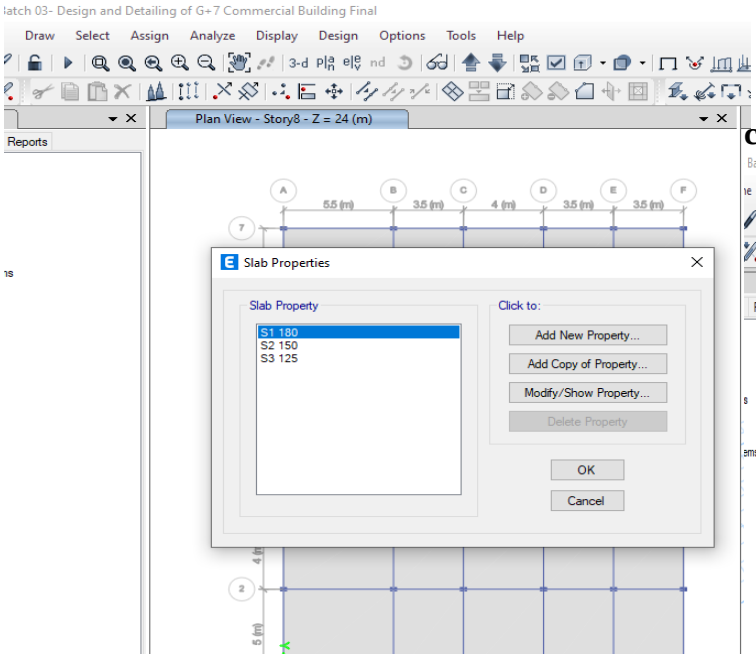


Fig 7 shows the slab member property

b). Beams Property

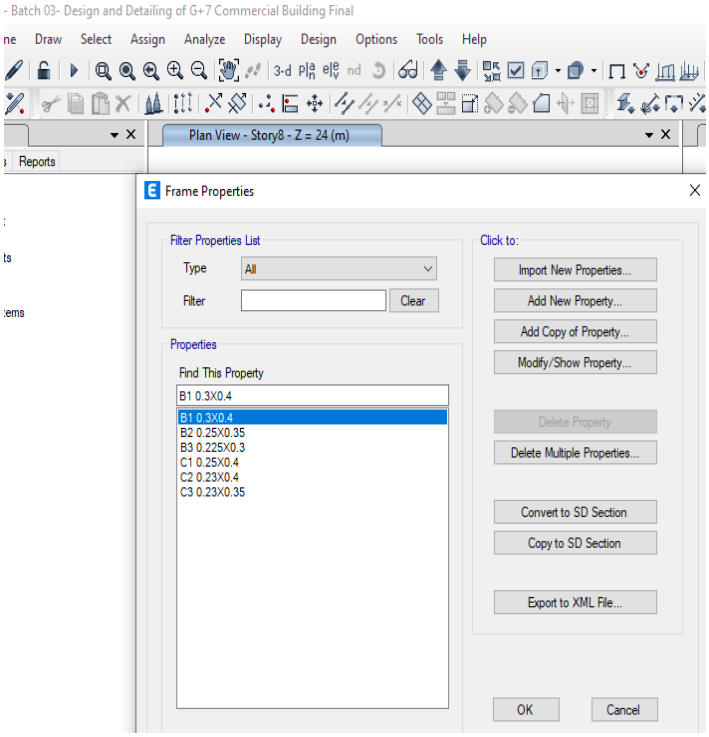


Fig 8 shows the Beam member property

c). Column Property

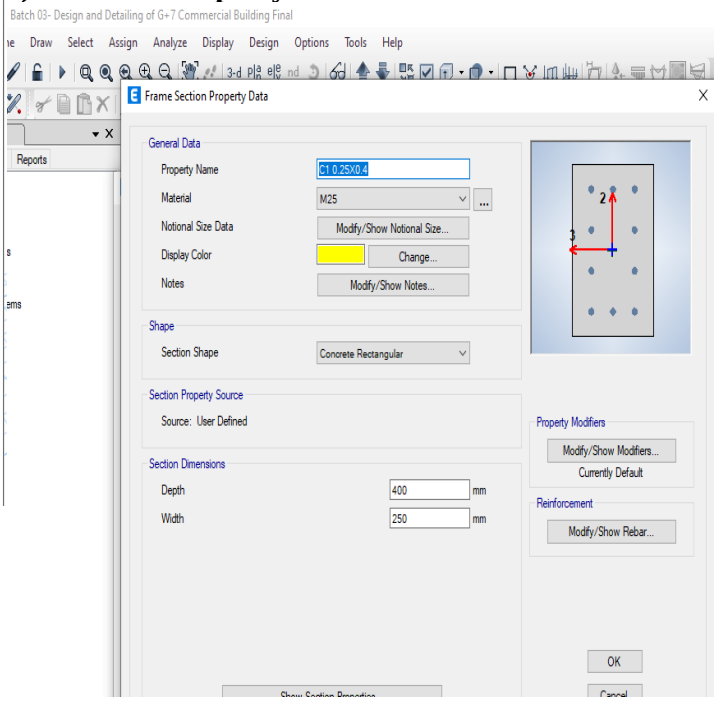


Fig 9 shows the column member property

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363

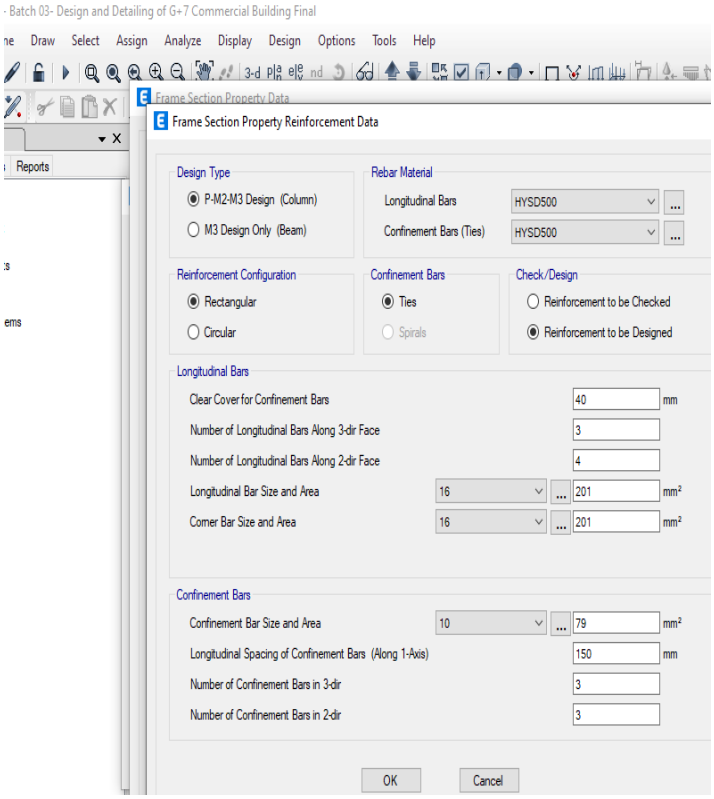


Fig 10 shows the design column member property

5.3 Assigning of Loads (Load Cases)

- Dead Load
- Live Load
- Floor Finishes
- Brick Wall Load
- Inner Partition Wall Loads
- Roof Loads

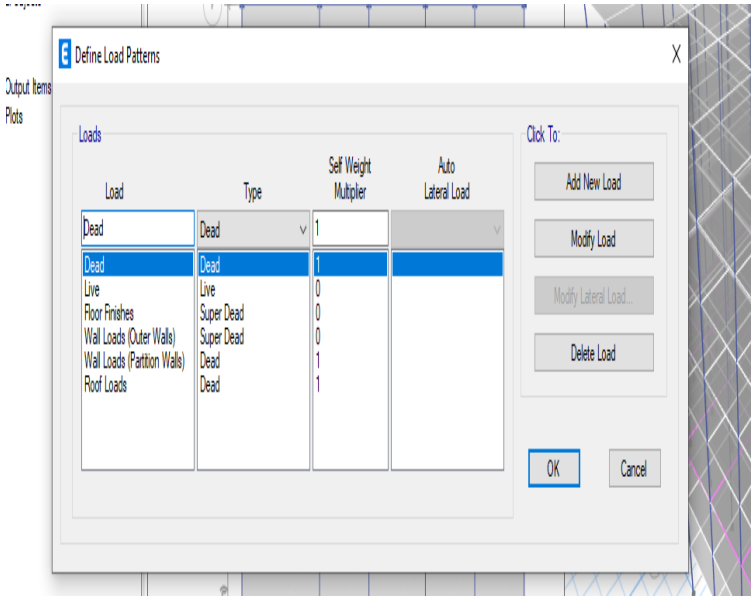


Fig 11 load patterns for the structure

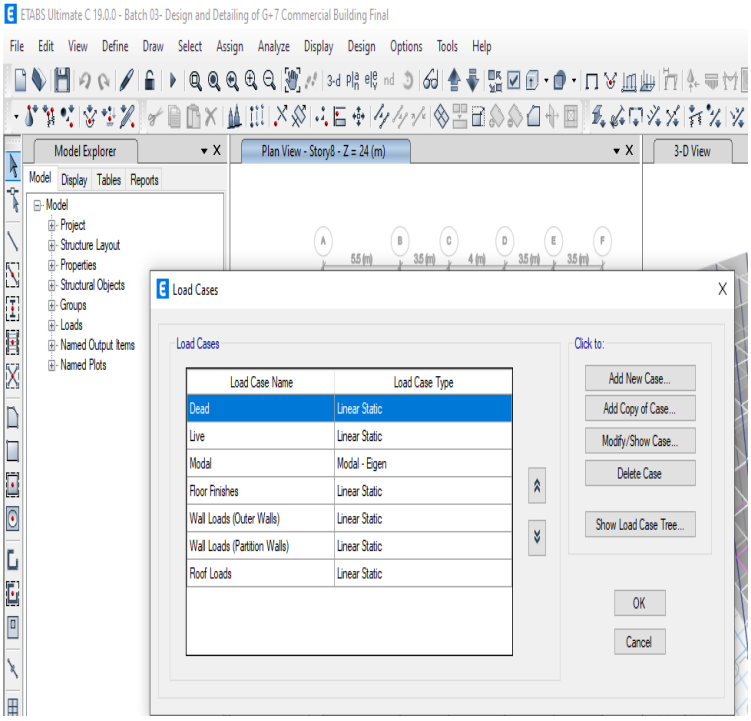


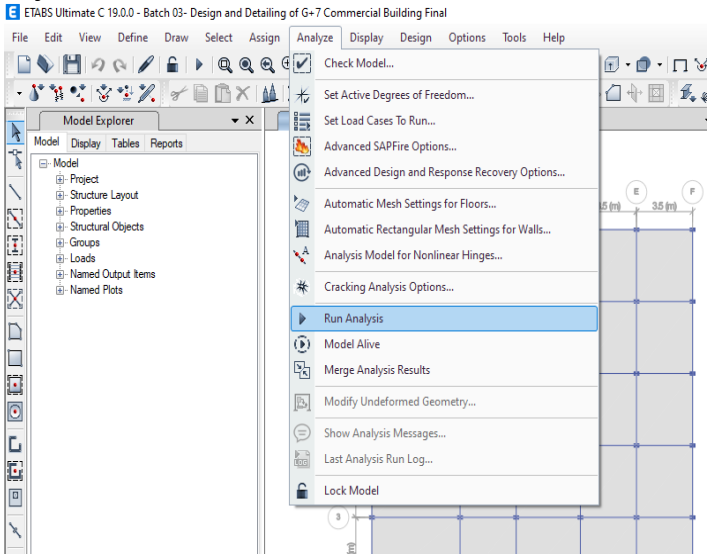
Fig 12 load cases for the structure

VI- ETABS RESULTS

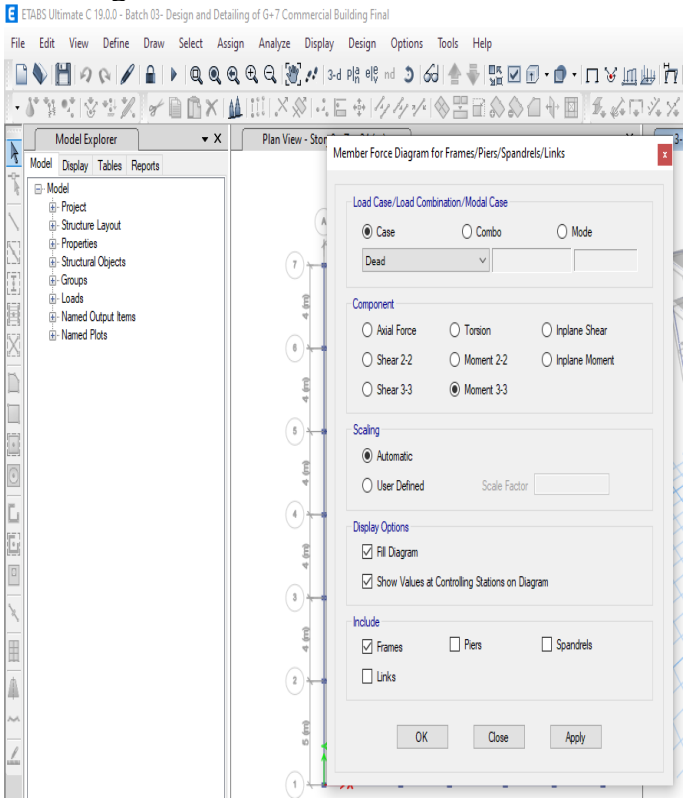
IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363

6.1 Etabs result output.

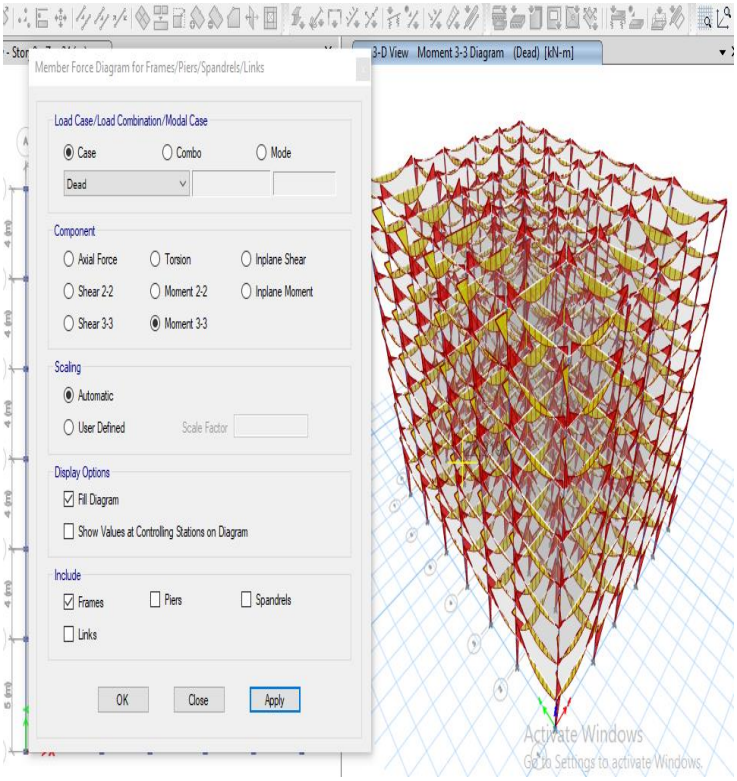
The analysis done from considering all the above parameters state that the structure is safe without any errors



6.2 Design Moment , axial and Shear Results

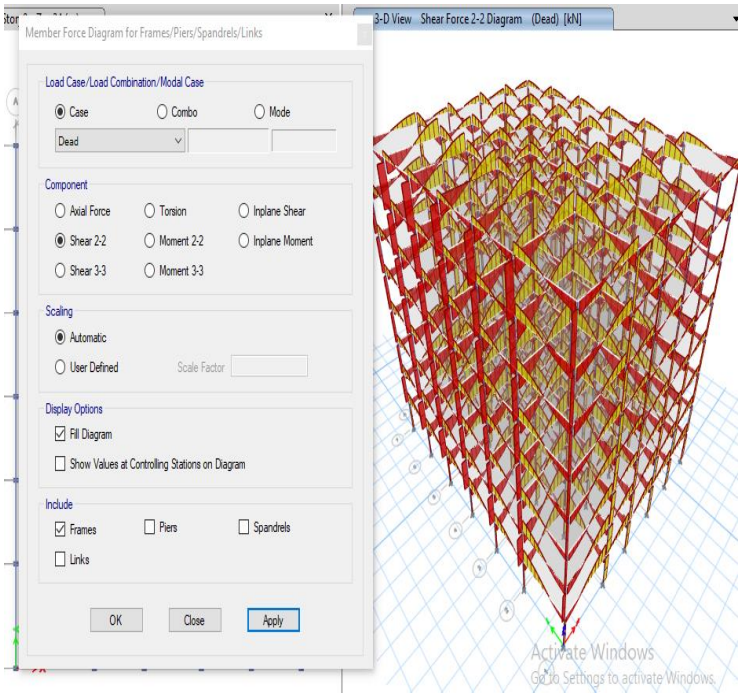


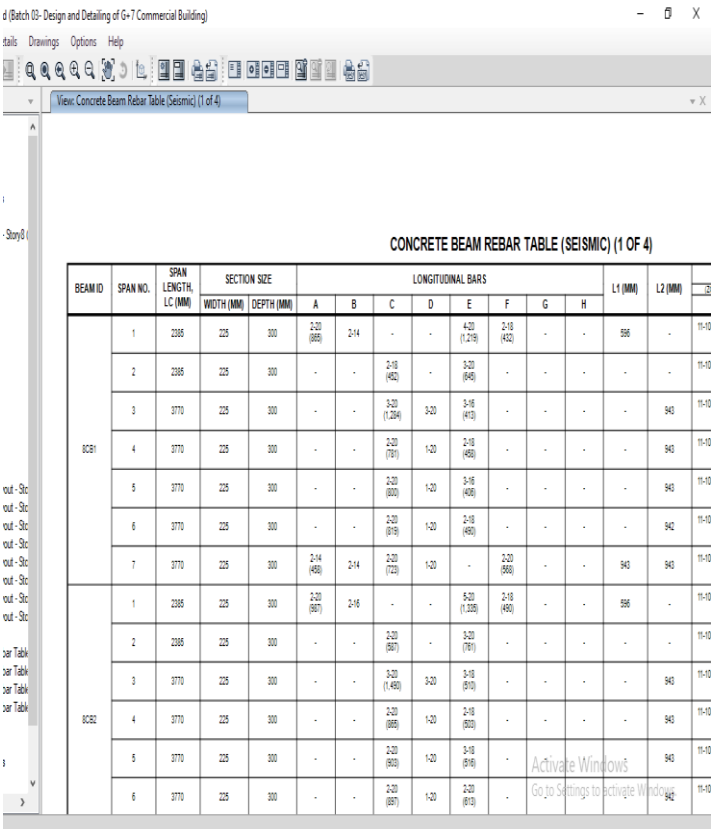
6.3 Bending Moment Results



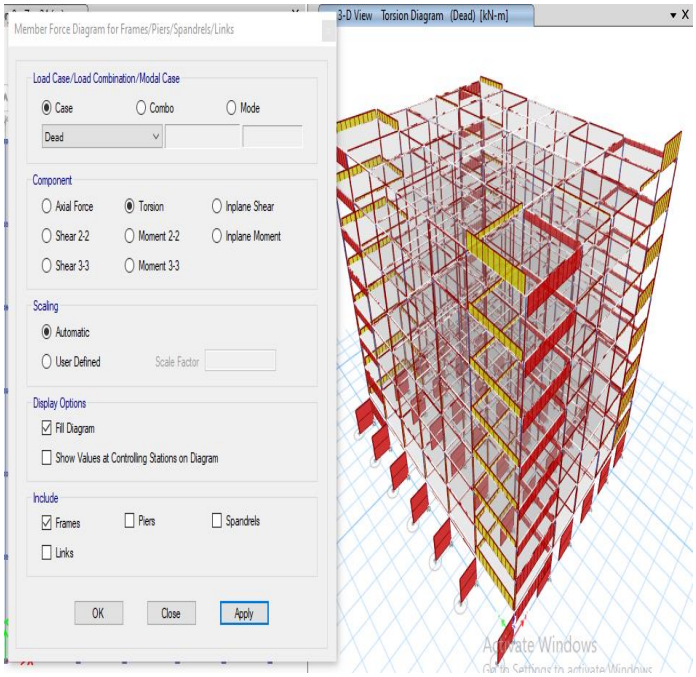
6.4 Shear Force Results

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363





6.5 Torsion Force Results

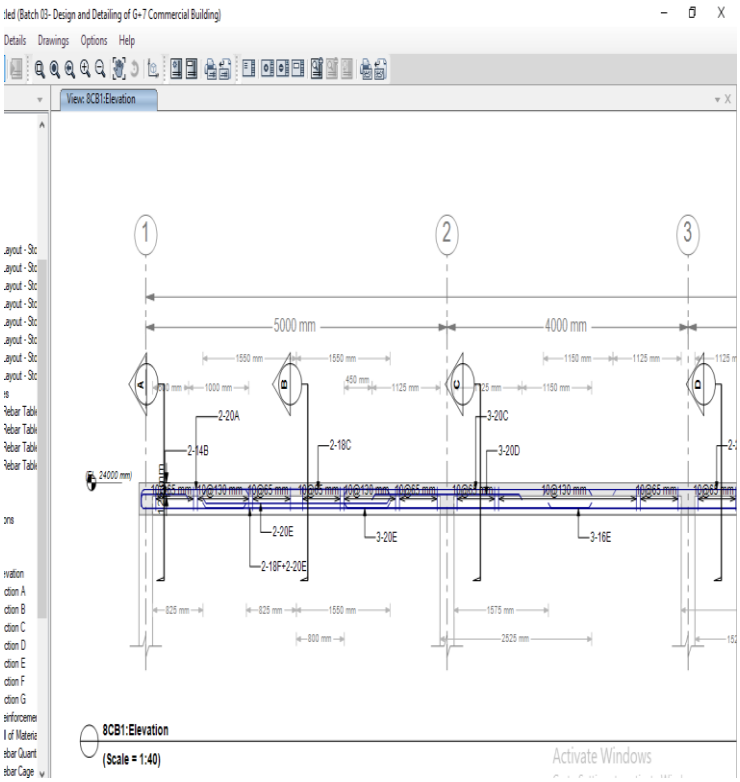


6.6 Reinforcement detailing Outputs

Fig 13 showing Rebar quantity

6.7 Detailing schedule of the elements (Covering over all the grids)

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363



6.8 Sectional Parameters of the detailed element

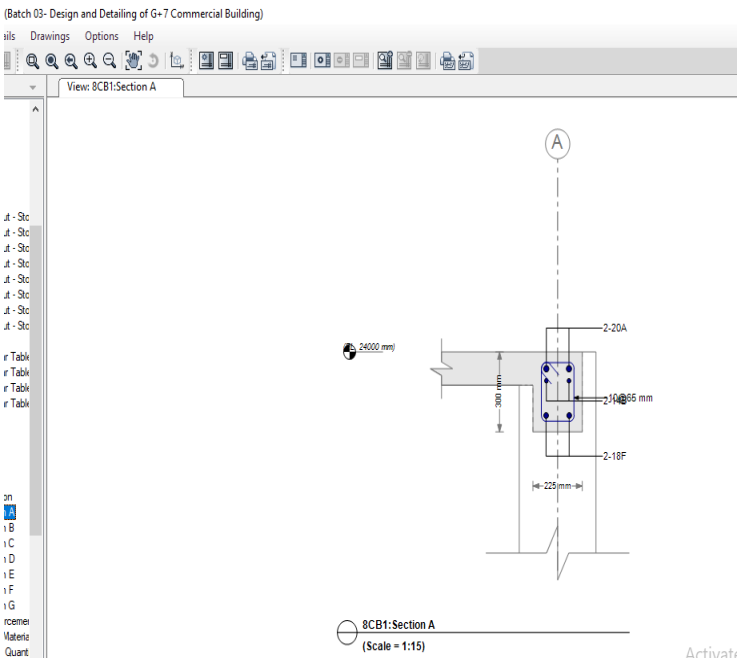


Fig 14 showing section 1

6.9 Reinforcement Profile and distribution schedule

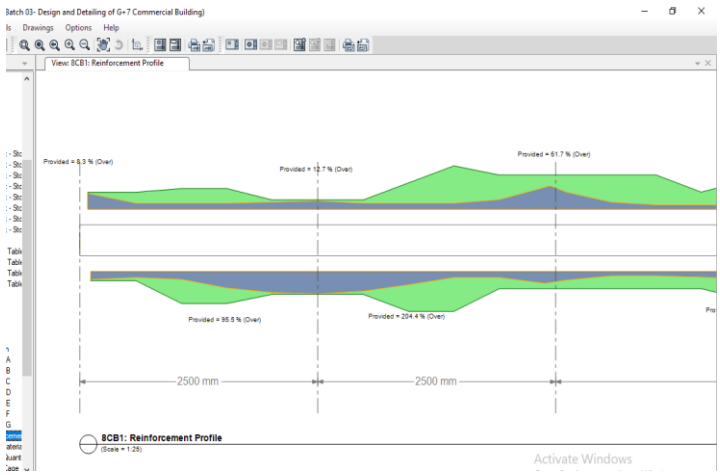
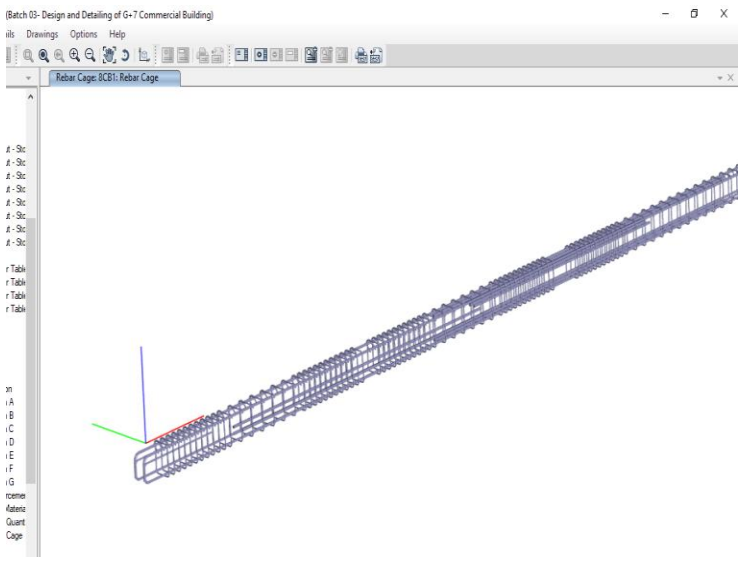
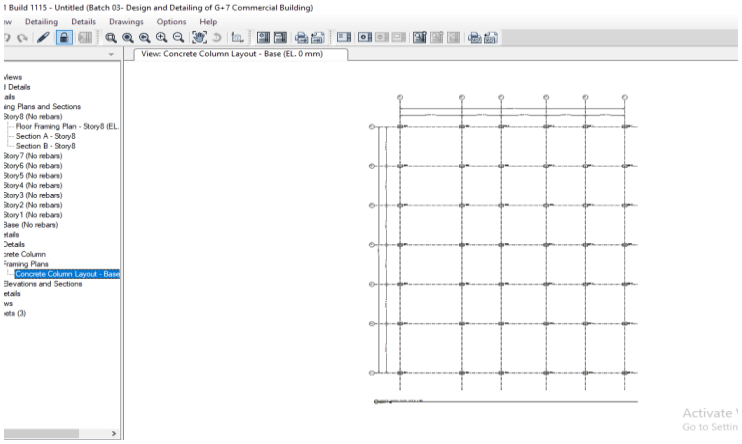


Fig 15 showing reinf schedule @ grid 1

6.10 Summary outputs of detailing





VII - CONCLUSION

Building plan was develop and draft in Auto-CAD with required dimension. During designing G+7 storeys commercial building structure is capable to sustain all loads acting on building. The design of slab, beam, column, is done with IS 456-2000 as limit state method in addition to that IS code 875 were also used for other loading parameters. Etabs has the ability to calculate the Reinforcement needed for any concrete section. The design output gives the complete detailing of reinforcement quantity of the complete structure as output and as per result; structure is safe without any errors as per output given by Etabs.

REFERENCES

- Sreeshna K.S, 'Analysis and Design of an Apartment building', IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 3, ISSN 2348 – 7968, March 2016.
- Amar Hugar, Sharanabasappa M Pujari, Beerappa G Pujari, Anaveerappa N Biradar, Gajendra, 'Analysis and Design of a Commercial cum Residential Building by Using Etabs', International Research Journal of Engineering and Technology (IRJET), Volume: 03, Issue: 06, e-ISSN: 2395 -0056, p-ISSN: 2395-0072, June-2016.
- Indian standard codal IS 875: Part 3 for wind load considerations. "Code of practice for Design loads (other than earthquake) for buildings and structures."
- Indian standard codal 456: 2000, "Indian Standard code of practice for general structural use of plain and reinforced.
- Design of R.C.C. Structures by Nirali Prakashan.
- Bandipati Anup, Dr. Dumpa Venkateswarlu, 'Comparison between Manual Analysis and Etabs. Analysis of Multi Storey Building', International Journal of Research Sciences and Advanced Engineering, Volume 2, Issue 15, PP: 216 - 224, SEPTEMBER' 2016.
- Borugadda Raju, Mr. R. Rattaiah, 'Analysis AND Design of High-Rise Building (G+30) Using STAAD.PRO', International Journal of Research Sciences and Advanced Engineering, Volume 2, Issue 12, PP: 50 - 54, OCT - DEC' 2015.
- Anoop.A, Fousiya Hussian, Neeraja.R, Rahul Chandran, Shabina.S, Varsha.S, 'Planning Analysis and Design of Multi Storied Building by STAAD.PRO.V8i', International Journal of Scientific & Engineering Research, Volume 7, Issue 4, ISSN 2229-5518, April-2016.
- Nasreen. M. Khan, 'Analysis and Design of Apartment Building', International Journal of Innovative Science, Engineering and Technology.

AUTHOR PROFILE

S Narasimha B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR.

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363

G Nikhil B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR

B Rakesh B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR.

M Pavan Kumar B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR.

Manapadu Gayathri B.Tech student in the Civil Engineering from Sri Visvesvaraya institute of technology and science, MBNR

Mohammed Abdul Aleem B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR

Mr. Syed Sabeel Pasha, ASSOCIATE PROFESSOR Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR