

Structural Analysis and Design of Commercial building by using Etabs

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Abstract: *Structural Analysis is a branch which involves in the determination of behavior of structures in order to predict the responses of different structural components due to Effect of loads. Each and every structure will be subjected to Either one or the groups of loads, the various kinds of loads Normally considered are dead load, live load, earth quake load and wind load. ETABS (Extended Three-Dimensional Analysis of Building System) is a software which is incorporated with all the major analysis engines that is static, dynamic, Linear and non-linear, etc. and especially this Software is used to analyze and design the buildings. Our project "Analysis and Design of Commercial building using ETABS software". A Multi-storied building is considered for this study. Analysis is carried out by static method and design is done as Per IS 456:2000 guidelines. Also, an attempt has been made to Design the structural elements manually. Drawing are done using Auto CAD. 3D Modelling is done using Revit Architecture.*

KEYWORDS : AutoCAD, ETABS, Revit, Bending moment, Shear force, IS codes.

I. INTRODUCTIONS

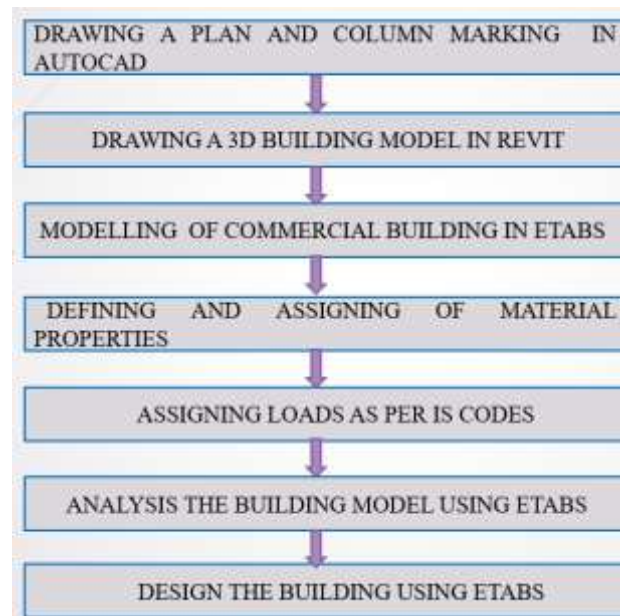
Now a days due to overpopulation and high cost of land, multi-storied building is more essential for metropolitan city. Multi-storied commercial building is the perfect solution for living of high populated area. A multi-storied building, which posses multiple floor above the ground level, which aim to increase the floor area of building in shortest built up area. Structure analysis is a subject which involves designing, planning to built up a perfect building. Basically each project are different with their design criteria such as incoming load, soil properties, dynamic load, built up area etc. Here we provided the details to complete a residential apartment theore- tically. We firstly collected some required data to measure the soil specific such as moisture content, bearing capacity of soil, types of soil etc. We provided the perfect parameter in beam, slab column and footing with the consideration of incoming load to avoid shear and bending collapse. In accordance with limit state method of collapse in IS456:2000 we built G+3 build- ing which deal with strength and stability of structure under maximum design load flexure, compression shear and torsion .

Commercial buildings are buildings where commercial activities take place. Commercial build- ings include office buildings, retail space, warehouses and more. This differs somewhat from commercial property, which also includes multi-family buildings like apartment buildings. The reason for this is that commercial buildings are where commerce happens, while commercial property earns money for its owners but doesn't have to have commerce happening in it. Multi-use buildings that have a mix of spaces, such as a retail area and apartments, can still be considered commercial in certain circumstances.

ETABS is an analysis and Design Based software, very much useful for structural engineers. In case of high-rise structures when it is designed in ETABS we get the most economical design. It is the most popular structural engineer's software product for model generation, analysis and multi-material design. It has an intuitive user-friendly GUI, Visualization tools, powerful analysis and design facilities and seam less integration to several other modelling and design software products.

II. PLANNING AND METHODS

To proceed with any sort of works, various methods or steps are adopted from its initial stage to final stage.



Following are some of the methods been adopted during analysis and design of multi-story commercial building.

Fig 1: Methodology

AUTOCAD is a computer-aided design (CAD) and drafting software application. Developed and marketed by AutoCAD was first released in December 1982 as a desktop app running on microcomputers with internal graphics controllers. The main use of AUTOCAD software is to draw or drafting the plan, elevation and sections of structures in 2D or 3D view. For the present project AUTOCAD is used for representing the plan of considered Commercial Building.

Autodesk Revit is a building information modelling software tool for architects, landscape architects, structural engineers, mechanical, electrical, and plumbing (MEP) engineers, designers and contractors. The original software was developed by Charles River Software, founded in 1997, renamed Revit Technology Corporation in 2000, and acquired by Autodesk in 2002. The software allows users to design a building and structure and its components in 3D, annotate the model with 2D drafting elements, and access building information from the building model's database.

NOTE: This Revit Architecture is used for building Architectural and Aesthetic looks. That's why we use Revit for 3d modelling.

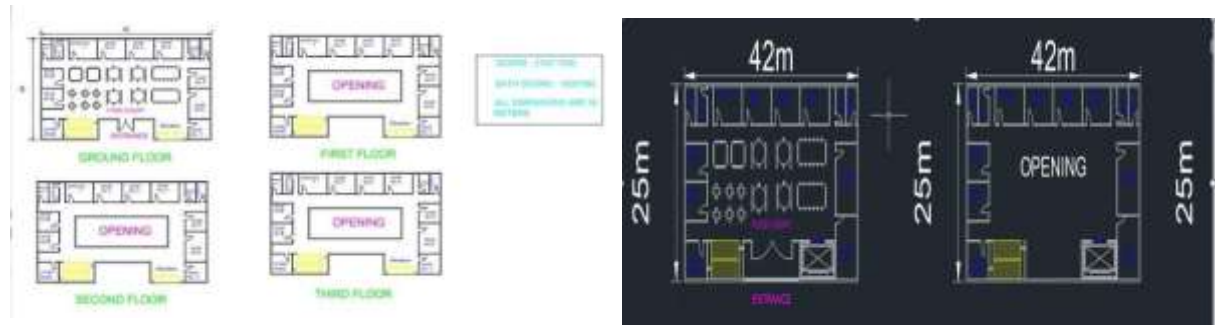


Fig 2: Building plan

The material is used for construction is reinforced concrete with M-30 grade concrete and Fe- 415 grade of steel.
 Type of the project = Structural Analysis Design of Commercial Building. Building Type = Commercial Building-Shopping Mall

Location = Hyderabad, Telangana. Type of Slab = Two-way slab

Total Built-up Area = 1050 sq.-m. (assumed 42m x 25m) Method of Analysis = Static Analysis (Linear)

Material Properties of the structure:

Beam Sizes = 300mm x 500mm Column Size = 300mm x 500mm Slab Thickness = 200 mm Number of stories = G+3

Height = 15m

Live Load = 5 kN/m and 1.5 kN/m (as per IS 875 part II-2015) Dead Load = Self -weight of members (as per IS 875 part I-2015) Seismic Load = Calculated as per IS 1893(part I) - 2016

Grade of Concrete and Steel:

Used M30 and Fe-415 Steel.

III. DESIGN AND ANALYSIS

A. Design procedures

This is the welcome screen of Etabs on left we will find option to open a new model below that option we can open existing model and also recent model which we worked earlier. On the right we find RESOURCES, TECH TIPS, WATCH AND LEARN VIDEOS, MANUALS (Manuals)

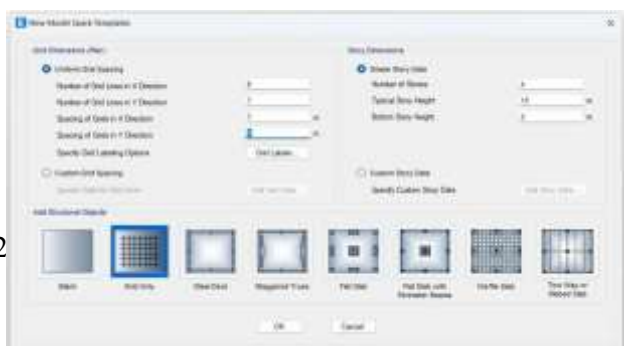


Fig 3: model creations

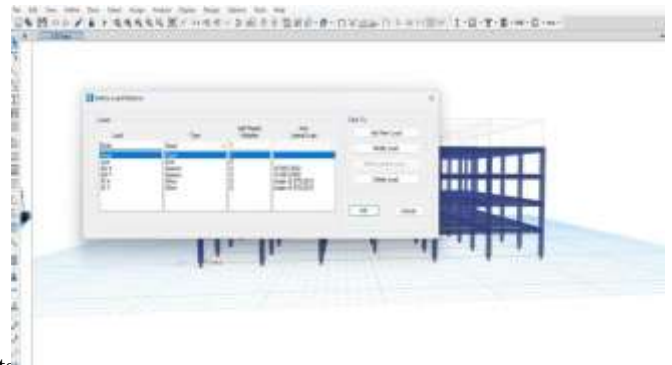


Fig 4: Supports and load assign

B. Analysis

New model change units to KN-M - Number of stories — 4- number of bays in X direction 5- number of bays in Y direction =4- storey height 3m -Give each bay width in Xdirection - bay width in Y direction - restraints -OK.

Define materials- add new materials-material type (concrete) material name (concrete)tick the switch to advanced property display option- material property options displays material name (concrete) -material type(concrete) -modify/show material properties material property data-material property - ok.

Define section properties frame sections-add new properties-frame section - property type(concrete)-select material(concrete)concrete reinforcement-select beam-ok. (concrete)select rectangular- section name (column)-material select column-ok-select rectangular-section name (column)-element-select column-ok.

-section name (slab) - material name(concrete)-thickness-

-fixed-ok.

lanes-Z-axis-ok-assign-frame -frame sections-columns-ok.

Select-select-select lines parallel to-coordinates axes or planes - X-axis and Y-axis - ok - assign frame - frame sections - beam-ok. Select quick draw floor-properties of object - slab - select all elements and assign.

Set display options- tick extrude view-ok.

Define- load patterns-load pattern (dead)-name type (dead)-multiplier (1)-load patterns load pattern (live)-name type (live)-add load pattern (wind load) -select-properties-framesections-select beams and columns-ok- assign-frame loads gravity-load pattern name (dead)Global Z -1 -OK.

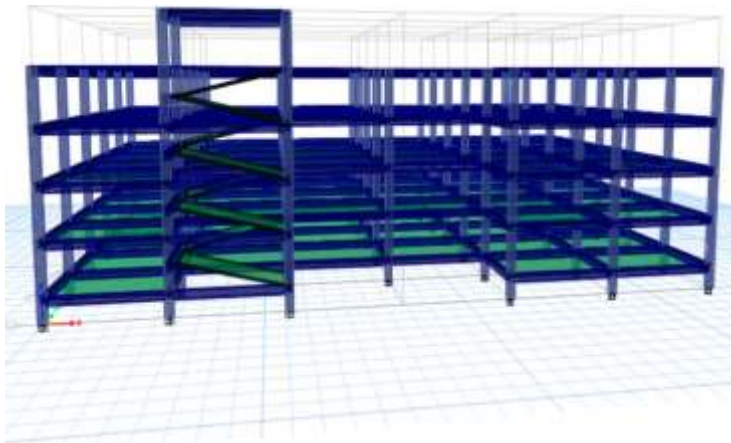
Select-select properties-area sections-slab-ok-assign-area loads -Self weight-load pattern name (dead)-Global Z=1 then ok.

Select-properties-frame sections-beam ok-assign-frame loads-distributed-load pattern name live)-uniform load 2 then 0k.

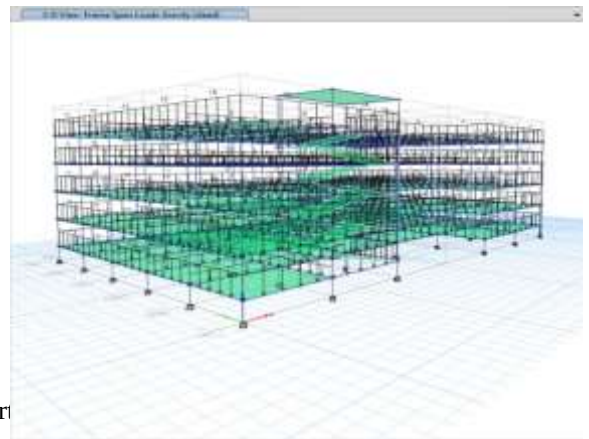
Define-load combinations-add new combo-load combination (comb)-load case name (dead and live)-load case type (linear static)-scale factor (1.5)- add- ok.

Analyze-set analysis options- ok- Analyze -run analysis -run now.

Go to design-concrete frame design-start design/check-view all members are passed



per



C. Shear force, Bending moment and Axial Force

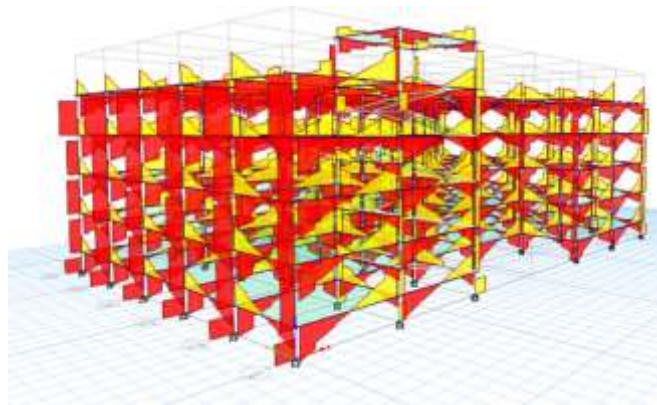


Fig 6: Bending Moment Results

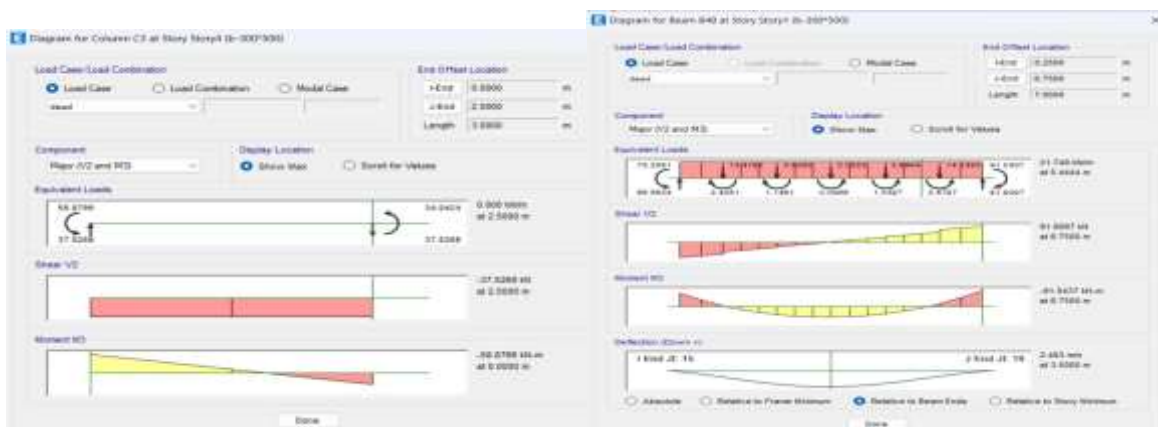


Fig 7: Bending moment diagram for column and beams

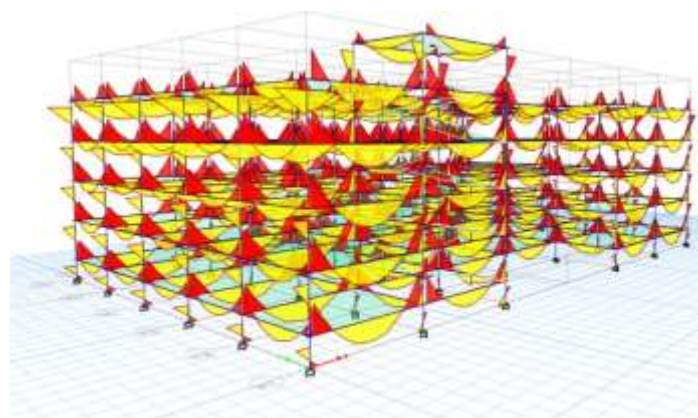


Fig 8: Shear Force

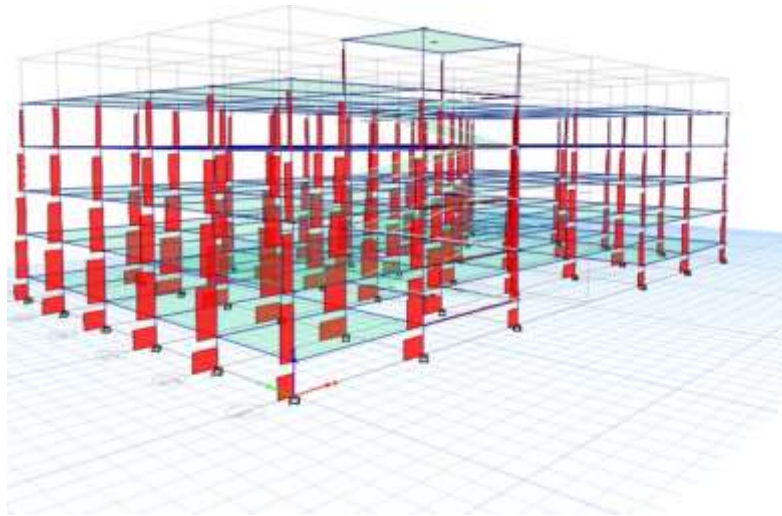


Fig 9: Axial Force Results

Due to huge output results, a sample of a beam report and a column report are shown below: Beam Result report:

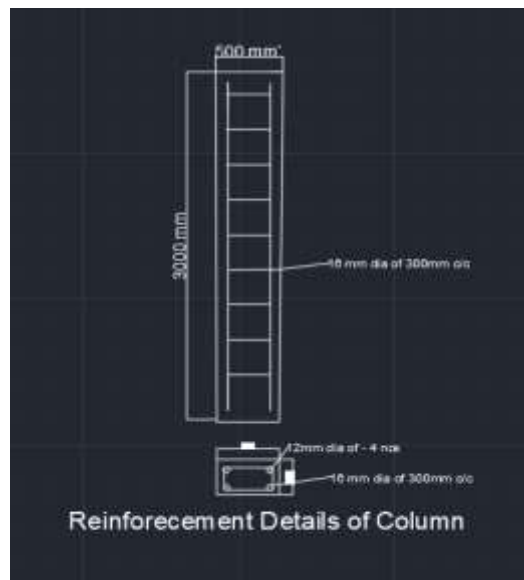


Fig 10: Reinforcement Details for Column

IV. CONCLUSION

- This project is mainly concentrated with the analysis and design of multi-storied commercial building with all possible cases of the load combinations as per IS Code using ETABS. meeting the design challenges are described in conceptual way.
- The Bending moment, shear force and axial force of the building was studied in ETABS Software.
- From the Revit and ETABS software we have studied the 3D modelling and Design of RCC Commercial building.
- Further in case of rectification in ETABS it is simple to change the values at the place where error occurred and the obtained results are generated in the output.

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