

MULTISTORIED RESIDENTIAL BUILDING ANALYSIS AND DESIGN WITH E-TABS

*1Mr. P M B Raj Kiran Nanduri, 2Mr.Pillamarri Bikku,3 Mr.Siddenki Mahesh,
4Mr.Jarapula Mohan
1234Assistant Professor
Department Of Civil Engineering
Samskruti College of Engineering and Technology, Hyderabad*

ABSTRACT: Structural design is the primary aspect of Civil Engineers and its analysis is backbone of Civil Engineering. The improper analysis and design leads to failure of structure resulting loss of life. To perform accurate analysis, the structural engineer is able to analyze the structure considering different constraints like to satisfy the serviceability and deformability etc., by following IS codes. Though conventional method is still practicing, our technology is upgrading equally or even more based on latest softwares due to time parameter.

Key Words; Analysis ,Design ,storey Drift, Storey Displacement, Analysis ,E-Tabs

I. INTRODUCTION

ETABS is a sophisticated, yet easy to use, special purpose analysis and design program developed specifically for building systems. ETABS 2013 features an intuitive and powerful graphical interface coupled with unmatched modeling, analytical, design, and detailing procedures, all integrated using a common database. Dating back more than 40 years to the original development of TABS, the predecessor of ETABS, it was clearly recognized that buildings constituted a very special class of structures. Early releases of ETABS provided input, output and numerical solution techniques that took into consideration the characteristics unique to building type structures, providing a tool that offered significant savings in time and

increased accuracy over general purpose programs.

1.1 What ETABS Can Do

ETABS offers the widest assortment of analysis and design tools available for the structural engineer working on building structures. The following list represents just a portion of the types of systems and analyses

1.2 Load Patterns

Loads represent actions upon the structure, such as force, pressure, support displacement, thermal effects, and others. A spatial distribution of loads upon the structure is called a load pattern. As many named load patterns as needed can be defined. Typically, separate load patterns would be defined for dead load, live load,

static earthquake load, wind load, snow load, thermal load, and so on.

1.3 Vertical Loads

Vertical loads may be applied to joint, frame and shell objects. Vertical loads are typically input in the gravity, or -Z direction.

Vertical load cases may also include element self-weight. Some typical vertical load cases used for building structures might include:

Dead load Superimposed dead load

If the vertical loads applied are assigned to a reducible live load pattern, ETABS provides you with an option to reduce the live loads used in the design phase.

1.4 Load Combinations

ETABS allows for the named combination of the results from one or more load cases and/or other combinations.

The first five design procedures are applicable to frame objects, and the program determines the appropriate design procedure for a frame object when the analysis is run.

Detailing Features

Schematic construction drawings showing floor framing, column schedules, beam elevations and sections, steel connection schedules, and concrete shear wall reinforcing may be produced.

II. LITERATUR REVIEW

The literature review was carried out under analysis and design on multi storey building using Etabs through various relevant books and journal papers .

Geethu (2018) Made a comparative study on analysis and design of multi storied building by STAAD.Pro and ETAB software's. They

provided the details of both residential and commercial building design. The planning was made in accordance with the national building code and drafted using Auto CAD software. They concluded that while comparing both software results.

Pushkar Rathod and Rahul Chandrashekar (2017): With the help of seismic analysis, the structure can be designed and constructed to withstand the high lateral movement of earth's crust during an earthquake. Any type of basic or a highly advanced structure which maybe under static or dynamic conditions can be evaluated by using ETABS. ETABS is a coordinated and productive tool for analysis and designs, which range from a simple 2D frames to modern high-rises which makes it one of the best structural software for building systems.

Sayyed A.Ahad1(2017) Design and Analysis of the residential building which has (G+10) stories has been done. Analysis was done using ETABS software Version15.2 which proved to be good enough in the design for construction and the structural analysis of all the sections. All the elements of structure like concrete wall, which retains weight of soil are provided. As per soil investigation reports they provided isolated footing. The sectional and design analysis were done using STAAD-PRO and result can be compared.

III. METHODOLOGY

3.1 PLAN IN ETABS

The line diagram and central line diagram of the proposed multi storied building plan has

been shown below. Which is considered for the design and Analysis by using ETABS

CENTRELINE DIAGRAM

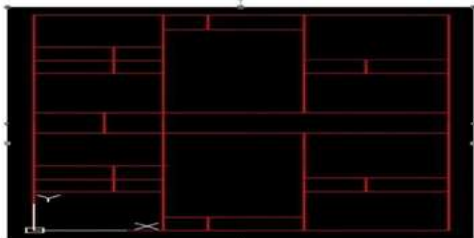


FIG – 1 (Center line diagram of a structure (buildings))



FIG-2 Plan

CONCRETE MATERIAL



FIG -3 Defining the material properties in Etabs.

MILD STEEL MILD GRADE 25



Fig: 4 Defining the mid steel bars for the lateral reinforcement tie bars as per IS codes

Steelforce have a range of Grade. 250 structural steel plate in a variety of thickness and sheet sizes from 3mm to 100mm thickness

3.2 BEAMS, COLUMNS AND SLABS:

The slab which is supported on Beams and columns is called a conventional slab. In this kind, the thickness of the slab is small whereas the depth of the beam is large and load is transferred to beams and then to columns. It requires more formwork when compared with the flat slab

3D VIEW:



FIG -5 Detailing the structural components of a building

The basic components of a building structure are the foundation, floors, walls, beams, columns, roof

3.3 SUPPORTS:

Fixed supports at base of the structure Since they restrain both rotation and translation, they are also known as rigid supports. This means that a structure only needs one fixed support in order to be stable

3.4 LOADS

Application of loads

This combination of loads include beam load, column load and slab load

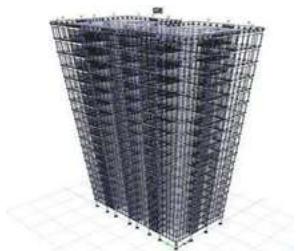


FIG -6 This combination of loads include beam load

Live load or imposed load is defined as the load on the structure due to moving weight.

3.5 WIND LOAD CALCULATION

Wind is air in motion relative to the surface of the earth. The primary cause of wind is traced to earth's rotation and differences in terrestrial radiation.

Analysis Using ETABS:

The procedure carried out for modeling and analyzing the structure involves the following steps:

Step-1: Create a plan in AUTOCAD. Select new model and a window appears then we had to select blank page and import plan from AUTOCAD to ETABS.

Step-2: Defining of material properties . we had first defined the material property by selecting define menu, new material for our structural components by giving the specified details in defining.

Step-3: After defining the property we draw beams and create columns in region for columns by which property assigning is completed for beams and columns.

Step-4: By keeping the selection at the base of the structure and selecting all the columns we assigned fixed supports.

Step-5: In ETABS all the load considerations are first defined and then assigned. The

loads in ETABS are defined as using static load cases command in define menu.

Step-6: After defining all the loads, dead loads are assigned including floor finishing.

IV. RESULT AND ANALYSIS

4.1 BENDING MOMENT OF STRUCTURE

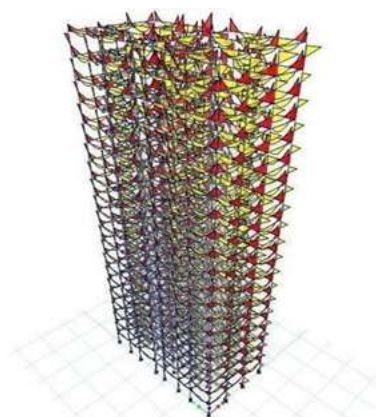


FIG-7 Bending moment of structure

4.2 MINIMUM SHEAR OF THE STRUCTURE



Fig-8 Minimum Shear Of The Structure

4.3 Auto Wind Loading

Indian IS875:1987 Auto Wind Load Calculation

This calculation presents the automatically generated lateral wind loads for load pattern

wl x according to Indian IS875:1987, as calculated by ETABS.

Exposure Parameters Exposure From = Diaphragms Structure Class = Class B Terrain Category = Category 3 Wind Direction = 0 degrees.

Basic Wind Speed, Vb [IS Fig. 1]	meter Vb = 44 sec
Windward Coefficient, Cp,wind	Cp,wind = 0.8
Leeward Coefficient, Cp,lee	Cp,lee = 0.5

4.4 DESIGN PROCESS

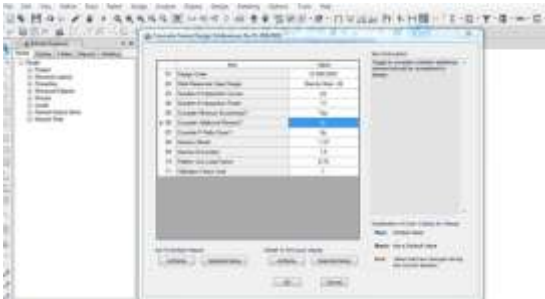


FIG-9 3D View Longitudinal Reinforcement Longitudinal Reinforcement. Longitudinal reinforcement is used in the analysis of several limit state conditions including: Ultimate moment capacity. Longitudinal Reinforcement for Shear Capacity.

DETAILING OF BEAM

DESIGN OF TWO WAY SLAB Given data:

fck = 25 KN/m² fy = 415KN/m² Live load = 2KN/m² Lx = 3.81m Ly = 4.2 m

Aspect ratio, Lx / Ly = 4.2/3.81
= 1.1 < 2

4.5 DESIGN OF RECTANGULAR COLUMN:

Column dimensions = 0.30*0.5 Height of the column = 3.5m Step: 1....

Step: 2....

Working load = 1.5*1500 = 2250 KN

Slenderness ratio $\lambda = l_{eff}/D_{eff}$

= (0.65*3500)/300

= 7.583 < 12

Hence the column is short column

Step: 3....

exmin = (L/500) + (Dx/30) or 20mm

= (3500/500) + (500/30) or 20mm

= 23.

66 or 20mm exmin = 20mm exmin < 0.05Dx

20 < 25

Hence ok

eymin = (L/500) + (Dy/30) or 20 mm

= (3500/500) + (300/30) or 20mm

=

17 or

20 mm 0.05Dx

> eymin

15 < 17

Hence ok .

Step: 4.... Longitudinal reinforcement

KKPu = 0.4 fck Ac + 0.67 fy Asc

2250*103 = 0.4 * 25*(300*500- Asc) +

0.67*415*

Asc Asc = 2108.32 mm²

As per clause 26.5.3.1 of IS 456:2000

The cross sectional area of longitudinal reinforcement shall not be less than 0.8% , not more than 4% of the gross sectional area of the column.

Ascmin = $(0.8/100)(300*500) = 1200$
 mm² Ascmax = $(4/100)(300*500) = 6000$
 mm²

$N = 2108.32/((\pi/4)*202) = 8$ no's

Provide 8no's 20 mm diameter HYSD bars as a Longitudinalreinforcement. LATERAL TIES

Use 8 mm Ø HYSD bars

Spacing : (As per clause 26.5. 3.2 of IS 456:2000)

i. 300 mm c/c

ii. Least lateral dimension of the compression member = 300mm

iii. 16* diameter of longitudinal reinforcement bar = $16*20 = 320$ mm

Therefore, Spacing = 300 mm c/c

Provide 8mm diameter HYSD bars at spacing of 300 C/C as Lateral reinforcement. Column reinforcement detailing

V. CONCLUSION

- This project has given an opportunity to recollect and co-ordinate the various methods of designing and engineering principles which we have learnt in our earlier classes.
- Design was done by using ETABS software and successfully verified manually as per IS 456-2000.
- By using ETABS, the analysis and design work can be completed within the stipulated time.
- The analysis and design results obtain from software are safe when compared with manual calculations and design.
- Usage of ETABS software minimizes the time required for analysis and design.

- In ETABS steel reinforcement adapted is adequate when compared to staad pro, This benefits the economic value of steel during construction.

- Analysis was done by using ETABS software and successfully verified manually as per IS456.

- Calculation by both manual work as well as software analysis gives almost same result

- Further the work is extended for a 4 storey building and found that the results are matching.

- As the 4-storey building has similar floors ETABS is the perfect software which can be adopted for analysis and design.

- Usage of ETABS software minimizes the time required for analysis and design.

- Analysis and design of an apartment building having G+10 storeys is done.

- The structural elements like RCC frame, shear wall and retaining walls are also provided.

- The analysis and design of a multi-storeyed building was done as part of our project.

- The study helped us to gain ample exposure various field practices in the analysis and design of multistoried buildings, and also in various construction techniques used in the industry.

- The analysis was done in ETABS 2015and detailing was done in Auto CAD 2010. The structural components beam, column, slabs, shear wall were designed manually.

- This study helped to understand and analyse the structural problem faced by the industry.
- Analysis and design of an apartment building having G+10 storeys is done.
- Analysis is done by using the software ETABS V15.2, which proved to be premium of great potential in analysis and design of various sections.
- The structural elements like RCC frame, shear wall and retaining walls are also provided. As per the soil investigation report, an isolated footing is provided.
- The design of RCC frame members like beam and column was done using ETABS. The analysis and design was done according to standard specifications to the possible extend.
- The various difficulties encountered in the design process and the various constraints faced by the structural engineer in designing up to the architectural drawing were also understood.
- The structure was analysed as ordinary moment resisting space frames in the versatile software Etabs 2015.

5.1 Scope Of Future Work :

This work is completely concentrated on analysis and design. This can be extended to comparison for design of conventional and software detailings, analysis on high rise buildings or more than G+ 20 storeys, performing seismic analysis for lower storeys and wind analysis for high rise buildings.

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