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Analysis & Design of Multistoried Residential Building by Using E-Tabs

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ABSTRACT: ***The fundamental component of civil engineering is structural design analysis, which is the principal function of civil engineers. Inadequate analysis and design cause the structure to collapse, which results in fatalities. The structural engineer may conduct an accurate analysis by adhering to IS regulations and taking into account various restrictions, such as ensuring serviceability and deformability. Even if the traditional approach is still in use, owing to time constraints, our technology is improving at least as much based on the newest software.***

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

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 storyed building plan has been shown below. Which is considered for the design and Analysis by using ETABS

CENTRELINE DIAGRAM

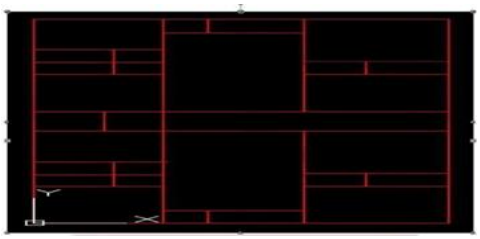

FIG – 1 (Center line diagram of a structure (buildings)

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:

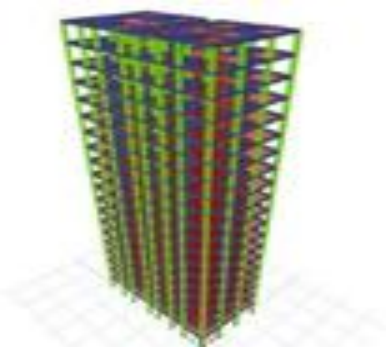

FIG -5 Detailing the structural components of a building

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

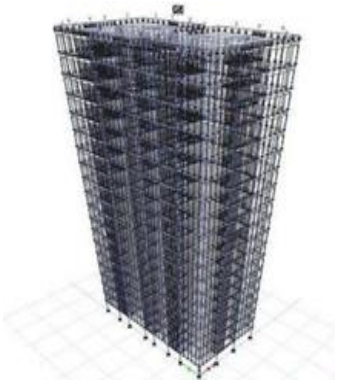

FIG -6 This combination of loads include beam load

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

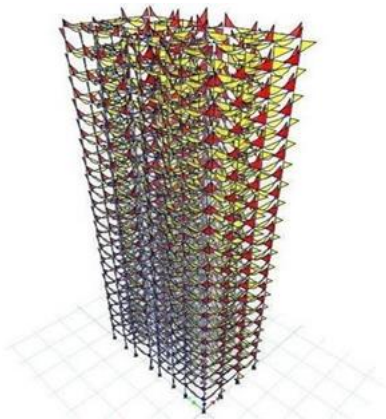

FIG-7 Bending moment of structure

4.2 MINIMUM SHEAR OF THE STRUCTURE

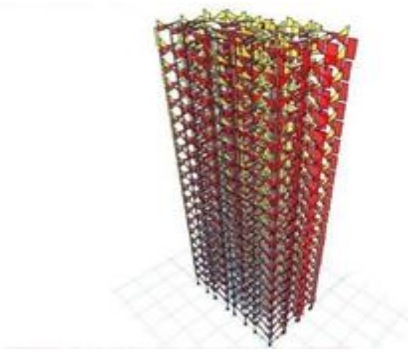

Fig-8 Minimum Shear Of The Structure

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

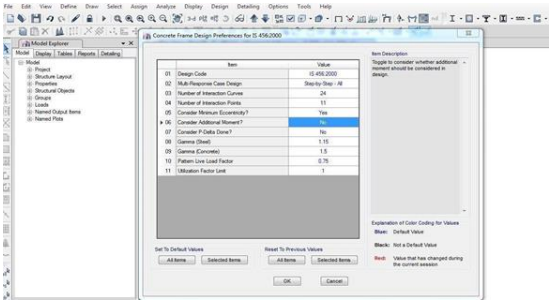

FIG-9 3D View Longitudinal Reinforcement

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 OFRECTANGULAR 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 λ = leff/Deff

= (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<0.0 5Dx 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 fyAsc

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/((π/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 =320mm 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

- Working on this project has allowed us to organise and review the many engineering concepts and design techniques we have studied in previous semesters.
- In accordance with IS 456-2000, design was completed using ETABS software and successfully validated manually.
- The analysis and design work may be finished in the allotted period by utilising ETABS.
- When compared to calculations and designs made by hand, the analysis and design outcomes obtained using software are safe.
- By using ETABS software, analysis and design time are reduced.
- When compared to staad pro, the steel reinforcement used in ETABS is sufficient, which increases the steel's economic worth during construction.
- In accordance with IS456, analysis was completed using ETABS software and successfully confirmed manually.
- The results of calculations made manually and via software analysis are almost identical.
- The work was expanded to include a four-story structure, and it was discovered that the outcomes matched.
- Since the floors of the four-story structure are comparable, ETABS is the ideal programme for study and design.

- By using ETABS software, analysis and design time are reduced.
- A G+10-story apartment building's analysis and design are completed.
- There are also offered structural components, such as retaining walls, shear walls, and RCC frames.
- As part of our assignment, we analysed and designed a multi-story skyscraper.
- The research gave us extensive exposure to a range of field practices in the analysis and design of multistory structures as well as different industry-standard construction methods.
- Auto CAD 2010 was used for detailing and ETABS 2015 for analysis. The research assisted in comprehending and analysing the structural issue that the industry was facing. The structural components beam, column, slabs, and shear wall were all designed by hand.
- A G+10-story apartment building's analysis and design are completed.
- The programme ETABS V15.2 is used for analysis, and it has shown to be excellent and very promising for section design and analysis.
- There are also offered structural components, such as retaining walls, shear walls, and RCC frames. There is an isolated footing supplied in accordance with the soil investigation findings.
- ETABS was used in the design of RCC frame members, such as the beam and column. To the greatest extent feasible, the analysis and design were completed in accordance with standard requirements.
- It was also recognised that the structural engineer faced a variety of challenges throughout the design phase, as well as limitations when designing to the architectural drawing.
- The flexible programme Etabs 2015 was used to examine the structure as conventional moment-resisting space frames.

5.1 Scope Of Future Work :

The focus of this study is solely on design and analysis. This may be expanded to include comparisons between software and traditional design details, study of high-rise buildings or those with more than G+ 20 stories, seismic analysis of lower stories, and wind analysis of high-rise structures.

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