International Journal of Engineering Science and Advanced Technology (IJESAT)
Vol 22 Issue 04, APRIL, 2022

DESIGN AND STRUCTURAL BEHAVIOUR OF MODERN STRUCTURE BY USING ETABS

[1]T. VENUGOPALA CHARI
Assistant Professor-Eswar College of Engineering. Emailid: venugopal4517@gmail.com
[2]P. SARDAR KHAN
Assistant Professor-Eswar College of Engineering. Email id: pathan.sardarkhan6@gmail.com
[3]B.SAI TEJA
Assistant Professor-Eswar College of Engineering. Email id: bodasaiteja03@gmail.com

ABSTRACT:

Etabs stands for extended three-dimensional analysis of building systems. The main purpose of this software is to design multi-storeyed building in a systematic process. The effective design and construction of an earthquake resistant structure have great importance all over the world. 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-PART 2:2002, IS 456-2000. Every structural engineer should design a building with most efficient planning and also be economical. They should ensure that is serviceable, habitable in healthy environmental for its occupants and have longer design period. Structurally robust and aesthetically pleasing building are beginning constructed by combining the best properties of any construction material and at the same time meeting a specific requirement like type of building and its loads, soil condition, time, flexibility and economy. The high-rise buildings are best suited solution. This Project discusses the analysis of a multistoried building depending up on the area prepare a plan based on the requirements. The plan area is 3500sqft of 15m height i,e G+4. And each floor consisting of 2 flats. Each flat with 3bhk software used to draw the plan is AutoCAD 2019.We have analysis and design of multistoried building using ETABS we have applied all the loads and its combination to the structure and it is safe.

Keywords: G+4, ETABS, multistoried building, Soil condition.

I INTRODUCTION

ETABS is the present day leading design software in the market. Many design company's use this software for their project design purpose. So, this paper mainly deals with the comparative analysis of the results obtained from the analysis of a multi storied building structure when analyses manually and using ETABS software. Structural response to earthquake depends on Dynamic characteristics of the structures and intensity, duration and frequency content of existing ground motion. Structural analysis means determination of the general shape and all the specific dimensions of a particular structure so that it perform the function for which it is created and will safely withstand the influences which will act on it throughout its useful life. C.V.S. Lavanya, Emily.P.Pailey, Md. Mansha Sabreen and U.P.B.C. The effective design and construction of a earthquake resistant structures have great importance all over the world. Geographical statistics of India show that almost 54% of the land is vulnerable to earthquakes. This project presents analysis and design if multi storied residential building using ETABS software with lateral loading effect of Earthquake. This project is designed as per INDIAN CODES- IS 1893-part2:2002, IS 456:2000. This analysis is carried out by considering severe seismic zones and behavior is assessed by taking type-II Soil condition. In our project we are considering a plan under zone –IV. Seismic Intensity is Severe and Zone Factor is 0.24 at Panaji. The building is proposed to have Ordinary RC moment-resisting frame and the Response Reduction Factor is 3.0 Design example of a six story building: 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 the upper columns because to reduce the failure in the structure. The diaphragm is rigid. The main beams rest on the columns to avoid local eccentricity. Comparison of analysis and design of regular and irregular configuration of multi storied building in various seismic zones using ETABS software. The center of mass is the unique point at the center of a distribution of mass in space. The center of mass is the mean location of a distribution of mass in space. Seismic Analysis of Multi-storied Building: As this project deals with the most economical column method in this project we have design the structure in an economical way by reducing the sizes in the sections. As the load is more at the bottom when compared to the top floors,

there is no need of providing large sizes at the top. Economizing the column by means of column orientation is longer span longer direction will reduce the amount of bending as a result there are of the steel is reduced.

REINFORCED CONCRETE BUILDINGS:

Reinforced concrete, Concrete in which steel is inserted in such a way, to the point that the two materials act together in opposing powers. The reinforcing steel— rods, bars, or meshes—ingests the tractable, shear, and occasionally the compressive stresses in a concrete structure. Plain concrete does not actually withstand pliably, and shear stresses caused by wind, tremors, vibrations, and different powers and is consequently inadmissible in most auxiliary applications. In fortified cement, the rigidity of steel and the compressive quality of solid cooperate to enable the part to continue these worries over significant ranges. The creation of fortified cement in the nineteenth century changed the development business, and cement wound up one of the world's most normal building materials. ("Reinforced concrete | building material", 2014

OBJECTIVES OF THE WORK :

To perform analysis and design of a building without any kind of failure as much as possible.

To make a building that is easy to maintain and survive with the least amount of damage.

To get a better understanding of the basic principles of a building.

To prepare 3D static resistant building by ETABS program for a better analysis.

To get a better understanding of the design from its columns, beams, slabs.

To make a building that is safe and has a better chance of being safe.

NEED OF THE WORK:

Minimum the risk better and safe is the life. the very fundamental quote which has a deep meaning. A good engineer is the one who never stops and keep doing best with the use of his developed knowledge and skills

The study which are yet made are far more less sufficient to develop better solutions and to know the more worthy solution further studies and more engineering has to be applied to get more wonderful results.

The way a building response to the forces it has to deal with. The need here is to make a structure safe from the external unpredictable forces. A safe structure means a safe life and a step towards modern construction..

SCOPE OF THE WORK:

The scope of the study is to produce good structural work for preforming analysis and design for a residential building.

To know about the design philosophy for the safe and economical design of structure

To increase the design life period and serviceability of the structure .

II SURVEY OF RESEARCH

Haroon Rasheed Tamboli&Umesh N. Karadi performed analysis using Equivalent Lateral Force Method for different reinforced concrete frame building models that included bare frame, infilled frame and open first story frame. In modeling of the masonry infill panels the Equivalent diagonal Strut method was used and the software ETABS was used for the analysis of all the frame models. Infilled frames should be preferred in seismic regions than the open first story frame, because the story drift of first story of open first story frame is very large than the upper stories, which might probably cause the collapse of structure. The infill wall increases the strength and stiffness of the structure. The static analysis of RC (Bare frame) structure lead to under estimation of base shear. Therefore other response quantities such as time period, natural frequency, and story drift were not significant. The underestimation of base shear might lead to the collapse of structure .

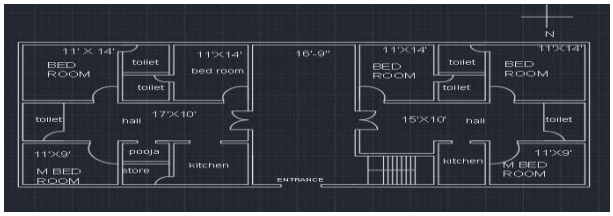
1.Varalakshmi V (2014) Analyzed a G+5 storey residential building and designed the various components like beam, slab, column and foundation. The loads namely dead load and live load were calculated as per IS 875(Part I & II)-1987 and HYSD bars i.e. Fe 415 are used as per IS 1986- 1985. They concluded that the safety of the reinforced concrete building depends upon the initial architectural and structural configuration of the total building, the quality of the structural analysis, design and reinforcement detailing of the building frame to achieve stability of elements and their ductile performance.

2.Chandrashekar (2015) Analyzed and designed the multistoried building by using ETABS software. A G+5 storey building under the lateral loading effect of wind and earthquake was considered for this study and analysis is done by using ETABS. They havealso consideredthe chances of occurrence of spread of fire and the importance of use of fire proof material up to highest possible standards of performance as well as reliability. They suggested that the wide chances of ETABS software which is very innovative and easier for

high rise buildings so that time incurred for designing is reduced.

3.Balaji.U and Selvarasan M.E (2016) Worked on analysis and design of multistoried building under static and dynamic loading conditions using ETABS. In this work a G+13 storey residential building was studied for the earth quake loads using ETABS. They assumed that material property to be linear, static and dynamic analyses were performed. The non-linear analysis was carried out by considering severe seismic zones and the behavior was assessed by considering type II soil condition. Different results like displacements, base shear were plotted and studied.

4.Geethu et.al (2016) A comparative study on analysis and design of multi storied building by STAAD.Pro and ETABS software. 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, ETABS software shows higher values of bending moment and axial force.

5.Kalyan chowdary Shaik Kamal Mohammed Azam This examination shows the technique for seismic execution estimation of elevated structures dependent on an idea of the limit range strategy. In 3D investigative model of thirty storied structures have been produced for symmetric structures Models and examined utilizing auxiliary examination device ETABS. The scientific model of the building incorporates immensely essential segments that impact the mass, quality, firmness and deformability of the structure. To contemplate the impact of solid center divider and shear divider at various positions amid quake, seismic examination utilizing both direct static, straight unique and non- straight static technique has been performed.

PREPARING PLAN IN AUTO CAD :

Depending upon the area prepare a plan based on the requirements. The below shown plan is of area 3500sqft of 15m height i.e., G+4. And each floor consists of 2 flats. Each flat with 3BHK. Software used to draw the plan is AUTOCAD 2019.

Fig 4.1 Plan in AutoCAD

CENTRE LINE DIAGRAM :

Draw center line diagram using a different layer. After completing center line diagram then save file.

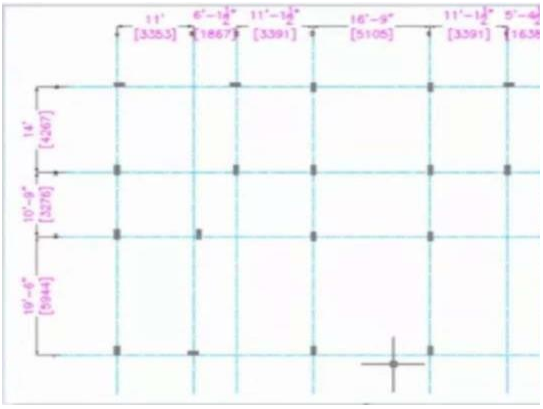
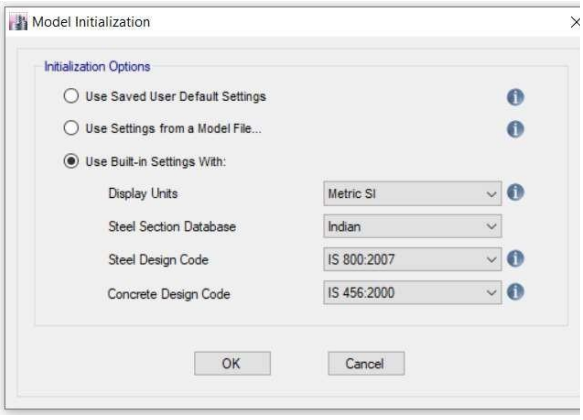


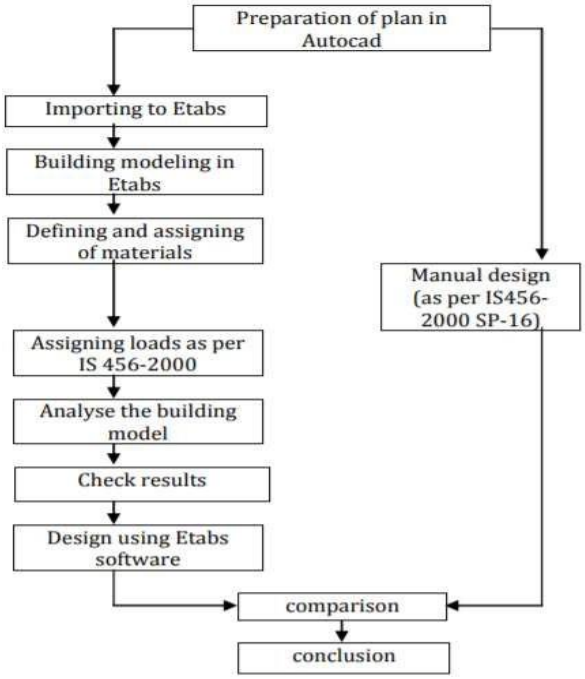
Fig 4.2 – Centre Line Diagram

PROCEDURE FOR ANALYSIS AND DESIGN :

Step 1: Open ETABS 2018 software and select units and IS codes based on your database. Thenclick on ok.



Step 2: Create the Grid points and Generation of structure after getting opened the program, select a new model and a window appears where we had entered the details of grid dimensions and story dimensions of our building. Here the program had generated 2D and 3D structure by specifying the building details in the following two windows.



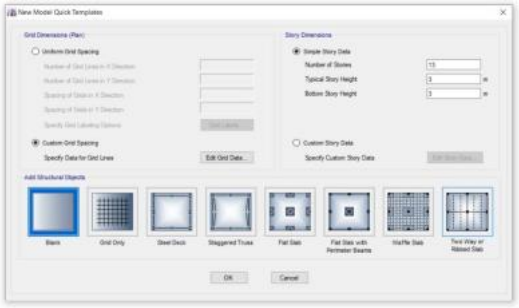


Fig 4.5 - Selecting templates

Step 3: After step 2 go to file menu select new model then import which was saved from autocad software.

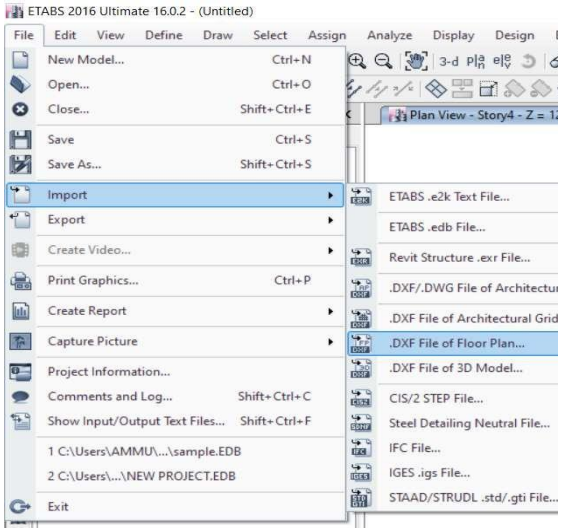


Fig 4.6 - Importing

Fig 4.7 -Defining material property

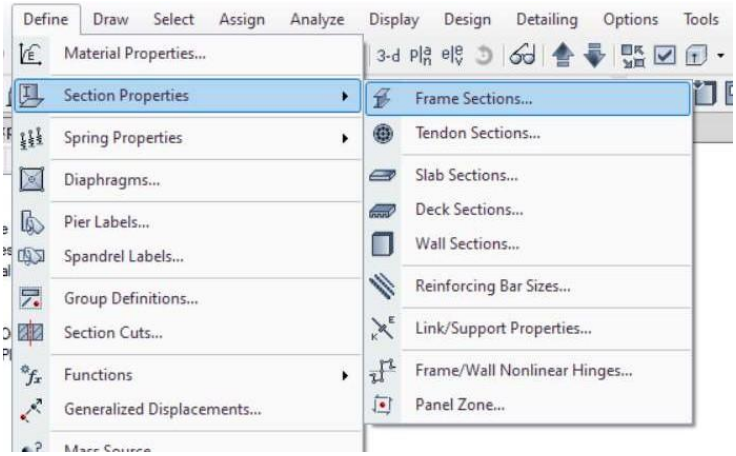
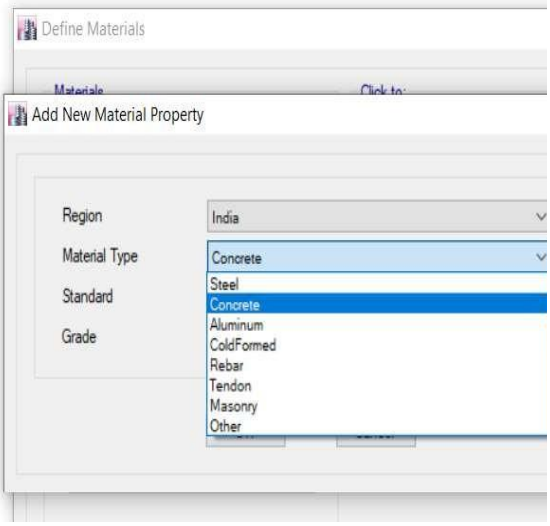


Fig 4.8- Defining section properties

Step 4: Define property- After importing, start to define the material property by selecting steel and concrete. After that define section properties (beams, columns, slabs, and wall) by giving this specifieddetails in defining. After that we define section size by selecting frame& slab section as shown belowand added the required section for beams, columns etc.



Step 5: Assigning of Property- After defining the property for materials and section properties, now draw the structural components using command menu → Draw line for beam and create columns in region for columns. Assigning is completed for beams, columns, slabs &wall sections.

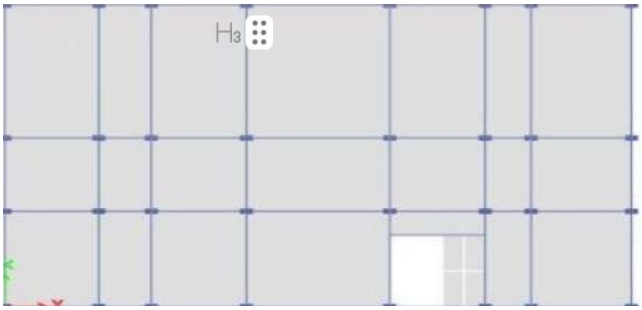


Fig 4.9 – Assigning all structural elements

RESULTS

STORY DATA :

This chapter provides model geometry information, including items such as story levels, point coordinates and element connectivity.

Table 5.1 – Story Definitions

Tower	Name	Height m	Master Story	Similar To	Splice Story	C
T1	Story4	3	Yes	None	No	Gray
T1	Story3	3	No	Story4	No	G
T1	Story2	3	No	Story4	No	I
T1	Story1	3	No	Story4	No	Y
T1	GF	3	No	Story4	No	F

PROPERTIES :

This chapter provides property information for materials, frame sections, shell sections, andlinks.

Materials:

Table 5.2 - Material Properties - General

Material	Type	SymType	Grade	Colour	Notes
4000Psi	Concrete	Isotropic	Unknown	Gray8Dark	
A416Gr270	Tendon	Uniaxial	Unknown	Cyan	
A615Gr60	Rebar	Uniaxial	Unknown	Blue	
A992Fy50	Steel	Isotropic	Unknown	Yellow	
HYSD415	Rebar	Uniaxial	Unknown	Magenta	
M20	Concrete	Isotropic	Unknown	Red	

Shell Sections :

Table 5.3- Area Section Property Definitions - Summary

Name	Type	Element Type	Material	Total Thickness m	Deck Material	Deck Depth m
Deck1	Deck	Membrane	4000Psi	0.1625	A992Fy50	0.075

Reinforcement Sizes:

Table 5.4 – Reinforcing Bar Siz

Name	Diameter m	Area m2
6	0.006	2.83E-05
8	0.008	0.0001
10	0.01	0.0001
12	0.012	0.0001
14	0.014	0.0002
16	0.016	0.0002
18	0.018	0.0003
20	0.02	0.0003
22	0.022	0.0004
25	0.025	0.0005
26	0.026	0.0005
28	0.028	0.0006
32	0.032	0.0008
36	0.036	0.001
40	0.04	0.0013
50	0.05	0.002

LOADS :

This chapter provides loading information as applied to the model.

Load Patterns

Table 5.5 - Load Pattern

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
dead	No	Dead	0	
live	No	Live	1	
seismic	No	Seismic	1	IS1893 2002
seismic xx	No	Seismic	1	IS1893 2002
seismic xx(1/6)	Yes	Seismic	1	IS1893 2002
seismic xx(2/6)	Yes	Seismic	1	IS1893 2002
seismic xx(3/6)	Yes	Seismic	1	IS1893 2002
seismic xx(4/6)	Yes	Seismic	1	IS1893 2002
seismic xx(5/6)	Yes	Seismic	1	IS1893 2002
seismic xx(6/6)	Yes	Seismic	1	IS1893 2002
seismic(1/6)	Yes	Seismic	1	IS1893 2002
seismic(2/6)	Yes	Seismic	1	IS1893 2002
seismic(3/6)	Yes	Seismic	1	IS1893 2002
seismic(4/6)	Yes	Seismic	1	IS1893 2002
seismic(5/6)	Yes	Seismic	1	IS1893 2002
seismic(6/6)	Yes	Seismic	1	IS1893 2002

CONCLUSION

Based on the analysis and design of multistoried building, the following conclusion's are made:

1. Our project deals with provision of earthquake resistant structure which is also economic
2. Maximum sizes of the beams and columns were provided as B 230x450 mm and C230x450mm.
3. There is a gradual increase in the value of lateral forces from bottom floor to top floor in softwareanalysis.
4. Maximum shear force is 93.8KN and maximum bending moment value is 79.5KN, which is actedat top floor of the building.

5.We have analysis and design of multistoried building using ETABS .We have applied all the loads and its combination & our structure is safe .

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