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Design and Analysis of G+22 Residential Building Using ETABS.

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ABSTRACT
ETABS stands for Extended Three Dimensional Analysis of Building System. This Software is used mainly to design and Analyse a structure. The Major analysis done is static, dynamic, linear, non linear, etc. In ETABS mainly designing of slabs, beams, columns are done the Live load and dead load and other loads acting on structure are been analysed and on such basis structures are designed. This project presents analysis and design of G+22 multi-storeyed residential building using ETABS software. The maximum shear forces, bending moments are computed and compared with all the other analysed cases. The structure is designed using IS (Indian-Standard) Code-IS 456:2000.
ETABS is commonly used to analyse steel and concrete structures, low and high rise buildings, and framed structures .ETABS was used to create the mathematical model of the Burj Khalifatechniques of ETABS which are specifically designed to takeadvantage of the unique physical and numerical characteristics associated withbuilding type structures. Post analysis ofthe structure, maximum shear forces, bending moments, are computed and compared with all the other analyzed cases.

I. INTRODUCTION

Civil engineering is one of the oldest branches of the engineering field which deals with works related to infrastructure, estate, Construction and other civil works. The Civil Engineering field deals with design, analysis, maintenance of structures such as roads, buildings, dams, etc. The task to build a beautiful and strong building is not an easy task which can even withstand against severe conditions. In world full of evolution and technology the field of civil engineering has also outgrown in various dimensions.

ETABS- "Extended 3D analysis of building systems" is a engineering software used for designing, planning and analysing the structure. This software consists of modelling tools, solutions to problems technique, and load analysing. ETABS can work out big structure and buildings and associated requirements. ETABS allows users to model easily and with a friendly graphical mode. It is used for the design and analyse of slabs, beams, columns, staircase, etc. ETABS is regarded worldwide as the leader in structural engineering analysis and design for its precision in calculating and computing the loads on structures, even its behaviour during earthquakes.

Most structural engineers use 3D integrated structural analysis and design software in their day to day work. This software grants modelling geometrics of structure and analysing the loads acting on structure much more efficient. In our country ETABS is mostly used for design and analysis for concrete framed structures. ETABS contains various versions starting from ETABS 9.0, 9.1, 9.2,…, v20.

Design rules for the composite construction has been developed over the years and have been undergoing improvements and still are being updated till today. These progressive changes oftenly resulted in more efficient uses of constituent materials and made to be better, less than expensive structures. There is no doubt that the search for further improvements in this field will be certainly beneficial because it has very wide scope for further improvement and also in research and development ahead.

Aim of The Study
The Design and Analysis of G+22 Residential Building using ETABS.
Objectives:

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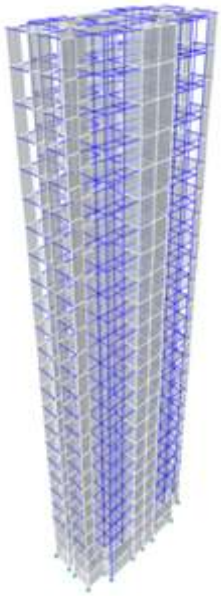
1. To Know the structural behaviour of structure such as slab, beam, column.
2. To Develop a 3D modelling of the building for easy and detailed calculations.
3. To learn the software for future scope in the field of construction.
4. The main objective of this study to analyse and design G+22 residential building using ETABS.
5. To design the structural components like beam and column.
6. To draw and create reinforcement details of structural components.
7. To analyse for shear and bending moment.
8. Site Survey.
9. Structural Analysis.

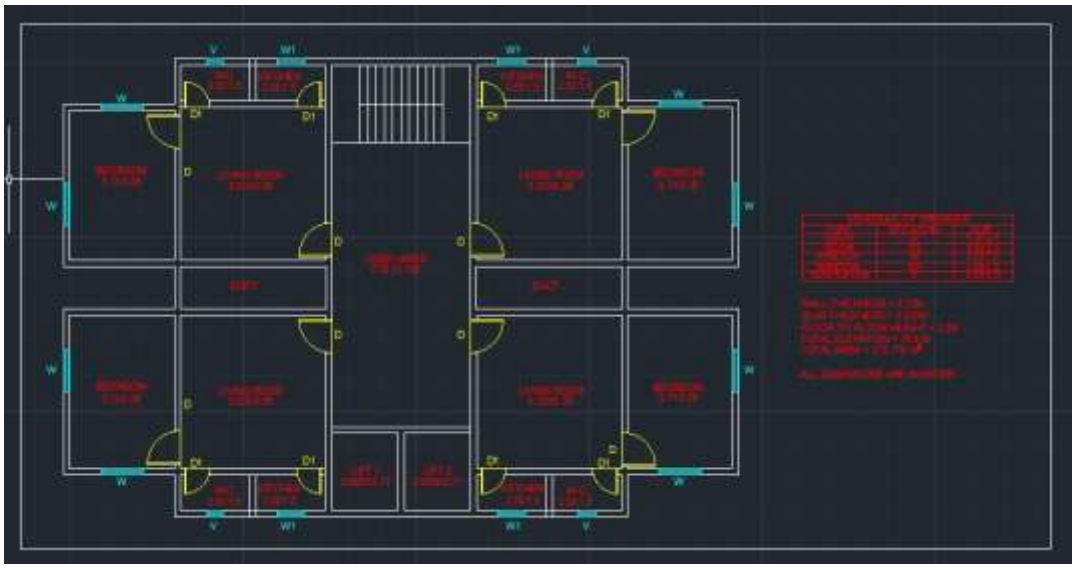
II. METHODOLOGY

Description of Building.

- Building Type: Residential Building.
- Building Elevation: 78.5 m.
- Total Area: 375.779 m2.
- Number of Storey: G+22.
- Construction Type: R.C.C Framed Structure.
- Number of Lift: 2 nos.
- Type Of Walls: Concrete and Fly ash blocks.
- Number of Rooms per floor: 4 Rooms



Plan



Dimensions of Floor and Each Flat

- Living Room :- 5.23 x 5.36 M
- Bedroom :- 3.7 x 5.36 M
- Kitchen :- 2.5 X 1.5 M

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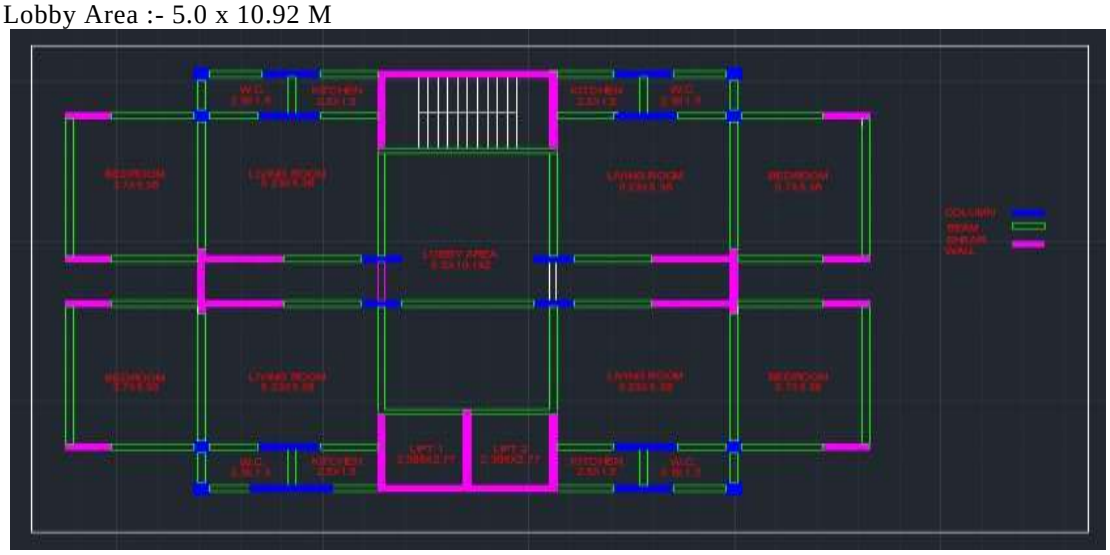
- Washroom :- 2.5 X 1.5 M
- Lobby Area :- 5.0 x 10.92 M
- Lift :- 2.385 x 2.77 M



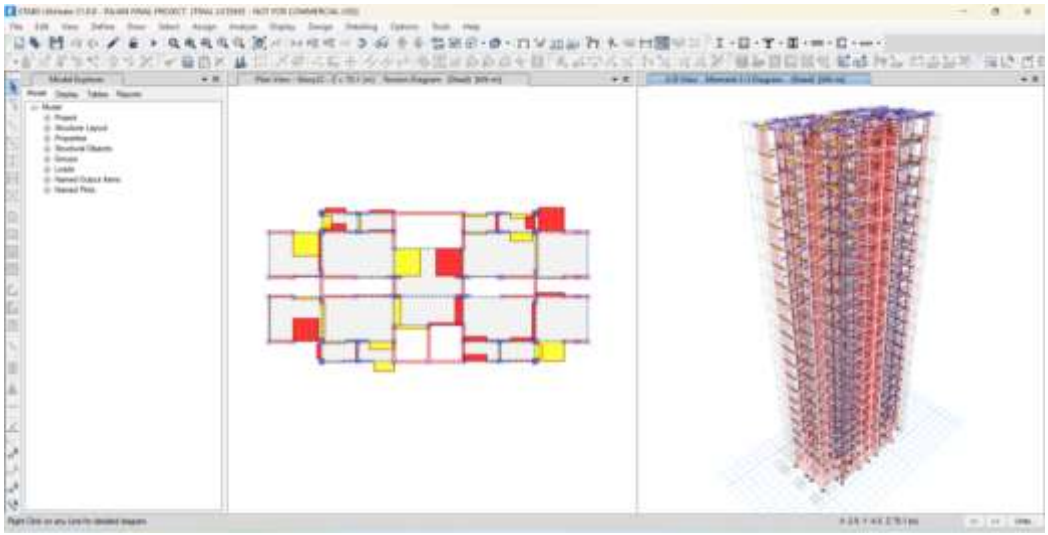
- **Column** – Blue
- **Beam** – Green
- **Shear wall** – Pink

Loading, Analysis, and Design

Once modeling is complete, ETABS automatically generates and assigns code-based loading conditions for gravity, seismic, wind, and thermal forces. Users may specify an unlimited number of load cases and combinations.

Given enveloping specification, design features will automatically size elements and systems, design reinforcing schemes, and otherwise optimize the structure according to desired performance measures.The Wind load acting on the structure is 44 m/s.

- Shear Force Diagram (SFD): The diagram which shows the variation of shear force along the length of the beam is called Shear Force Diagram (SFD).
- Bending Moment Diagram (BMD): The diagram which shows the variation of bending moment along the length of the beam is called Bending Moment Diagram (BMD).



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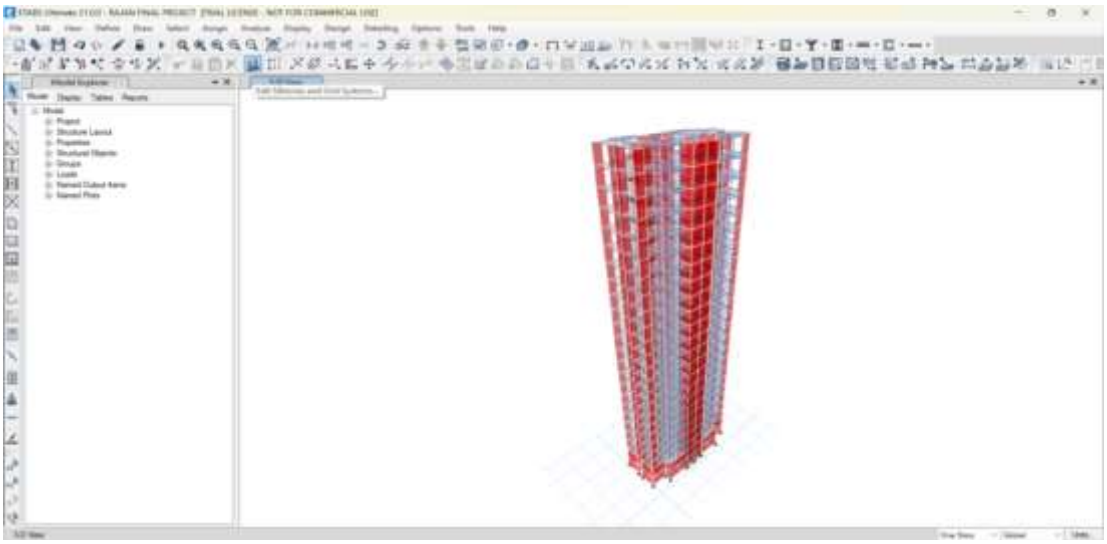

1. Structure Data

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

Story Data

Tower	Name	Height m	Master Story	Similar To	Splice Story	Color
T1	Story24	3.2	Yes	None	No	Yellow
T1	Story23	3.2	Yes	None	No	Yellow
T1	Story22	3.2	Yes	None	No	Yellow
T1	Story21	3.2	No	Story22	No	Gray8Dark
T1	Story20	3.2	No	Story22	No	Blue
T1	Story19	3.2	No	Story22	No	Green
T1	Story18	3.2	No	Story22	No	Cyan
T1	Story17	3.2	No	Story22	No	Red
T1	Story16	3.2	No	Story22	No	Magenta
T1	Story15	3.2	No	Story22	No	Yellow
T1	Story14	3.2	No	Story22	No	Gray8Dark
T1	Story13	3.2	No	Story22	No	Blue
T1	Story12	3.2	No	Story22	No	Green
T1	Story11	3.2	No	Story22	No	Cyan
T1	Story10	3.2	No	Story22	No	Red
T1	Story9	3.2	No	Story22	No	Magenta
T1	Story8	3.2	No	Story22	No	Yellow
T1	Story7	2.9	No	Story22	No	Gray8Dark
T1	Story6	3.2	No	Story22	No	Blue
T1	Story5	3.2	No	Story22	No	Green
T1	Story4	3.2	No	Story22	No	Cyan
T1	Story3	3.2	No	Story22	No	Red
T1	Story2	3.2	No	Story22	No	Magenta
T1	Story1	3.2	No	Story22	No	Yellow

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2. Materials

Material Properties - General

Material	Type	SymType	Grade	Color	Notes
HYSD415	Rebar	Uniaxial	HYSD Grade 415	Yellow	
HYSD500	Rebar	Uniaxial	HYSD Grade 500	Green	
M30	Concrete	Isotropic	M30	Magenta	
M50	Concrete	Isotropic	M50	Gray8Dark	
Tendon	Tendon	Uniaxial	Grade 270	Gray8Dark	

3. Frame Sections

Frame Section Property Definitions - Summary (Part 1 of 3)

Name	Material	Shape	Color	Area cm2	J cm4	I33 cm4	I22 cm4	As2 cm2	As3 cm2
BEAM 250X850	M50	Concrete Rectangular	Blue	2125	360728.2	1279427.1	110677.1	1770.8	1770.8
C2 230X2500	M30	Concrete Rectangular	Yellow	5750	955150.4	29947916.7	253479.2	4791.7	4791.7
C3 230X1250	M30	Concrete Rectangular	Gray8Dark	2875	448197.3	3743489.6	126739.6	2395.8	2395.8
C4 230X1800	M30	Concrete Rectangular	Blue	4140	671254.7	11178000	182505	3450	3450
C5-500X500	M50	Concrete Rectangular	Green	2500	880208.3	520833.3	520833.3	2083.3	2083.3

Frame Section Property Definitions - Summary (Part 2 of 3)

Name	S33Pos cm3	S33Neg cm3	S22Pos cm3	S22Neg cm3	Z33 cm3	Z22 cm3	R33 mm	R22 mm	CG Offset 3 mm	CG Offset 2 mm	PNA Offset 3 mm
BEAM 250X850	30104.2	30104.2	8854.2	8854.2	45156.3	13281.3	245.4	72.2	0	0	0
C2 230X2500	239583.3	239583.3	22041.7	22041.7	359375	33062.5	721.7	66.4	0	0	0
C3 230X1250	59895.8	59895.8	11020.8	11020.8	89843.8	16531.3	360.8	66.4	0	0	0
C4 230X1800	124200	124200	15870	15870	186300	23805	519.6	66.4	0	0	0
C5-500X500	20833.3	20833.3	20833.3	20833.3	31250	31250	144.3	144.3	0	0	0

Frame Section Property Definitions - Summary (Part 3 of 3)

Name	PNA Offset 2 mm	Area Modifier	As2 Modifier	As3 Modifier	J Modifier	I33 Modifier	I22 Modifier	Mass Modifier	Weight Modifier
BEAM 250X850	0	1	1	1	0.1	1	1	1	1
C2 230X2500	0	1	1	1	1	1	1	1	1
C3 230X1250	0	1	1	1	1	1	1	1	1
C4 230X1800	0	1	1	1	1	1	1	1	1
C5-500X500	0	1	1	1	1	1	1	1	1

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4. Shell Sections

Area Section Property Definitions - Summary

Name	Type	Element Type	Material	Total Thickness mm	Deck Material	Deck Depth mm
SLAB 200 M50	Slab	Membrane	M50	200		
WALL 200 M50	Wall	Shell-Thin	M50	200		
WALL 400	Wall	Shell-Thin	M50	400		

5. Reinforcement Sizes

Reinforcing Bar Sizes

Name	Diameter mm	Area cm2
10	10	0.8
18	18	2.5
20	20	3.1

6. Loads

This chapter provides loading information as applied to the model

Load Patterns

Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
DL	No	Dead	1	
ELX	No	Seismic	0	IS1893 2002
ELX+E	No	Seismic	0	IS1893 2002
ELX-E	No	Seismic	0	IS1893 2002
ELY	No	Seismic	0	IS1893 2002
ELY+E	No	Seismic	0	IS1893 2002
ELY-E	No	Seismic	0	IS1893 2002
LL	No	Live	0	
SIDL	No	Super Dead	0	

Functions - Response Spectrum - IS1893 2002

Name	Period sec	Value	Z	Soil Type	Damping Ratio
IS1893	0	0.24	0.24	II	0.05
IS1893	0.1	0.6			
IS1893	0.55	0.6			
IS1893	0.8	0.408			
IS1893	1	0.3264			
IS1893	1.2	0.272			
IS1893	1.4	0.233143			
IS1893	1.6	0.204			
IS1893	1.8	0.181333			
IS1893	2	0.1632			
IS1893	2.5	0.13056			
IS1893	3	0.1088			
IS1893	3.5	0.093257			
IS1893	4	0.0816			
IS1893	4.5	0.0816			
IS1893	5	0.0816			
IS1893	5.5	0.0816			

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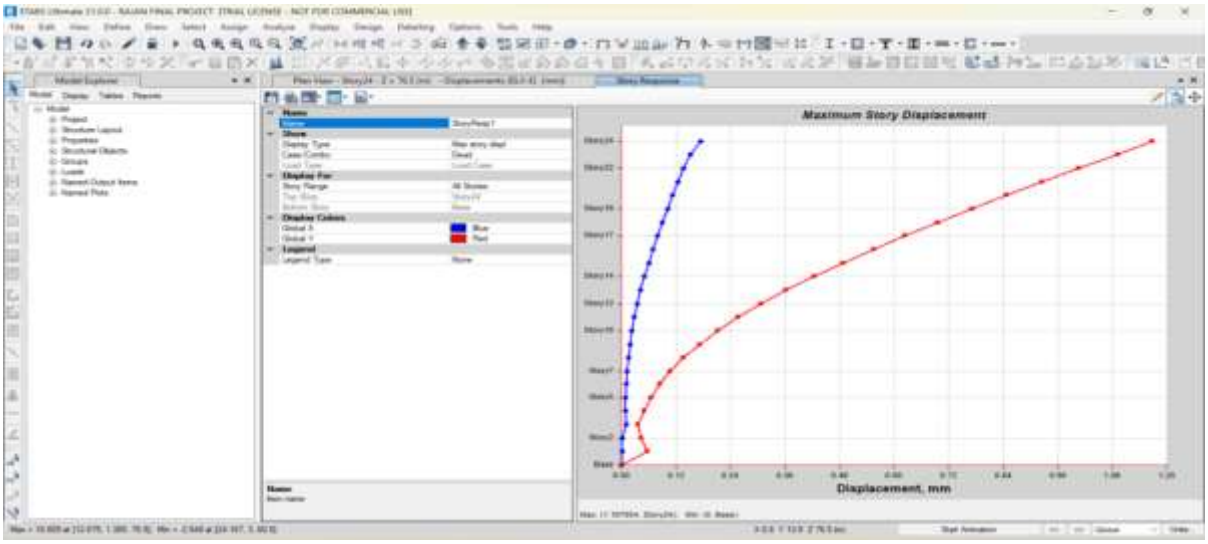
Name	Period sec	Value	Z	Soil Type	Damping Ratio
IS1893	6	0.0816			
IS1893	6.5	0.0816			
IS1893	7	0.0816			
IS1893	7.5	0.0816			
IS1893	8	0.0816			
IS1893	8.5	0.0816			
IS1893	9	0.0816			
IS1893	9.5	0.0816			
IS1893	10	0.0816			

Load Case Definitions - Summary

Name	Type
Dead	Linear Static
Live	Linear Static
Modal	Modal - Ritz
SIDL	Linear Static
ELX	Linear Static
ELX+E	Linear Static
ELX-E	Linear Static
ELY-E	Linear Static
ELY+E	Linear Static
ELY	Linear Static
RSX	Response Spectrum
RSY	Response Spectrum

❖ Storey Displacement- Story displacement is the absolute value of displacement of the storey under action of the lateral forces. The importance of story drift is in design of partitions/ curtain walls.The acceptance lateral displacement limit for wind load case could be taken as H/500 (some may take H/400).



Model has been checked and solved.
The Model has been checked and No warning messages were generated.
The Structure has no errors in design and analysis hence model has been checked.

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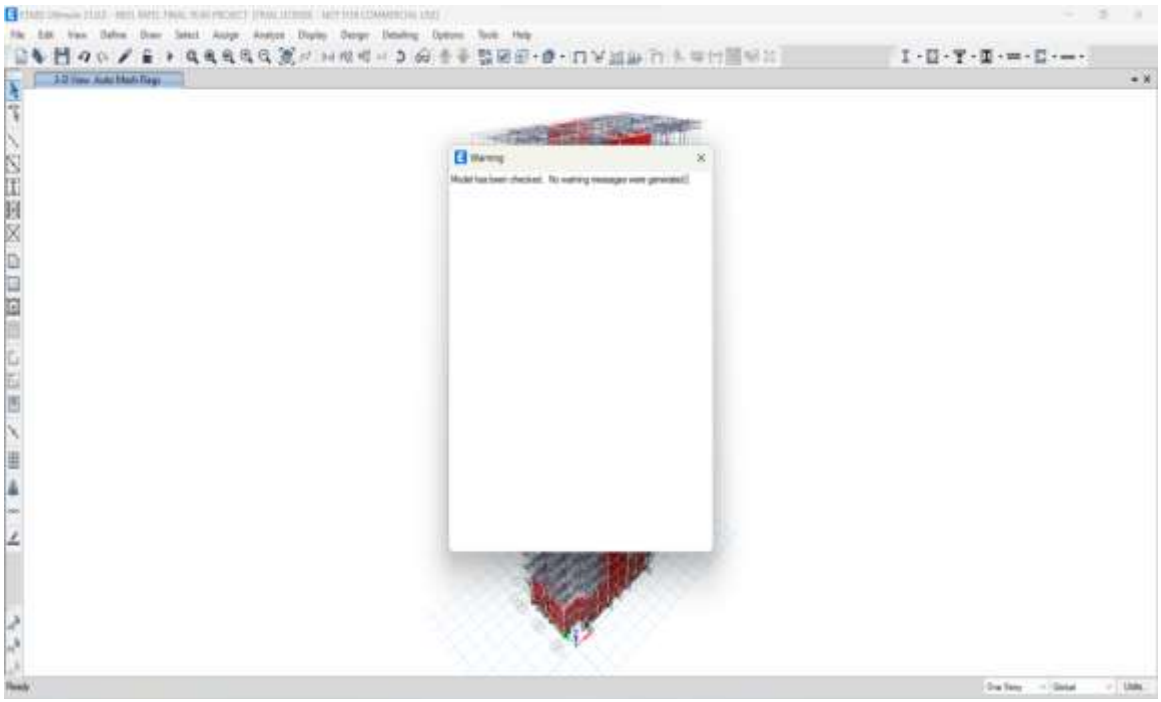

III. CONCLUSION

- Design and analysis of an G+22 residential building has be done and solved.
- Analysis of structure has been done by using the software ETABS V 21.0.0, which has been proved to be of great potential in analysis and design of the structure.
- The structural elements usually placed are RCC frame, shear wall are also provided.
- The design and analysis are carried out and done as per standard specifications used in the industry.
- There were many difficulties encountered during the project designing and understood and rectified by operating software.
- ETABS allows users ease of handling and good graphical interface optimizing users work and also time saving.
- One can easily calculate and compute the amount of reinforcement required in a structure.
- It offers 3D view of the Structure.
- Users can calculate wind loads and Seismic loads acting on the structure.
- ETABS is mainly used for design and analysis of Framed RCC Structures.

FUTURE SCOPE

- The designing and analysis work done in ETABS can be also carried out in staad pro and compare the results obtained.
- The foundation and tanks are also to be provided.
- The dynamic analysis is to be carried out.
- Different types of slabs, columns, type of footing , foundation can also be applied.

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