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Optimization of Shear wall and study on Non-Linear behaviour of Reinforced Concrete Residential Building using ETABS

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Abstract - Current practices in earthquake engineering only apply single earthquake on building structure during modelling and analysis. However, in real earthquake event, the tremors always occur repeatedly until two (or) three times after the first tremor. This phenomenon can affect the stiffness and strength of the structural system. Due to lack of time, any rehabilitation action is impractical. Thus, the building may experience greater damage due to several repeated tremors. This project gives a brief idea about the non-linear behavior of generic reinforced concrete building under excitation of single and repeated earthquake.

Non-Linear behaviour of structure, in term of inter storey drift ratio were presented using incremental dynamic analysis curve. The results from analysis demonstrate that the repeated earthquake phenomenon require greater inter storey drift demand compared to single earthquake. This is a nature of earthquake and in technical views it is called as repeated earthquake phenomenon. Thus, in reality the earthquake load might hit the structure more than one time during an earthquake event.

The present project is to reduce the time period of the residential G+4 building which in turn reduces the modal value, so that the sudden collapse of the building can be resisted. Dynamic load cases which include both wind and seismic loads should be applied and non-linear analysis should be performed.)

Key Words: ETABS, Shear wall, Non-linear behaviour, Residential building

1. INTRODUCTION

INDIA is a large country that has more than its share of major natural hazards like drought, floods, earthquake and cyclones throughout its history of civilization. The ten-year period of the International Decade for Natural Disaster Reduction (IDNDR), came as a good opportunity for the country to look back at what had been done in the past, new initiatives taken during the decade, and plan ahead for reducing the impact of natural hazards on its people, settlements and economic development.

Earthquakes occur due to movements along faults that have evolved through geologic and tectonic processes. Often, they occur without any prior warning and are therefore unpredictable. Among all the natural calamities, earthquakes are the most disastrous since their impacts can cover large areas causing deaths, injuries and destruction on a massive scale. The extent of the impact of an earthquake depends on its magnitude, location and time of occurrence. A large part of India is liable to a wide range of probable maximum seismic intensities, where shallow earthquakes of magnitudes of 5.0 or more on the Richter scale, are known to have occurred in the historical past or have been recorded in the last 100 years. A catalogue prepared by the India Meteorological Department (IMD) lists about 1200 known earthquakes. According to this catalogue, there are 8 earthquakes of M 8.00, 43 of M 7.0 –7.9, 312 of M 6.0 –6.9, the rest of M 5.00 – 5.9. Table 1 gives a list of different magnitude earthquakes in India, with more than thousand deaths. The largest earthquake in India occurred in 1897 in the Shillong Plateau and it had a magnitude of 8.7. This and the 1950 earthquake of M 8.6 in Sadiya region have been so intense that the rivers changed their courses, ground elevations got changed permanently and stones were thrown upward with an acceleration exceeding 1 g.

1.1 SCOPE OF THE PRESENT INVESTIGATION

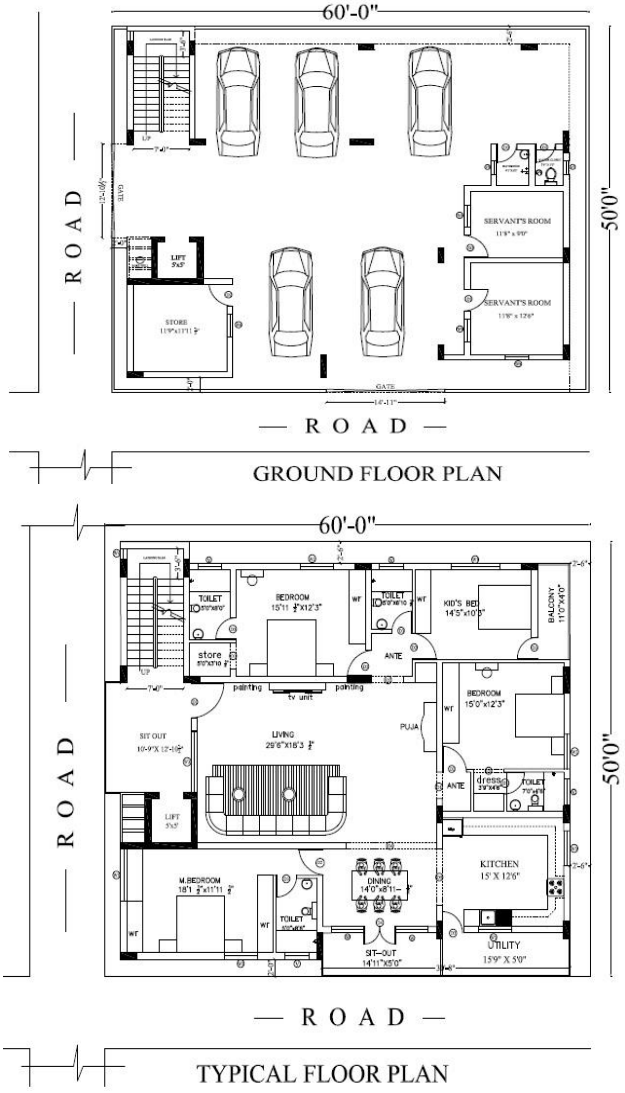
The main reasons for construction related accidents are carelessness, technical faults, inappropriate use of tools, wrong reaction of workers, abuse of alcohol, and most important no proper awareness about potential sources of accidents. A construction site is the place where people come to work together mainly to earn money to support their families. A place where people come together for doing a living must be safe; no economical consideration justifies an accident. What a great tragedy for a family, if for the reason of a preventable working accident, no more income is available. Knowing the sources of potential and predictable accidents means that we can prevent them. It is the duty of a construction supervisor to know the potential sources of accidents and to prevent them as far as possible.

2. REVIEW OF LITERATURE

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 modelling, analytical, design, and detailing procedures, all integrated using a common database. Although quick and easy for simple structures, ETABS can also handle the largest and most complex building models, including a wide range of nonlinear behaviours, making it the tool of choice for structural engineers in the building industry.

3. MODELLING OF A STRUCTURE

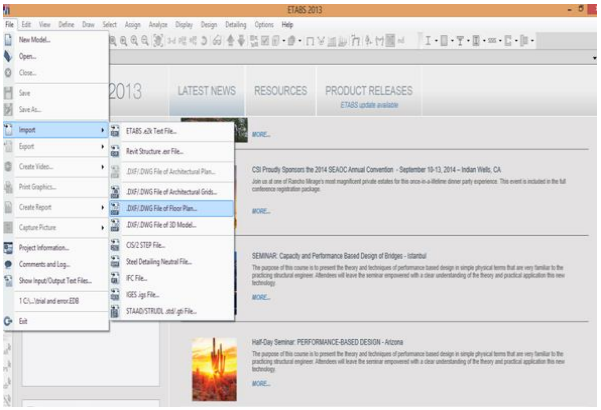
This chapter says that how to model a structure in auto cad, converted in to ETABS format, Define material properties, frame dimensions, slab dimensions, primary loads assignment, and check Model and about preliminary analysis. It provides idea about tool s used in this chapter. You can understand Auto CAD export and ETABS import.



3.1Typical floor plans

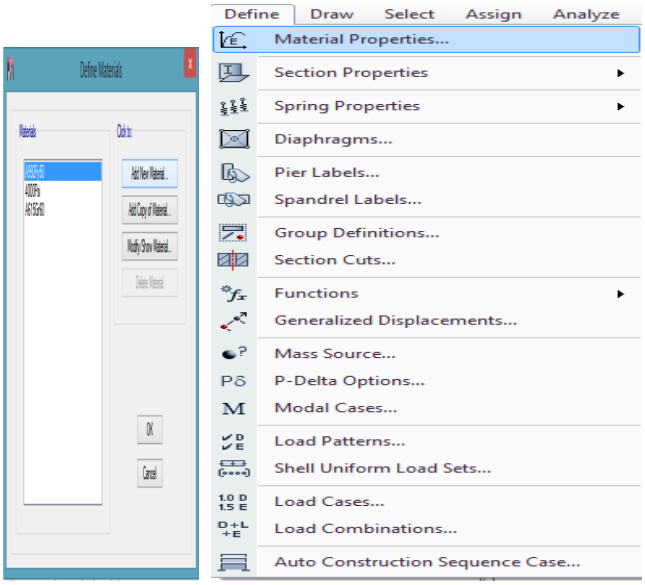
3.1IMPORT TO ETABS

- Save the auto cad model in the working folder. Then open e tabs icon  in desktop.
- Go file → import → .DXF/.DWG File of Floor Plan…. Hit left button on mouse.



3.2 ETABS Startup Interface

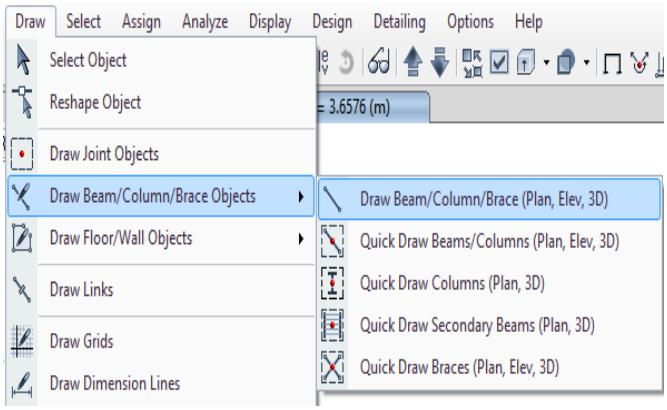
3.2DEFINE MATERIAL PROPERITIES



- A992Fy50, 4000psi, A615Gr60 are default materials in the software.
- Add copy of material… is used; define already existing material with another name.
- Modify /show material….is used; change the existing material properties.
- Hit add new material property icon, change all properties as shown below.

3.3 DRAW BEAM, COLUMN AND SLAB ELEMENTS

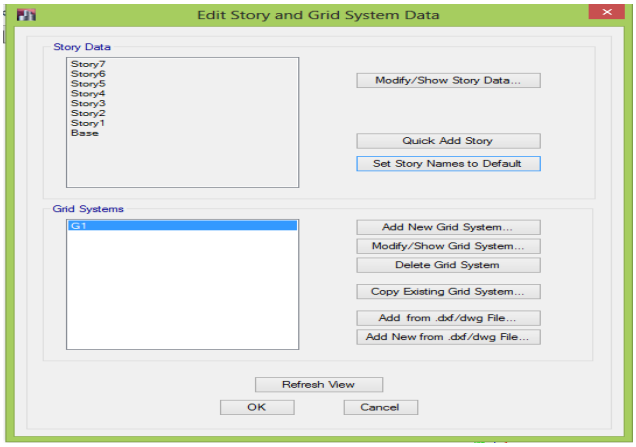
- Draw  draw beam/column/brace objects  draw beam/column/brace.



3.3 Draw Beam, Column and Slab Elements

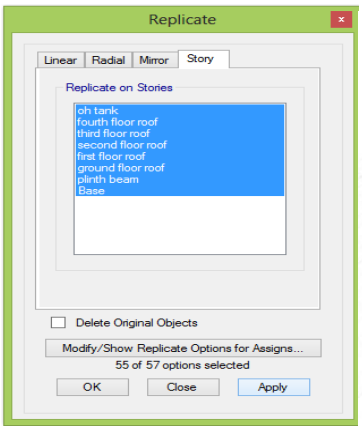
3.4 CREATION OF 3-D MODEL

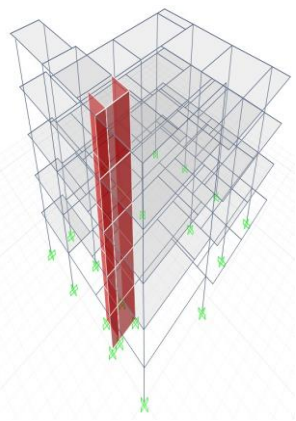
EDIT EDIT STORY AND GRID SYSTEM QUICK ADD STORY UP TO STORY 7



3.4 Extension of Stories

- Edit → replicate → story → select all story in the replication hit apply and then ok.





3.5 Replication of Story Data

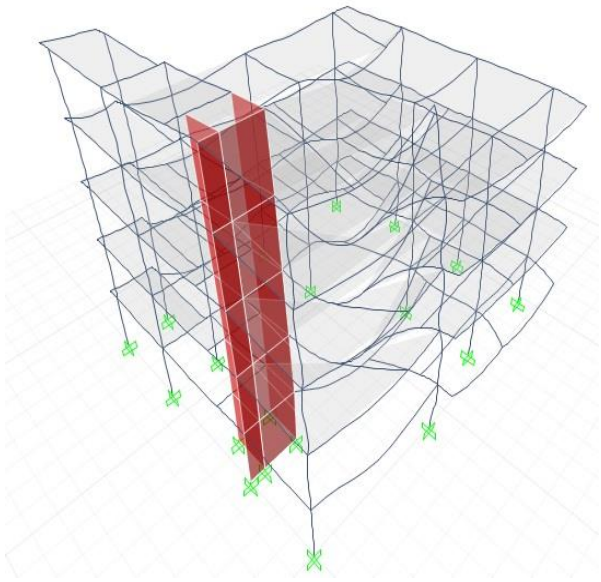
3.5ASSIGN LOADS TO FRAME AND SLAB ELEMENTS

Select → Select → object type…. Beam → select close.

- Assign → frame loads → distributed → load pattern name dead uniform load apply close.
- Select → Select → object type…. → floors → select close.
- Assign → shell loads → distributed → load pattern name dead uniform load Load 4KN/m^2 → applies → close.
- Select → Select → object type…. → floors → select close.
- Assign → shell loads → distributed → load pattern name → live uniform load load 3KN/m^2 applies close.
- Assign → joint → restraints → FIXED → OK.

3.6 RUN ANALYSIS

- Analysis → check model → check all tick marks ok.



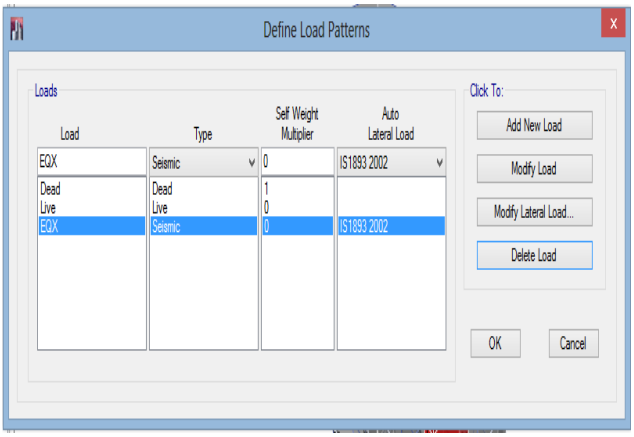
3.6Deflected Shape after analysis

4. ADVANCED ANALYSIS AND DESIGN

This chapter provides you information about advanced earth quake lateral force analysis, defining the earth quake load

patterns, load combinations, force and stress diagrams, story response plots for EQX and EQY and design frame members

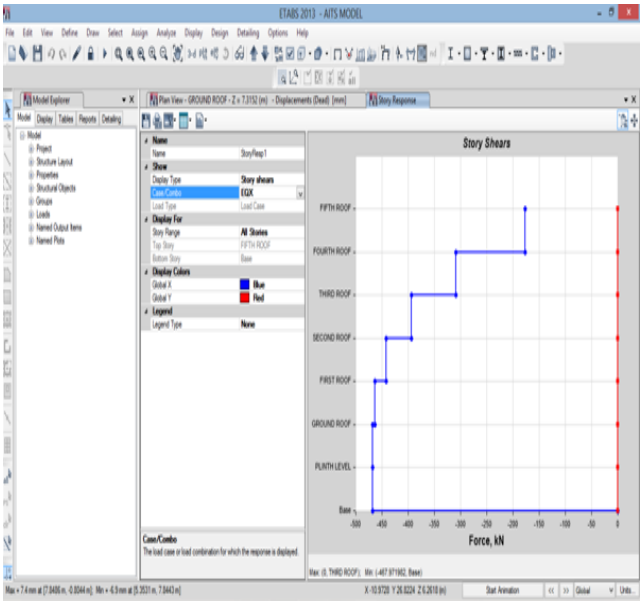
Define → load pattern → load as EQX →type as seismic → self weight → 0 → auto lateral loads IS 1893 2002→ Add new load.



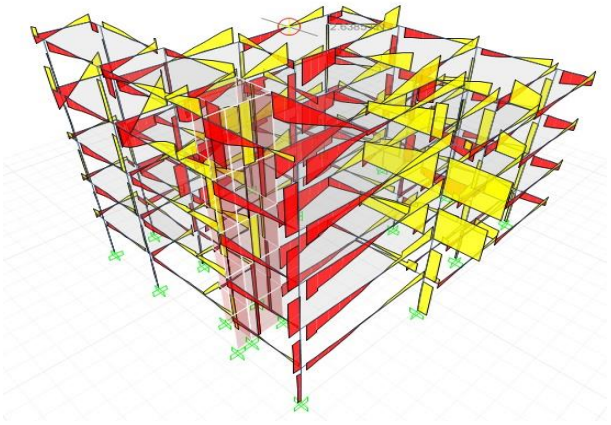
4.1Defining Load Patterns

4.1STORY RESPONSE PLOTS

Goto→display → story respones plots → display type → story shears case/comb → EQX.



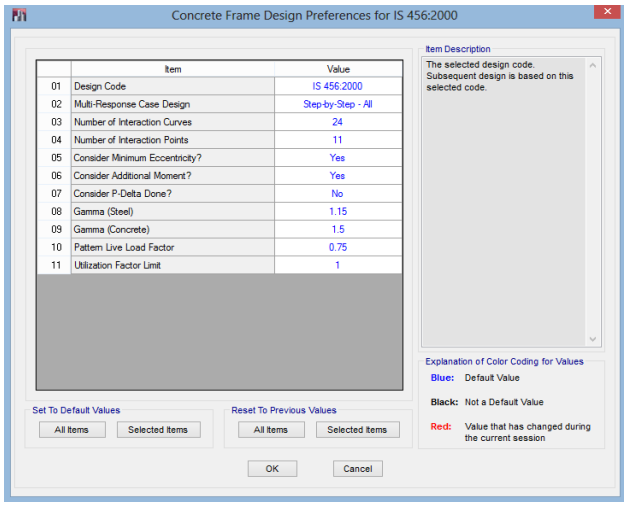
4.2Story Response Plot



4.3Shear Stresses

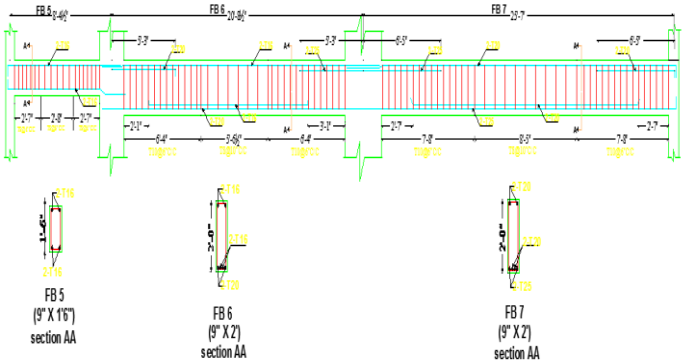
4.2 CONCRETE FRAME DESIGN AND CHECK

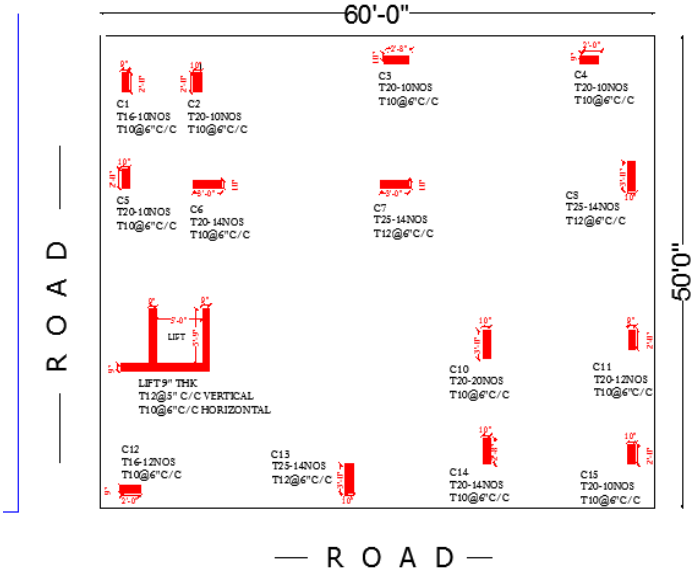
Design → concrete frame design → design preferences as IS 456:2000.



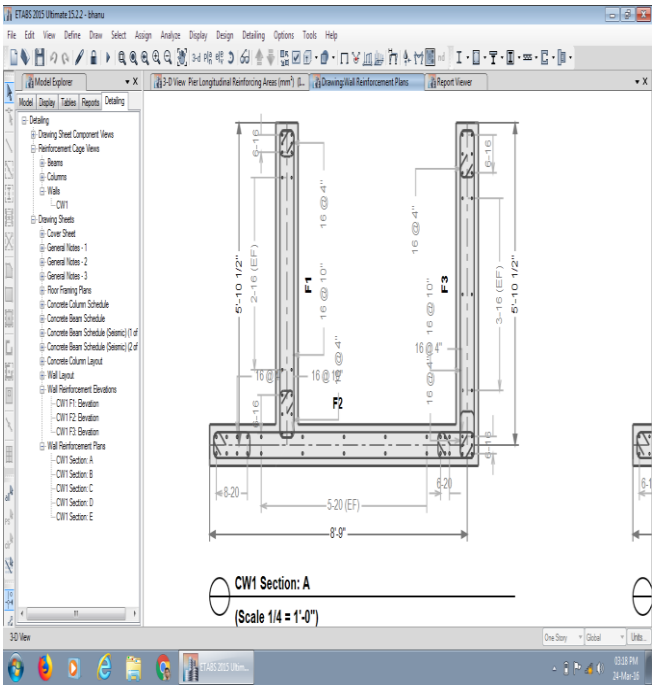
4.4Design Preferences

4.3Reinforcement Details





COLUMN DETAILS



5.3 Shear wall design section

5. CONCLUSIONS

- Safety levels has considerably increased wit increase in shear wall thickness during non-linear analysis.
- Displacement values has decreased in storey height in comparison with RCC framed structure.
- Provision of shear wall results in a huge decrease in base shear and roof displacement both symmetrical building and un-symmetrical building.
- Performance based seismic design obtained leads to a small reduction in steel reinforcement when compared to code based seismic design (IS 1893:2002) obtained by ETABS.

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BIOGRAPHIES

"Mr. PALLI BHANU PRAKASH RAO is pursuing postgraduate studies at AITS, Tirupati. He is keen in conducting research in the area of optimization of shear wall and study on non-linear behaviour of reinforced concrete residential Building using ETABS."

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