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ALTERATION IN IRREGULAR STRUCTURAL BEHAVIOR DUE TO PARAMETRIC VARIATIONS UNDER PUSHOVER ANALYSIS

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Abstract – Earthquake is the one of the most dangerous natural hazards to damage structure in the world. Now a day construction space is very less, So tall structures are more introduce on field. Irregular structure cannot analysis by seismic method (linear static method) for this analysis we use nonlinear static method. For the analysis E-tabs software is Using for Pushover analysis we can understand that at which joint beam or column is first damage when earthquake occur. Pushover analysis method we cannot design structure but ductile detailing make structure safer. This study help to improve structure performance in earthquake.

Key Words: **Irregular Structure, pushover analysis, E-tabs.**

1.INTRODUCTION

In the event of an earthquake, structure damage typically begins at the weakest point within a building. A structure is classified as regular when its design displays nearly symmetrical configuration around the axis, while irregularity emerges from the absence of symmetry and disruption in geometry, mass distribution or load bearing components. In urban setting with limited construction space, irregularities manifest more frequently, necessitating structural engineers to possess comprehensive knowledge of irregular structure response to seismic activity.

Irregularities within building structure often stem from uneven mass, strength, and stiffness distribution along their height. Constructing such building in high seismic zones complicates analysis and design. Two primary irregularity type are recognized.

1. Plan irregularities

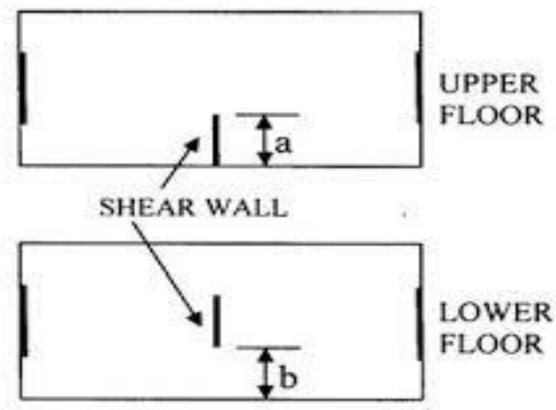


FIGURE 1- Plan irregularities

2. Vertical irregularities

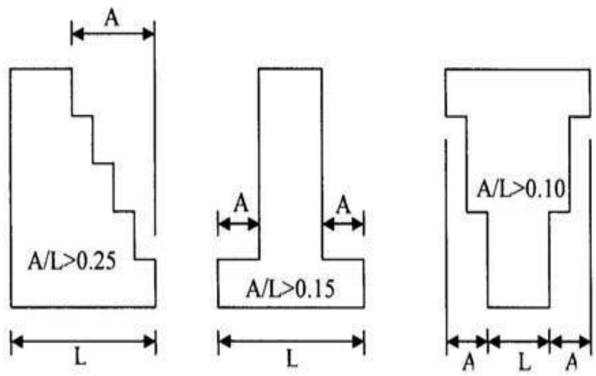


FIGURE 2- Plan irregularities

Plan or vertical irregularities render structures susceptible to seismic forces. Torsional irregularity and sudden increases in overturning moment are consequences of structural irregularities. Therefore, addressing irregularity becomes a critical aspect in the design phase, especially when considering stiffness irregularity resulting from abrupt stiffness changes between adjacent floors, like setback in a building's elevation.

Using nonlinear static analysis, also known as pushover analysis, assesses a structure ability to bear ultimate load and deflection. It modals local nonlinear effects like flexural hinges at joins, deforming the structure until enough hinges form a collapse mechanism or reach the plastic deformation limit. The analysis generates a static pushover curve plotting a strength based parameter against deflection. For instance, it correlates strength levels in parts of the structure with lateral displacement or plots bending moments against plastic hinges.

These results offer insights into the structural system's ductile capacity, indicating failure mechanisms, load levels and deflections leading to failure. When analysing frame objects, material nonlinearity is assigned to specific hinge location based on criteria like FEMA-356 or user-defined standards.

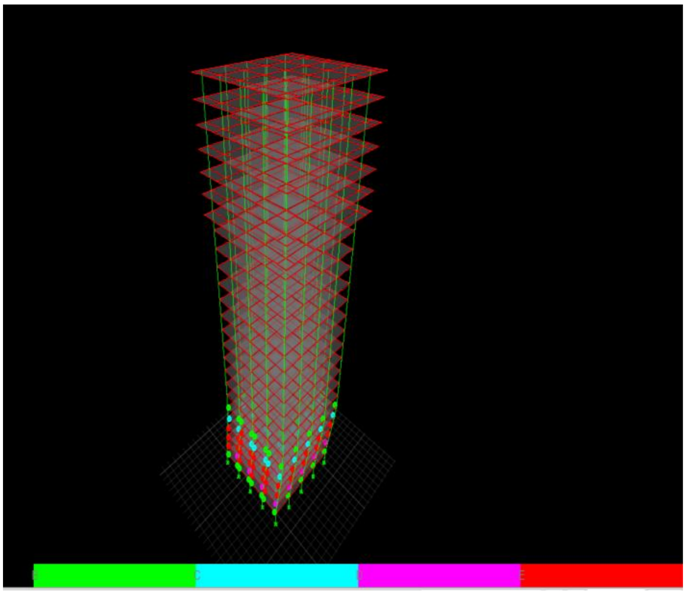


FIGURE 3 - Hinges

Hing location can see like this FEMA-356 and ASCE 41-13. various software features like strength drop, displacement control, p-delta effect, staged construction, and link assignments are available for use in static pushover analysis.

Pushover Analysis For the procedure of Pushover analysis, the required codes are taken from Federal Emergency Management Agency (FEMA) and Applied Technical Council (ATC) are the two agencies which provide guidelines formulated for the Non-linear Static Analysis or Pushover Analysis under seismic rehabilitation that included documents FEMA-356, FEMA-273 and ATC-40

1.2 Objective

 As civil engineers, our responsibility is to design structures that can withstand earthquakes in various zones and protect people's lives.

 Study the different types of structural irregularities.

 Compare structural parameters like storey shear and storey displacement in R.C.C. buildings.

 Analyze vertical irregularities in structures.

 Compare analysis results of structures in seismic zones III, IV, and V using ETABS software.

1.3 Aim of Study

 Determine the extent of possible changes in the seismic behavior of RC building models.

 Introduce a symmetrical bare frame building model in different zones using Pushover analysis.

 Assess the impact of seismic zone factors in zones III, IV, and V on the building's seismic performance.

3. MODELING

1. Capacity: This is the ultimate strength of a structural component, not considering the reduction factor used in design. It refers to the strength at the yield point on the capacity curve and includes strain hardening effects for deformation control.

2. Capacity Curve: A graph plotting base shear against roof displacement, also known as pushover analysis.

3. Capacity Spectrum: A method using graphs to show how a building might handle an earthquake, comparing building strength to potential earthquake shaking. The "performance point" is where these lines intersect, indicating potential building movement during an earthquake.

4. Demand: Instead of using forces, we estimate how much a building might bend or move during an earthquake, shown in a "demand spectrum" graph that changes over time.

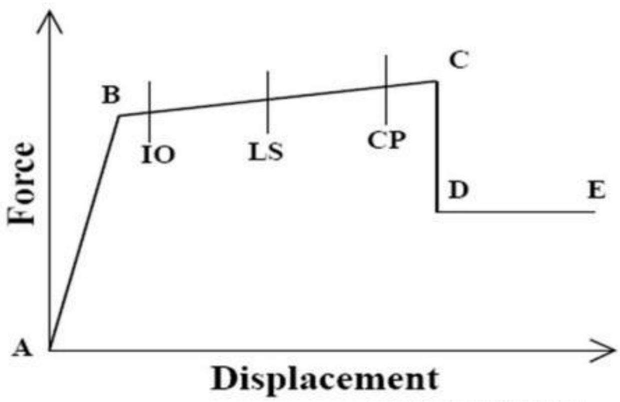


FIGURE- PUSHOVER FORCE /DISPLACEMENT GRAPH

5. Performance Point: The intersection of the capacity spectrum and demand spectrum graphs, indicating how well a building design handles forces.

6. Building Performance Level: The combined performance of structural and non-structural components, described using different performance levels through pushover analysis.

7. Operational Level (OP): The building sustains no permanent damage, retaining original strength and stiffness. Major cracks may appear in partition walls and ceilings.

8. Immediate Occupancy Level (IM): The building sustains no drift, retaining original strength and stiffness. Minor cracks may appear in partition walls and structural elements, and elevators and fire protection are operable.

9. Life Safety Level (LS): The building retains residual strength and stiffness, with gravity load-bearing elements functioning. Some drift and damage to partition walls and non-structural elements are observed, but hazards are mitigated.

10.Collapse Prevention Level (CP): The building has weakened strength and rigidity but retains load-bearing capacity. It may experience significant permanent tilting, collapse of non-essential walls, and damage to non-supporting parts.

11. Plastic Hinge: The location where inelastic action occurs in a structural member.

12. Formation of Plastic Hinge: Plastic hinges likely form near the ends of beams and columns where maximum moments occur during an earthquake, requiring ductility at these sections.

3.1 MODEL

This study focuses on the earthquake analysis of high-rise buildings. The specifications are based on IS 1893-2016 part 1 and IS 13920. Various column and beam sizes were analyzed using ETABS to select the most economical sections. Loading details were taken from IS 1893-2016 part 1, IS 1893 part 2, and IS 875. Material properties were chosen according to IS 456-2000. Seismic factors were selected based on the location, type of structure, and soil type as specified in IS 1893-2016

- Make 2 type of story model. First one is 20 story, 25 story and 30 story.

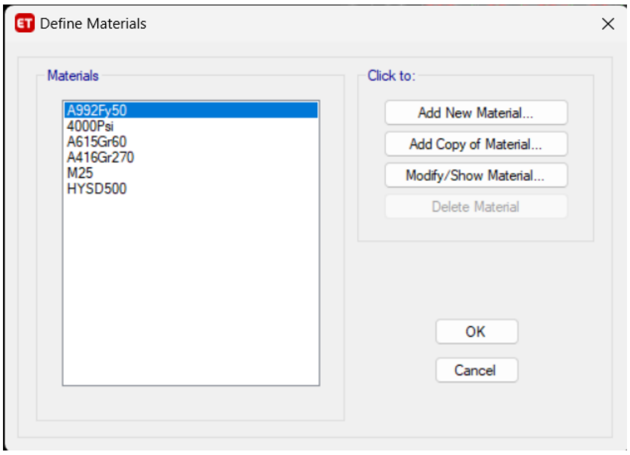
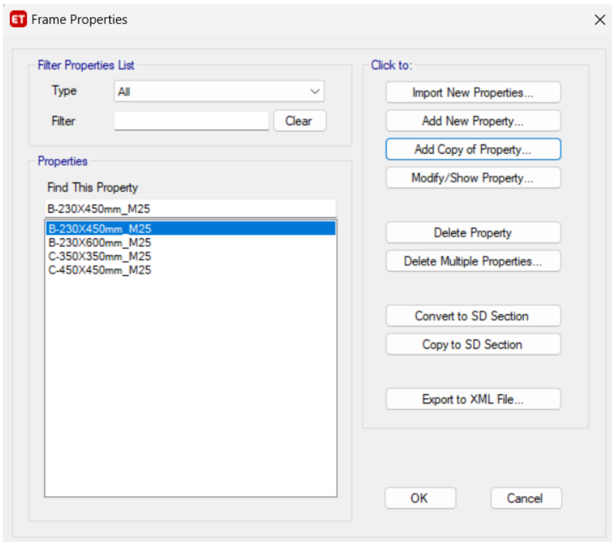


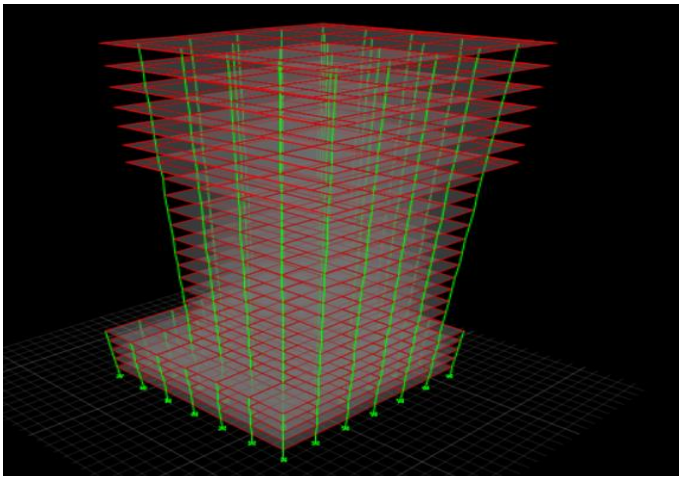
FIGURE 4-concrate and steel materials

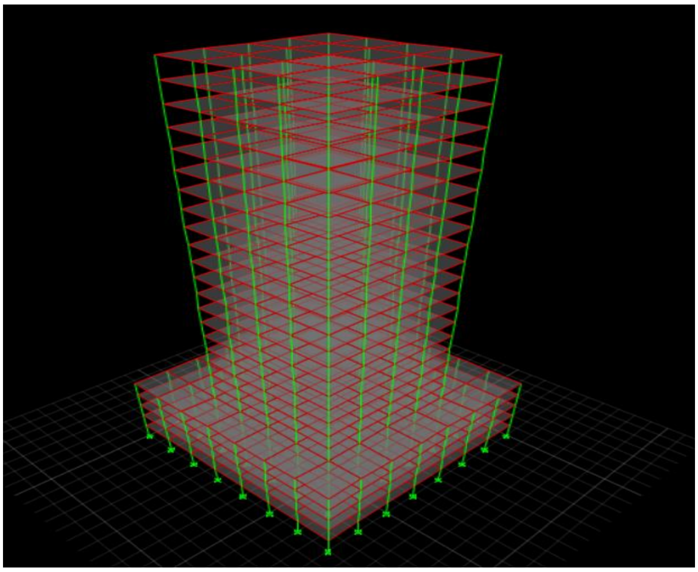


FUGURE 5- beam colunm property

In this reasurch we use material and section size as bilove. The frame aliment use in the modal are shown as belowe. Total two type of column and two type of beam are use.

Name	Material	Shape
C-350x350mm	M25	Concrete Rectangular
C-450x450mm	M25	Concrete Rectangular
B-230X450mm	M25	Concrete Rectangular
B-230X600mm	M25	Concrete Rectangular
S-150mm	M25	Mambrane





FUGURE 6- MODALS

4. RESULTS

Through this pushover analysis we can understand the bihavier of structure, and which junction is first colleps during the earthquake we can understand.

As we can see in figure 9 , we can see some colour in this image and this colouers inform that which junction is critical during earthquake.

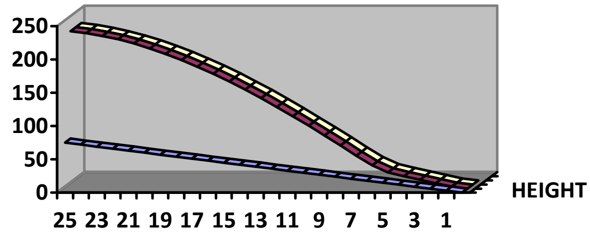


FIGURE 7-Story displacement

The maximum displacement of each story due to earthquake in Y direction for various seismic zones of India have been plotted as above. The observation from the graphs leads to the results that the pattern of the displacement for each zone and for each structure remain same. The only change is in the value of maximum displacement in different seismic zones. The displacement in irregular buildings is much higher than regular and vertically irregular buildings. The least displacement has been observed in the regular building.

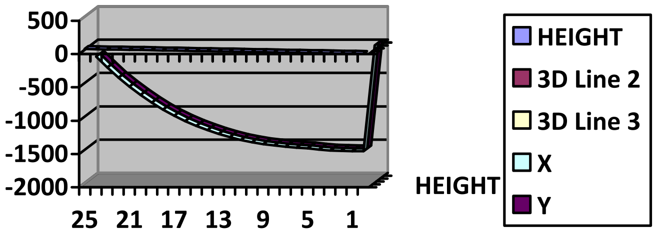


FIGURE 8-Story shear

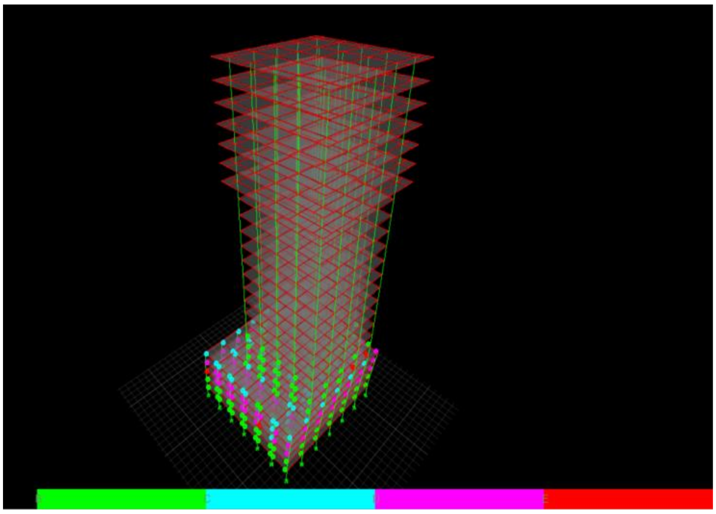


FIGURE 9 -Hinges

- Hingies created in model after pushover analysis complited this image shows the point at with point collepse.

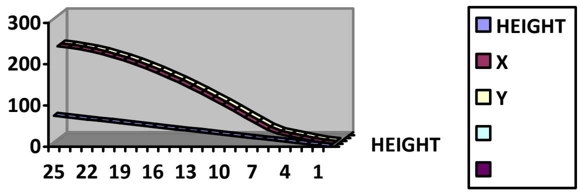


FIGURE 10-Story displacement

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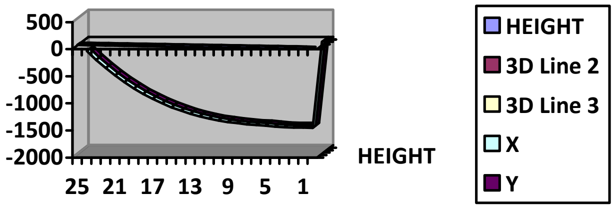

FIGURE 11-Story shear

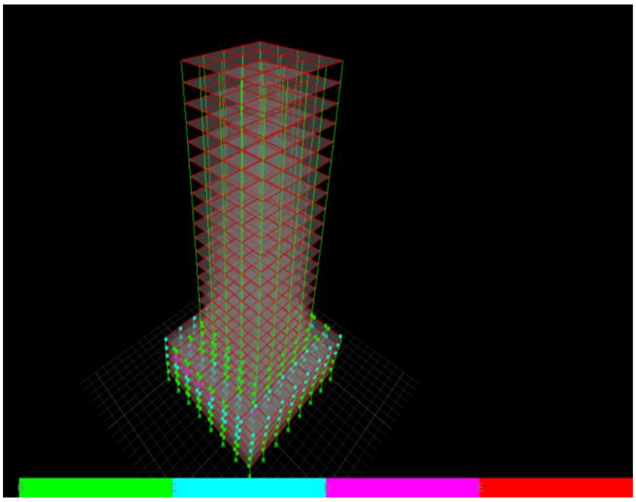

FIGURE 12-Hingies

5. CONCLUSIONS

- In vertically irregular structures, both displacement and drift values are significantly higher compared to regular structures during both EQ-X and EQ-Y.
- Pushover analysis indicates that most hinges form at the basement level and at points where there are sudden changes in the plan. Irregular structures have the most hinges, followed by vertically irregular structures, and then regular structures.
- Collapse hinges are only found in irregular and vertically irregular structures, with none observed in regular structures.

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