

Ductility based seismic analysis of irregular RCC framed structure by using STAAD Pro.

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Abstract - This paper is concerned with the ductility base seismic analysis of various irregular buildings and regular buildings. The objective of the project is to carry out seismic analysis on various RCC Buildings using staad Pro. Response Spectrum Analysis, Time History Analysis & Static Analysis has been done on various irregular and regular structures and compare the result & Behavior in various zones and find out the valuable outcomes.

Key Words: Dynamic Analysis (Response Spectrum Analysis), Static Analysis, Time History Analysis, RCC structure, IS 13920 2016, IS 1893:2016.

1. INTRODUCTION

The type of irregularity in the building structures is of various type, mass irregular, vertical irregular, stiffness irregular as per IS1893. When such buildings are constructed in high seismic zones, the analysis and design become more complicated and result may vary when we change the Zone. As we change the zone of irregular building compare the result compare the effect of seismic zone of that particular structure and compare the result

1.1 objectives

To calculate the Design lateral forces on following structures Using Response Spectrum Analysis, Time History Analysis and Equivalent Static Analysis and to compare the results of various irregular structures. Using STADD Pro V8i software

- Regular buildings
- Vertical Irregular buildings
- Mass Irregular Building
- Stiffness Irregular Building

To study the various irregularities in the following structures as per IS1893:2016 namely

- Mass
- Stiffness
- Vertical Geometry irregularities.

To carry out ductility-based seismic analysis and design as per IS 13920:2016 for various structure for various zones and compare the results.

To carry out seismic design as per IS 1893:2016 corresponding to equivalent static analysis and time history analysis and to compare the difference in design.

2. METHODOLOGY

The steps undertaken in the present study to accomplish the above-mentioned objectives are as follows:

- Review of existing literatures /paper by different researchers
- Selection of types of regular and irregular structures
- Select a regular structure, Mass Irregular structure, stiffness irregular structure, and vertical irregular structure.
- Performing analysis i.e. response spectrum analysis static analysis & Time history analysis on selected building models using STAAD.Pro V8i.
- Detailed discussion on moment for various zone and structure and compare the result in form of chart.

Seismic load/ combination is given as per IS 1893- 2016. Following assumptions are used for the calculation.

- Zone factor – 0.36 (Zone5)
- Zone factor – 0.24 (Zone4)
- Zone factor – 0.16 (Zone3)
- Zone factor – 0.10 (Zone2)
- Soil type – 2 (Medium Stiff Soil)
- Importance Factor -1
- Response Reduction Factor – 5

Table -1: General Loading

S.No	Description	Load	Code used
	Dead load		
1	Slab thickness =150mm	3.75 kn/sqm	Is 875 part-1:1987
2	Finishing	2.0 kn/sqm	Is 875 part-1:1987
3	230mm brick wall 3.5 mtr ht.	15 kn/m	Is 875 part-1:1987
4	115mm brick wall 3.5 mtr ht.	7.5 kn/m	Is 875 part-1:1987
5	230mm brick wall 1.0 mtr ht.	4.6 kn/m	Is 875 part-1:1987
6	115mm brick wall 1.0 mtr ht.	3.0 kn/m	Is 875 part-1:1987
7	230mm brick wall 2.0 mtr ht.	11.5 kn/m	Is 875 part-1:1987
	Live load		
8	Corridor	4 kn/sqm	Is 875 part-2:1987
9	Room & washroom	3 kn/sqm	Is 875 part-2:1987
10	Terrace	2 kn/sqm	Is 875 part-2:1987
11	Zone-2	.10	Is1893:part-1
12	Zone-3	.16	Is1893:part-1
13	Zone-4	.24	Is1893:part-1
14	Zone-5	.36	Is1893:part-1
15	Importance factor	1	
16	Response reduction factor	1.5 SMRF	
17	Damping	5 %	
18	Soil type	2	
19	Seismic parameter		Is1893:2016

REGULAR STRUCTURE: Regular buildings were analysed using THA, RSA and Static Analysis using IS codes 13920 & 1893 and compares the results.

MASS IRREGULAR STRUCTURE: The structure is modelled as same as that of normal regular Structure but the weight on particular floor of the structure is more than other floor due to swimming pool. There is mass variation in that case due to water load or any other load.

VERTICALLY GEOMETRIC IRREGULAR- vertical irregularities in the structure are of various types this kind of structure is same as regular structure .in this kind of structure some of the columns may discontinue after some height or may reduce the floor width.

STIFFNESS IRREGULAR STRUCTURE (SOFT STOREY): - In this kind of the structure there is a soft story in the building structure. Soft story is one in which lateral stiffness as per IS1893 is less as compare to other stories.

CODES USED: -

- IS 456- code of practice for plain and reinforced concrete
- IS 13920:2016- Ductile Detailing of Reinforced Concrete Structure Subjected to Seismic Forces- Code of Practice.
- IS 875 – Code of Practice for Design Loads Part 2 – Imposed Load
- IS 1893:2016 – Criteria for Earthquake Resistant

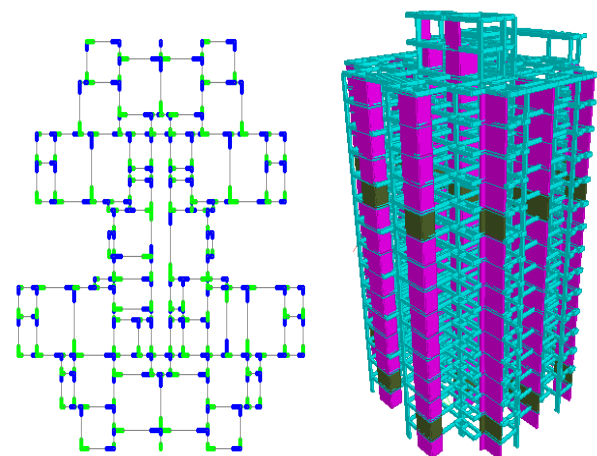


Figure 1 - Regular Sstructure

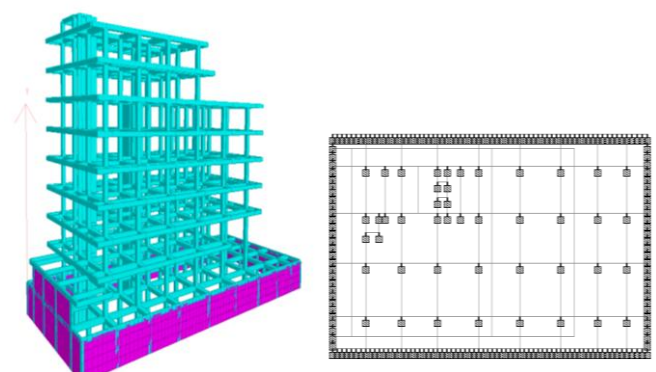


Figure 2 - Mass Irregular Sstructure

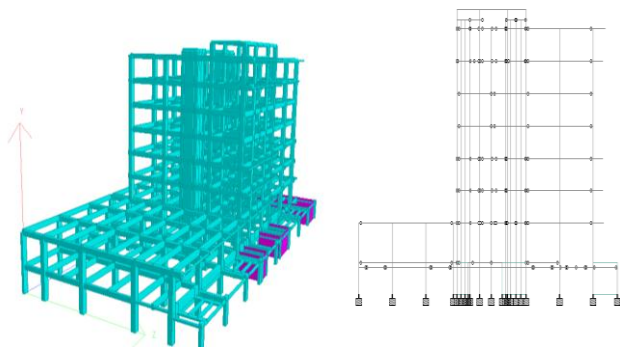


Figure 3 - vertical geometric irregular structure

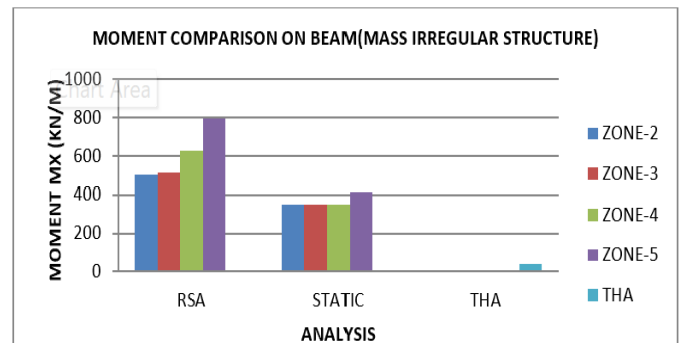


Chart-3 Mass Irregular Structure

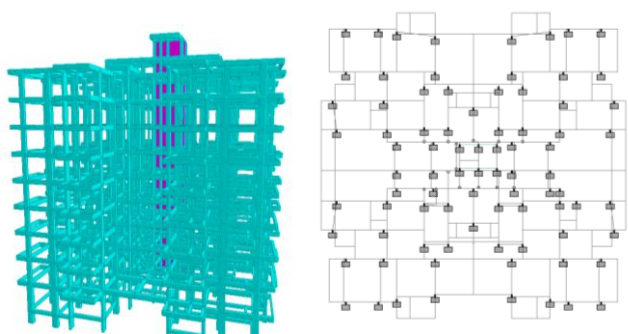


Figure 4 - Sstiffness Irregular structure

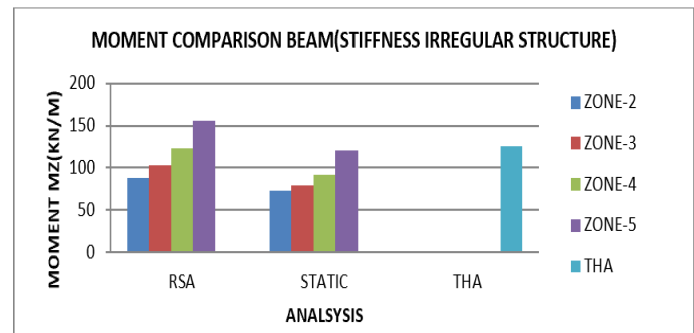


Chart-4 Stiffness Irregular Structure

RESULTS

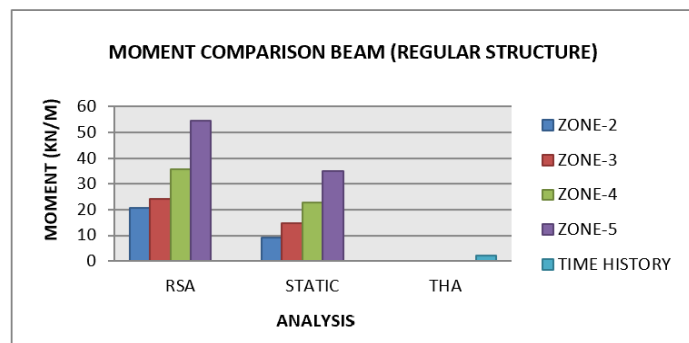


Chart-1 Regular Structure

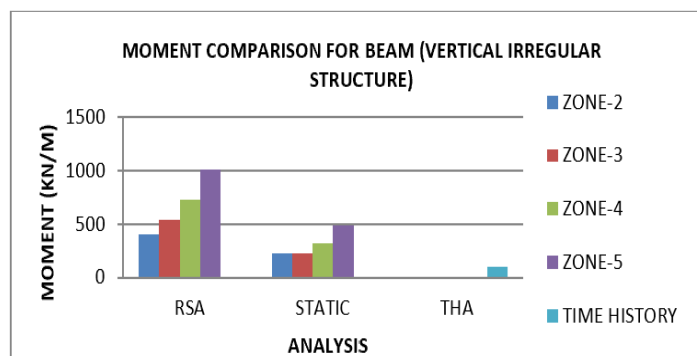


Chart-2 Vertical Irregular Structure

CONCLUSIONS

- According to results of RSA, THA & Static Analysis of regular building, bending moment of beam were considered and compares the result in various zones as the zone change for particular building bending moment increase by **three** time in Zone-5 when compare with Zone-2.
- According to results of RSA, THA & Static Analysis of **regular building, vertical irregular, stiffness irregular & Mass Irregular Building**, bending moment of beam in case of THA when Compare with response Spectrum Analysis is very low.
- According to results of RSA, Analysis of **regular building**, bending moment of Column were considered and compares the result in various zones as the zone change for particular building bending moment remains same for ZONE 2,3,4 but higher in ZONE-5
- According to results of Static, Analysis of regular building, bending moment of Column were considered and compares the result in various zones as the zone change for particular building bending moment increase as the Zone of Building Change

- According to results of RSA, THA & Static Analysis of **vertical irregular** building, bending moment of beam were considered and compares the result in various zones as the zone change for particular building bending moment increase by **two** time in Zone-5 when compare with Zone-2.
- According to results of RSA Analysis of vertical irregular building, bending moment of columns were considered and compares the result in various zones as the zone change for particular building bending moment increase by **five** time in Zone-5 when compare with Zone-2.
- According to results of RSA Analysis of mass irregular building, bending moment of beam were considered and compares the result in various zones as the zone change for particular building bending moment increase by **2** time in Zone-5 when compare with Zone-2.
- According to results of Static Analysis of mass irregular building, bending moment of beam were considered and compares the result in various zones as the zone change for particular building bending moment almost same for all zones.
- According to results of RSA Analysis of mass irregular building, bending moment of Columns were considered and compares the result in various zones as the zone change for particular building bending moment almost 10 times higher in Zone-5 when compare with Zone 2,3,4.
- According to results of RSA, Static & THA Analysis of mass irregular building, compare with other building higher grade of concrete were used as compare to others
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