STUDY OF SETBACK AND MASS IRREGULAR RC BUILDING UNDER SEISMIC EFFECT

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ABSTRACT:

The structure can't design for actual seismic intensity. If structure is designed for actual seismic intensity, construction cost will be too high. So to achieve economy we reduce actual intensity of earthquake with the help of Response reduction factor. The properly designed and detailed RC framing sustains large inelastic deformation without collapse and having larger lateral strength as compare to design strength. Pushover analysis is an advanced tool to evaluate non linear behavior and gives the sequence and mechanism of plastic hinge formation.

Key words: Seismic intensity, Response reduction factor, Inelastic deformation, Pushover analysis, Plastic hinge

1. Introduction

Modern infrastructure incorporates many irregularities in structure to fulfill functional, aesthetic, luxury and economic demand. From past experiences it is clearly observed that irregular structures are more liable to damage. In this study, considering setback and mass irregular structures. All structures for both OMRF and SMRF criteria. As per IS 1893:2016 the structure is vertical geometric irregular if lateral load resisting system of on any story is more than 150% of story below and structure is said to be mass irregular if seismic weight of any story is greater than 125% of adjacent story

The seismic design of structure mostly depends on elastic force. Generally, non linear response of structure is not considered in design process but it has considerable effect which is introduced by Response reduction factor (R). Static non linear analysis is conducted on al regular and irregular structures to estimate behavior of structure in inelastic limit. IS 1893:2016 provides 'R' value only for regular structure. This study will estimate exact value of 'R' for irregular structures in both OMRF and SMRF category.

2. Research significance

Due to economic and functional needs, mass irregularities and setbacks incorporated in structure. Poor performance of structure with irregularities is experienced during past earthquakes. Response reduction factors (R) only for regular structures are mentioned in IS1893:2016. Therefore it is essential to calculate actual response reduction factor for irregular structures.

3. Objectives of study

To study seismic response of setback and mass irregular structure and provide design accordingly.

Estimation of response reduction factor of irregular structures.

4. Response reduction factor (R)

The concept of response reduction factor is to reduce the seismic force and incorporate non-linearity with the help of over strength, redundancy and ductility. The 'R' value represents the ratio of the maximum lateral force if structure remains elastic (Ve) to lateral force (Vd) to be designed. Generally, it is the function of various parameters of structural system such as strength, ductility, damping and redundancy.

1.Strength factor (Rs):

This the measure of additional strength a structure has beyond its design strength. Overstrength can be employed to reduce the forces used in the design, hence leading to economical design. It is the ratio of maximum base shear to design base shear.

Rs= Vu/Vd

2. Ductility factor (Rμ):

It is the measure of capacity of structure to withstand large inelastic deformations without significant loss of strength. 'Rμ' is ratio of maximum displacement to yield displacement.

Rμ=Δu/Δy

3. Redundancy factor (Rr):

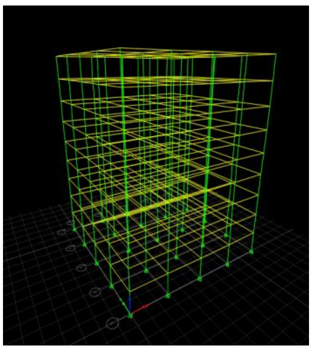
This factor is used to reduce system reliability to the individual frame reliability. Taken as Rr=1.

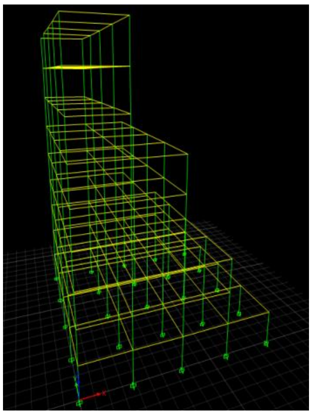
4. Damping factor (R€):

In the absence of energy dissipating devices consider damping factor is 1

5. Structural modeling:

Type of structure	OMRF & SMRF
Grade of concrete	M 40
Grade of steel	Fe 415
Floor height	3 m
Beam size	300X600 mm
Column size	500X500 mm
Slab Thickness	200 mm
Dead load	12 KN/m
Live load	4 KN/m
Bay width	5 m
No of bays in both directions	4
Zone	3





6. Pushover Analysis

Pushover analysis is static non linear analysis used to determine the capacity of structure. In this procedure predefined lateral load patterns are assigned along building height. The lateral forces are monotonically increased in constant proportion with displacement control until certain deformation reached. The plastic hinges have been assigned for structural members. The output of this analysis is pushover plot between base shear and roof displacement.

7. Results and discussion

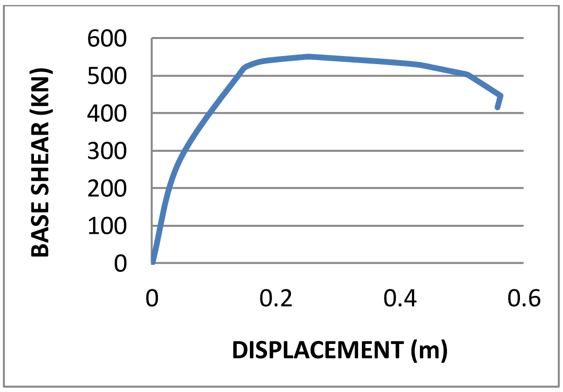
The output of the non linear analysis is a push over curve plotted between roof displacement and base shear. The analysis is done for the three structures and corresponding curve for the ordinary and special moment resisting frames is obtained.

The response reduction factors for OMRF and SMRF models are compared and provided design accordingly.

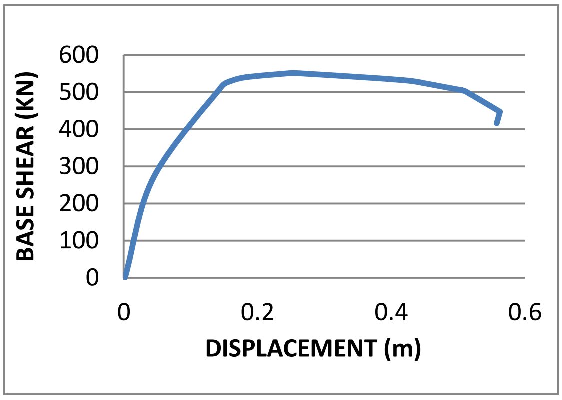
I.PUSHOVER CURVE

1.REGULAR STRUCTURE

A.OMRF



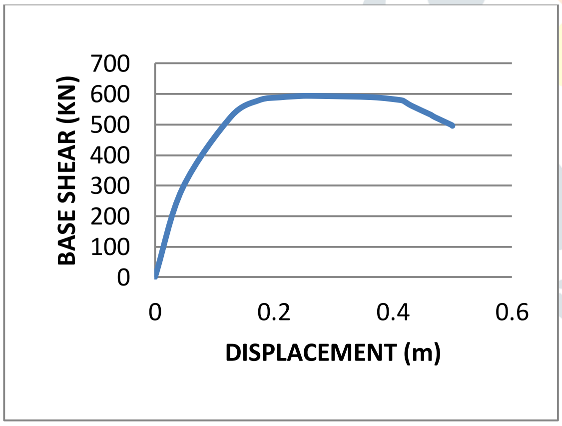
B.SMRF



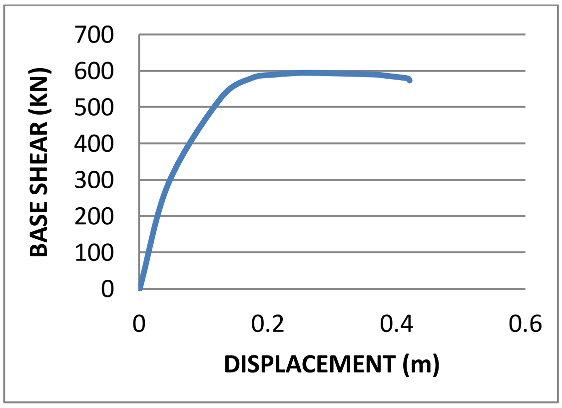
MODEL NAME	OMRF	SMRF
Regular Model	3.26	4.74
Mass irregular model	3.78	4.31
Geometric irregular model	2.78	3.34

1ST STORY

A.OMRF



B.SMRF



2.
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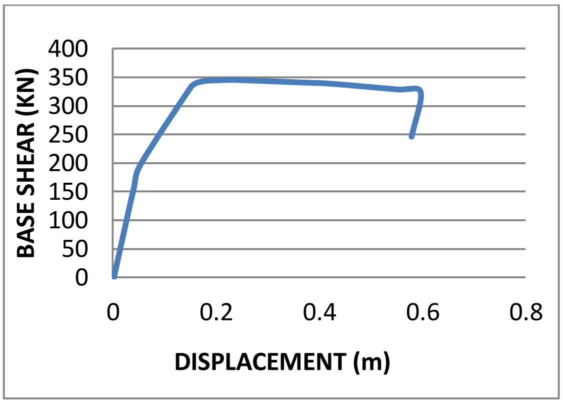
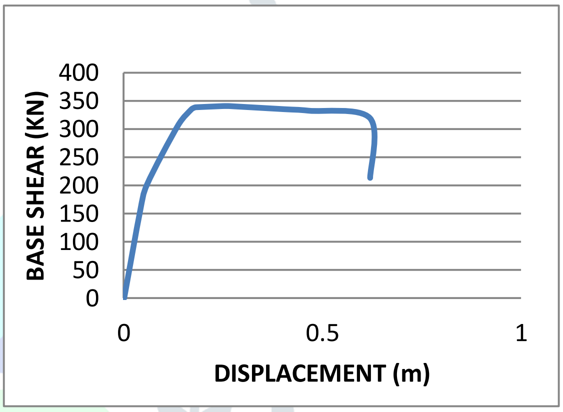
3.GEOMETRIC IRREGULAR

A.OMRF



B.SMRF



II.RESPONSE REDUCTION FACTOR (R)

III.RC SECTION DETAIL

FRAMES	MEMBER	REINFORCEMENT
OMRF	Beam	4-25φ bottom +3-16φ top
	Column	8-25φ
SMRF	Beam	4-25φ bottom+ 4-20φ top
	Column	6-32φ & 2-25 φ

8. CONCLUSION

1. The SMRF frames show the highest R value as compare to OMRF frames.

2. The present study shows that both OMRF and SMRF failed to achieve the respective target values of R recommended by IS code.

3. The effect of considering confinement mainly leads to the design of OMRF and SMRF.

4. The confinement in concrete plays a major role in strength and ductility of RC member.

5. Further research in this direction required before determination about adequacy of codal requirements.

9. REFERENCES

1. G.P.Cimellaro(2014) “Bidirectional pushover analysis of irregular structures”, *Journal of Structural Engineering*, 11(1721),1721-1731

2. Erdal Irtem(2009):Mohamad amin(2008), Adaptive forced base multimode pushover analysis for seismic evaluation of midrise buildings, *Journal of Structural Engineering* 30(12), 3793–3807.

3. Bahram shahrooz,Jack moehie(2006), Evaluation of seismic performance of reinforced concrete frames *Journal of Structural Engineering* 40(14), 1571–1589.

4. Sharon L Wood(2014), Seismic response of RC frames with irregular profiles *Journal of Structural Engineering*, 37(2), 305–328.

5. X.Qi,S.J.Pantaopoulou(2008), Seismic analysis methods for irregular buildings *Journal of Structural Engineering*, 30(9),1379–1398.