SEISMIC RESPONSE OF REGULAR AND IRREGULAR GEOMETRIC RC BUILDING FRAMES WITH SHEAR WALL

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Abstract
Seismic behaviour of a structure is highly affected by it's by configuration. The functional efficiency of structures in addition to its attractive aesthetical appearance raises the demand for construction of setback buildings. Setback buildings possess vertical irregularity and hence the setback buildings need to be designed and analysed with lot of case. In this work, the seismic response parameter such as storey displacement of setback buildings and regular buildings are compared to find out how setback causes localisation of seismic effects. An Irregular building is assumed to be located in zone V.
Keywords- Setback, Shear core, Response spectrum analysis.

I. INTRODUCTION

In recent years there has been a change in the complexity of residential and commercial structures from that of a few decades ago. It used to be that residential and commercial structures were primarily rectangular in shape and thus followed traditional lateral load paths. With advances in technology, these structures are now more complex in shape and contain multiple irregularities.

Response spectrum analysis is carried out by considering different seismic zones, medium soil type for all zones and for zone II & III using OMRF frame type and for those of the rest zones using OMRF & SMRF frame types. Different response like lateral force, overturning moment, story drift, displacements, base shear are plotted in order to compare the results of the dynamic analysis. [1]

The performance of a high rise building during strong earthquake motions depends on the distribution of stiffness, strength and mass along both the vertical and horizontal directions. If there is discontinuity in stiffness, strength and mass between adjoining storeys of a building then such a building is known as irregular building. [2]

II. SCOPE AND OBJECTIVES

•To analyse seismic response parameter such as roof displacement of setback buildings and regular buildings.
•To evaluate the effectiveness of introduction of RC shear core in the setback tower.

III. METHODOLOGY

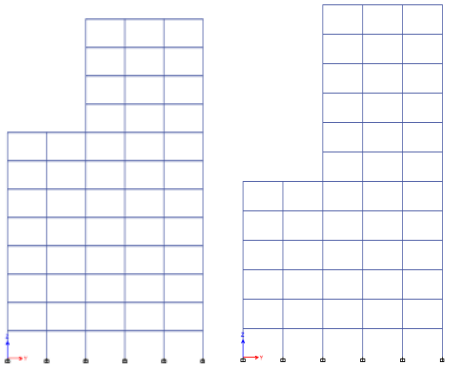
In this study, structure considered is three-dimensional 12-storey RC buildings. The plan dimension of the RC buildings is 25m x 25m. The cross sections of the structural elements are determined in such a way that it is adequate enough to withstand the basic seismic load combinations as per IS 1893(Part 1):2016. Irregular setback models are made by creating setback in zone V. The frames of building are assumed to be fixed at their base on an infinitely rigid foundation.

Details of structural elements
Building parameters of 12 storey structure in zone V

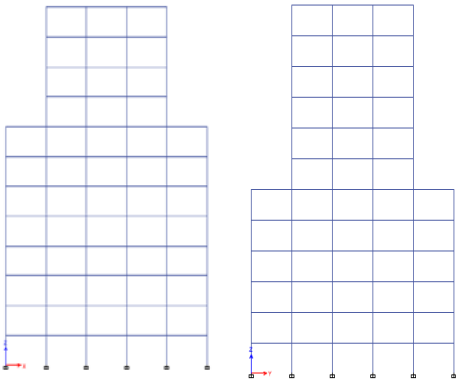
No of bays in X-direction	= 5 bays at 5m c/c
No of bays in Y-direction	= 5 bays at 5m c/c
Height of storey	= 3m
Column size	= 600mm x 600mm
Beam size	= 400mm x 500mm
Slab Thickness	= 130mm
Reinforced concrete	= 25kN/m^3

230 mm thick masonry wall= 20kN/m^3
100 mm thick parapet wall = 20kN/m^3
Live Load
Floor = 3kN/m^2
Roof = 1.5kN/m^2

(a) R

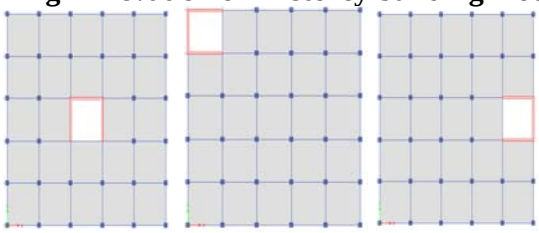


(b) 2ASYM4 (c) 2ASYM6



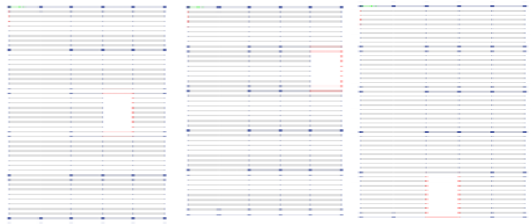
(d) SYM4 (e) SYM6

Fig 1 Elevation of 12 storey building models



(a) R-SWI (b) R-SW2 (c) R-SW3

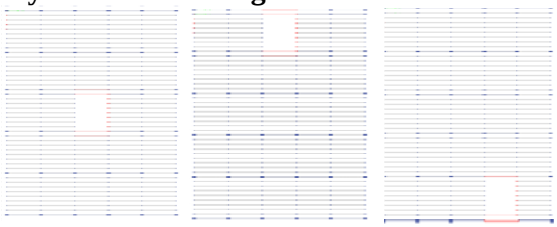
Fig 2 Location of shear core in 12 storey regular building models



(a) (b) (c)

(a) 2ASYM4-SWI and 2ASYM6-SW1
(b) 2ASYM4-SW2 and 2ASYM6-SW2
(c) 2ASYM4-SW3 and 2ASYM6-SW3

Fig 3 Location of shear core in 12 storey asymmetric building models



(a) (b) (c)

(a) SYM4-SWI and SYM6-SW1
(b) SYM4-SW2 and SYM6-SW2
(c) SYM4-SW3 and SYM6-SW3

Fig 4 Location of shear core in 12 storey symmetric building models

IV. RESULTS AND DISCUSSIONS

Storey displacement is calculated for all the setback models along the direction of force in both (x direction and y direction) and results are shown below. In Fig 5 and Fig 6 the displacement profile of regular 12 storey building is compared with three regular with shear wall of 12 storey building models such as R-SW1, R-SW2, R-SW3 in zone V.

In regular buildings shows that displacement is more than other model buildings in x direction but in R-SW2 and R-SW3 shows more displacement in y direction due to placing shear wall at corner and at side of the frame. In R-SW1 shows less displacement in x and y direction. So therefore placing of shear wall at center gives more stiffness compare with other models.

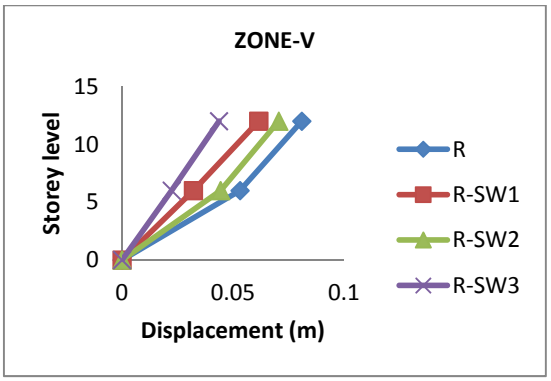


Fig 5 Displacement of regular building models along x direction

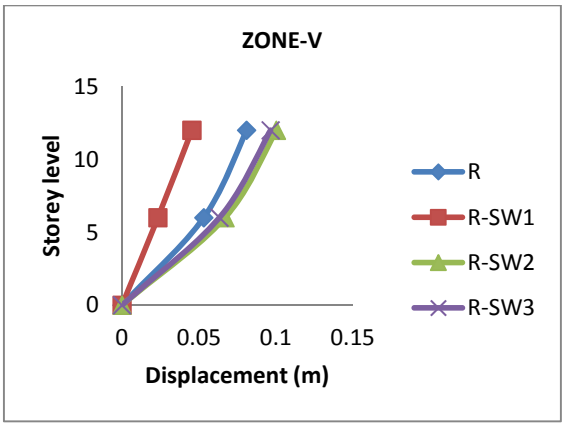


Fig 6 Displacement of regular building models along y direction

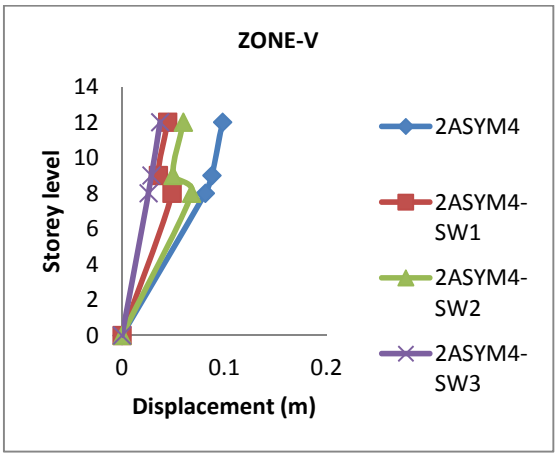


Fig 7 Displacement of 2ASYM4 building models along x direction

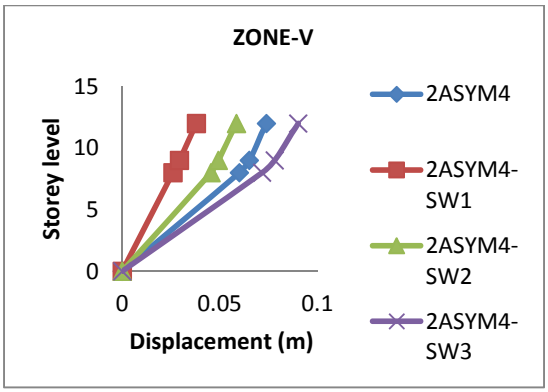


Fig 8 Displacement of 2ASYM4 building models along y direction

In Fig 7 and Fig 8 the displacement profile of 12 storey asymmetric building models (2ASYM4) compared with three asymmetric with shear wall of 12 storey building models such as 2ASYM4-SW1, 2ASYM4-SW2, 2ASYM4-SW3 in zone V in both x and y directions.

The same trend is observed in the displacement profile of 12 storey 2ASYM6 asymmetric buildings frames as shown in Fig 9 and Fig 10 in both x and y direction respectively in zone V.

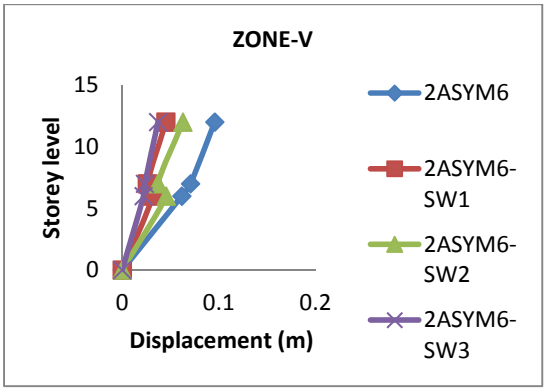


Fig 9 Displacement of 2ASYM6 building models along x direction

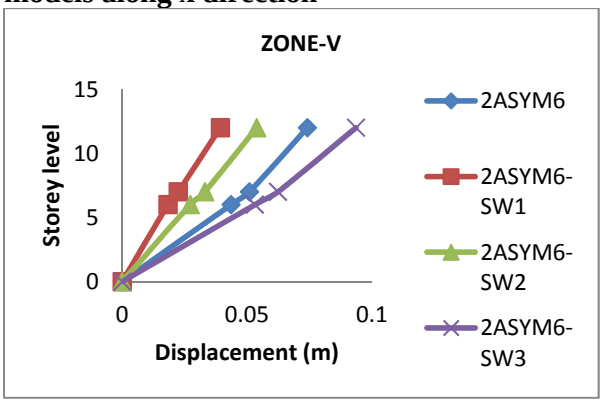


Fig 10 Displacement of 2ASYM6 building models along y direction

In Fig 11 and Fig 12 the displacement profile of 12 storey symmetric building models (SYM4) compared with three symmetric with shear wall of 12 storey building models such as SYM4-SW1, SYM4-SW2, SYM4-SW3 in zone V in both x and y direction. In SYM-SW1 shows less displacement in x and y direction. So therefore placing of shear wall at center gives more stiffness compare with other models.

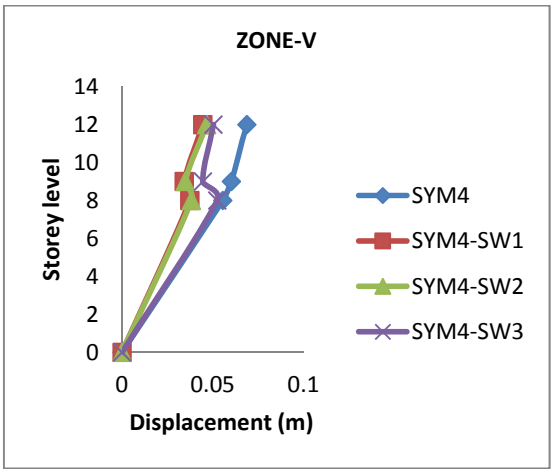


Fig 11 Displacement of SYM4 building models along x direction

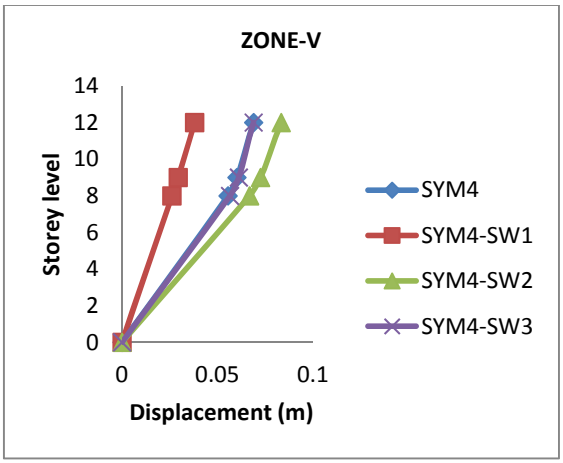


Fig 12 Displacement of SYM4 building models along y direction

The same trend is observed in the displacement profile of 12 storey SYM6 asymmetric buildings frames as shown in Fig 13 and Fig 14 in both x and y direction respectively.

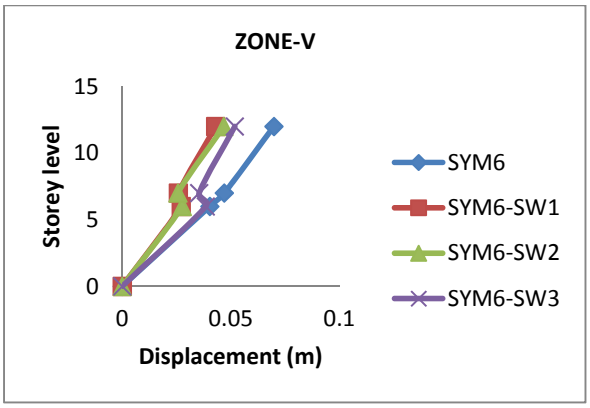


Fig 13 Displacement of SYM6 building models along x direction

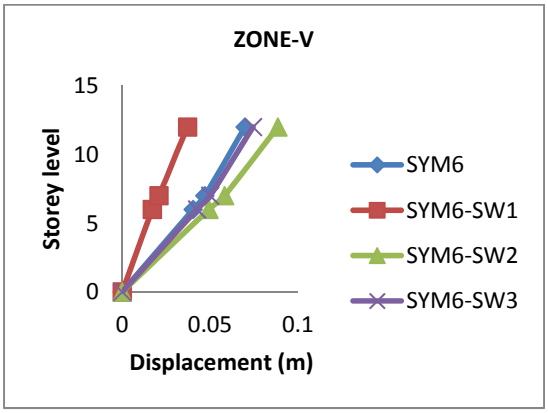


Fig 14 Displacement of SYM4 building models along y direction

V. CONCLUSIONS

- The storey displacement in regular and irregular geometric RC building frames is more efficiency when the shear wall is placed at the centre of the plan.
- The introduction of RC shear core in the regular and irregular models reduced the displacement.
- The storey displacement is found to be much higher in the upper stories of the setback frames. This shows that they attract relatively higher force compared to buildings with regular geometry during the earthquake ground motion.
- Irregular models shows increases in displacement due to less stiffness compare to regular models.

VI. REFERENCES

[1] Girum Mindaye, Dr. Shaik Yajdani (2016) “Seismic Analysis of a Multistorey RC Frame Building in Different Seismic Zones”.

[2] Oman Sayyed, Suresh Singh Kushwah, Aruna Rawat (2017) "Seismic Analysis of Vertical Irregular RC Building with Stiffness and Setback Irregularities".
[3] IS 1893 (Part 1):2016, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part 1 – General Provisions and Buildings (Fifth Revision), Bureau of Indian Standard, New Delhi.
[4] IS 456 -2000, Plain and reinforced concrete - Code of practice, Bureau of Indian Standards, New Delhi.