International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 06 | June -2017 www.irjet.net p-ISSN: 2395-0072

Seismic Performance Study On RC Wall Structures

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Abstract - *Shear wall are the system are one of the most commonly used lateral load resisting system in high rise building. Shear wall is used to resist large horizontal load and support gravity load. Shear wall has high in plane stiffness and strength which can be used to simultaneously resist large horizontal loads. They are usually used in tall building to avoid collapse of buildings. It may become imperative from the point of view of economy and control of lateral deflection. By providing shear wall the structure become safe and durable and also more stable the function of shear wall is to increase rigidity for wind and seismic load resistance. This paper presents the study of seismic performance of RC wall buildings. Response spectrum method with 5% damping has been performed using ETABS software in according with IS 1893:2002. The influence of stiffness irregularities in the form of soft storey, door openings provided at different positions and by varying the seismic zones are studied. The performance of RC wall building is evaluated in terms of Response spectrum base shear, storey displacements and modal time period.*

Key Words: RC wall, Tunnel Form, Response Spectrum Analysis, Base Shear, Storey Displacement, Time Period.

1. INTRODUCTION

The disastrous effects of past earthquakes on life and properties have increased the need for a close review of the conventional lateral load resisting systems and to adopt innovative and modified lateral load resisting systems for effective and efficient mitigation of earthquake forces. Dual systems with moment resting frames and shear wall elements have gained significant popularity in the recent years as effective construction methods in high seismicity areas. The significant improvement in the seismic capacity achieved by buildings by the introduction of shear walls have led to the concept of buildings built entirely of reinforced concrete walls popularly called as RC walled buildings.

A RC walled building essentially consists of a load carrying mechanism composed of reinforced concrete (RC) shear walls and slabs only and is being increasingly utilized in the construction of multistory residential units. Monolithic RC walled building constructions are also referred to as 'Box Construction' and 'Tunnel Form Construction'. Tunnel form buildings provide superior seismic performance compared to conventional RC frame and dual systems, which suffered significant damage and total collapse in many regions during recent devastating earthquake. Apart from its enhanced seismic performance, RC walled buildings also offer the advantage of increased floor area owing to the presence of thin wall elements as opposed to heavy columns and masonry walls.

Fig-1: RC wall (Tunnel Form) Construction

Recent advances in formwork technology have made RC wall buildings an attractive and affordable choice of construction especially for mass housing applications. This technology involves pre-fabricated formwork units and facilitates casting of an entire floor (including wall and slab arrangement) monolithically. Speed of construction as high as 4 to 5 days per floors can be easily achieved. This monolithic action of slabs and walls is one of the main attributes enhancing the seismic performance of these structures. Apart from mass house application, RC walls are the obvious choice for lift core walls, chemical and nuclear containers and other special applications.

2. MODELING AND ANALYSIS

In the present work, seismic analysis of RC wall building is carried out using response spectrum method using ETABS.

Table -1: General description and parameters of the structures

Number of stories	G+3
Storey height	3m
Grade of concrete	M25
Grade of steel	Fe500
Slab thickness	150mm
Wall thickness	250mm
Response reduction factor	3
Live load on floors and roof	3.0kN/m² and 2.5kN/m²
Floor finishes on floors and roof	0.75kN/m² and 0.5kN/m²
Seismic zone	V (Z=0.36)
Soil type	Medium (type II)

All dimension in meters.

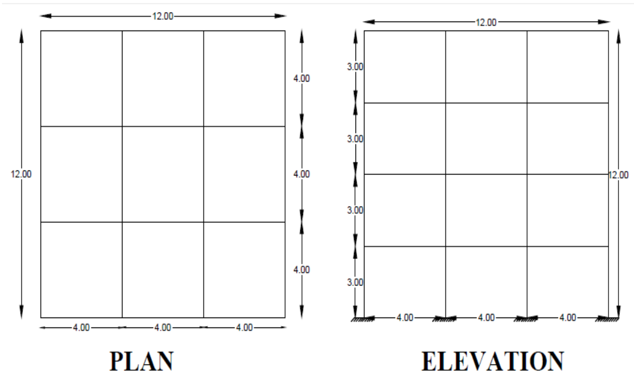
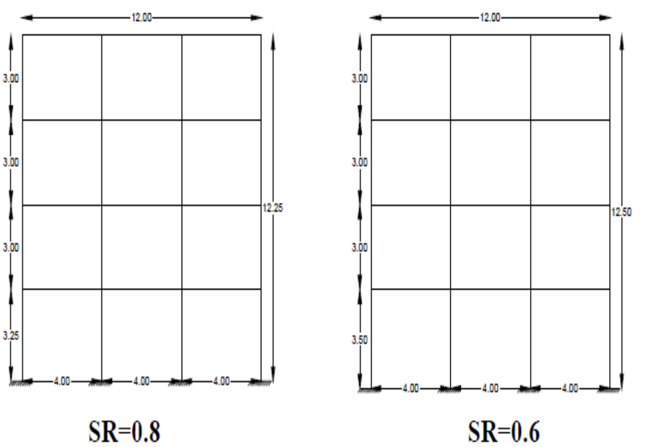


Fig-2: The plan and elevation of the RC wall building.

The various stiffness irregularities ratio differentiate the basic model into 4 cases and the models are classified as follows.



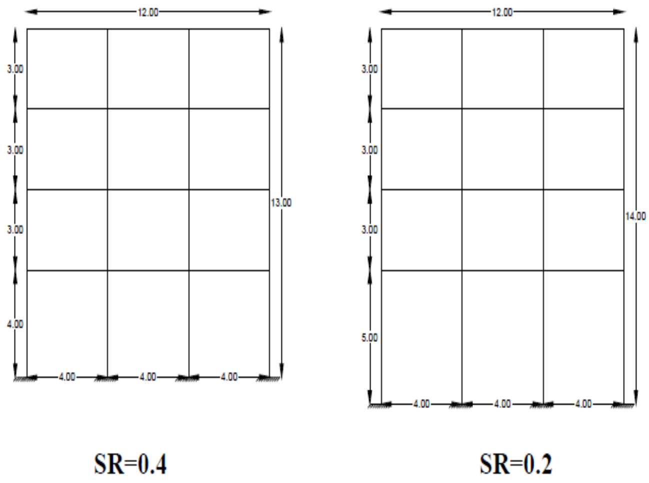


Fig-3: Different case of buildings with irregularities in stiffness ratio.

The various stiffness irregularities ratio differentiate the basic model into 4 cases and the models are classified as follows.
Size of door opening = 1mX2m

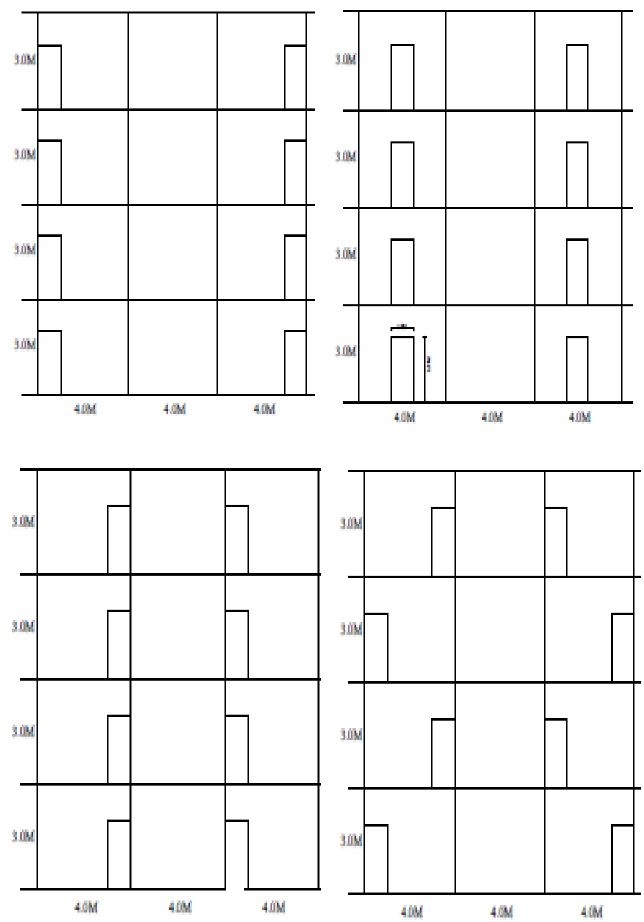


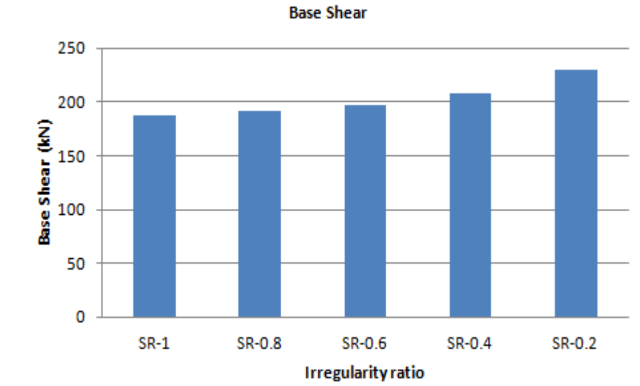
Fig-4: Different cases of buildings with door openings at various positions.

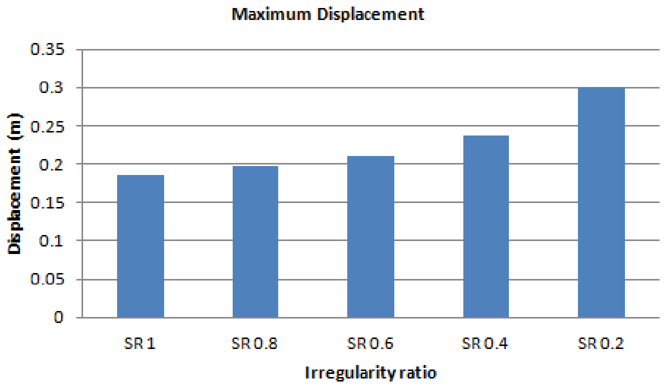
3. RESPONSE SPECTRUM ANALYSIS

Response spectrum analysis is a linear static analysis method which facilitates in earthquake-resistant design of structures. It helps to obtain the peak structural responses under linear range. It is a plot of peak or steady state response (displacements, velocity and acceleration) of series of oscillations of varying natural frequency that are forced into motion. It is very useful tool for earthquake engineering for analyzing the performance of structures and equipment in earthquakes, since many behave principally as simple oscillators (also known as single degree of freedom systems).

4. RESULTS AND DISCUSSION

An attempt is made to study the effect of stiffness irregularity ratio, different door opening cases and varying the seismic zone as per IS code 1893:2002.





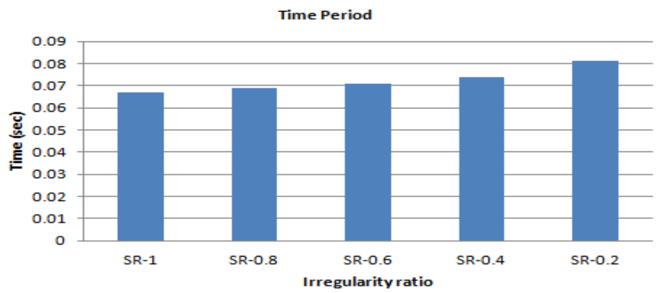
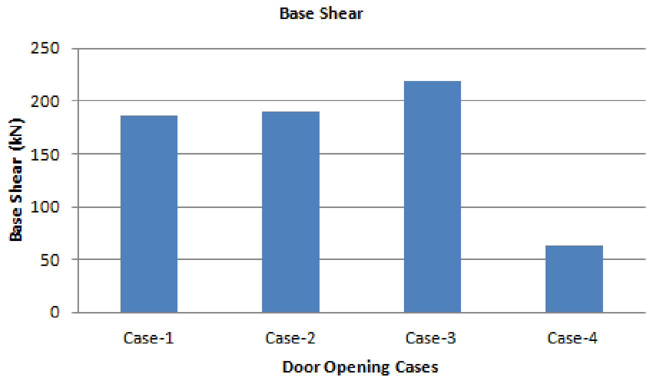
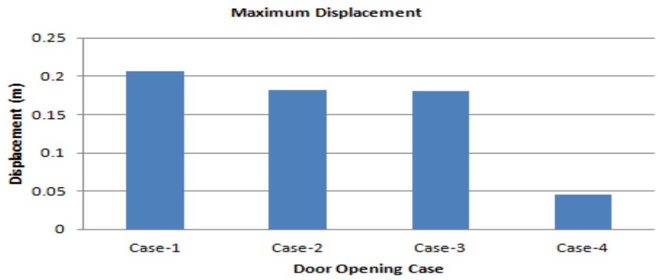


Chart-1: Base shear, displacement and time period values for various irregularity ratios.





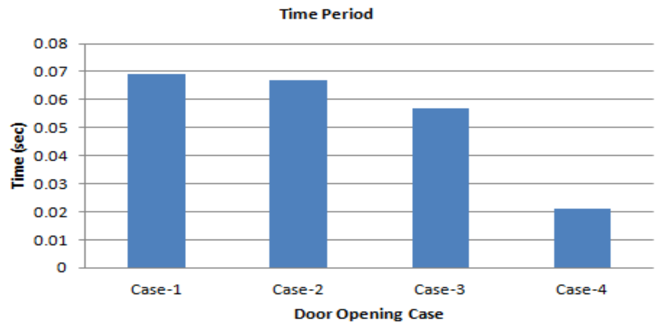
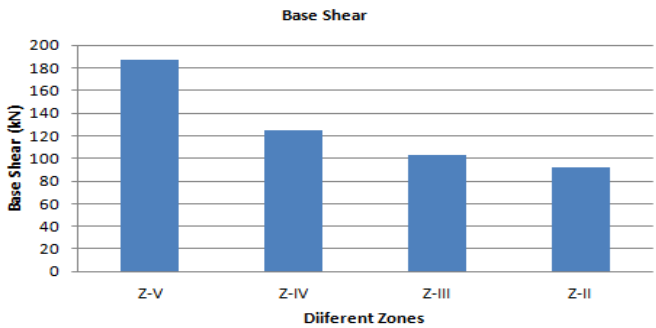
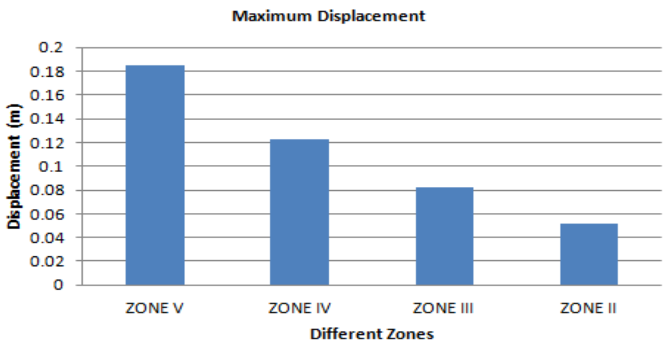


Chart-2: Base shear, displacement and time period values for door opening cases.





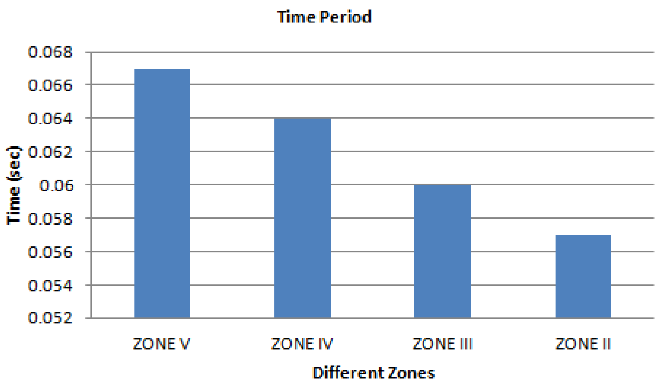


Chart-3: Base shear, displacement and time period values for different zone conditions.

3. CONCLUSIONS

In the present study attempts are made to study the seismic behavior of RC structures from response spectrum analysis. The analysis of seismic performance is made by the development of base shear, bending moment, displacement and time period values. Following are some of the conclusions drawn from the present study.

1. In medium rise buildings provision of shear wall is found to be effective in enhancing the overall seismic capacity of the structure. The results obtained in terms of base shear and displacement which show capacity of the building and gave the real behaviour of structures.
2. From the tables and the plots of base shear in the RC Wall building it is seen that the base shear of stiffness irregularity ratio 0.2 is 20% more than the general case building. In stiffness irregularity ratio SR= 0.2, Door Opening Case 3 and Seismic Zone V has maximum base shear value. In stiffness irregularity ratio SR= 1, Door Opening Case 4 and Seismic Zone II has minimum base shear value.
3. It is seen that from the tables and plots of storey displacements that RC Wall Building with Seismic Zone II is 72% lesser than the general case building and it produced much lesser displacements when considered in all cases of stiffness irregularity ratio, Door Opening Cases and Seismic Zones. Hence we can conclude that RC Wall Building being much safer against deflections caused by earthquake.
4. It can be seen that the modal time period for RC Wall Building is lesser and almost equal to same in all the cases.
5. Presence of shear walls makes the tunnel form building stiffer.

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