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Seismic Analysis of Building with Different Location of Shear Wall and Infill Wall

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***Abstract*: The structure in high seismic areas may be susceptible to the severe damage. Along with gravity load structure has to withstand to lateral load which can develop high stresses. Now a day, shear wall (SW) and infill wall (IW) in R.C.(Reinforce concrete) structure are most popular system to resist lateral load due to earthquake, wind, blast etc. Shear wall are used for lateral load resisting in high rise building Shear wall has high in plane stiffness and strength which can be used to simultaneously resist large horizontal loads and support gravity loads. Masonry infill wall are normally considered as non-structural element and there stiffness contribution are generally ignored in practice, such approach can lead to an unsafe design. Infill behaves like compression strut between column and beam and compression force are transferred from one node to another. In this study, G+7 storey RC structure is modelled as bare frame, shear wall and infilled frame with their different arrangements. Response spectrum and time history method are used for analysis in SAP2000 software and structure was assumed to be situated in zone II. The infill walls were modelled as equivalent diagonal strut. Following parameter are determining like base shear and storey drift.**

***Keywords*— Bare frame, Equivalent diagonal strut, Infill wall, Shear wall**

I. INTRODUCTION

In recent times, reinforced concrete buildings have become common in world, particularly in cities. A typical RC building is made of horizontal members (beams and slabs) and vertical members (columns and walls), and supported by foundations that rest on ground.

The frequent occurrence of the major earthquakes in the Indian subcontinent, and construction of tall buildings, especially over the last two decades demands for the construction of earthquake resistant buildings. The Concept of seismic design is to provide building structure with sufficient strength and deformation capacity to sustain seismic demands imposed by ground motion with adequate margin of safety. Even if the probability of occurrence of earthquake within the life span of structures is very less, strong ground motion would generally cause greater damage to the structure.

a. Shear wall

In modern tall buildings, shear walls are commonly used as a vertical structural element for resisting the lateral loads that may be induced by the effect of wind and earthquakes which cause the failure of structure. Shear wall are one of the excellent means of providing earthquake resistance to multistoried reinforced concrete building. The structure is still damaged due to some or the other reason during earthquakes. Behavior of structure during earthquake motion depends on distribution of weight, stiffness and strength in both horizontal and planes of building. To reduce the effect of earthquake reinforced concrete shear walls are used in the building. These can be used for improving seismic response of buildings. Structural design of buildings for seismic loading is primarily concerned with structural safety during major Earthquakes, in tall buildings, it is very important to ensure adequate lateral stiffness to resist lateral load. The provision of shear wall in building to achieve rigidity has been found effective and economical. When buildings are tall, beam, column sizes are quite heavy and steel required is large. So there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these place and displacement is quite heavy which induces heavy forces in member [1]. Shear wall behave like flexural members. Shear walls are usually used in tall building to avoid collapse of buildings. Shear wall may become imperative from the point of view of economy and control of

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lateral deflection. When shear wall are situated in advantageous positions in the building, they can form an efficient lateral force resisting system. They are usually provided between column lines, in stair wells, lift wells, in shafts that house other utilities.

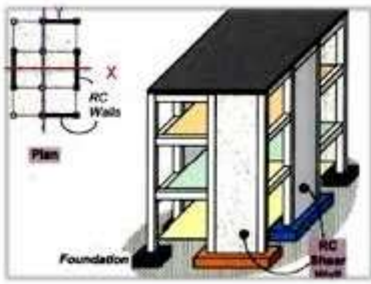

Fig.1 Shear wall

b. Infill wall

Masonry construction is one of the oldest building techniques. Masonry structures are found in almost every built environment around the world and in many historic buildings that are still in use today. In modern structures, it is mostly found in the form of external or internal infill walls. Reinforced concrete (RC) frame buildings with masonry infill walls have been widely constructed for commercial, industrial and multi storey residential uses in seismic regions. Masonry infill typically consists of bricks or concrete blocks constructed between beams and columns of a reinforced concrete frame. The masonry infill panels are generally not considered in the design process and treated as architectural (non-structural) components. Nevertheless, the presence of masonry infill walls has a significant impact on the seismic response of a reinforced concrete frame building, increasing structural strength and stiffness (relative to a bare frame) [2]. Infill behaves like compression strut between column and beam and compression force are transferred from one node to another[9].Infill reduces the lateral deflection of the building, displacement, bending moments in frame and increasing axial forces in columns also infills can increase the overall strength, lateral resistance and energy dissipation of the structure[10].

c. Soft storey

A soft storey building is one that has a discontinuity in the stiffness of the building where one storey is significantly more flexible than adjacent storeys. According to IS1893:2002 [7], a soft storey has lateral stiffness less than 70% of that of the storey immediately above, or less than 80% of average stiffness of the three storeys above.

II. SYSTEM DEVELOPMENT

a. Concept of equivalent diagonal strut

Investigators have proposed various approximations for the width of equivalent diagonal strut. Originally proposed by polyakov [3] and subsequently developed by many investigators, the width of strut depends on the length of contact between wall and column αh and between the wall and beam αL shown in Fig 2. Holmes [4] recommended a width of the diagonal strut equal to one-third of the length of the panel. Stafford smith [5] developed the formulation for αh and αL on the basis of beam on an elastic foundation. the following equations are proposed

$$\alpha_h = \frac{\pi}{2}\sqrt[4]{\frac{4E_f I_c h}{E_m t \sin 2\theta}} \quad \ldots\ldots\ldots\ldots(1)$$

$$\alpha_L = \pi\sqrt[4]{\frac{4E_f I_b l}{E_m t \sin 2\theta}} \quad \ldots\ldots\ldots\ldots(2)$$

Where

E_m and E_f = elastic modulus of the masonry wall and frame material respectively

I_c and I_b = moment of inertia of column and beam frame respectively.

t,l = Thickness and length of the infill wall, respectively

$$\theta = \tan^{-1}\frac{h}{l}$$

Hendry [6] has proposed following equation to determine equivalent strut or equivalent or effective width of strut.

$$w = \frac{1}{2}\sqrt{{\alpha_h}^2 + {\alpha_l}^2} \quad \ldots\ldots\ldots\ldots(3)$$

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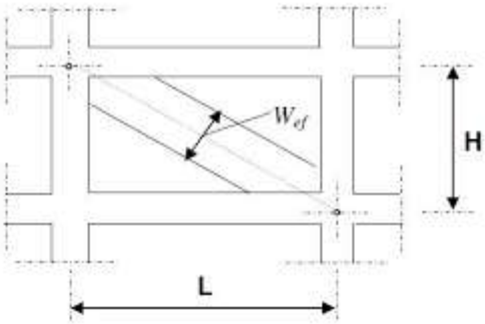

Fig. 2 Equivalent structure

b. Different arrangements of model

In this paper different location of shear wall is take for different model as follows:

a) Shear wall at center
b) Shear wall at core and parallel side
c) Shear wall at corner
d) Shear wall at periphery

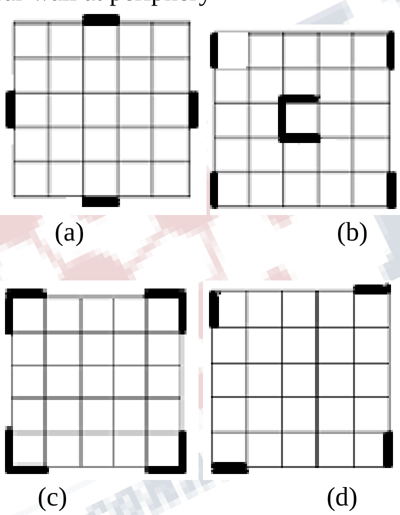

Fig.3 shows different location of shear wall in model.

For the infill wall different location used in this paper are as follows:

- Bare frame
- Full masonry infill wall
- Masonry infill wall with one soft storey at ground level
- Masonry infill wall with two soft storey at ground level

c. Problem description

G+7 Building with soft storey is modeled in SAP2000 FEM based software for frame situated in zone II. RC frame with and without infill wall also RC frame with and without different arrangement of shear wall are adopted in the analysis of this study. The geometry of the building is as shown in fig. 4 and the building configuration data is shown in table I.

Table I: Building Configuration Data

Each storey height	3 m
Thickness of external wall	0.23 m
Thickness of internal wall	0.15 m
Thickness of slab	0.15 m
Thickness of parapet wall	0.15 m
Height of parapet wall	1 m
Floor finish	1 kN/m2
Live load	3 kN/m2
Grade of concrete (f_{ck})	M 25
Grade of steel (f_y)	Fe 500
Size of beam	0.3m x 0.4 m
Size of column	0.4m x 0.6 m
Thickness of shear wall	0.23m
Width of equivalent diagonal strut	6

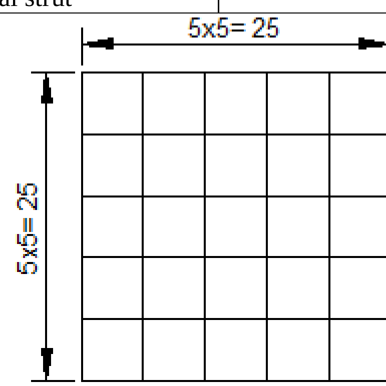

Fig. 4 Plan of G+7Building

III. PERFORM ANALYSIS

a. Response spectrum method

The objective of response spectrum analysis is to obtain the likely maximum response of the systems. The response spectrum is a plot of the maximum response (maximum displacement, velocity, acceleration or any other quantity of interest) to a specified load function for all possible single degree-of-freedom systems. The abscissa of the spectrum is the natural period (or frequency) of the system and the ordinate is the maximum response. It is also a function of damping. The design response a spectrum given in IS 1893:2002 [8] for a 5% damped system.

b. Time history analysis

In order to examine the exact linear behavior of building structures, linear time history analysis has to be carried out. In this method, the structure is subjected to real ground motion records. This makes this analysis method quite different from all of the other approximate analysis methods as the inertial forces are directly determined from these ground motions and the responses of the building either in deformations or in forces are calculated as a function of time, considering the dynamic properties of the building structure. The earthquake record use to analyze the building is Imperical Valley (El Centro 1979).

IV. RESULTS

a. Base shear

The Fig.5 shows that comparison of base shear for bare frame and for different location of shear wall. Due to provision of shear wall base shear increases. Among all the location of shear wall corner shear wall shows higher base shear.

Table II. Base shear with and without shear wall

Model	Base shear (KN)
Bare frame	14770
Center shear wall	18400
Core with parallel side shear wall	18560
Corner shear wall	18920
Periphery shear wall	18610

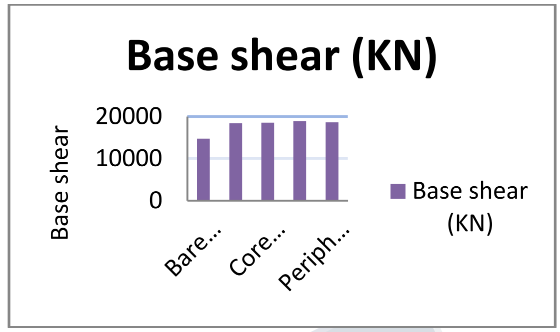

Fig.5 Base shear with and without shear wall

The Fig.6 shows that comparison of base shear for bare frame and for different location of infill wall. Due to provision of infill wall base shear increases. Among all the location of infill wall one soft storey infill wall shows higher base shear.

Table III. Base shear for with and without infill wall

Model	Base shear (KN)
Bare frame	14770
Full masonry infill wall	39250
One soft storey infill wall	44130
Two soft storey infill wall	32250

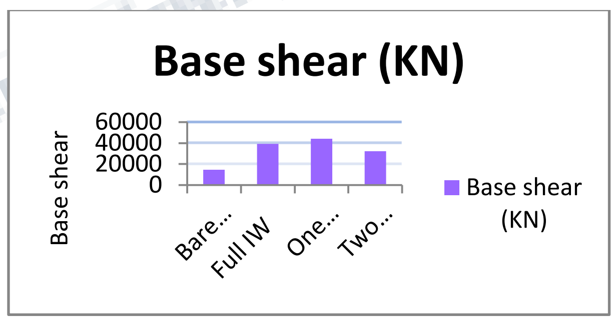

Fig.6 Base shear for with and without infill wall

From Fig.5 and Fig. 6 it is observed that provision of shear wall and infill wall increases global stiffness which increases base shear.

b. Max. storey drift

Storey drift is the displacement of one storey to the other storey level above or below [8]. The Fig.7 shows that comparison of max. storey drift for bare frame and for different location of shear wall. Shear wall reduces the storey drift. Among all the location of shear wall corner shear wall shows less storey drift.

Table IV. Max. Storey drifts with and without shear wall

Model	Max.Storey drift (M)
Bare frame	3.47 E-4
Center shear wall	2.53 E-4
Core with parallel side shear wall	2.73 E-4
Corner shear wall	4.33 E-5
Periphery shear wall	9.8 E-5

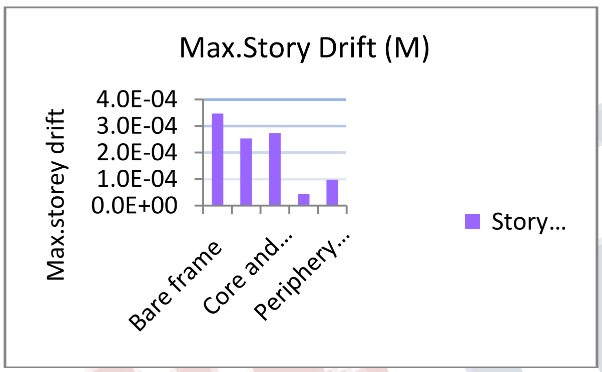

Fig.7 Max.storey drift with and without shear wall

The Fig.8 shows that comparison of max. storey drift for bare frame and for different location of infill wall. Infill wall reduce the storey drift. Among all the location of infill wall full infill wall shows less storey drift.

Table V. Max. storey drift with and without infill wall

Model	Max.storey drift (M)
Bare frame	3.47 E-4
Full masonry infill wall	2.2 E-5
One soft storey infill wall	2.84 E-4
Two soft storey infill wall	4.6 E-4

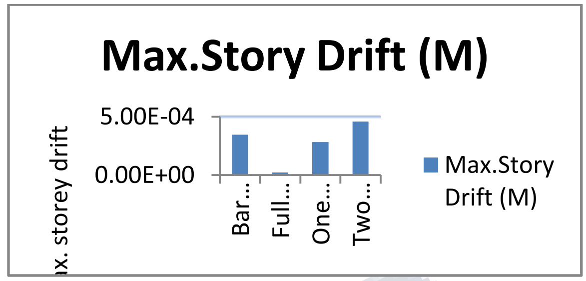

Fig.8 Max.storey drift with and without infill wall

V. CONCLUSION

In this study, Response spectrum and time history analysis were performed for G+7 RC frame structure with masonry infill wall and shear wall frame at their different location. The infill wall were modeled as equivalent diagonal strut. Some of main conclusion as follows:

- RC frame with shear wall is having higher value of base shear than bare frame.
- RC frame with masonry infill with and without soft storey is having highest value of base shear than bare frame.
- Max. storey drift for all shear wall model is less as compared to bare frame.
- From the all types of shear wall, location of shear wall at corner gives better result. It shows more base shear and less storey drift as compared to other shear wall location.
- The max. storey drift of infill wall without soft sotrey is 0.00325% and infill wall with one soft storey is 0.0063% less compared to bare frame.
- The max. storey drift of shear wall reduces 0.0074% to 0.0303% as compared to bare frame.

REFERENCES

1. P. P. Chandurkar, Dr. P. S. Pajgade," Seismic Analysis of RCC Building with and Without Shear Wall", IJMER, Vol. 3, Issue. 3, pp-1805-1810, May - June 2013

2. Siamak Sattar and Abbic B.Liel "Seismic Performance of Reinforced Concrete Frame Structures With and

Without Masonry Infill Walls" University of Colorado, Boulder.

3. S.v.Polyakove,"masonry in framed building, gosudalst-vennoe' stvo literature po straitel' stuv I Arkitecure, moskva, trans. G.L. cairns", building research sation Watford Herts, 1956

4. Holmes,M., "Combined loading on infilled Frames", proceeding of the institute of civil engineers,25,pp 31-38,1963.

5. Stafford-Smith, B "behavior of square infill frame" journal of the structural Davisson, Proceeding Of ASCE Vol.91 No ST1, PP381-403,1996.

6. 5 .Henry A.W. structural masonry, 2nd ed. Macmillan Press. 1998

7. Pankaj Agarwal & Manish Shrikhande, "Earthquake resistant Design of structure", page no 282-311, PHI publication.

8. IS 1893(Part 1): 2002"Criteria for Earthquake Resistant Design Of Structures Part 1 General Provisions and Buildings (Fifth Revision) Bureau of Indian Standards New Delhi.

9. Wakchaure M.R, Ped S. P," Earthquake analysis of high rise building with and without in filled walls", IJEIT, Volume 2, Issue 2, August 2012

10. C V R Murty , Sudhir K Jain," Beneficial influence of masonry infill walls on seismic performance of RC frame buildings", 12th World Conference on Earthquake Engineering.