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SEISMIC BEHAVIOUR OF INFILLED FRAME STRUCTURES WITH AND WITHOUT SHEAR WALL

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Abstract - *Reinforced concrete shear walls are used in bare frame building to resist lateral force due to wind and earthquakes. They are usually provided between column lines, in stair wells, lift wells, in shafts that house other utilities. Shear wall provide lateral load resisting by transferring the wind or earthquake load to foundation. Besides, they impart lateral stiffness to the system and also carry gravity loads. But bare frame with shear wall still become economically unattractive. If the structural engineer considered property of the non-structural element in structural design along with other elements like shear wall gives better results. The non-structural element which is already exists in structure but not considered in a structural design as a structural element like curtain wall. The curtain wall means partition wall which is made up of brick masonry therefore it is called as masonry wall and also it is called as an infill wall. If the properties of the infill wall like density and modulus elasticity of brick masonry are considered in structural design, it will helps to improve the strength and stiffness of the structure.*

Key words: Infilled frame, shear wall, pushover analysis

INTRODUCTION

Masonry infill panels are used as interior partitions in the reinforced concrete structures. Reinforced concrete along with masonry infill panels provides good seismic performance. Shear wall system is one of the most commonly used lateral load resisting system in high rise buildings. Shear wall has high in plane stiffness and strength which can be used to simultaneously resist large horizontal loads and support gravity loads, which significantly reduces lateral sway of the building and thereby reduces damage to structure and its contents. Shear walls in buildings must be symmetrically located in plan to reduce ill-effects of twist in buildings. When shear walls are situated in advantageous positions in the building, they can form an efficient lateral force resisting system by reducing lateral displacements under earthquake loads. Therefore it is very necessary to determine effective, efficient and ideal location of shear wall. The brick masonry infill wall and shear wall are considered as non-structural element in analysis and design. From the effect of previous significant earthquakes, it is concluded that the seismic risk in urban areas are increasing. Hence there is a need to revise this situation and it is believed that one of the most effective ways of doing this is through, the improvement of code provisions than those currently available. However, masonry infill wall and shear wall may contribute remarkably in increasing the stiffness of reinforced concrete frame. This attracts part of the lateral seismic shear forces on buildings, thereby reducing the loads on the RC members.

Building description

Type	Public building
Zone	III
Importance factor	1
Height	31m
Ground storey height	4m
Floor to floor height	3m
Depth of slab	150mm
Size of column	700x350mm
Size of beam	600x230mm
Size of infill	360x230mm
Size of shear wall	3000x200mm
LL on floor	$4kN/m^2$
LL on roof	$1.5kN/m^2$

NEED FOR THE STUDY

The seismic analysis of RC (Bare frame) structure leads to under estimation of base shear. The underestimation of base shear may lead to the collapse of structure during earthquake shaking. Therefore it is important to consider the infill walls in the seismic analysis of structure. Masonry infill wall and shear wall may contribute remarkably in increasing the stiffness of reinforced concrete frame. The difference in parameters such as maximum storey displacement, storey drift, and base shear should be found out in the case of different models. The better position for shear wall in the infilled frame should be found out by analyzing infilled structure with shear wall at different positions.

SCOPE

The present study deals with nonlinear static pushover analysis of infilled frame structure with and without shear wall using the software ETABS, in order to find various parameters such as displacement, drift, and base shear for finding the more suitable structure and also the better position of shear wall in the infilled structure.

OBJECTIVES

- To study the performance of infilled frame structure with and without shear wall.
- To study various parameters such as displacement, drift, and base shear of the structure.
- To identify the better position of the shear wall in infilled frame structure.
- Compare the results to identify best structural configuration

METHODOLOGY

- Literature survey
- Modeling of structures
- Assigning material properties
- Assigning load cases
- Pushover analysis
- Comparison of results

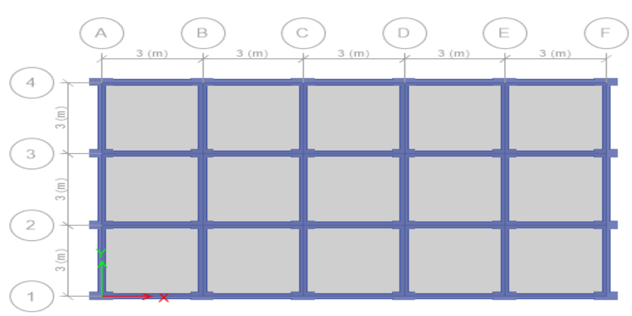

Fig. 3.5 Building plan

Material properties

The materials include M20 concrete, Fe 415 steel and masonry infill. The density and modulus of elasticity of concrete and masonry infill are given as per standard value.

- Concrete

  Weight per unit volume = 25kN/m^3

  Poisson ratio = 0.2

  Modulus of elasticity = 22360.68Mpa

- Masonry

  Weight per unit volume = 21.2068kN/m^3

  Poisson ratio = 0.2

  Modulus of elasticity = 36x10^5Mpa

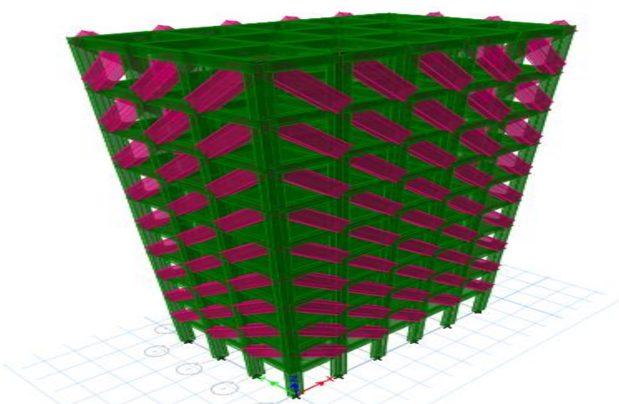

Fig.1 3D view of infilled frame

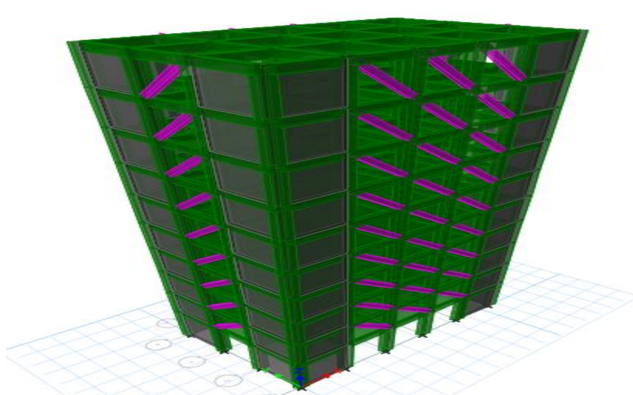

Fig.2 3D view of infilled frame with corner shear wall

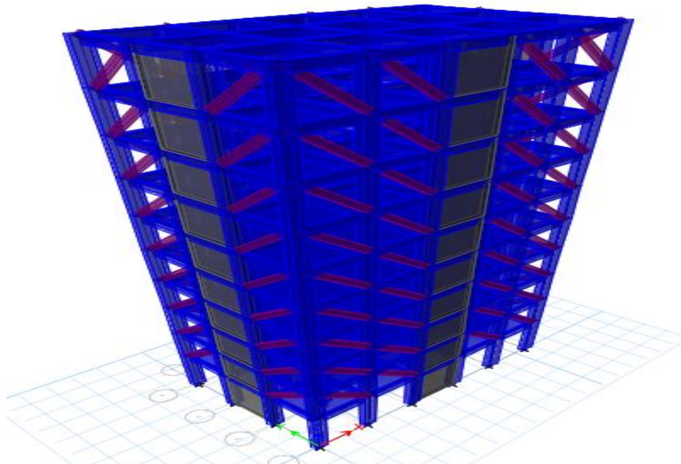

Fig.3 3D view of infilled frame with one wall on each side at middle

RESULTS AND DISCUSSION

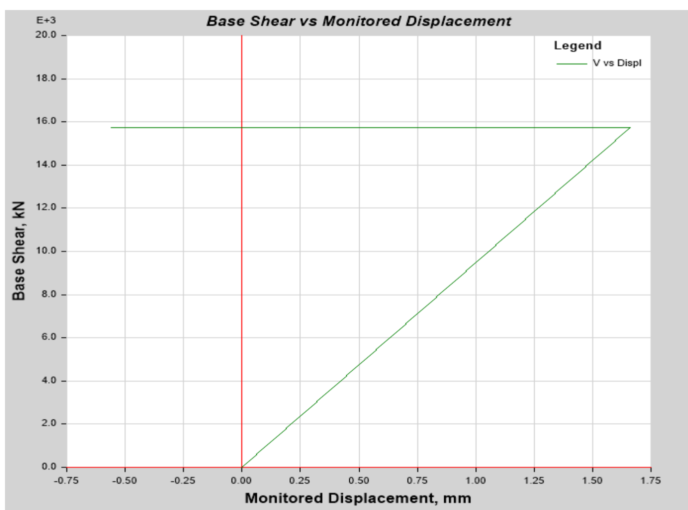

Fig. 4 Pushover curve in infilled frame with one wall on each side at middle

Table 1 Base force Vs monitored displacement of infilled frame with one wall on each side at middle

Monitored displacement (mm)	Base force (kN)
0	0
1.9	15465.0525
-0.5	15465.0525
1.9	15465.0525
-0.5	15465.0525
1.9	15465.0525

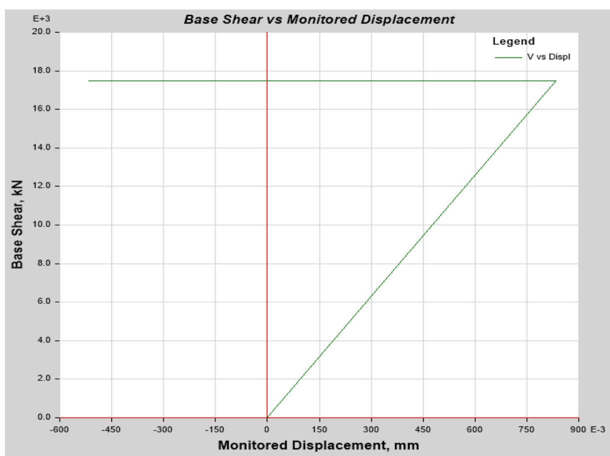

Fig. 5 Pushover curve of infilled frame with corner shear wall

Table 2 Base force Vs monitored displacement of bare frame with one wall on each side at middle

Monitored displacement (mm)	Base force (kN)
0	0
12.6	14657.2295
1.656×10^{-2}	14657.2295
12.6	14657.2295
1.656×10^{-2}	14657.2295
12.6	14657.2295

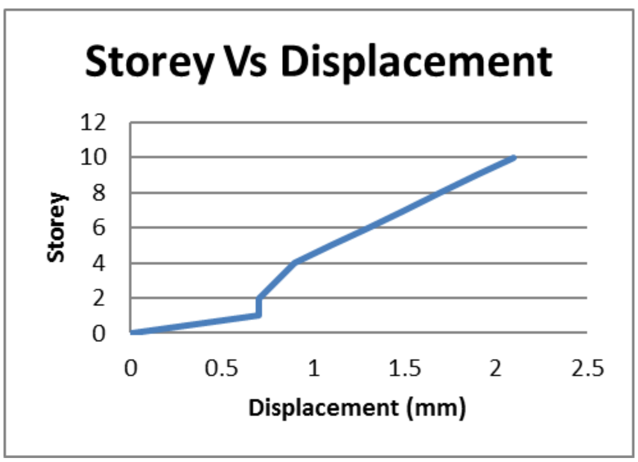

Fig.6 Maximum storey displacement in infilled frame with one wall on each side at middle

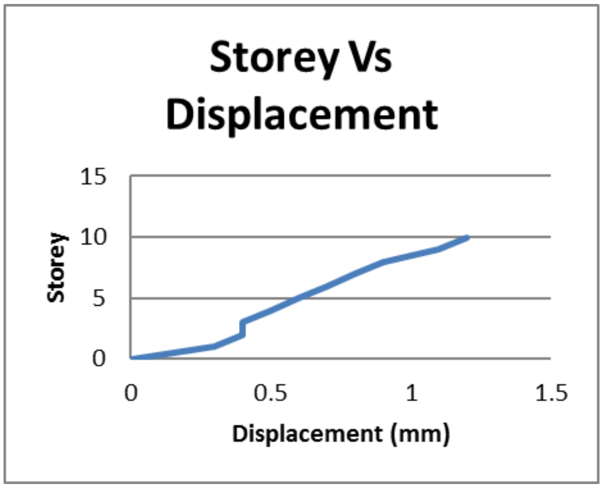

Fig.7 Maximum storey displacement in infilled frame with corner shear wall

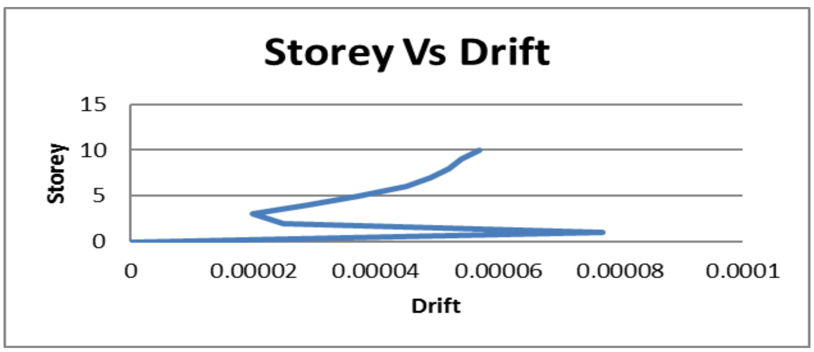

Fig.8 Maximum storey drift in infilled frame with corner shear wall

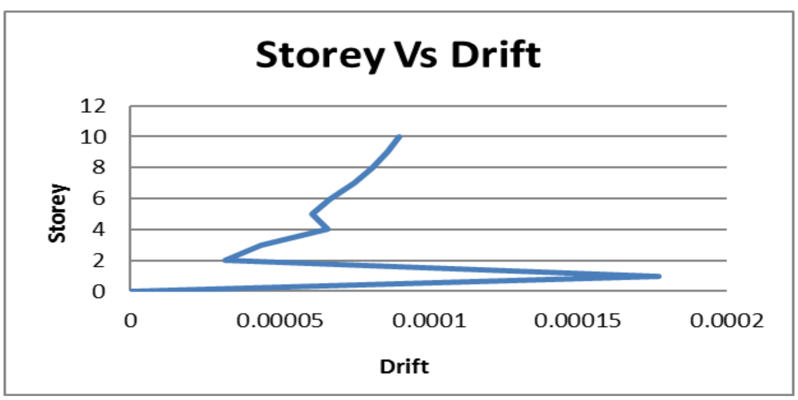

Fig.9 Maximum storey drift in infilled frame with one wall on each side at middle

Base shear in various models

Model	Base shear (kN)
Bare frame	12869.47
Infilled frame	13967.02
Bare frame with corner shear wall	16955.06
Infilled frame with corner shear wall	16955.07
Bare frame with one wall on each side at middle	14657.22
Infilled frame with one wall on each side at middle	15465.05

CONCLUSIONS

The nonlinear static pushover analysis of infilled frame structure with and without shear wall is considered for finding various parameters such as displacement, drift, and base shear. Four types of structures are considered for analysis. They are bare frame, infilled frame, bare frame with corner shear wall, infilled frame with corner shear wall, bare frame with one wall on each side at middle and infilled frame with one wall on each side at middle. The base shear of bare frame with corner shear wall and infilled frame with corner shear wall is maximum and approximately equal. Among the structures infilled frame with corner shear wall shows less displacement and drift than that of others. From this it is clear that the better position for shear wall is the corner.

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