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Seismic Analysis of Masonry Infilling In Multistoried Building

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Abstract: *Reinforced concrete frame buildings with masonry infill walls have been built all around the world, specifically in the high seismic regions. Observations from past earthquakes show that these buildings can endanger the life of their occupants and lead to significant damage and loss. Masonry infilled frames built before the development of new seismic regulations are more susceptible to collapse given an earthquake event. These vulnerable buildings are known as non-ductile concrete frames. Therefore, there is a need for a comprehensive collapse assessment of these buildings in order to limit the loss in regions with masonry infilled frame buildings.*

The main component of this research involves assessing the collapse performance of masonry infilled, non-ductile, reinforced concrete frames in the Performance Based Earthquake Engineering framework. To pursue this goal, this study first develops a new multi-scale modeling approach to simulate the response of masonry infilled frames up to the point of collapse. In this approach, a macro (strut) model of the structure is developed. Present work describe the nature of RC frame building with G + 13 storey with different masonry infill materials like brick masonry and AAC blocks masonry is taken into considerations. Building is irregular in plan with L shape consider for analysis

1. Introduction

Reinforced concrete frames with masonry infill walls are a common practice in countries like India, where the region is prone to seismic activity. Generally the masonry infill walls are treated as nonstructural element in structural analysis and only the contribution of its mass is considered and it's structural properties like strength and stiffness is generally not considered. Although it contributes significantly to the lateral stiffness of the frame structures. There are no such specific references to infill walls in the Indian seismic standard (IS 1893:2002) that is currently used in India. One of the drawbacks of neglecting the infill as a structural member is the irregularities in the building caused by the uncertain position of infill and openings in them. The traditional modeling of Reinforced concrete frame structures in which the effect of infill is not considered assumes the structures more flexible than they really are. Because of this reason the building codes obtrudes an upper limit to the natural period of a structure. The contradiction may occur in the analysis and proportioning of structural member in traditional modeling because it does not take strength and stiffness characteristic into account. Actually there is increase in the overall stiffness of the structure by the effect of infill walls which finally leads to the shorter time periods. A systematic model of force deformation response of infill is required to correctly analyze the infilled structures.

Numbers of finite element models has been evolved to foresee the behavior of infilled frames (Asteris 2003; Shing et al.1992; Dymiotis et al 2001 ;), such type of modeling is too time taking for the investigation of the large structures. Hence the most popular approach is a macro-modeling substituting the entire infill as single equivalent strut.

The study of the complicated behavior of masonry infill by polyakov (1956) suggested that the infill and frame disparate excluding at two compression corners. He established the idea of equivalent diagonal strut and proposed that transformation of stresses from the frame to infill occurs only in the compression zone of the infill.

Another study conducted by Holmes (1961) suggested that the infill can be replaced by equivalent diagonal strut that is pin jointed at corners and is of same thickness and material and its width is equal to one third of the diagonal.

2. Material and method

Following data is used in the analysis of the RC frame building models

- Type of frame: Special RC moment resisting frame fixed at the base
- Seismic zone: ш
- Number of storey: G+13

- Floor height: 3. m
- Depth of Slab: 120 mm
- Size of beam: (230 × 450) mm
- Size of column: (400 × 600) mm
- Spacing between frames: 5 m along X directions 3 m along Y directions
- Floor finish: 2 KN/m2
- Terrace water proofing: 1.5 KN/m2
- Materials: M 25 concrete, Fe 415 steel , Brick infill and AAC block infill
- ThickNess of infill wall: 230 mm
- Density of concrete: 25 KN/m3
- Density of brick infill: 18 KN/m3
- Density of AAC block infill : 7 KN/m3
- Poison Ratio of concrete : 0.2
- Poison Ratio of brick masonry : 0.16
- Poison Ratio of AAC masonry : 0.25
- Compressive strength of concrete 5000 = 25000 Mpa
- Compressive strength of brick masonry : 5 Mpa
- Compressive strength of AAC masonry : 4.5 Mpa
- Live load on floor: 3 KN/m3
- Type of soil: Medium
- Response spectra: As per IS 1893(Part-1):2002
- Damping of structure: 5 percent

Model properties

Bare frame model: In this model only frame is model. Effect of infill wall is not included in this model.

Modified infill model 1 : In this model practical aspect is consider.. Also 6th floor is keep vacant to meet any functional requirements.

Modified infill model 2 : In this model ground floor , 6th floor and 13th floor is keep vacant

After comparing convention clay brick and AAC blocks model found that base shear of AAC blocks is reduced in grate amount which is in % as below

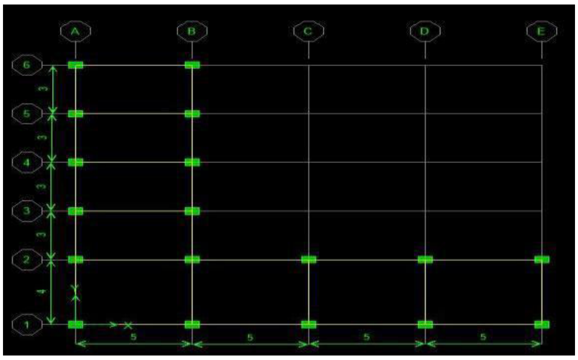

Fig No.1 Plan of frame

3. Result and discussion

After comparing convention clay brick and AAC blocks model found that base shear of AAC blocks is reduced in grate amount which is in % as below

Table no 3.1 Discussion on comparative study of Brick and AAC infill model for base shear

Direction	Bare frame	Modified infill 1	Modified infill 2
X static	38.37	35.21	30.20
Y static	38.30	35.13	30.19
X dynamic	19	25.71	26.37
Y dynamic	18.71	27.46	23.87

After comparing convention clay brick and AAC blocks model found that storey drift of AAC blocks is reduced in grate amount which is in % as below

Table no 3.2 Discussion on comparative study of Brick and AAC infill model for storey drift

Direction	Bare frame	Modified infill 1	Modified infill 2
Static X 14th floor	35.29	23.07	9.61
1st floor	35.29	32.35	24.352
Static Y 14th floor	31.81	21.05	7.69
1st floor	43.93	34.09	30.43
Dynamic X 14th floor flfflfloor	10	7.69	6.25
1st floor	17.64	20	17.39
Dynamic Y 14th floor	16	9.52	11.11
1st floor	16	16	27.02

After comparing convention clay brick and AAC blocks model found that top storey displacement of AAC blocks is reduced in grate amount which is in % as below

Table no 3.3 Discussion on comparative study of Brick and AAC infill model for top storey displacement

	Bare frame	Modified infill 1	Modified infill 2
X static	50	50	50
Y static	42.85	33.33	33.33

Natural periods of vibration of buildings depend upon their mass and lateral stiffness. Presence of infill walls in buildings increases both the mass and stiffness of buildings; however, the contribution of latter is more significant. Consequently, the natural periods of an infill frame are normally lower than that of the corresponding bare frame.

Table no 3.4 Comparative study of time period in sec of first three mode shape of brick and AAC infill model

Mode	Bare frame		Modified infill 1		Modified infill 2	
	Brick	AAC	Brick	AAC	Brick	AAC
1	2.5	2.1	1.2	1.1	1.3	1.2
2	2.3	2.0	1.0	0.9	1.1	1.0
3	2.0	1.7	0.9	0.8	1.0	0.9

4. CONCLUSION

1) The seismic requirement of the structure in terms of storey drift and the maximum average roof displacement of the structure are markedly enhanced by the introduction of infill. Top storey displacement is reduce of infill fill frame upto 50%
2) Primary frame action of a moment resisting frame is converted to the primary truss action due to the introduction of the infill leading to the increased axial forces in column in infill frame model.
3) The base shear experienced by models with AAC blocks was significantly smaller than with conventional clay bricks which results in reduction in member forces which leading to reduction in required amount of Ast to resist member forces. So economy in construction can be achieved by using AAC blocks instead of conventional clay bricks. The performance of AAC block infill was superior to that of Conventional brick infill in RC frame. Static base shear reduce upto 38% and 29% for dynamics.
4) Drift of structure is also reduced in grate amount so that overall performance of frame with full infill as conventional clay bricks and AAC blocks was significantly superior to that of bare frame.

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