

Comparison of Earthquake Resistant Building with and Without Infill Walls In Zone II & IV Using Etabs

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ABSTRACT: Now-a- days reinforced concrete frames are most common in building construction practice around the globe. The vertical gap in reinforced concrete frames that is created by the columns and beams are generally filled in by brick or masonry and it is referred a brick infill walls or panels. When the construction of frame is done, these walls are built of burnt clay bricks in cement mortar. These walls are typically 200 to 115mm thick. Due to functional requirements, the openings are provided in the frames for windows, doors etc. This project deals with the comparison of an earthquake resistant building with & without infill's in Zone II & Zone IV. We have used ETABS software for analyzing & Designing of the Building.

KEYWORDS: E Tabs, Codes, Zone II and Zone IV

I. INTRODUCTION

Reinforced concrete (RC) frame buildings with masonry infill walls have been widely constructed for commercial, industrial and multi-family residential uses in seismic-prone regions worldwide. Masonry infill typically consists of brick masonry or concrete block walls, constructed between columns and beams of an RC frame. These panels are generally not considered in the design process and treated as non-structural components. In a country like India, Brick masonry infill panels have been widely used as interior and exterior partition walls for aesthetic reasons and functional needs. Though the brick masonry infill is considered to be a non-structural element, it has its own strength and stiffness. Hence if the effect of brick masonry is considered in analysis and design, considerable increase in strength and stiffness of overall structure may be observed. Present code, IS 1893(Part-I): 2000 of practice does not include provision of taking into consideration the effect of infill. It can be understood that if the effect of infill is taken into account in the analysis and design of frame, the resulting structure may be significantly different. Significant experimental and analytical research is reported in various literatures, which attempts to explain the behavior of in filled frames. Moreover, infill, if present in all storeys gives a significant contribution to the energy dissipation capacity, significantly decreasing the maximum displacements. Therefore the contribution of masonry is of great importance, even though strongly depending on the characteristics of the ground motion, especially for frames which has been designed without considering the seismic forces. When sudden change in stiffness takes place along the building height, the story at which this drastic change of stiffness occurs is called a soft story. According to IS 1893(Part-I): 2000, a soft story is the one in which the lateral stiffness is less than 50% of the storey above or below. 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 non-structural 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

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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.

To understand the effect of infill masonry on the lateral strength and stiffness of structures various experiments have been conducted since early 50's. Actually the lateral load carrying mechanism is modified from the primary frame action to primary truss action by the effect of infill, which causes the increase in axial force and decrease in bending moment and shear force of the frame members. There is generally increase in damping of structures due to the generation of cracks with growing lateral drift. The infill walls may adversely affect the structure during the seismic excitation if it is not placed properly. The non-appearance of infill wall in a certain storey may lead to the soft storey effect which is one of the major ill effects of the infill walls.

II. OBJECTIVE

Based on the literature review presented in chapter 2, the silent objectives of the present study have been identified as follows:

1. To analyze multistory and multi bay (G+10) moment resisting building frame for earthquake forces
2. Comparative study the effects of building analysis with and without infill walls. To study various responses such as Shear force, Bending moment, axial force, displacement etc. of buildings. This study will give the difference between performance of RC frame with and without infill walls.

III. METHODOLOGY

The methodology worked out to achieve the above-mentioned objectives is as follows:

1. Review the existing literature and Indian design code provision for analysis and design the earthquake resistance building.
2. Considering two different building with same parameter for the modelling.
3. Model the selected building without infill walls considering infill strength/stiffness.
4. Perform analysis for selected building for both gravity, and earthquake loads and comparative study is obtained from the analysis.
5. Also design the building manually for analysis results obtained and compared with the area of steel of the models obtained.
6. Observation of results and discussion.

IV. NEED OF STUDY

Earthquake of the 15 th January 1934 in Bihar and Nepal. After this earthquake, doubts arose about our professional practices, building by-laws, construction materials, building codes and education for civil engineers and architects. Our concern is to make our structure withstand such forces. Every building must withstand significant lateral force. We need to give our attention while designing the plan, section of a building, selecting the construction material and while implementing the ideas in the construction phase. There are tremendous techniques that can be embraced by a normal building. When dispatching the forces toward the footing from the structure, columns play a vital role than that of the beams so designing a structure with strong columns than beams is appreciated.

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V. ANALYSIS AND SYNTHESIS

The Results obtained are of different parameters such as Storey displacement, axial loads, moments etc. Firstly, the results obtained by carrying out Analysis for Symmetric building for TWELVE storey's and then the Results obtained are listed. Subsequent Discussions are made about the Results for Symmetric buildings individually and also considering the Storey effect of Symmetric buildings by comparing the Responses of the structure in different zones.

Story	Without infill	With infill
story 1	1	0.79
story 2	2.5	1.7
story 3	4	2.7
story 4	5.6	3.7
story 5	7.1	4.7
story 6	8.6	5.7
story 7	10	6.7
story 8	11.4	7.5
story 9	12.5	8.3
story 10	13.5	9
story 11	14.3	9.6
story 12	14.8	9.9

Table 1 : DISPLACEMENT OF STRUCTURE WITH AND WITHOUT INFILL IN ZONE 2

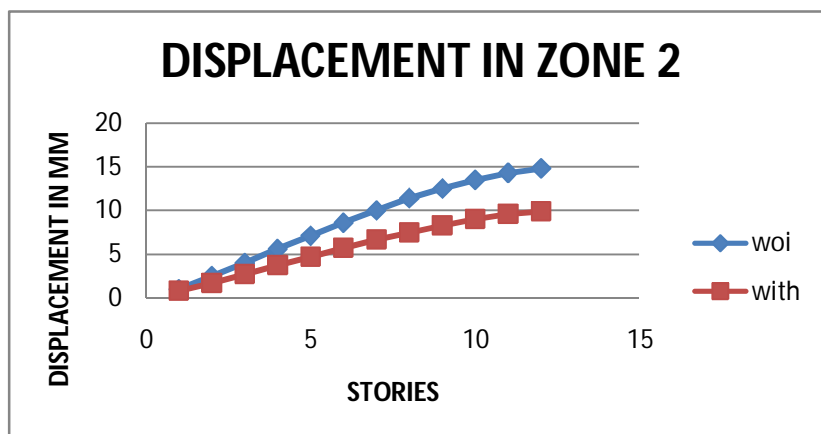


Figure1: Comparison Of Story Displacement Of The Twelve Storey Symmetrical Building In Seismic Zone II

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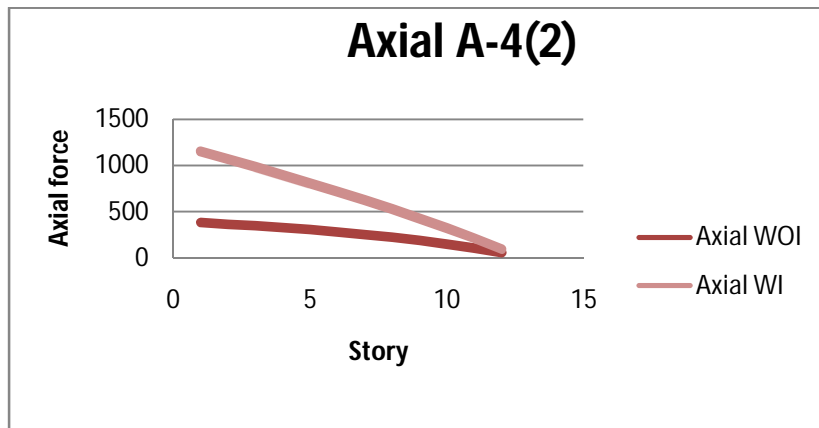


Figure 1: Comparison Of Axial Loads For Exterior Of Twelve Storey Symmetrical Building In Different Seismic Zone II

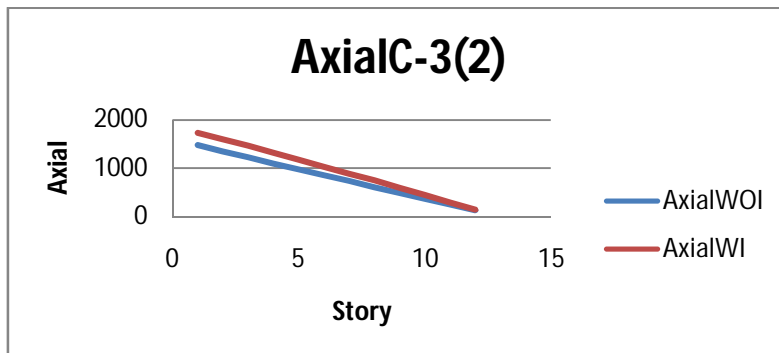


Figure 3: Comparison Of Axial Loads For Interior Of Twelve Storey Symmetrical Building In Different Seismic Zone II

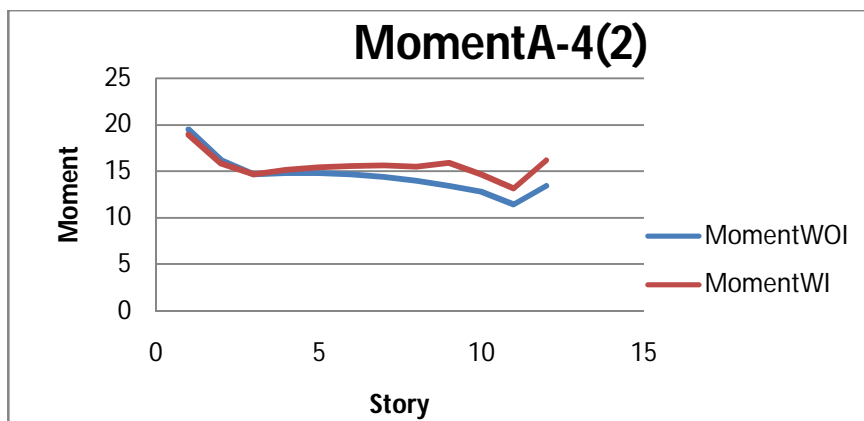


Figure 4: Comparison Of Moment 3-3 For Exterior Of Twelve Storey Symmetrical Building In Different Seismic Zone II

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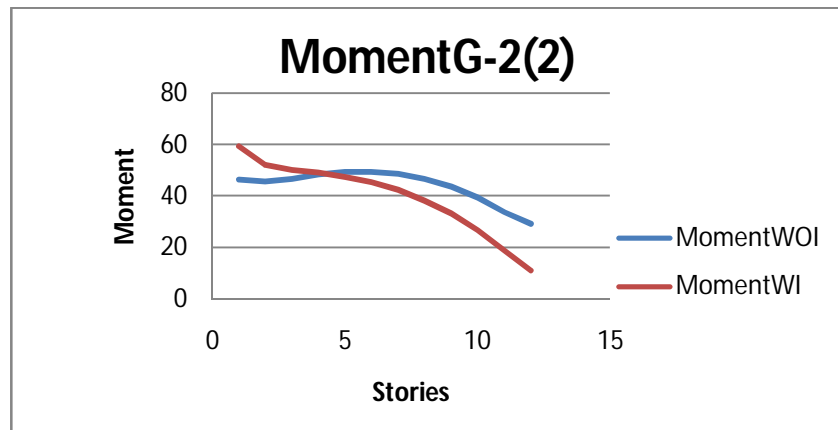


Figure 5: Comparison Of Moment 3-3 For Interior Of Twelve Storey Symmetrical Building In Different Seismic Zone II

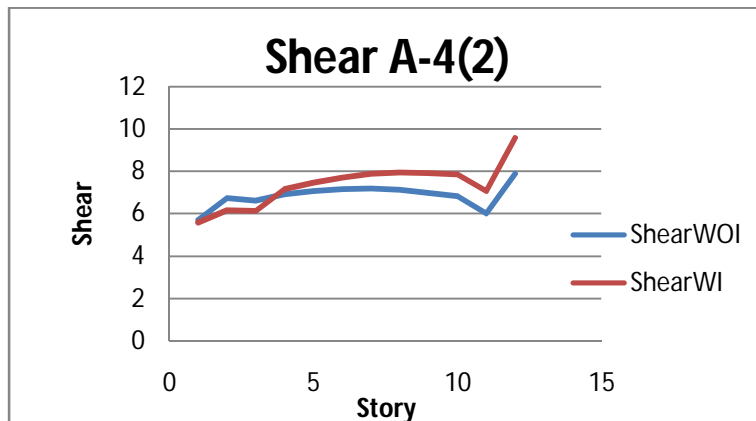


Figure 6: Comparison Of SHEAR 3-3 For Exterior Of Twelve Storey Symmetrical Building In Different Seismic Zone II

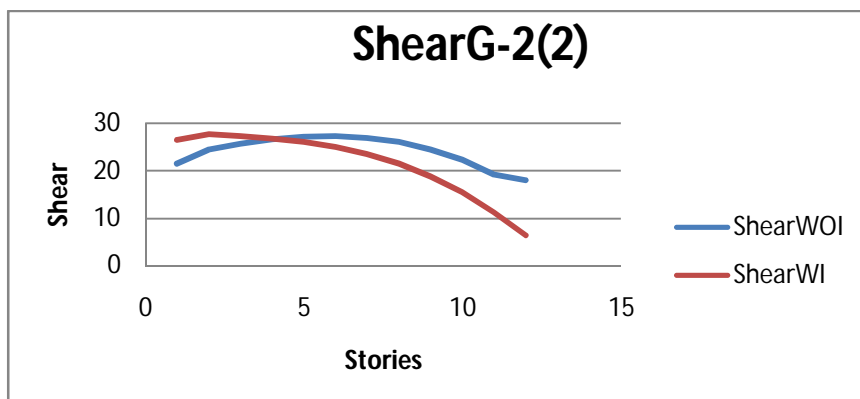


Figure 7: Comparison Of SHEAR 3-3 For Interior Of Twelve Storey Symmetrical Building In Different Seismic Zone II

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Story	Without infill	With infill
story 1	2.4	1.9
story 2	5.9	4.1
story 3	9.5	6.5
story 4	13.2	8.9
story 5	16.8	11.34
story 6	20.2	13.6
story 7	23.6	15.9
story 8	26.6	18.06
story 9	29.3	19.9
story 10	31.6	21.5
story 11	33.3	22.8
story 12	34.5	23.7

Table 2: DISPLACEMENT OF STRUCTURE WITH AND WITHOUT INFILL IN ZONE 4

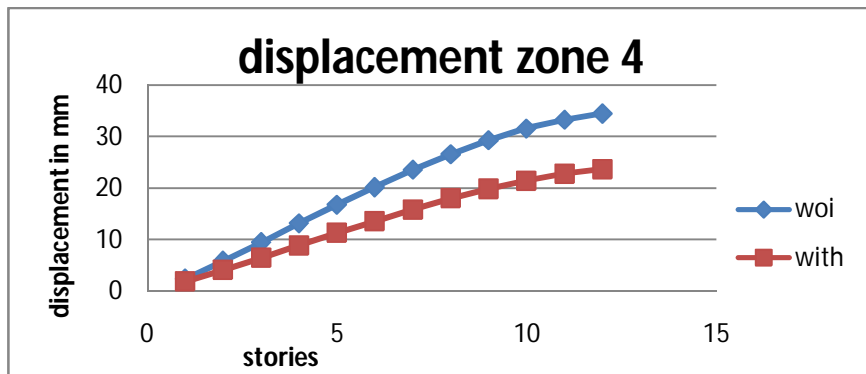


Figure 8: Comparison Of Story Displacement Of The Twelve Storey Symmetrical Building In Seismic Zone IV

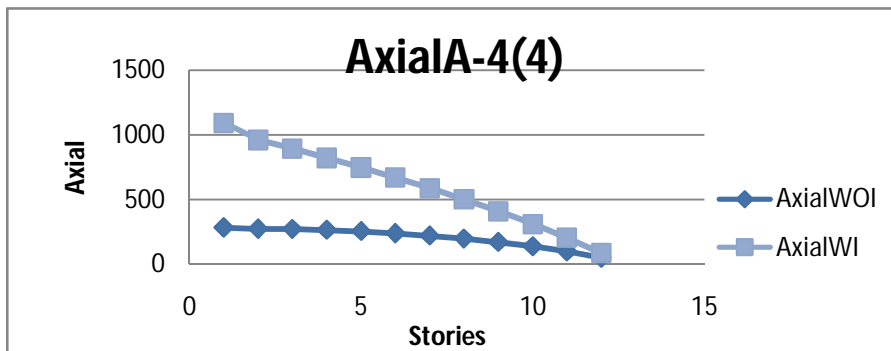


Figure 9: Comparison Of Axial Loads For Exterior Of Twelve Storey Symmetrical Building In Different Seismic Zone IV

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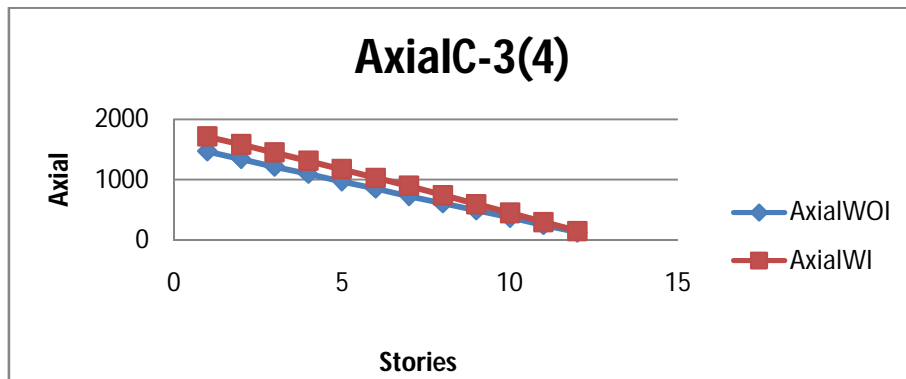


Figure10: Comparison Of Axial Loads For Interior Of Twelve Storey Symmetrical Building In Different Seismic Zone IV

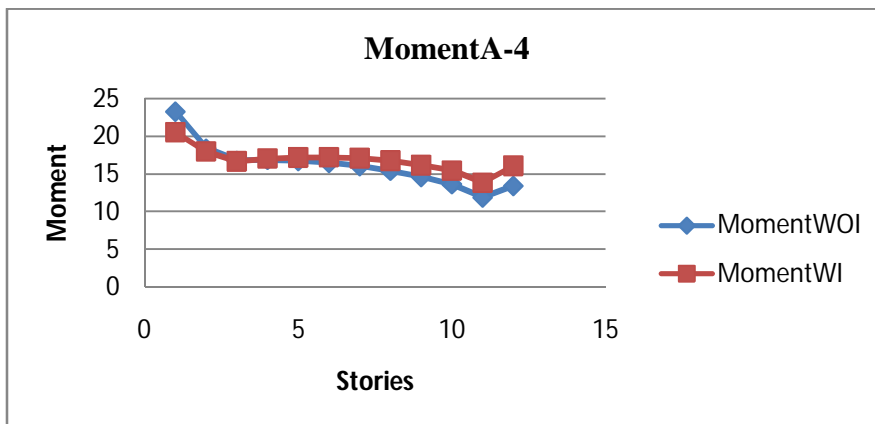


Figure 11: Comparison Of Moment 3-3 For Exterior Of Twelve Storey Symmetrical Building In Different Seismic Zone IV

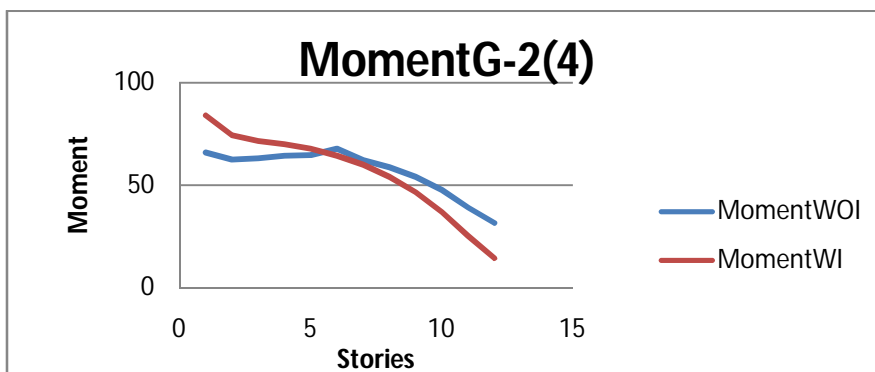


Figure 12: Comparison Of Moment 3-3 For Interior Of Twelve Storey Symmetrical Building In Different Seismic Zone IV

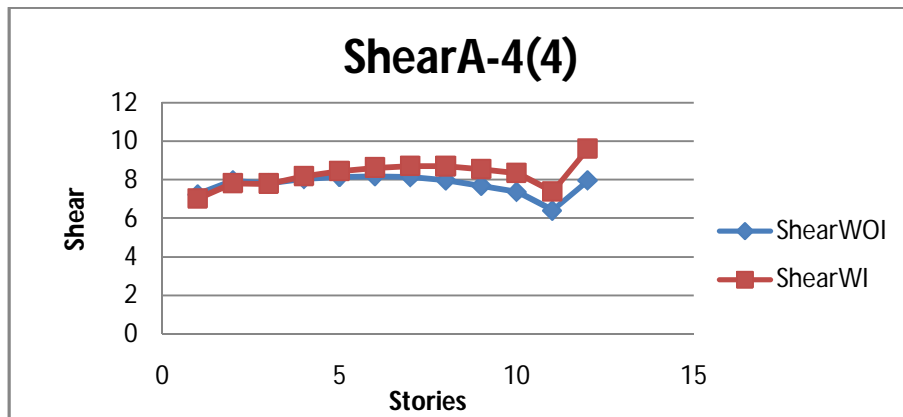


Figure 13: Comparison Of SHEAR 3-3 For Exterior Of Twelve Storey Symmetrical Building In Different Seismic Zone IV

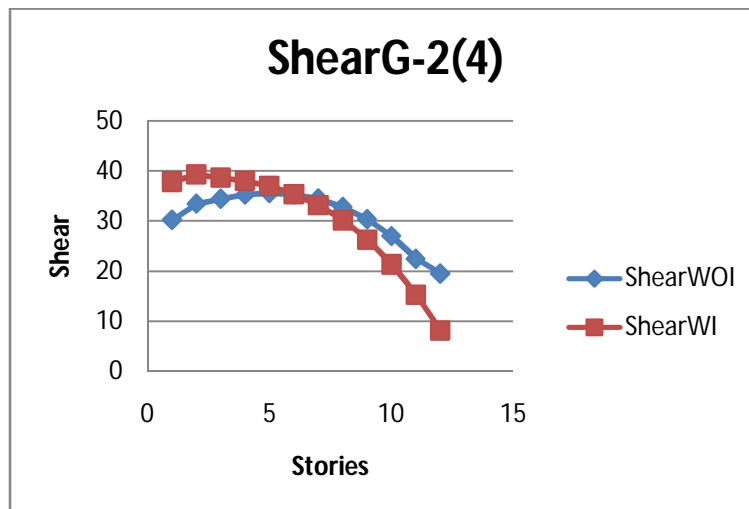


Figure 14: Comparison Of SHEAR 3-3 For Interior Of Twelve Storey Symmetrical Building In Different Seismic Zone IV

VI. CONCLUSIONS

The following conclusions are drawn based on the analysis and design of RC building designed for gravity loads and earthquake forces in II & IV zone.

Almost every multi-storey building is made up of moment resisting RC frames in most of the developing countries. Brick infill masonry or concrete masonry are mostly used to infill the vertical space created by the beams and columns in the frame. These infill panels are generally not the intrinsic part of the moment resisting frame and usually they have openings in them for the utilitarian demand of doors, windows etc.

There are advantageous and disadvantageous effect of infill masonry according to the previous studies and experience obtained during earthquake. There is increase in overall lateral strength. Damping of the structure is also affected by the infill walls; increase in damping of the structure due to the effect of infill causes the increase in energy dissipation capacity of the structure. In addition to that the total horizontal displacement and the storey drift of the structure are greatly reduced by the introduction of infill in moment resisting reinforced concrete frame. However there are disadvantageous effect of infill such as soft storey and short column effect

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1. The top story displacement of structure with infill wall in zone IV was reduced by 31.2% compared to structure without infill wall.
2. The top story displacement of structure with infill wall in zone II was reduced by 33.1% compared to structure without infill wall
3. The max top floor displacement for all the building studied are found to be less than permissible deflections of $0.004H$, where H = total height of the building ($0.004 \times 36 = 144$ & the top roof displacement for zone II & IV is 34.5mm AND 14.8mm. As per clause no. 7.11.1 of IS- 1893 (part-1): 2002 the storey drift in any storey due to specified design lateral force with partial load factor of 1 shall not exceed $0.004h$ times the storey height.
4. Similarly the inter storey drifts are found to be less than the permissible value of $0.004h$, where h = floor height

VI. FURTHER SCOPE

Comparative study of seismic behavior of multi-storey flat slab and conventional reinforced concrete framed structures under different zones.

1. Seismic behavior of a reinforced concrete framed structures using shear wall under different soil interaction.
2. Comparisons of multi storied framed structure with wind and seismic analysis.
3. Since a damping property of infill structure is not yet established there is a scope for further research on this topic.
4. Verification of the formulation with different geometry structure especially with masonry infill panel will be of great interest.

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