

# A REVIEW ON R.C.C. STRUCTURE WITH FULLY, PARTIALLY AND WITHOUT INFILLED WALL IN DIFFERENT SEISMIC ZONES OF INDIA

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**Abstract:** Since long masonry infill are being used to fill up the voids between the horizontal and vertical structural elements such as beams and columns. They are treated as non-structural elements and they are not considered during the analysis and design of the structure such an approach can lead to an unsafe design. But, when laterally loaded they tends to interact with the RC frame, changing the structural behaviour. However, infill walls contribute to lateral stiffness and seismic resistance to the building. In this study an approach is made in which seismic analysis of Reinforced Concrete frame structure is done considering full infilled walls, without infilled walls and partially infilled walls. In this analysis, a G+ 15 story R. C. frame structure is considered in seismic zone IV and V on medium soil strata by performing response spectrum analysis using STAAD PRO software. On the basis of this work results has been obtained. Results for Maximum Nodal Displacement, Maximum Reactions, Maximum Base Shear and Maximum Story Shear are compared for different models.

**KEYWORDS:** RC frame, infill walls, response spectrum, medium soil, seismic zone, STAAD PRO.

## 1. INTRODUCTION

The infills are mostly used as interior partition walls and external walls which are protecting from outside environment to the building. The masonry infill panels are generally not considered in the design process and treated as architectural (non-structural) components. Reinforced concrete (RC) frame buildings with masonry infill walls have been widely constructed for commercial, industrial and multi-story 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 presence of masonry infill walls has a significant impact on the seismic response of a reinforced concrete frame building, increasing structural strength and stiffness. Properly designed infills can increase the overall strength, lateral resistance and energy dissipation of the structure. An infill wall reduces the lateral deflections and bending moments in the frame, thereby decreasing the probability of collapse. Recent studies have shown that the use of masonry infill panel has a significant effect not only on the strength and stiffness but also on the energy dissipation mechanism of the overall structure. Neglecting the effects of masonry infill can lead to inadequate assessment of structural damage of infill frame structures subjected to intense ground motions.

In developing countries like India there is increasing need of high-rise buildings. High-rise building is a solution of land scarcity in developing cities and due to scarcity of land commercial utilization of high-rise buildings and their construction is enhanced. Around the business section of cities wide office space is needed which is easily be available in high-rise buildings and tall buildings.

### 1.1 INFILLED WALLS

Infill walling is the generic name given to a panel that is built in between the floors of the primary structural frame of a building in other words Infill panel walls are a form of cladding built between the structural members of a building. The structural frame provides support for the cladding system, and the cladding provides separation of the internal and external environments. Infill walls are considered to be non-load bearing, but they resist wind loads.

Functional requirements for infill panel walls include:

- They are self-supporting between structural framing members.
- They provide weather-resistance.
- They provide thermal and sound insulation.

- The provide fire resistance.
- They provide sufficient openings for natural ventilation and glazing.

## 1.2 OBJECTIVE OF THE STUDY

The main objective of this work is to do the comparative study of seismic analysis of R.C.C. framed structure with full infilled walls, without infilled walls and partially infilled walls in seismic zone IV and V. The same structure is analysed by STAAD PRO software.

Following are the objectives of this work-

1. To study the Maximum Nodal Displacement in both the horizontal directions, Maximum Reactions, Maximum Base Shear and Maximum Moments for both the structures.
2. To study the effect of full infilled walls, partially infilled walls and without infilled walls on the overall structure.

## 2. LITERATURE REVIEW

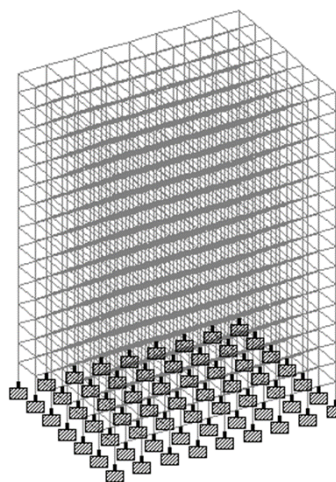
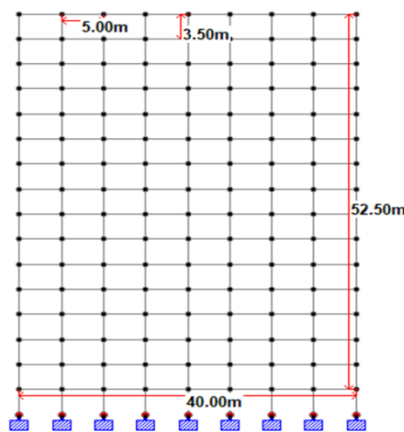
- Shriyanshu Swarnkar (2015), studied 4, 8 and 12 storey buildings with their number of bays increasing from 3 to 6 were modelled as bare and infilled frame. Equivalent Static Analysis (ESA), Response Spectrum Analysis (RSA) and non-linear static Pushover analysis were performed on all structures. Base shear capacity for both ESA and RSA were compared for bare and infilled frame. Pushover curves were plotted for all structures and comparison was made and they concluded that Infill panels being stiffer than columns fail first and simultaneously from which it was observed that infill panels are responsible for initial stiffness of the structure.
- Ayman Abd-Elhamed (2015), investigated the seismic response of reinforced concrete (RC) frame building considering the effect of modelling masonry infill (MI) walls. The seismic behaviour of a residential 6-storey RC frame building, considering and ignoring the effect of masonry, is numerically investigated using response spectrum (RS) analysis. The considered herein building is designed as a moment resisting frame (MRF) system following the Egyptian code (EC) requirements. Two developed models in terms of bare frame and infill walls frame are used in the study. Equivalent diagonal strut methodology is used to represent the behaviour of infill walls, whilst the well-known software package ETABS is used for implementing all frame models and performing the analysis. The results of the numerical simulations such as base shear, displacements, and internal forces for the bare frame as well as the infill wall frame are presented in a comparative way. The results of the study indicate that the interaction between infill walls and frames significantly change the responses of buildings during earthquakes compared to the results of bare frame building model. Specifically, the seismic analysis of RC bare frame structure leads to underestimation of base shear and consequently damage or even collapse of buildings may occur under strong shakings. On the other hand, considering infill walls significantly decrease the peak floor displacements and drifts in both X and Y-directions.
- Ravish Khan et. al. (2016), analysed two models of tall structures with different symmetric and asymmetric plan geometries are analysed by linear static method and designed for the same. The analysis results are shown in terms of storey shear, storey drift and storey displacement in all the two models.
- Sorina Constantinescu (2017), presents a study about the effect of masonry infill walls on the behaviour of framed buildings, in seismic areas. The study was done for a building that will be built in Bucharest, Romania. In this case, the building will have 6 stories. The bays are narrow, because of the architecture requirements. The structure is composed of concrete frames. The masonry infill walls may assure an enhanced rigidity of the structure. Framed structures in seismic areas tend to have important lateral displacements and great bending moments at the ground floor in columns. It is important to establish the influence those walls have on the structure's behaviour.
- Kasım Armağan KORKMAZ (2007), study, a 3-story R/C frame structure with different amount of masonry infill walls is considered to investigate the effect of infill walls on earthquake response of these type of structures. The diagonal strut approach is adopted for modelling masonry infill walls. Pushover curves are obtained for the structures using nonlinear analyses option of commercial software SAP2000. Nonlinear analyses are realized to sketch pushover curves and results are presented in comparison and the effects of irregular configuration of masonry infill wall on the performance of the

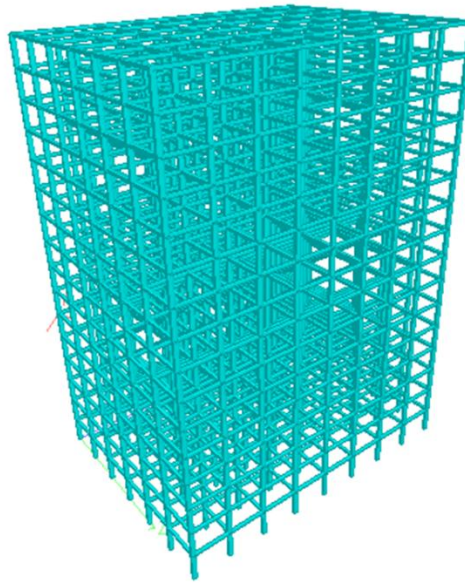
structure are studied. From the pushover curves, story displacements, relative story displacements, maximum plastic rotations are determined. Regarding with the analysis results, the effects of irregularities are determined.

### 3. METHODOLOGY

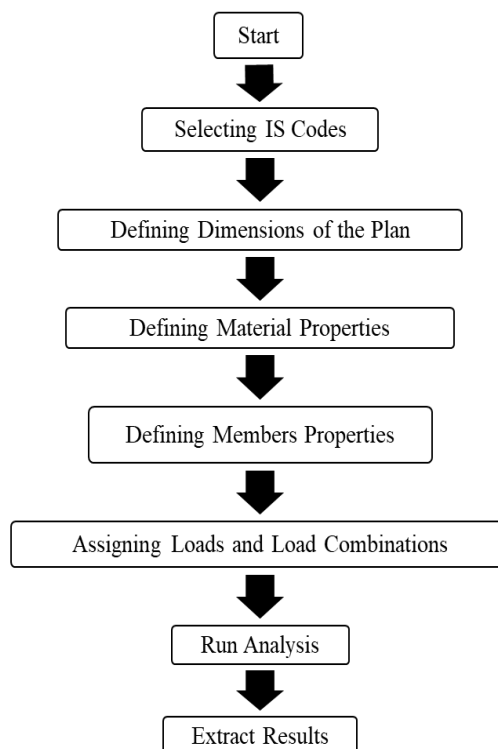
Cases under consideration:

Software used	Configuration of Building	Model Dimensions	Story	Remarks
STAAD Pro.	Rectangular with Full Infilled walls	40m x 30m	16	Seismic forces of ZONE IV and V as per IS: 1893:2002.
STAAD Pro.	Rectangular with Partial Infilled walls	40m x 30m	16	Seismic load of ZONE IV and V as per IS: 1893:2002.
STAAD Pro.	Rectangular without Infilled walls	40m x 30m	16	Seismic load of ZONE IV and V as per IS: 1893:2002.





### 3.1 FLOW CHART DIAGRAM

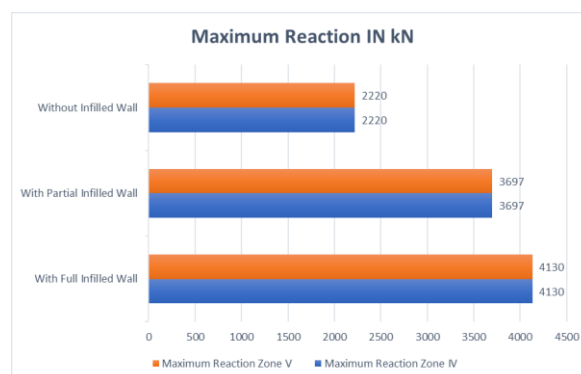


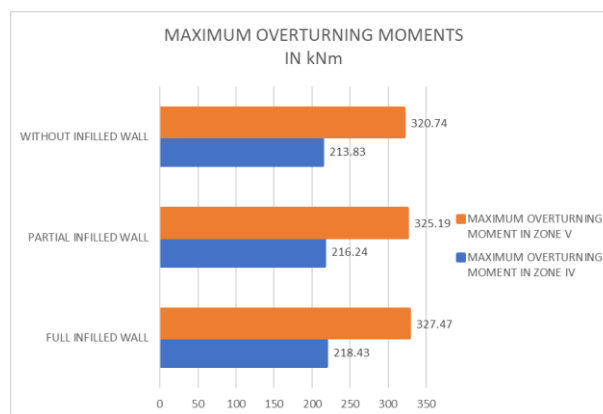
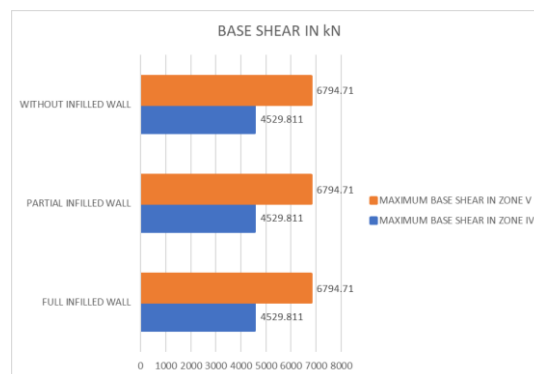
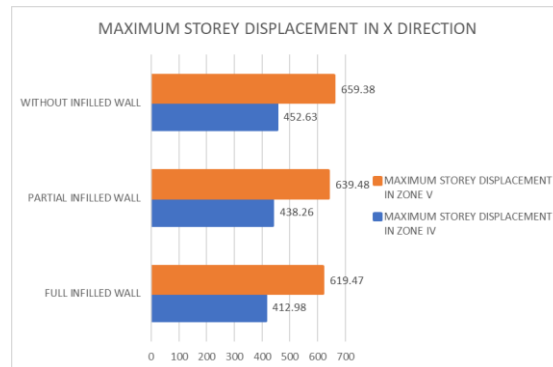
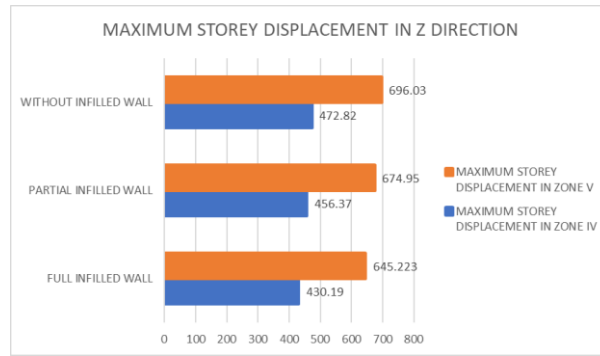
### 3.2 Specifications:

Specifications	Data
Storey Height	3.5 m
No. of Bays Along Length	8
No. of Bays Along Height	16
No. of Bays Along Width	6
Bay Length Along Length	40 m

<b>Bay Length Along Height</b>	56 m
<b>Bay Length Along Width</b>	30 m
<b>Concrete Grade</b>	M-25
<b>Density of R.C.C.</b>	25 KN/m <sup>3</sup>
<b>Density of Masonry</b>	20 KN/m <sup>3</sup>
<b>Columns</b>	350mmx500mm
<b>Beams</b>	300 mm x 350 mm
<b>Slab Thickness</b>	120 mm
<b>Wall Thickness</b>	
<b>Interior</b>	100 mm
<b>Exterior</b>	200 mm
<b>Support Conditions</b>	Fixed
<b>Dead Load</b>	Taken by Software
<b>Live Load-</b>	
<b>Roof</b>	1 KN/m <sup>2</sup>
<b>Rest of the structure</b>	2 KN/m <sup>2</sup>
<b>Exterior Full Wall Load</b>	12.6 kN/m
<b>Interior Full Wall Load</b>	6.3 kN/m
<b>Partial Exterior wall load</b>	9.44 kN/m
<b>Partial Interior wall load</b>	4.72 kN/m
<b>Soil Conditions</b>	Medium Soil
<b>Damping Ratio</b>	5%, as per IS-1893: 2002 (Part-1)
<b>Response Reduction Factor</b>	3
<b>Importance Factor</b>	1
<b>Zone Factor</b>	0.24 as per IS 1893-2002 (Part-1)

#### 4. RESULTS AND DISCUSSION





## 5. CONCLUSIONS

- Maximum Reactions increases as we provide partial infill wall and full infill wall in the structure and are minimum for No infill wall structure.

- The value of Reaction does not depend on seismic zone so it is same for Full infilled wall structure, Partial infilled wall structure and No infilled wall structure in seismic zone IV and V and Full Infilled wall structure has more reaction than Partial and Without or No Infilled wall structure.
- Base Shear shows no change for all the three cases and only depends upon the zone.
- With the increase in seismic zone from IV to V base shear increases from an amount of 51% in all the structures.
- Maximum storey displacements are minimum for Full infill wall structure and increases as we provide partial infill wall structure and are maximum for no infill wall structure. Hence, we can conclude infill wall plays an important role if maximum storey displacement parameter has given more importance.
- Maximum storey displacement increases by an amount of 16.8 mm and 26.5 mm in X direction and Z direction respectively in seismic zone IV and V respectively because we have taken a rectangular geometry with 40 m in X direction and 30 m in z direction.
- With the increase in seismic zone from IV to V maximum storey displacement increases from an amount of 66.68% in X and Z direction both.
- The values of Maximum Overturning Moments are more for infilled wall structure because the weight of the structure is more in full infill wall structure as compared to partial and no infilled wall structure for both the seismic zones.
- The maximum displacement at all the stories decreases by an amount of approximately 11 % if we provide Partial infill wall and by an amount of approximately 19 % if we provide Full infill wall as compared to the structure having No infill wall.

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