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Behavioral Study of Redundancy in Steel and RCC frames

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ABSTRACT*:* This paper describes the seismic analysis of steel and RCC 2D frames with and without masonry infill walls. The Seven storied frame with different number of bays is analyses. Different results of Time period, Base shear and displacement were obtained using software. It is observed that providing brick infill indicates considerable and acceptable effects as compared to bare frames and it was found that infill wall reduces the time period, displacement for steel as well as RCC frames. Masonry infill walls are found in most existing steel frame building systems. The masonry infill walls which are constructed after completion of steel frames are considered as non-structural elements. Although they are designed to perform architectural functions, masonry infill walls do resist lateral forces with substantial structural action .In addition to this, infill walls have a considerable strength and stiffness and they have significant effect on the seismic response of the structural system. There is a general agreement among of the researchers that infill frames have greater strength as compared to frames without infill walls. The presence of the infill walls increases the lateral stiffness considerably. Due to the change in stiffness and mass of the structural system, the dynamic characteristics change as well. In conventional analysis of infill frame systems, the masonry infill wall may be modeled using an equivalent strut model

Keywords: Seismic analysis, Masonry infill walls, STAAD.

Introduction

Structural redundancy is an important concept in seismic design of structures. Redundancy of structures became the focus of research after major structural failure of buildings caused by catastrophic earthquakes such as 1994 Northridge and 1995 Kobe. It has been emphasized in seismic design codes that redundancy of structures plays an important key in seismic performance of structures. The configuration of structural system and number of lateral load resisting line of a building, which is referred as redundancy, has significant role in seismic performance of existing structures. Infill masonry walls are commonly constructed in the exterior frames of steel frames buildings. Their effects on the behavior of the steel frame buildings typically are ignored during design process. This study investigates the effect of infills on the redundancy of the steel frames. The rapid expansion of today's housing market and the dwindling availability of large empty lots in urban areas, The objectives of this research work is to carry out a review to determine the conceivability of polymerase chain reaction (PCR) based methods to profile any fungal contaminating sorghum, to evaluate the toxicogenicity of fungal isolated, to determine, to validate the ability of LC-MS/MS to profile *aflatoxin, ochratoxins, fumonisins, zearalenone, deoxynivalenol, HT-2 toxin, T-2 toxin, citrinin and ergot alkaloids* contaminating sorghum, identification of non-toxigenic fungi as bio-control agents against mycotoxin contamination of sorghum, and the evaluation of fungicide effects of *Parkia biglobosa (Jacq.) and d'Eucalyptus camaldulensis (Steu.)* against fungi contaminating sorghum. Research works considered are from the last ten years. has prompted the increasing construction of slender buildings. With lower stiffness, the overall stability of these structures has become a primary concern in the structural design of buildings. In many countries situated in seismic regions, reinforced concrete frames are in-filled fully or partially with brick masonry panels with or without openings. Although the infill panels significantly enhance both the stiffness and strength of the frame, their contribution is often not taken into account because of the lack of knowledge of the composite behaviour of the frame and the infill. Reconnaissance after three or four earthquakes in India has shown researchers and practitioners around the world the potential beneficial effects of masonry infill walls in multistory buildings. In framed structures, the frames are infilled with stiff construction such as brick or concrete block masonry, primarily to create an enclosure and to provide safety to the users. Such masonry walls are known as infill walls, are more

ductile than the isolated ones. Unless adequately separated from the frame, there will be structural interaction of the frame and infill panels. The strength and energy dissipation capacity of an infilled

frame is much higher than that of bare frame. A frame with an infill wall is very effective against an earthquake, even though input force increases because of the higher stiffness. However, these walls cause stress concentration in particular members and/or torsional deformation of the frame. Also, the shear distribution throughout the structure is altered.

Frames With Masonry Infill Walls

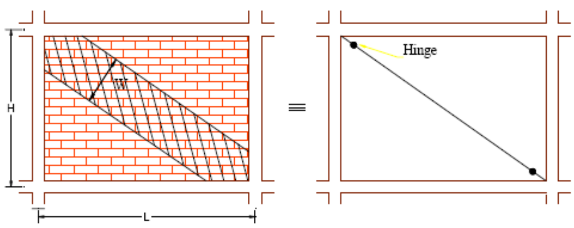


Fig.1 Modeling of masonry infill wall as equivalent diagonal strut element

Masonry infill walls are found in most existing steel frame building systems. The masonry infill walls which are constructed after completion of steel frames are considered as non-structural elements. Although they are designed to perform architectural functions, masonry infill walls do resist lateral forces with substantial structural action .In addition to this, infill walls have a considerable strength and stiffness and they have significant effect on the seismic response of the structural system. There is a general agreement among of the researchers that infill frames have greater strength as compared to frames without infill walls. The presence of the infill walls increases the lateral stiffness considerably. Due to the change in stiffness and mass of the structural system, the dynamic characteristics change as well. In conventional analysis of infill frame systems, the masonry infill wall may be modeled using an equivalent strut model

Equivalent lateral force method (Seismic Coefficient method):

Seismic analysis of most of the structures is still carried out on the assumptions that the lateral (horizontal) force is equivalent to the actual force. (dynamic) loading. This method requires less effort because, except for the fundamental period, the periods and shapes of higher natural blocks of vibration are not required. The base shear which is the total horizontal force on the structure is calculated on the basis of the structure's mass, its fundamental period of vibration, and corresponding shape. The base end shear is distributed along the of the structure in terms of lateral forces, according to the code formula. The effective width of diagonal strut is calculated by using Holmes's equation.

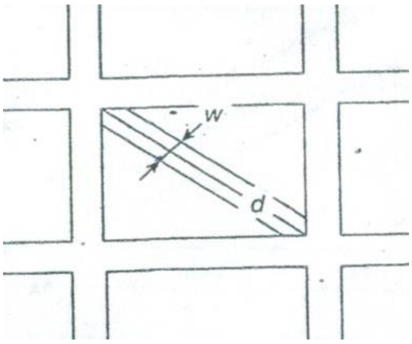


Fig. 2 : Equivalent Diagonal strut model (Holmes, 1961)

$$w = d/3 \qquad (1)$$

Where w is the width of equivalent strut and d is the diagonal length of the infill

Parametric Study

To implement proposed method for quantifying redundancy in infill walls steel frames and RC frames, several types of steel frames and RC frames including 7- storey with 2, 4, 6, 8 and 10 bays were considered. The storey height and bay length of models are fixed to 3.2m and 4m, respectively. All models were located in zone V (high seismic risk zone). The values of time period, base shear and displacement of with and without infill wall were computed and compared.

Load Combinations

1) EQX
2) DL
3) LL
4) 1.5(DL + LL)
5) 1.5(DL + EQX)
6) 1.5(DL - EQX))

7) 1.2(DL+ LL+ EQX)

8) 1.2(DL+ LL- EQX)

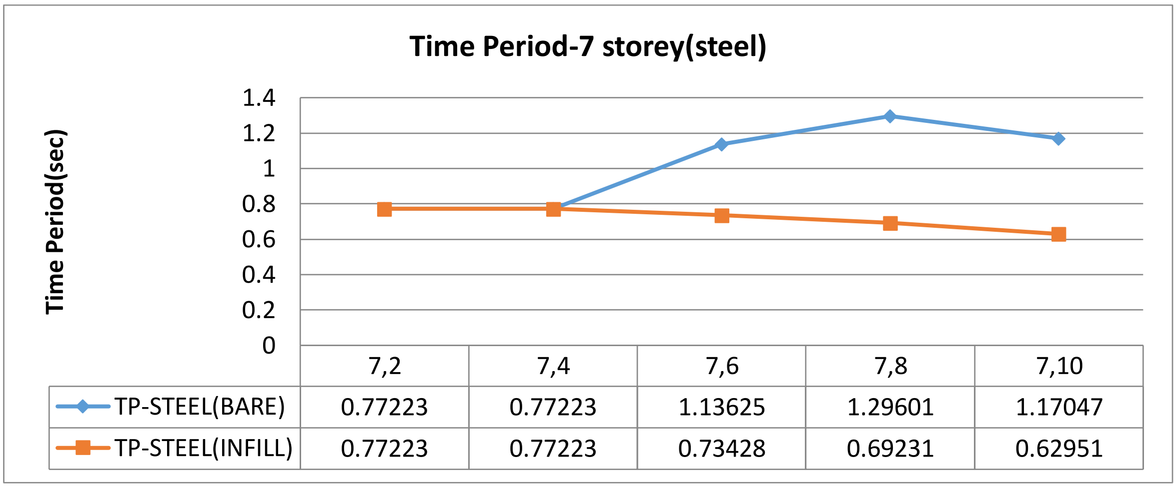
9) 0.9 DL+ 1.5 EQX

10) 0.9 DL – 1.5 EQX

Results

In the present study, different 2D models were studied and analysed in detail. Seismic analysis was carried out as per IS: 1893(Part I)-2002 guidelines The variations of Time period, Base shear and Displacement are presented as below.

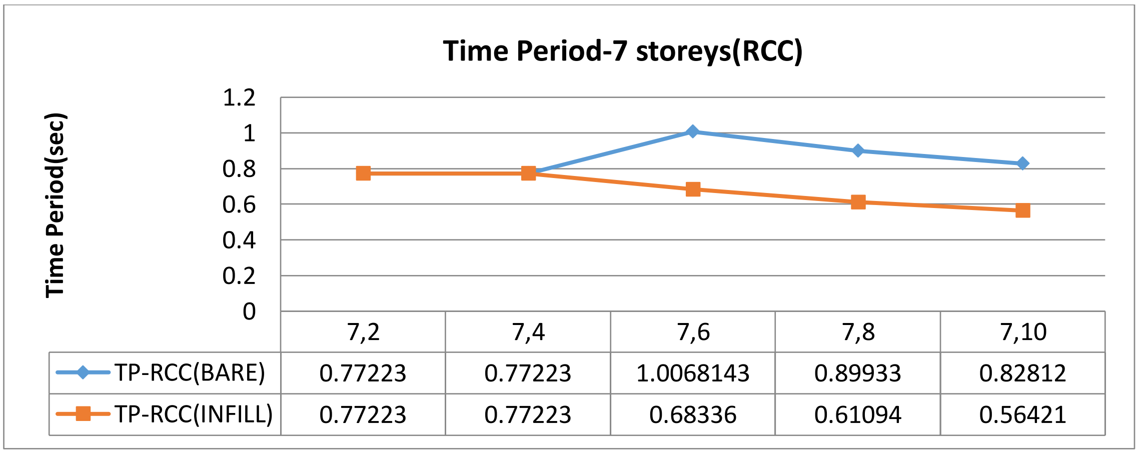
- **Time Period**



	7,2	7,4	7,6	7,8	7,10
TP-STEEL(BARE)	0.77223	0.77223	1.13625	1.29601	1.17047
TP-STEEL(INFILL)	0.77223	0.77223	0.73428	0.69231	0.62951

On X-axis: (7, 2)- (Storey, Bays)

Fig. 3. Time Period of Steel Frames With And Without Infill

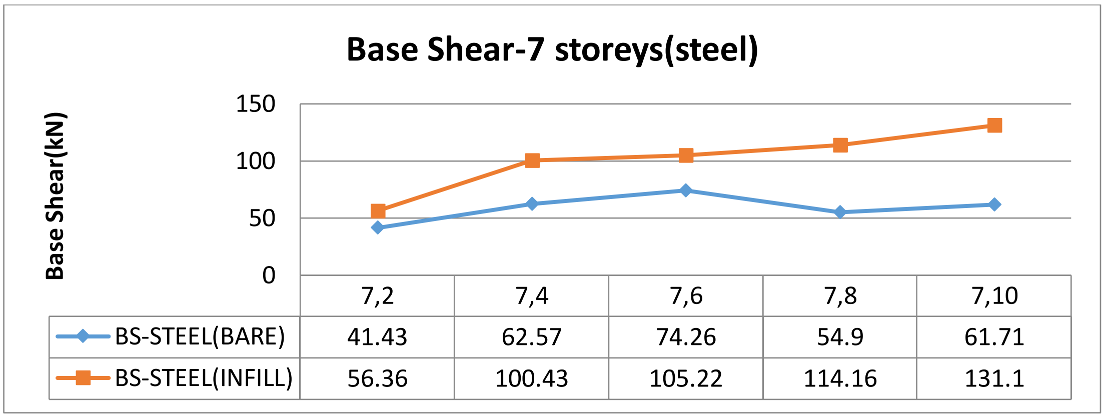


	7,2	7,4	7,6	7,8	7,10
TP-RCC(BARE)	0.77223	0.77223	1.0068143	0.89933	0.82812
TP-RCC(INFILL)	0.77223	0.77223	0.68336	0.61094	0.56421

On X-axis: (7, 2)- (Storey, Bays)

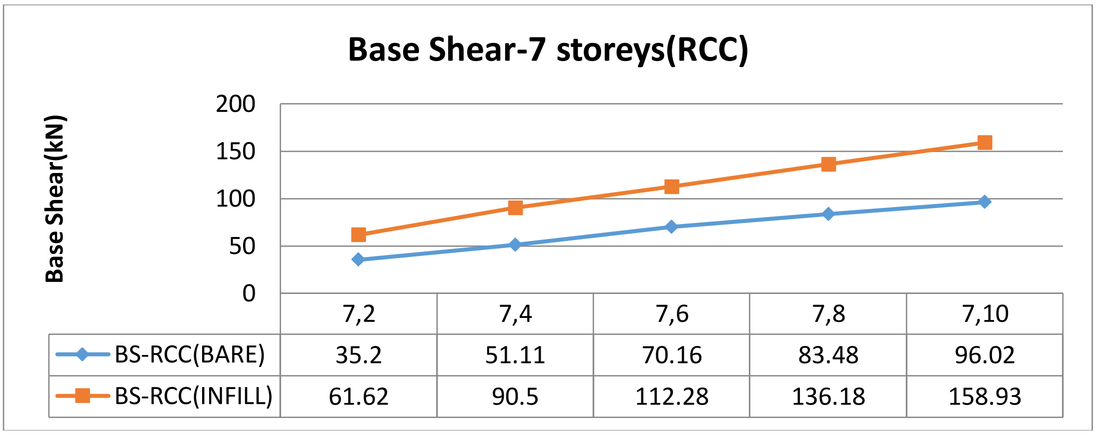
Fig. 4. Time Period of RCC Frames With And Without Infill

- **Base Shear**



On X-axis: (7, 2)- (Storey, Bays)

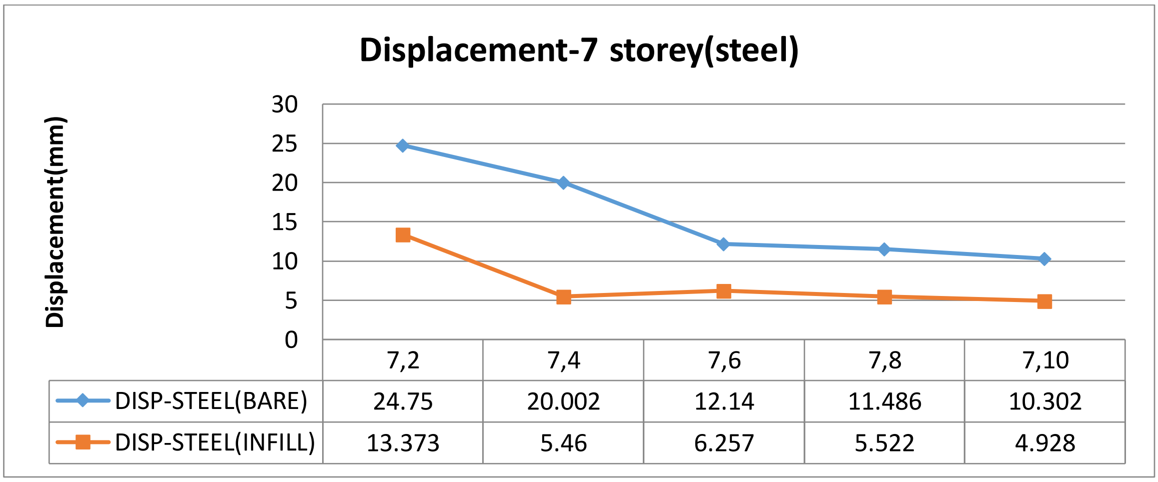
Fig. 5. Base Shear of Steel Frames With And Without Infill



On X-axis: (7, 2)- (Storey, Bays)

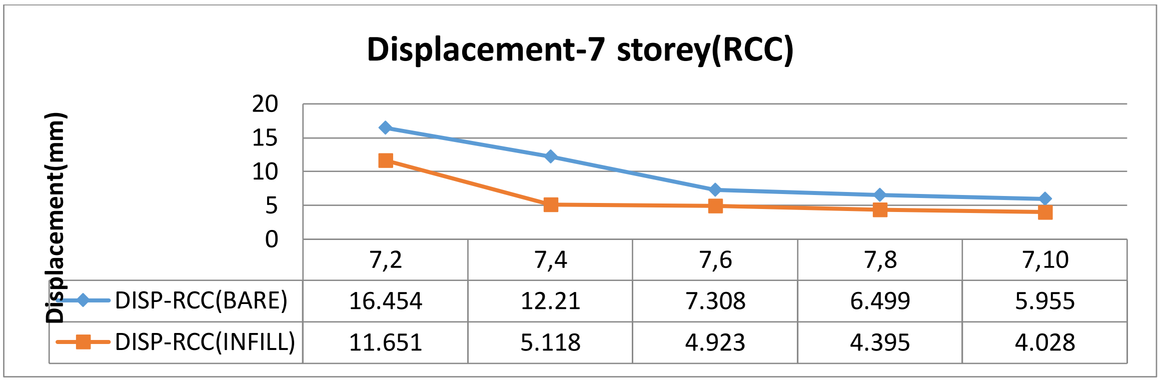
Fig. 6. Base Shear of RCC Frames with and Without Infill

- **Displacement**



On X-axis: (7, 2)- (Storey, Bays)

Fig. 7. Displacement of Steel Frames With And Without Infill



On X-axis: (7, 2)- (Storey, Bays)

Fig. 8. Displacement of RCC Frames With And Without Infill

Discussions

Following observations were made. As the number of bays are increasing the time period in the infill frame is decreasing. The time period of (7 storey 10 bays) frame with infill is 46% less than the time period of (7 storey10 bays) bare frame . When infill is provided in steel frame the base shear increases due to the increase in weight of the structure. (7 storey 10 bays) of infill has the value 53% more than the value of (7 storey 10 bays) of bare frame. For e.g. the base shear of infill frame has increased by 53% than bare for(7 storey, 10 bays). Provision of infill reduces the displacement of frames. Particularly for (7storey 10 bays) of infill frame displacement has reduced by 52% compared to bare frame. The displacement of infill frame has reduced by 52% than bare frame for (7 storey, 10 bays) building

Conclusions

Following prominent conclusions were made. The effect of number of bays is marginal for Time Period but substantial for Base Shear. It can be concluded that the redundancy in the form of masonry infill wall will reduce the Time period, displacement substantially for steel as well as RCC frames. However, the base shear is increased. Effect of masonry infill walls is almost same for Time Period and Displacement parameters for (7 storey,10 bays), whereas increment in Base Shear is less in moderate buildings. So masonry infill walls shall preferably be considered for steel frames.

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Declarations: The manuscript has not been submitted/presented for consideration to any other journal or conference.

Data Availability: The author holds all the data employed in this study and is open to sharing it upon reasonable request.

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