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Out of Plane Behavior of Contained Masonry Infilled Frames Subjected to Seismic Forces

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Abstract: **Brick masonry infill although considered as non-structural element largely affects the strength, stiffness and ductility of the reinforced concrete frames during the application of lateral loads due to wind or earthquake. Contained masonry refers here to the brick masonry which is used as infill in a reinforced concrete frame, wound round with 8mm diameter mild steel wires in vertical and horizontal directions and stitched to the brick masonry as well as to the reinforced concrete frames. This thesis focuses on the seismic behaviour of reinforced concrete structures with contained masonry infill, with a particular interest in the development of rational procedures for the analysis and design of RC frames with contained masonry infill. The estimation of the natural frequencies of the structural system is the basic investigation in dynamic analysis of a structure. Therefore the analysis is primarily to find out the modal frequencies of the structure and to simulate the mathematical model to earthquake loads. The structure vibrates in different modes when the earthquake takes place. The methodology suggested is to carry out a detailed study on the influence of contained masonry infill including un-reinforced masonry infill in multi-storey Reinforced Concrete frames on the fundamental natural frequencies and response due to various earthquake excitation forces. Numerical Finite element analysis is carried out on two dimensional Reinforced Concrete Frames under different configurations of contained masonry infill in addition to plain masonry and bare frames. The RC frames were designed and detailed as per relevant Indian standard codes. The present work consists of study of the behaviour of five storeyed RC frames infilled with contained masonry and also infilled with plain masonry, subjected to various earthquake excitation forces. Three types of models are considered for analysis; five storey frames of 4m wide, 5m wide and 6m wide models having total height of 16m with plain masonry infill and contained masonry infill are considered.**

Keywords: **Seismic Behavior, Masonry Infill, Earthquake Excitation Forces.**

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1. INTRODUCTION

General:

Reinforced Concrete (RC) frames with plain masonry infill panels are one of the most widely used forms of multi-storey construction. It provides better insulation for the effects such as heat, wind, rain, and extreme climatic conditions and is having strong fire resistance also. The masonry infills are constructed after the basic frame work of beams, columns and slabs have gained sufficient strength. They develop a week bond between masonry panel and concrete frame at ends side surface of the wall. Therefore they are considered as non structural members and the frames are analyzed and designed considering the masonry as dead mass neglecting the interactions of such panels. This assumption is reasonable and justifiable for the gravity loads, but the same is not true for the structure with masonry infill panels when subjected to lateral loads due to earthquake or wind. Under seismic loads, additional stiffness due to masonry infill will modify and influence the structural response of the RC frames and it significantly alters the dynamic behaviour of the frame.

The internal design forces are dependent on the originating forces which depend on the strength and deformability criteria of the constituent member elements. The internal design forces depend upon the accuracy of the method employed in their analytical determination. Analysing and designing buildings for the static forces are routine work with the use of affordable computers and specialized programs. On the other hand, dynamic analysis is a time consuming process which requires additional input information related to mass of structure and also the aspect ratio of the member and an understanding of structural dynamics for interpretation of analytical results are prerequisite.

The main purpose of linear dynamic analysis is to evaluate the time variation of stresses and deformations in structures caused by arbitrary dynamic loads. Vibration properties of buildings can be estimated by solving Eigen value problem given by:

$$[k - \omega_n^2 m]\emptyset_n = 0, where, \omega_n = \frac{2\pi}{T_n} \ldots\ldots\ldots.(1)$$

Where k and m are the stiffness and mass matrices of buildings respectively, and ω_n, $\emptyset_n$ and T_n are the natural frequency, mode shape and natural period of buildings respectively, for the n^{th} mode. Given k and m, the Eigen value problem is to find positive $\omega_n S$ and corresponding $f_n S$. Buildings can vibrate in different mode shapes, and there can be as many mode shapes possible as number of dynamic degrees of freedom in the building. Dynamic degrees of freedom in a structure are the number of independent coordinates in which the structure can undergo motion under dynamic forces. Depending upon the type of building, only the first few mode shapes may govern the response of the building. Lateral displacement, u at any point on the buildings during earthquakes can be expressed as a linear combination of all the mode shapes of buildings as given below:

$$u = \sum_{n=1}^{N} \emptyset_n q_n \quad \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where, q_n are the n^{th} modal coordinates and N is the total number of modes. Shear forces on buildings can be estimated as stiffness times the lateral displacement. Therefore, mode shapes of building play an important role in estimating the design base shear for buildings [Kaushik et al (2006)].

Finite element analysis has been carried out on the models and the RC frames are modelled using 2D concrete element, while the masonry infill is modelled using shell element, and reinforcement bars are modelled using 2D SD section. The SAP2000 version14 FE software is used for performing the analysis. Three types of frames are analysed namely 4m 1bay 5storey frames, 5m 1bay 5storey frames, and 6m 1bay 5storey frames. Each category consists of bare frame, frame with plain masonry in all floors, and frame with contained masonry infill in all floors. Contained masonry consists of 8mm wires in horizontal and vertical in all floors.

2. METHODOLOGY

In the present investigation a simpler procedure for finite element method of analysis of infilled frames which take into consideration all factors. The finite element idealization is done. Frame members are represented by 2D concrete elements (beam elements). The reinforcement (which also incorporates creep and plasticity) has uni-axial stiffness only and is assumed to be smeared throughout the element. Directional orientation is accomplished through user specified angles. The analysis is carried out using SAP 2000 Ver. 14 Commercially available finite element software.

The following three types of models are considered for analysis

1. One bay 5storey bare RC frame.
2. One bay 5 storey RC frames infilled plain masonry.
3. One bay 5 storey RC frames fully infilled with contained masonry.

DIMENSIONS OF RC FRAME:

Shape and size of the infill:

The infill panels are usually square or rectangular depending on the type of building and spacing of columns. The normal height of the floor is in the range of 2.5m to 3.0m. The thickness of walls may vary from 100 to 230 mm. In the present investigation the floor to floor height is maintained at 3.2 m constant and makes the panel height to vary from 2.65m to

2.75m depending on the size of the beam while the span is varying in the range of 4m to 6m. The beam and column dimensions are varied as per span length.

Design:

The RC frames comprises of columns and beams. Analysis of the frames is done using SAP 2000 software. Dead load and earthquake load are considered for analysis.

Dead load (DL):

The dead load is considered as per IS 875-1987 (Part I-Dead loads), "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures".

1. Unit weight of Reinforced Concrete = 25 kN/m^3

Unit weight of Brick = 19.2 kN/m^3

Earthquake Load (EL):

The earthquake load is considered as per the IS 1893-2002(Part 1). The factors considered are

1. Zone factors = 0.10, 0.16, 0.24, 0.36 (zone1-zone 5)
2. Importance factor = 1.0
3. Response reduction factor = 5.0
4. Soil condition = Rock
5. Damping = 5%

	For M_{25} Concrete	For Fe-415 Rebar	For Brick
Modulus of elasticity, E in kN/m^2	2.5×10^7	2.0×10^8	1.5×10^7
Poisson's ratio, U	0.2	0.3	0.18

Details of RC frame:

For 4m wide

1. Breadth of Column, *b* = 0.23 m
2. Depth of Column, *d* = 0.40 m
3. Breadth of Beam, *b* = 0.23 m
4. Depth of Beam, *d* = 0.45 m

For 5m wide:

1. Breadth of Column, *b* = 0.23 m
2. Depth of Column, *d* = 0.45 m
3. Breadth of Beam, *b* = 0.23 m
4. Depth of Beam, *d* = 0.50 m

For 6m wide:

1. Breadth of Column, *b* = 0.23 m
2. Depth of Column, *d* = 0.50 m
3. Breadth of Beam, *b* = 0.23 m
4. Depth of Beam, *d* = 0.55 m
5. Thickness of masonry infill, *t* = 0.23 m
6. Height of masonry infill, *h* = 3.20 m
7. Height of column, h_{col} = 3.20 m

3. MODELLING AND METHODS

Modelling using FE software:

About SAP2000 ver.14:

SAP2000 is a stand-alone finite-element-based structural program for the analysis and design of civil structures. It offers an intuitive, yet powerful user interface with many tools to aid in the quick and accurate construction of models, along with the sophisticated analytical techniques needed to do the most complex projects.SAP2000 is object based, meaning that the models are created using members that represent the physical reality. A beam with multiple members framing into it is created as a single object, just as it exists in the real world, and the meshing needed to ensure that connectivity exists with the other members is handled internally by the program. Results for analysis and design are reported for the overall object, and not for each sub-element that makes up the object, providing information that is both easier to interpret and more consistent with the physical structure.

Finite Element Steps in Analysis of 2D RC Frames:

In this chapter, analysis of 2D RC frames can be done in two methods, they are:

1. Modal Analysis Method.
2. Response spectrum Analysis Method.

Modal Analysis Method:

Modal analysis is the first and important step of analysis, whether it is analytical or theoretical. Modal analysis is the study of the natural characteristics of the structures. This analysis characterises the dynamic properties of an elastic structure by identifying its mode of vibration. The response of the structure is different at each of the different natural frequencies. These deformation patterns are called mode shapes. Both the natural frequency (which depends on the mass and stiffness distributions in structure) and mode shapes are used to help the design of structural system mainly for dynamic applications.

2D RC frames are modelled and the analysis is done considering vibrations in out of plane. The deformed shape obtained is useful in analysing and knowing the behaviour and structural characteristics of the model. The geometry of 2D RC frames is developed as per the dimensions. Appropriate material properties and boundary conditions are assigned and modal analysis is carried out.

Three types of frames are analysed namely 4m 1bay 5storey frames, 5m 1bay 5storey frames, and 6m 1bay 5storey frames. Each category consists of bare frame, frame with plain masonry in all floors, and frame with contained masonry infill in all floors. Contained masonry consists of 8mm wires in horizontal and vertical in all floors.

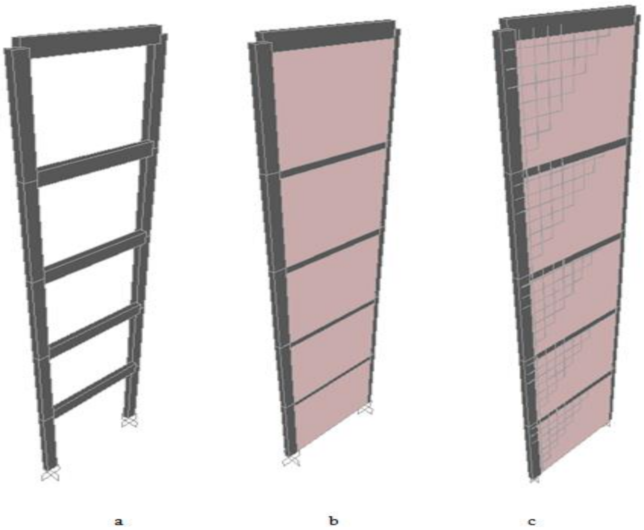

Figure1 showing typical models for 4m, 5m, and 6m 1bay 5storey frames

a) *Bare frame*

b) *Plane masonry*

c) *Contained masonry*

Under dynamic loading the basic investigation starts with the estimation of natural frequency and mode shapes. The steps involved in analysis are as follows.

1. Mode shapes:

Mode shapes are the deformed shape of the structure. It plays an important role in identifying the response of the structure for dead load. Typical Mode shapes for 4m, 5m, and 6m 1bay 5storey frames model with natural frequency is as shown.

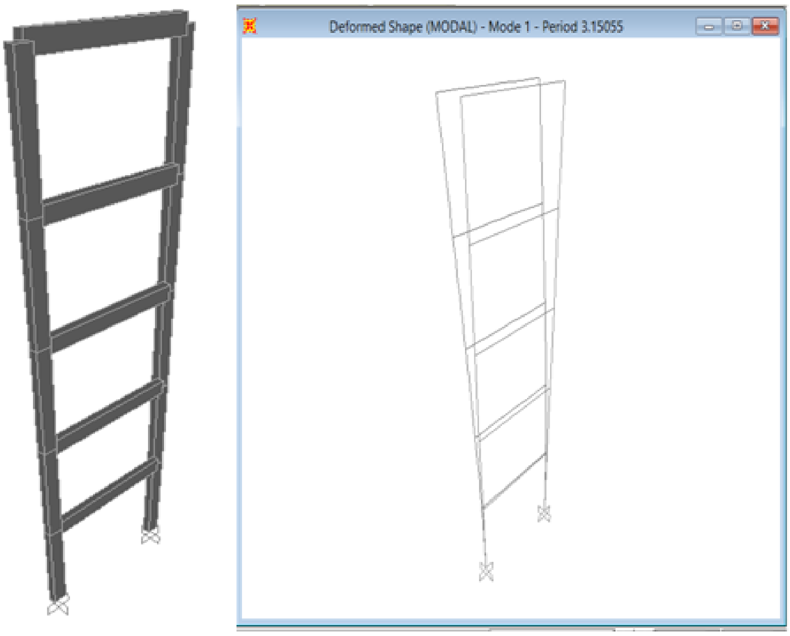

Figure 1.a) showing out-of-plane behaviour of RC Bare frame

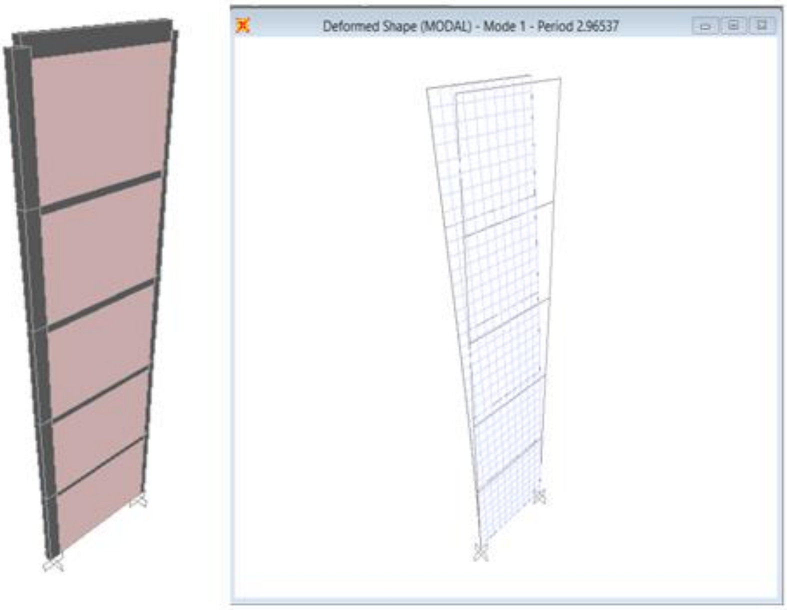

Figure.1.b)showing out-of-plane behaviour of Plane masonry RC frame

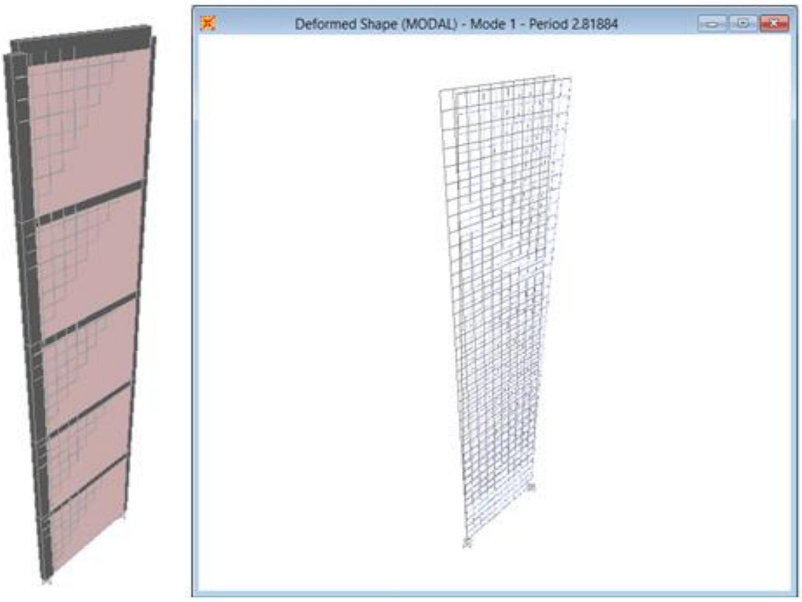

Figure.1.c) showing out-of-plane behaviour of contained masonry RC frame

Table 1.1: Natural frequencies for RC frame models

Models	Frequency in Hz		
	Aspect Ratio		
	1.30	1.68	2.07
Bare Frame	0.3174	0.3005	0.2861
Plane Masonry	0.3372	0.3236	0.3104
Contained Masonry	0.3548	0.3440	0.3337

Response Spectrum Analysis Method:

A response spectrum is simply a plot of the peak or steady-state response (displacement, velocity or acceleration and infill stress) of a series of oscillators of varying natural frequency, that are forced into motion by the same base vibration or shock. The resulting plot can then be used to pick off the response of any linear system, given its natural frequency of oscillation. One such use is in assessing the peak response of buildings to earthquakes. The science of strong ground motion may use some values from the ground response spectrum (calculated from recordings of surface ground motion from seismographs) for correlation with seismic damage.

The parameters considered are type of soil, type of construction, the dynamic behaviour of the prototype structure and the appropriate seismic zone. The earthquake spectrum is an average smoothened plot of maximum acceleration as a function of frequency or time period of vibration for a specified damping and for a site-specific condition.

4. RESULT AND DISSCUSION

In the present study Linear dynamic analysis is performed to evaluate seismic response of bare, plane masonry frame and contained masonry frame model.

From this analysis the modal parameters such as natural frequencies, mode shapes and response characteristic such as max deflection, max acceleration, max masonry stress and max bending moment are carried out and the results are tabulated and discussion were made.

Modal analysis results:

These are the results obtained from the modal analysis of the structure. These results consist of natural frequencies.

Table 1.2 Out of plane natural frequency for RC frame models

Models	**Frequency in Hz**		
	Aspect Ratio		
	1.30	1.68	2.07
Bare Frame	0.3174	0.3005	0.2861
Plane Masonry	0.3372	0.3236	0.3104
Contained Masonry	0.3548	0.3440	0.3337

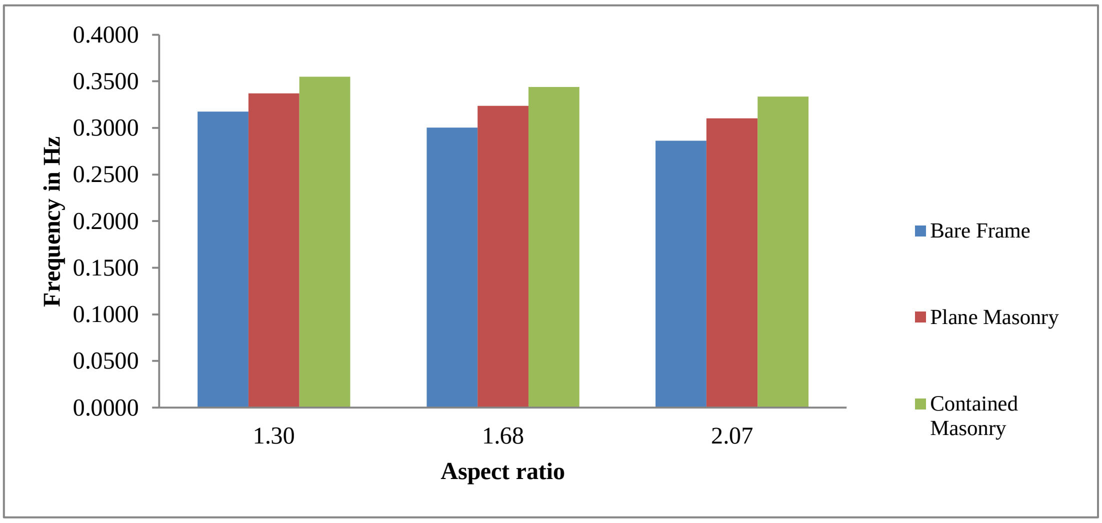

Figure1.2 showing frequency verses aspect ratio for all RC frame models

From above Figure 1.2 it is observed that, as the aspect ratio increases natural frequency decreases due to the increase in the mass of the frame. The natural frequency of frame Bare Frame decreases when compare to Plane Masonry, whereas the natural frequency of Contained Masonry frame is more than the frequency of the Bare Frame and Plane Masonry. The Contained Masonry has the highest natural frequency followed by Plane Masonry, Bare Frame and due to the masonry in fills and the Containment adds stiffness to the structure. As the stiffness increases in the out-of-plane direction, the natural frequency increases. Hence it is clearly observed that the Contained Masonry has a role in the earthquake response of the structure.

Response characteristics results:

Max. Deflection:

Max. Deflection is the structural output result obtained after dynamic analysis of the structure. The masonry infilled RC frame is analyzed for the different seismic zones as specified by the IS 1893 (part 1):2002. The maximum deflection is taken from the result. Tables and graphs shown below are the results obtained from response spectrum analysis.

Table 1.3: Maximum deflection Comparison at the point object: 12

Models	**Aspect ratio**	**Deflection in mm**			
		Zone II	Zone III	Zone IV	Zone V
Bare Frame	1.30	15.95	25.51	38.27	57.41
	1.68	16.77	26.83	40.24	60.36
	2.07	17.44	27.91	41.86	62.80
Plane Masonry	1.30	15.73	25.16	37.74	56.61
	1.68	16.36	26.18	39.27	58.91
	2.07	17.04	27.27	40.91	61.36
Contained Masonry	1.30	15.05	24.08	36.12	54.18
	1.68	15.45	24.71	37.07	55.60
	2.07	15.81	25.29	37.94	56.90

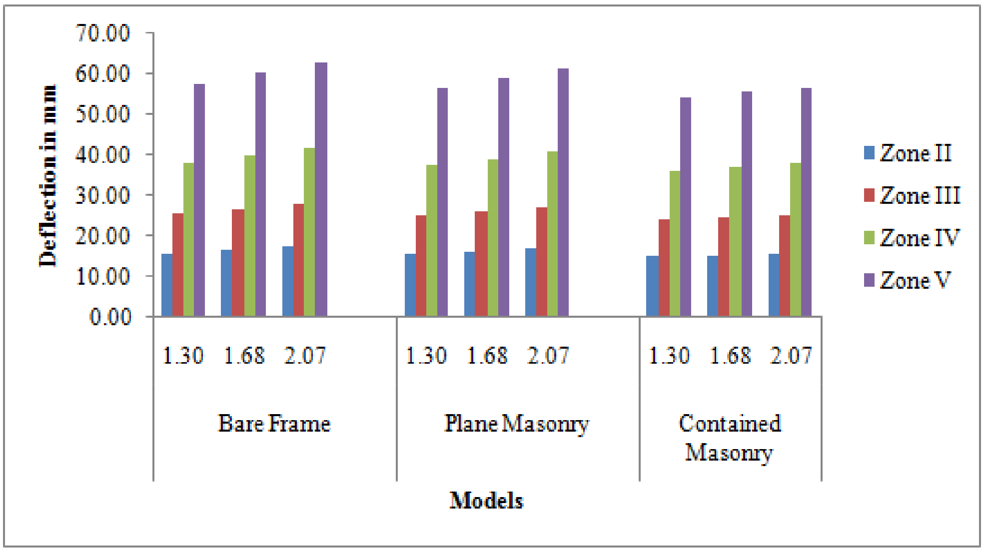

Figure 1.3: showing comparison of max. Deflection verses models

From Fig.1.3, it is observed that the deflection in the Bare Frame at the point object 12 is maximum, compared to the other two conditions (i.e. Plane Masonry and Contained Masonry) which show its criticality in the earthquake resistant design. As the mass increases, deflection decreases. Also the deflection increases from Zone II to Zone V. This indicates that the BF is having maximum deflection because of less stiffness. Plane Masonry and Contained Masonry are having less deflection values because of more stiffness. It is also observer that Plane Masonry and Contained Masonry having same mass, the deflection in Contained Masonry reduced as compared to Plane Masonry due to additional stiffness added to the Contained Masonry by containing it. As the aspect ratio increase from 1.30 to 1.68, deflection of the frame increases by 0.82% in Bare Frame and 0.63% in Plane Masonry, where as it increases by 0.4% in Contained Masonry. When the aspect ratio changes from 1.68 to 2.07, deflection of the frame increases by 0.67% in Bare Frame and 0.68% in Plane Masonry, whereas it increases by 0.36% in Contained Masonry. The deflection increases from Zone II to Zone V with higher percentage in Bare Frame, Plane Masonry, and Contained Masonry respectively. This indicates that the Bare Frame is having maximum deflection because of less stiffness. Plane Masonry and Contained Masonry are having less deflection values because of more stiffness. Hence it is clearly observed that the Contained Masonry has a role in the earthquake response of the structure.

Max. Acceleration:

Table 1.4: Maximum acceleration Comparison at the point object: 12

Models	**Aspect ratio**	**Acceleration in m/s^2**			
		Zone II	Zone III	Zone IV	Zone V
Bare Frame	1.30	0.1884	0.3015	0.4522	0.6783
	1.68	0.1837	0.2939	0.4408	0.6612
	2.07	0.1768	0.2829	0.4243	0.6365
Plane Masonry	1.30	0.2443	0.3909	0.5863	0.8794
	1.68	0.2393	0.3828	0.5742	0.8614
	2.07	0.2364	0.3783	0.5675	0.8512
Contained Masonry	1.30	0.2481	0.3969	0.5954	0.8930
	1.68	0.2442	0.3907	0.5861	0.8792
	2.07	0.2436	0.3897	0.5846	0.8769

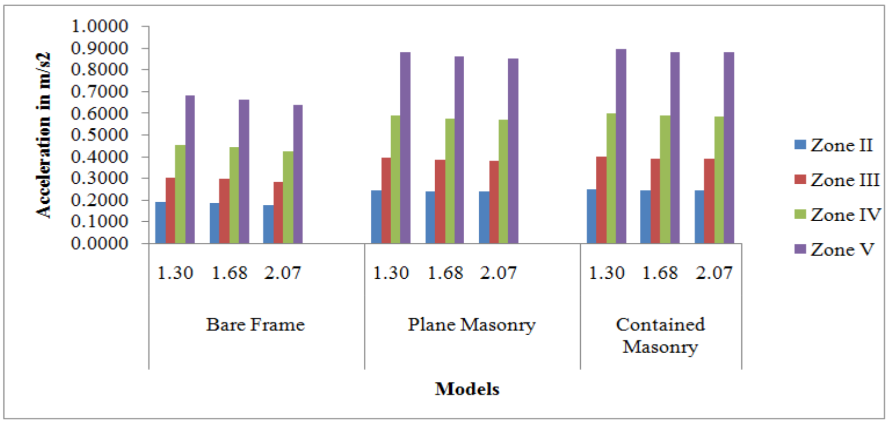

Figure 1.4: showing comparison of max. Acceleration verses models

From Fig.1.4, it is observed that the acceleration in the Bare Frame at the point object 12 is less as compared to the other two conditions (i.e. Plane Masonry and Contained Masonry) which show its criticality in the earthquake resistant design. As the mass increases, acceleration increases. This indicates that the Bare Frame is having less acceleration because of less mass. Plane Masonry and Contained Masonry are having higher acceleration values because of more mass. It is also observer that Plane Masonry and Contained Masonry having same mass, the acceleration in Contained Masonry increased as compared to Plane Masonry due to additional stiffness added to the Contained Masonry by containing it. As the aspect ratio increase from 1.30 to 1.68 for Zone II, acceleration of the frame decreases by 0.0047% in Bare Frame and 0.005% in Plane Masonry, whereas it increases by 0.0039% in Contained Masonry. When the aspect ratio changes from 1.68 to 2.07, acceleration of the frame decreases by 0.0069% in Bare Frame and 0.0029% in Plane Masonry, whereas it increases by 0.0006% in Contained Masonry. The acceleration increases from Zone II to Zone V with higher percentage in Bare Frame, Plane Masonry, and Contained Masonry respectively. This indicates that the Contained Masonry is having maximum acceleration because of more stiffness. Plane Masonry and Bare Frame are having less acceleration values because of less stiffness. Hence it is clearly observed that the Contained Masonry has a role in the earthquake response of the structure.

MASONRY STRESS:

Max. Normal stress σ_x

Table 1.5: Maximum Normal stress σ_x Comparison

Aspect ratio	**Models**	**Max. Normal stress σ_x in kN/m^2**			
		Zone II	Zone III	Zone IV	Zone V
1.30	Plane Masonry	643.21	1029.13	1543.70	2315.55
	Contained Masonry	156.74	250.78	376.17	564.25
1.68	Plane Masonry	691.37	1106.19	1659.29	2488.94
	Contained Masonry	172.62	276.19	414.28	621.43
2.07	Plane Masonry	924.07	1478.52	2217.78	3326.66
	Contained Masonry	206.80	330.88	496.32	744.49

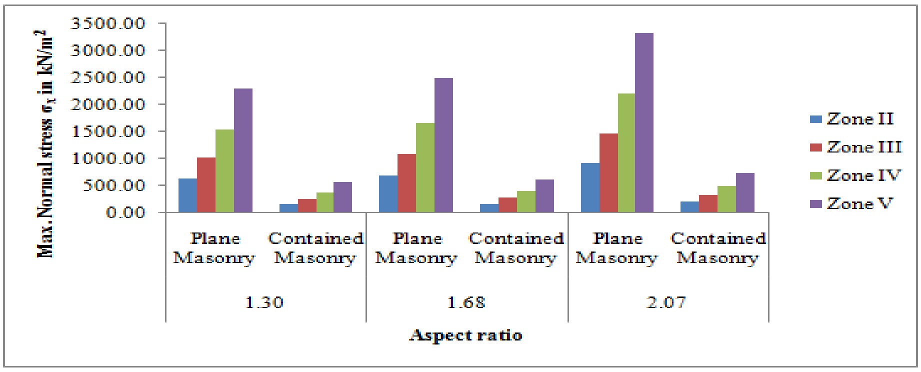

Figure 1.5: showing Max. Normal stress σ_x verses Aspect ratio of RC bare frame models

From Fig.1.5, it is observed that the Normal stress σ_x in the Plane Masonry is high as compared to the Contained Masonry which shows it's criticality in the earthquake resistant design. As the stiffness increases, stress decreases. This indicates that the Plane Masonry is having higher stress because of less stiffness. As the aspect ratio increase from 1.30 to 1.68 and from 1.68 to 2.07 for Zone II, stress in the Plane Masonry and Contained Masonry increases. This indicates that the stress increases as the mass increases. The stress increases from Zone II to Zone V with higher percentage in Plane Masonry and Contained Masonry respectively. Hence it is clearly observed that the Contained Masonry has a role in the earthquake response of the structure.

Max. Normal stress σ_y:

Table 1.6: Maximum Normal stress σ_y Comparison

Aspect ratio	Models	Max. Normal stress σ_y in kN/m^2			
		Zone II	Zone III	Zone IV	Zone V
1.30	Plane Masonry	1205.62	1928.98	2893.48	4340.21
	Contained Masonry	842.14	1347.22	2021.13	3031.70
1.68	Plane Masonry	1252.95	2004.73	3007.09	4510.63
	Contained Masonry	891.50	1426.39	2139.59	3209.39
2.07	Plane Masonry	1361.16	2177.86	3266.78	4900.17
	Contained Masonry	952.11	1523.38	2285.06	3427.60

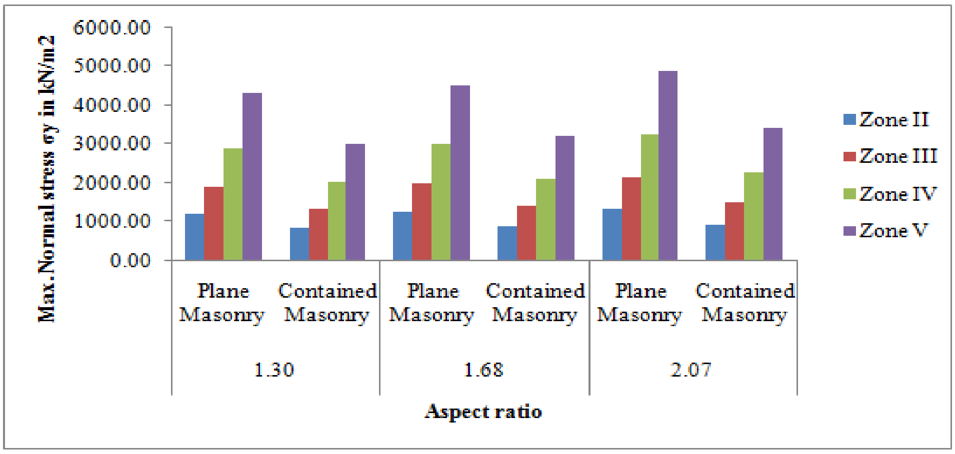

Figure 1.6: showing Max. Normal stress σ_y verses Aspect ratio of RC bare frame models

From Fig.1.6; it is observed that the Normal stress σ_y in the Plane Masonry is high as compared to the Contained Masonry which shows it's criticality in the earthquake resistant design. As the stiffness increases, stress decreases. This indicates that the Plane Masonry is having higher stress because of less stiffness. As the aspect ratio increase from 1.30 to 1.68 and from 1.68 to 2.07 for Zone II, stress in the Plane Masonry and Contained Masonry increases. This indicates that the stress increases as the mass increases. The stress increases from Zone II to Zone V with higher percentage in Plane Masonry and Contained Masonry respectively. Hence it is clearly observed that the Contained Masonry has a role in the earthquake response of the structure.

Max. Shear stress σ_{xy}:

Table 1.7: Maximum Normal stress σ_{xy} Comparison

Aspect ratio	Models	Max. Shear stress σ_{xy} in kN/m^2			
		Zone II	Zone III	Zone IV	Zone V
1.30	Plane Masonry	533.00	852.80	1279.20	1918.81
	Contained Masonry	218.25	349.20	523.79	785.69
1.68	Plane Masonry	575.11	920.18	1380.27	2070.40
	Contained Masonry	240.58	384.92	577.38	866.07
2.07	Plane Masonry	672.97	1076.75	1615.13	2422.69
	Contained Masonry	263.72	421.95	632.92	949.38

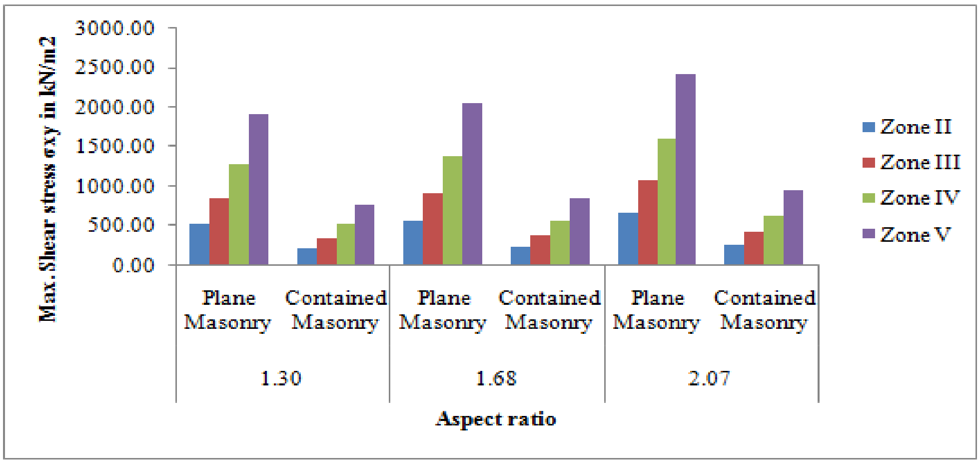

Figure 1.7: showing Max. Shear stress σ_{xy} verses Aspect ratio of RC bare frame models

From Fig.1.7, it is observed that the Shear stress σ_{xy} in the Plane Masonry is high as compared to the Contained Masonry which shows it’s criticality in the earthquake resistant design. As the stiffness increases, stress decreases. This indicates that the Plane Masonry is having higher stress because of less stiffness. As the aspect ratio increase from 1.30 to 1.68 and from 1.68 to 2.07 for Zone II, stress in the Plane Masonry and Contained Masonry increases. This indicates that the stress increases as the mass increases. The stress increases from Zone II to Zone V with higher percentage in Plane Masonry and Contained Masonry respectively. Hence it is clearly observed that the Contained Masonry has a role in the earthquake response of the structure.

Max. Bending Moment:

Table 1.8: Maximum bending moment M_2comparison at the point object: 1

Aspect ratio	Models	Max. Bending moment M_2 in kN-m			
		Zone II	Zone III	Zone IV	Zone V
1.30	Bare Frame	2.44	3.90	5.85	8.77
	Plane Masonry	6.38	10.21	15.31	22.97
	Contained Masonry	4.25	6.79	10.19	15.28
1.68	Bare Frame	2.91	4.66	6.98	10.48
	Plane Masonry	7.59	12.15	18.22	27.33
	Contained Masonry	5.09	8.14	12.22	18.32
2.07	Bare Frame	3.38	5.41	8.12	12.18
	Plane Masonry	9.29	14.86	22.30	33.44
	Contained Masonry	6.04	9.57	14.49	21.73

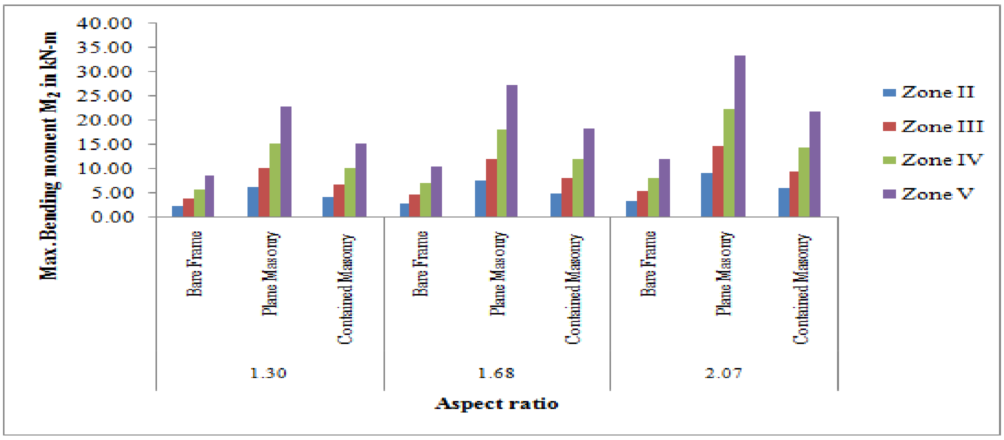

Figure 1.8: showing comparison of Max. Bending moment M_2 verses Aspect ratio of RC bare frame models

From Fig.1.8, it is observed that the moment in the Bare Frame at the point object 1 is less as compared to the other two conditions (i.e. Plane Masonry and Contained Masonry) which show its criticality in the earthquake resistant design. As the mass increases, moment increases. This indicates that the Bare Frame is having less moment because of less mass. Plane Masonry and Contained Masonry are having higher moment values because of more mass. It is also observer that Plane Masonry and Contained Masonry having same mass, the moment in Contained Masonry decreased as compared to Plane Masonry due to additional stiffness added to the Contained Masonry by containing it. As the aspect ratio increase from 1.30 to 1.68 for Zone II, bending moment of the frame increases by 0.0047% in Bare Frame and 0.0121% in Plane Masonry, whereas it increases by 0.0084% in Contained Masonry. When the aspect ratio changes from 1.68 to 2.07, bending moment of the frame increases by 0.0047% in Bare Frame and 0.017% in Plane Masonry, whereas it increases by 0.0095% in Contained Masonry. The moment increases from Zone II to Zone V with higher percentage in Bare Frame, Plane Masonry, and Contained Masonry respectively. This indicates that the Plane Masonry is having maximum bending moment because of less stiffness. Bare frame and Contained Masonry are having less moment values because of more stiffness. Hence it is clearly observed that the Contained Masonry has a role in the earthquake response of the structure.

5. CONCLUSION

Present numerical investigation is an attempt to understand the behaviour of RC frames infilled with plain masonry and RC frames infilled contained masonry under different earthquake excitation forces. The parameters such as panel aspect ratio, the orientation of containment element in contained masonry such as vertical & horizontal containment in both directions which influence the behaviour are considered.

Following are the major conclusions

1. The natural frequency of the structure with all cases found to increases from RC bare frame to contained masonry infilled frame for various earthquake excitation forces.

2. The Lateral deflection of the structure with all cases found to decreases from RC bare frame to contained masonry infilled frame for various earthquake excitation forces.

3. The joint acceleration of the structure with all cases found to increases from RC bare frame to contained masonry infilled frame for various earthquake excitation forces.

4. The Masonry stresses of the structure with all cases found to decreases from Plane masonry infilled frame to contained masonry infilled frame for various earthquake excitation forces.

5. The Max. Bending moment of the structure with all cases found to increase in Plain masonry as compared to bare frame and contained masonry infilled frame even though contained masonry is having more mass it found to decreases than Plane masonry infilled frame in all cases.

6. Contained masonry in RC frames alters and influences the strength and stiffness of the RC frame and also it increases the wall ductility and energy dissipation required during dynamic loading such as earthquake.

Containment eliminates the sudden brittle behaviour typically associated with brick masonry infill, which is a major seismic hazards problem in earthquake prone regions. In addition, it maintains the wall integrity even after sever damage.

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