International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue 09
August 2017

Seismic Evaluation of a Highrise Building with and Without Infill Walls

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Abstract

Infill wall is the generic name given to a panel that is built in between the floors of the primary structural frame of a building and provides support for the cladding system. Now a days infill wall is considered to be non-load bearing member. In the design and assessment of building, the infill walls are usually treated as nonstructural Element and they are ignored in analytical models because they are assumed to be non-beneficial to the structural response. By increasing the strength and stiffness of the frame, infill wall actually lead to greater seismic force which is due their stiffening effect on the whole structure. The present Objective this work is to compare the behavior of RCC Building with and without Masonry infill walls in different positions. The parametric Studies comparison of Maximum Story Displacement, Maximum Story Drift generated in Normal Building and Masonry infill wall buildings Using Response Spectrum Analysis in ETABS Software.

Keywords: Response Spectrum Analysis, Bare Frame RCC Building, RCC Building with masonry infill walls, Storey Drift, Storey Displacement, ETABS software.

I. INTRODUCTION

A series of connected, interrelated elements together form a system is called a structure which provides adequate rigidity and can resist a series of external load effects applied to it, including its own self weight. In civil engineering , a structure is usually made up of beams, columns, cables, slabs. Failure of a structure can occur from many types of problems such as if the structure is not strong and tough enough to support the load, due to instability, failure is caused by manufacturing errors, from the use of defective materials, failure is from lack of consideration of unexpected problems. Earthquakes are caused by differential movements of the earth's crust. An earthquake is the result of a rapid release of strain energy stored in the earth's crust that generates seismic waves. Structures are vulnerable to earthquake ground motion and damage the structures. The result of these movements is the well-known 'ground shaking' that can lead to significant damage and/or collapse of buildings, infrastructure systems (e.g. dams, roads, bridges, via ducts etc.),landslides, when soil slopes lose their cohesion, liquefaction in sand and destructive waves or' tsunamis' in the maritime environments. Here are the biggest reasons buildings fail in an earthquake.

1.1 INTRODUCTION TO INFILL WALLS

Interior partitions and Exterior wall in buildings are infill walls which are frequently used. In the design and assessment of building, the infill walls are usually treated as non-structural element and they are ignored in analytical models because they are assumed to be non-beneficial to the structural response. The reinforced concrete buildings cause undesirable effects such as softstorey effect, short-column effect and torsion and out-of plane collapse under seismic loading masonry infill. Masonry infill walls are stiffer in nature, thus attracts more lateral seismic shear force on building. This research work is mainly focused on seismic behavior of RC frames in filled with masonry panels. In multi-storey buildings, the RC frame structures are constructed initially due to ease of construction and rapid work in progress. In filled RC frame buildings the masonry are commonly constructed for commercial, residential and industrial buildings in seismic regions. In RC frame brick walls is just architectural point of view and to make partition and other aspect. In multistory buildings, the ordinarily occurring vertical loads i.e. dead or alive, do not cause much of an effects, but the lateral loads due to wind or earthquake tremors are a matter of great concern and need special consideration in the design of buildings. These lateral forces can produce the critical stress in a structure, set up undesirable vibrations, and in addition, cause lateral sway of the structure which can reach a stage of discomfort to the occupants. The countries which are situated in seismic region, reinforced concrete frames which are filled fully or partially by 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 behavior of the frame and the infill. During the elastic response phase, the presence of brick infill walls increases in plane lateral stiffness of the structure and reduced its fundamental period, and as a result leads to larger shear forces.

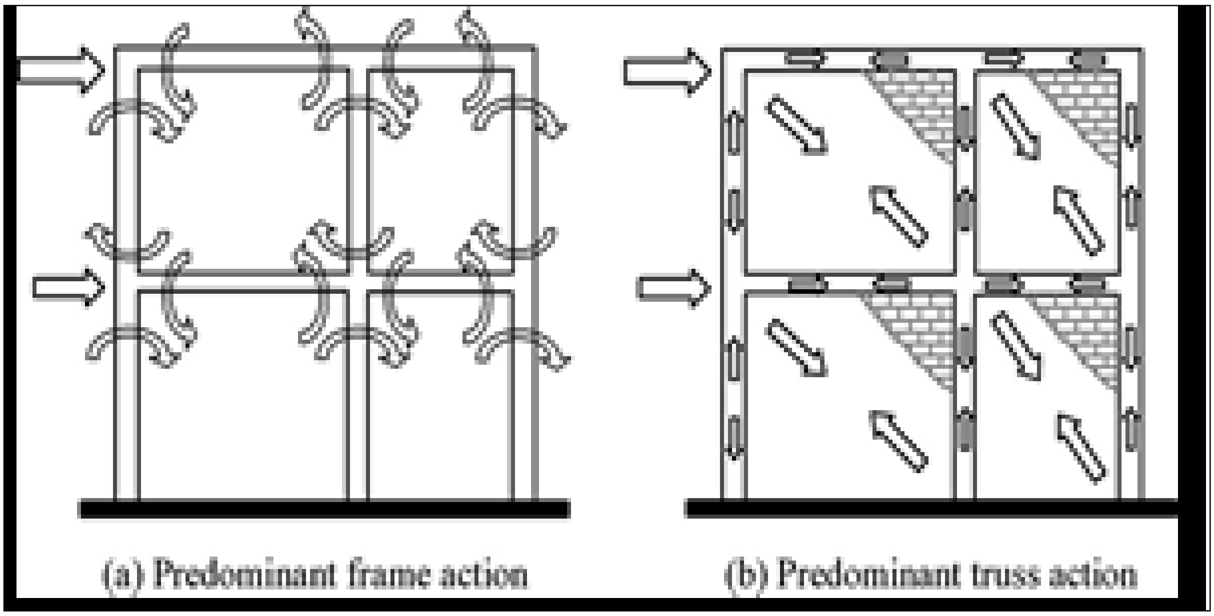

(a) Predominant frame action
(b) Predominant truss action

Fig No: 1. 1 Change in lateral-load transfer mechanism due to masonry infill

1.2 ROLE OF INFILL

To increase the ultimate lateral resistance of the system existence of the infilling is noted while resulting in less ultimate lateral deflection for lower infilling. For higher percentages of infilling the effect on both parameters is more pronounced. Two phenomena arise through the stage of loading and result in the response nonlinearity. First is to find the stiffness degradation of the reinforced concrete with load-induced orthography depending on both the applied dynamic load and the inherent deformational characteristics of the frame. To find the progressive strength reduction of either of the diagonal struts is the second one, according to level of loading it is found to be sequential.

1.3 OBJECTIVE AND SCOPE

If structure is not constructed in earthquake prone areas the structure needs not to be analyzed for the seismic analysis, the dead load and live load analysis is enough without considering the seismic forces. As occurrence of earthquakes in India is increasing day by day the demand of seismic analysis is increasing. In this present work Seismic analysis of a malty storey building with and without infill walls has been analyzed under Response spectrum Analysis.

The purpose of this project is

1. To study the seismic behavior of malty storey building with and without infill Walls using Response Spectrum analysis by using ETABS software.
2. To study and evaluate various Seismic assessment parameters such as Storey Displacement, Storey Drift.
3. To compare the maximum Storey Drift, Storey Displacement of a Normal Building with infill walls building obtained by the Response Spectrum method.

II. METHODOLOGY

On the basis of external action, the behavior of structure or structural materials, and the type of structural model selected the analysis is performed. Based on the type of external action and behavior of structure, the analysis can be further classified as given below

A. Equivalent static analysis
B. Nonlinear Static Analysis
C. Response Spectrum Method

From the above methods I have chosen the Response Spectrum Analysis for the analysis of a Flat Slab, Grid Slab and Flat Plate.

A series of oscillators with varying natural frequency is simply a plot of the steady state response or peak of response spectrum, that are forced into motion by the same base vibration or shock. To pick off the response of any linear system the resulting plot is used, given its natural frequency of oscillation. One such use is in assessing the peak response of buildings to earthquakes. Some values are used from the ground response spectrum by the science of strong ground motion with seismic damage (calculated from recordings of surface ground motion from seismographs).

III MODELLING

Nine Normal building and different position of infill walls in buildings are taken for the analysis. The height of each floor will be taken as 3m.The Buildings are subjected to vertical loads as well as Horizontal Loads.

DETAILS OF NORMALBUILDING

Table No 3.1 shows the details of Normal Building

1. Plan Dimensions	25 m X 25 m
2.Length in X- Direction	25 m
3.Length in Y- Direction	25m
4. Floor to floor height	3m
5. No. of Stories	9
6.Total height of Building	26.75 m
7.Slab Thickness	150 mm
10. Beam Size	300 mm X 450 mm
11. Size Of the column	450mmX 450 mm
13. Grade of Concrete	M25
14. Grade of steel	Fe415
15. Panel Dimensions	5m X 5 m
16.Loading	Terrace Remaining FLR
A)Live Load	1.5 kN/sq.m 4 kN/sq.m
B) Dead Load	3 kN/sq.m 2.7 kN/sq.m

3.4 DETAILS OF INFILL WALL AT CENTER OF A BUILDING

TableNo3.2showsthe details of infill wall at center of a building

1. Plan Dimensions	25 m X 25 m
2.Length in X- Direction	25 m
3.Length in Y- Direction	25m
4. Floor to floor height	3m
5. No. of Stories	9
6.Total height of Building	26.75 m
7.Slab Thickness	150 mm
10. Beam Size	300 mm X 450 mm
11. Size Of the column	450mmX 450 mm
13. Grade of Concrete	M25
14. Grade of steel	Fe415
15. Panel Dimensions	5m X 5 m
16.Loading	Terrace Remaining FLR
A)Live Load	1.5 k N/sq. m 4 k N/sq. m

B) Dead Load	3 k N/sq. m 2.7 k N/sq. m
17. masonry infill wall thickness	230 mm
18. location of infill wall	Edge Center of the building

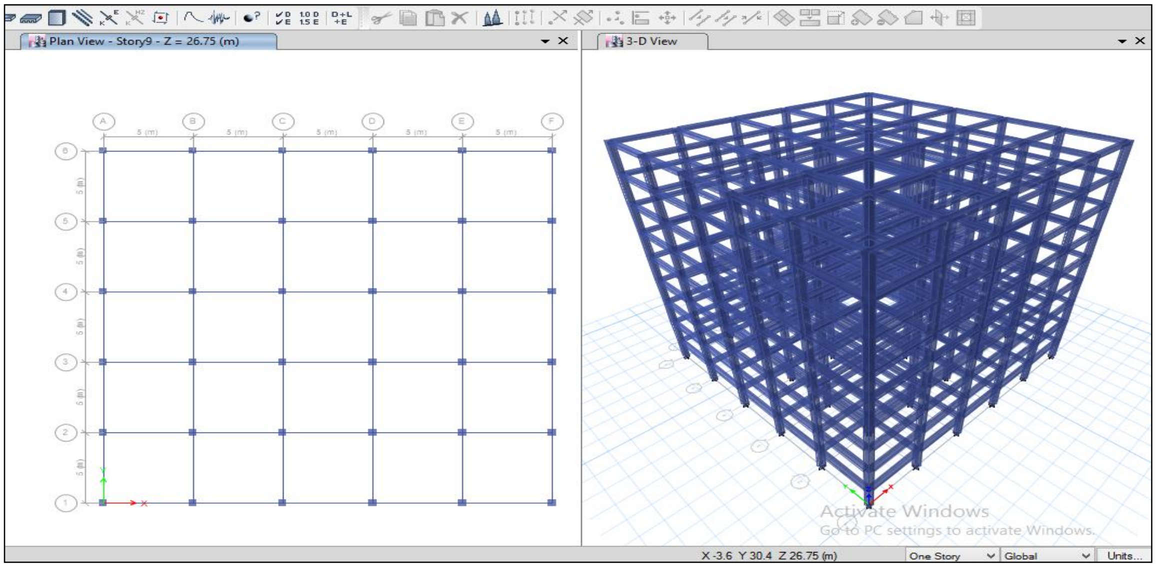
DETAILS OF INFILL WALL AT CORNER OF A BUILDING

TableNo3.3showsthe details of infill wall at corner of a building

1. Plan Dimensions	25 m X 25 m
2.Length in X- Direction	25 m
3.Length in Y- Direction	25m
4. Floor to floor height	3m
5. No. of Stories	9
6.Total height of Building	26.75 m
7.Slab Thickness	150 mm
10. Beam Size	300 mm X 450 mm
11. Size Of the column	450mmX 450 mm
13. Grade of Concrete	M25
14. Grade of steel	Fe415
15. Panel Dimensions	5m X 5 m
16.Loading	Terrace Remaining FLR
A)Live Load	1.5 k N/sq. m 4 k N /sq. m
B) Dead Load	3 k N/sq. m 2.7 k N/sq. m
17. masonry infill wall thickness	230 mm
18. location of infill wall	Edge Center of the building

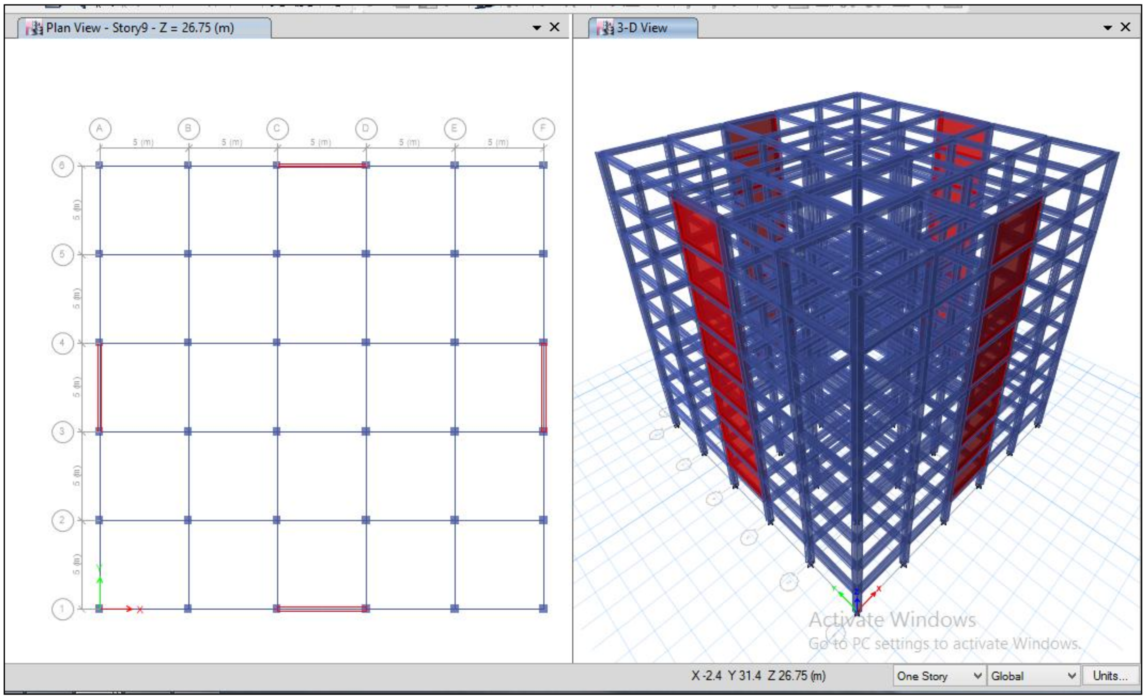
IV .ANALYSIS OF MODEL

NORMAL BUILDINGMODELINGBY USINGETABS



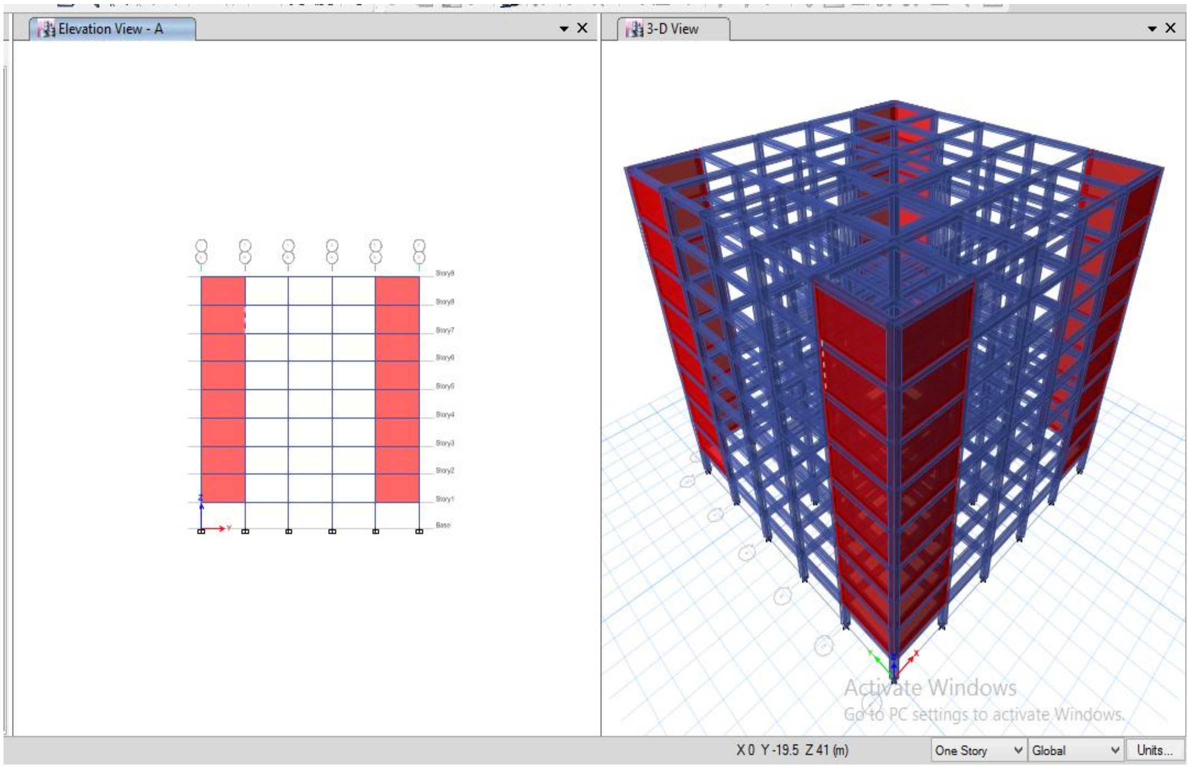
Three- Dimensional view of the Normal Building in ETABS.

LOCATION OF INFILL WALL AT CENTER OF BUILDINGMODELINGBY USINGETABS



Three- Dimensional view of Location of Infill Wall at Center of Building Modeling By Using E-tabs.

LOCATION OF INFILL WALL AT CORNER OF BUILDINGMODELINGBY USINGETABS

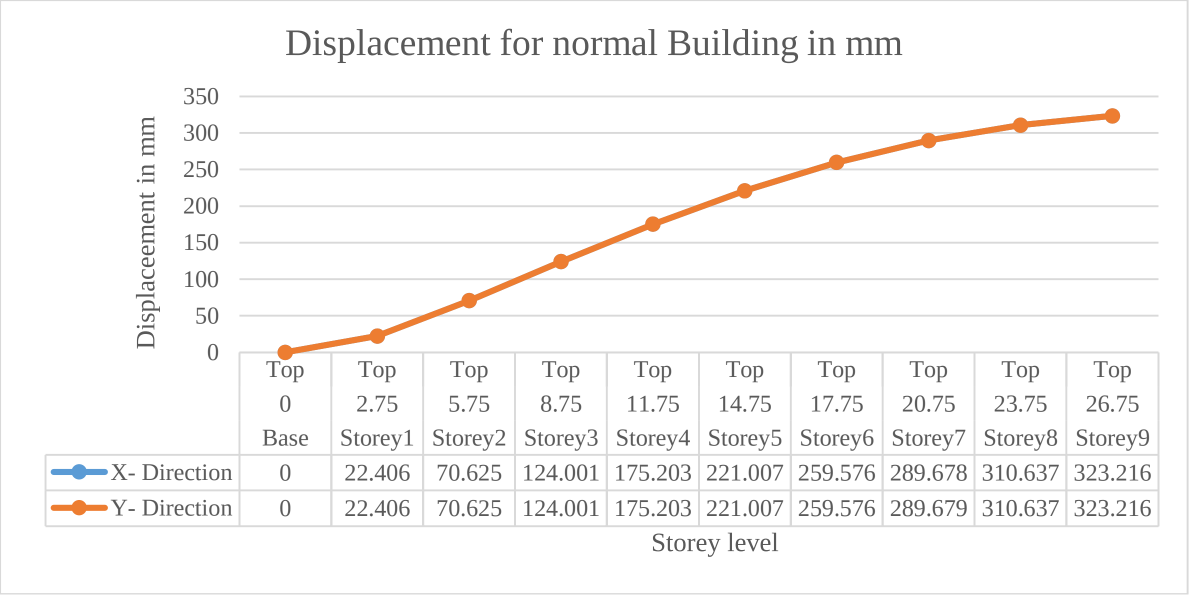


V. RESULTS AND DISCUSSION

The maximum storey Displacement and drifts of Normal Building and Different locations of masonry in fill walls in buildings in different stores for Response spectrum analysis has been collected. The Storey Drift and Displacement of Normal Building and Different locations of masonry in fill walls in building results are taken for Response spectrum analysis drawn based on the results.

5.1 Story Displacement in Zone III:

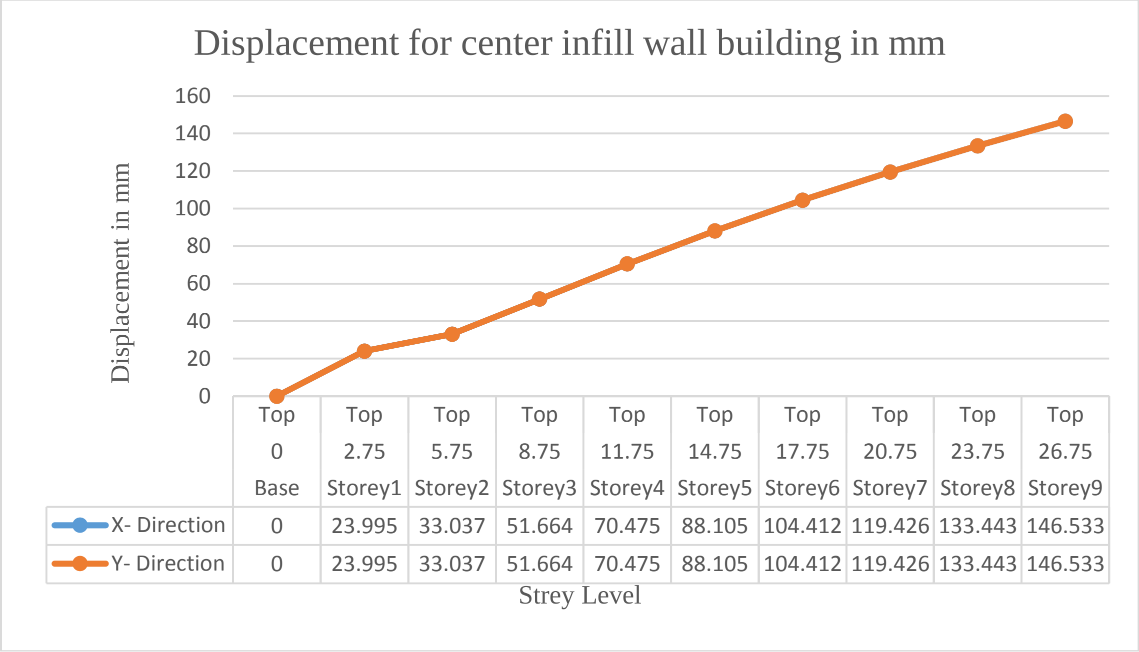
The Below Figures from5.1-5.3Show the Storey Displacement of Normal Building, location of masonry in fill wall at center and corner of the building With respect to Zone III Medium Soil (soil Type II).



Displacement for normal Building in mm

	Top 0 Base	Top 2.75 Storey1	Top 5.75 Storey2	Top 8.75 Storey3	Top 11.75 Storey4	Top 14.75 Storey5	Top 17.75 Storey6	Top 20.75 Storey7	Top 23.75 Storey8	Top 26.75 Storey9
X- Direction	0	22.406	70.625	124.001	175.203	221.007	259.576	289.678	310.637	323.216
Y- Direction	0	22.406	70.625	124.001	175.203	221.007	259.576	289.679	310.637	323.216

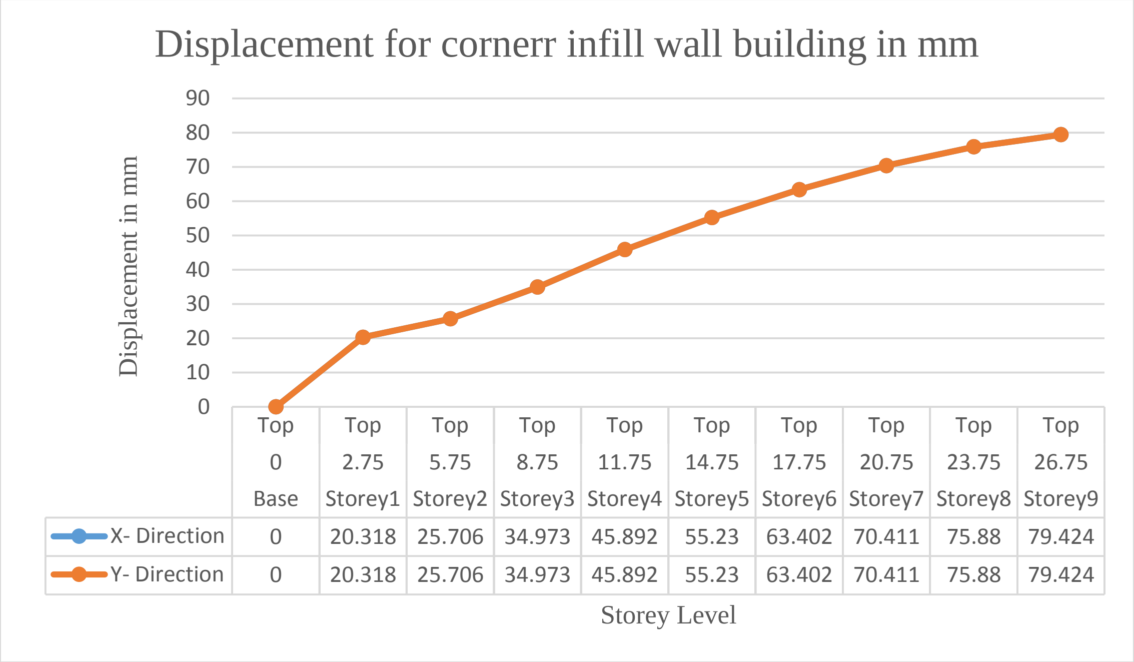
Fig.5.1Storydisplacementin ZoneIIISoilIIGraph



Displacement for center infill wall building in mm

	Top 0 Base	Top 2.75 Storey1	Top 5.75 Storey2	Top 8.75 Storey3	Top 11.75 Storey4	Top 14.75 Storey5	Top 17.75 Storey6	Top 20.75 Storey7	Top 23.75 Storey8	Top 26.75 Storey9
X- Direction	0	23.995	33.037	51.664	70.475	88.105	104.412	119.426	133.443	146.533
Y- Direction	0	23.995	33.037	51.664	70.475	88.105	104.412	119.426	133.443	146.533

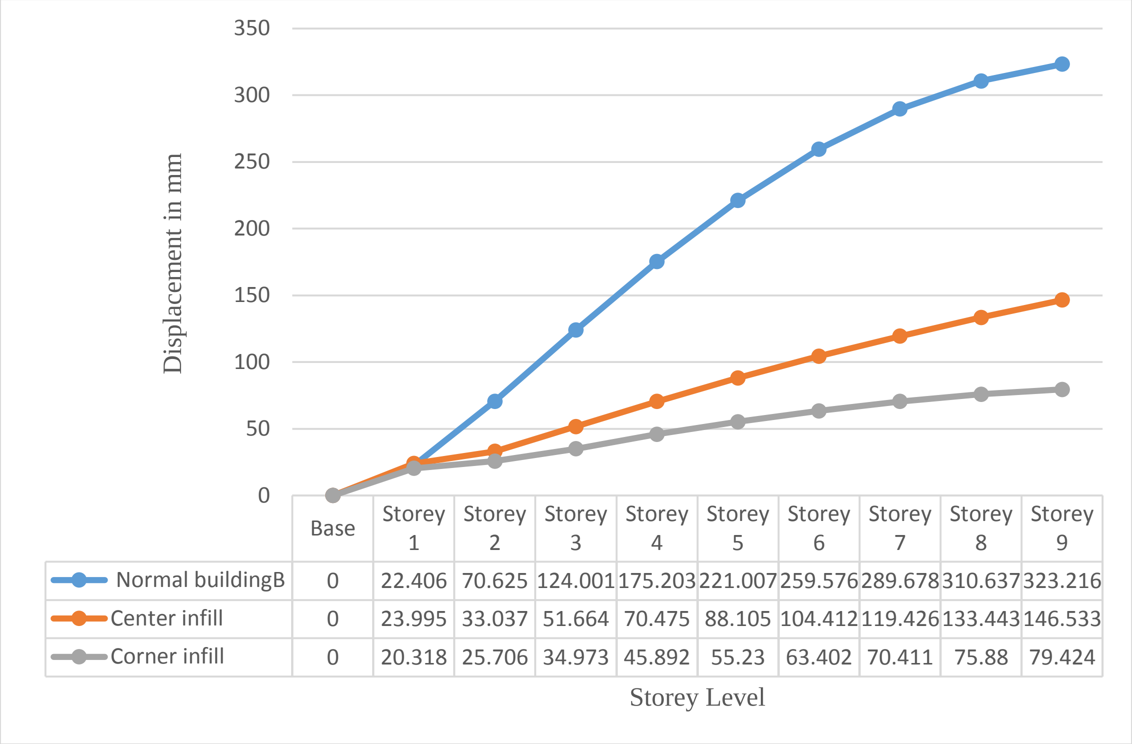
Fig.5.2Storydisplacementin ZoneIIISoilIIGraph



	Top 0 Base	Top 2.75 Storey1	Top 5.75 Storey2	Top 8.75 Storey3	Top 11.75 Storey4	Top 14.75 Storey5	Top 17.75 Storey6	Top 20.75 Storey7	Top 23.75 Storey8	Top 26.75 Storey9
X- Direction	0	20.318	25.706	34.973	45.892	55.23	63.402	70.411	75.88	79.424
Y- Direction	0	20.318	25.706	34.973	45.892	55.23	63.402	70.411	75.88	79.424

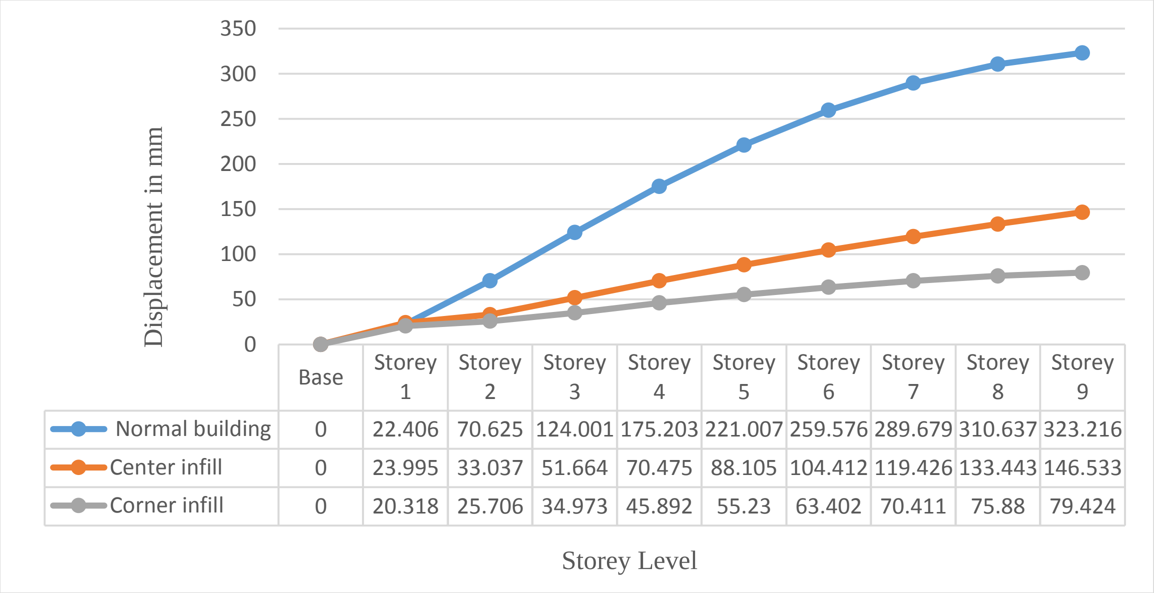
Fig.5.3 Storey displacement in Zone III Soil II Graph

The below graph shows the Storey Displacement of a normal building, position of a masonry infill wall at center and corner of a building. Here the Maximum Displacement Occurs in Normal Building Compare to Location of a Masonry in fill at center and corner of a buildingto the Unit Weight of Member. The Below Graph Show the Displacement in X- Direction and Y- Direction of a Normal Building, Location of masonry at center and corner of a building. And the Maximum displacement was occur in Normal Building.



	Base	Storey 1	Storey 2	Storey 3	Storey 4	Storey 5	Storey 6	Storey 7	Storey 8	Storey 9
Normal buildingB	0	22.406	70.625	124.001	175.203	221.007	259.576	289.678	310.637	323.216
Center infill	0	23.995	33.037	51.664	70.475	88.105	104.412	119.426	133.443	146.533
Corner infill	0	20.318	25.706	34.973	45.892	55.23	63.402	70.411	75.88	79.424

Fig.5.4Storeydisplacement of Zone III Soil II Graph in X- Direction



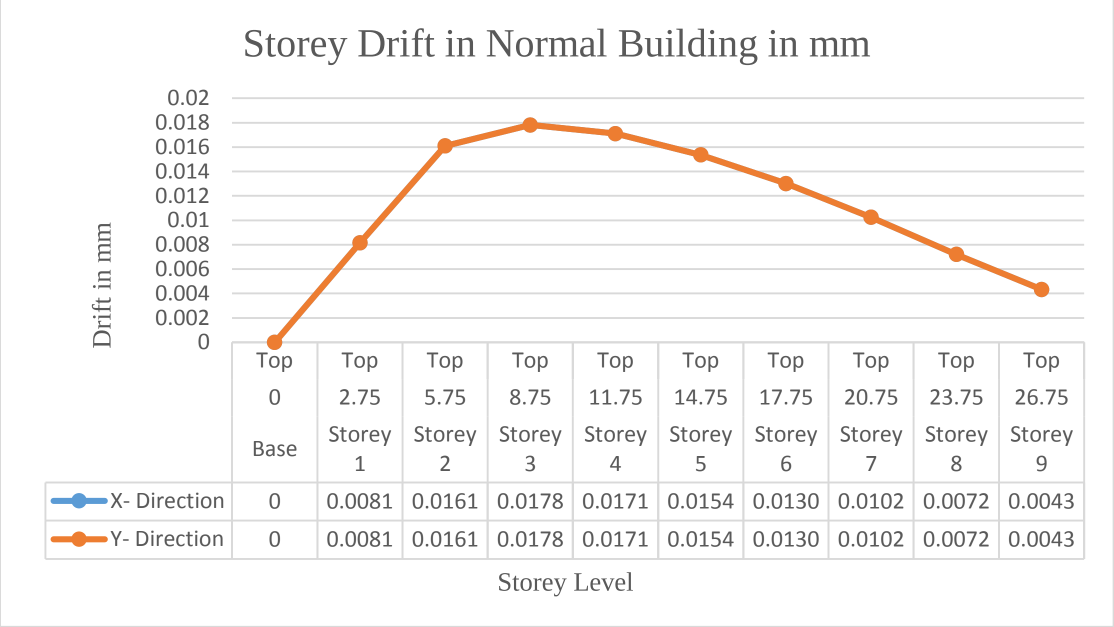
	Base	Storey 1	Storey 2	Storey 3	Storey 4	Storey 5	Storey 6	Storey 7	Storey 8	Storey 9
Normal building	0	22.406	70.625	124.001	175.203	221.007	259.576	289.679	310.637	323.216
Center infill	0	23.995	33.037	51.664	70.475	88.105	104.412	119.426	133.443	146.533
Corner infill	0	20.318	25.706	34.973	45.892	55.23	63.402	70.411	75.88	79.424

Fig.5.5Storydisplacement of Zone III Soil II Graph in Y- Direction

From the above Graphs I concluded that the Provision of Masonry infill Wall at Corner Gives the less Displacement compare to Normal Building and Location of Shear wall at Center.

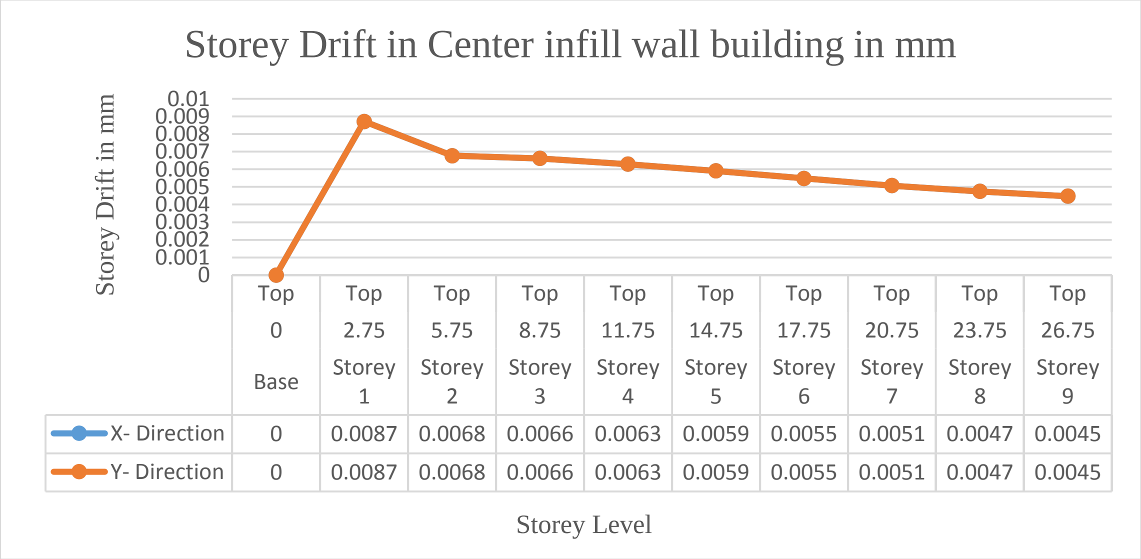
5.2.2 Story Drift Zone III:

The Below Figures from 5.6-5.8Show the Story Drift of Normal Building, location of masonry in fill wall at center and corner of the building With respect to Zone III Medium Soil(Soil Type II).



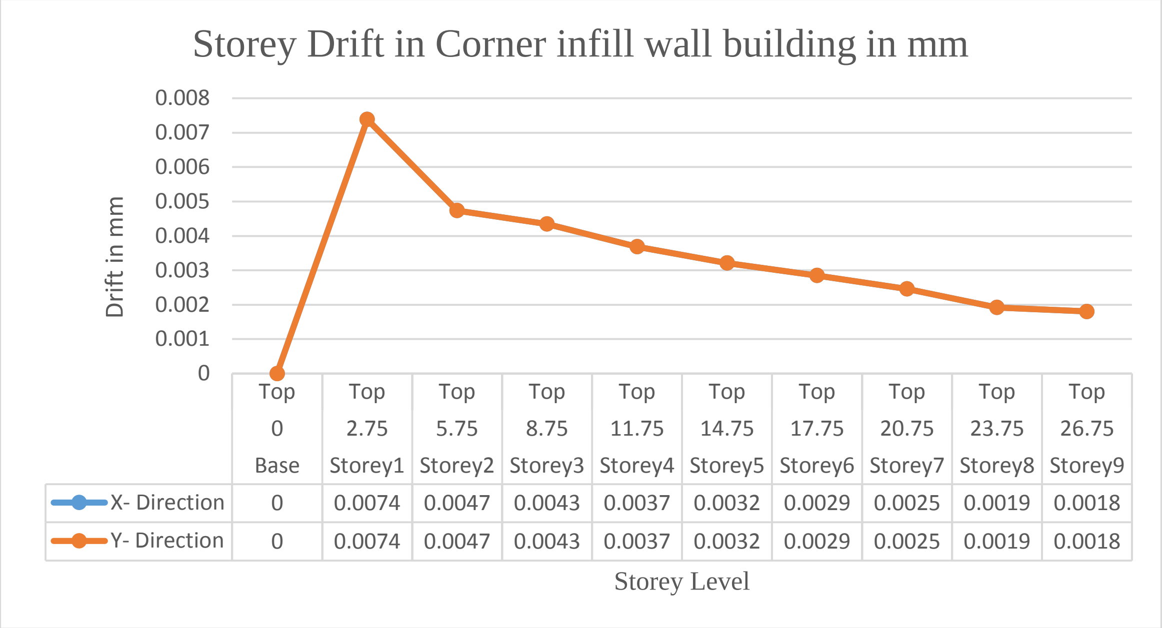
	Top 0 Base	Top 2.75 Storey 1	Top 5.75 Storey 2	Top 8.75 Storey 3	Top 11.75 Storey 4	Top 14.75 Storey 5	Top 17.75 Storey 6	Top 20.75 Storey 7	Top 23.75 Storey 8	Top 26.75 Storey 9
X- Direction	0	0.0081	0.0161	0.0178	0.0171	0.0154	0.0130	0.0102	0.0072	0.0043
Y- Direction	0	0.0081	0.0161	0.0178	0.0171	0.0154	0.0130	0.0102	0.0072	0.0043

Fig.5.6Storeydrift in Zone III Soil II Graph



	Top 0 Base	Top 2.75 Storey 1	Top 5.75 Storey 2	Top 8.75 Storey 3	Top 11.75 Storey 4	Top 14.75 Storey 5	Top 17.75 Storey 6	Top 20.75 Storey 7	Top 23.75 Storey 8	Top 26.75 Storey 9
X- Direction	0	0.0087	0.0068	0.0066	0.0063	0.0059	0.0055	0.0051	0.0047	0.0045
Y- Direction	0	0.0087	0.0068	0.0066	0.0063	0.0059	0.0055	0.0051	0.0047	0.0045

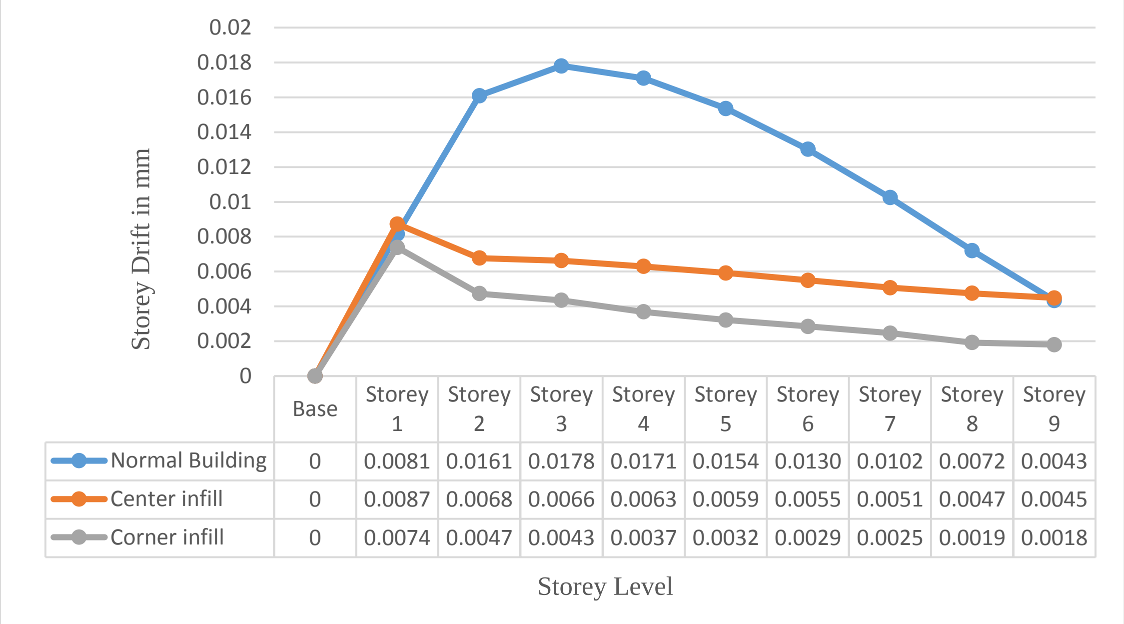
Fig.5.7 Storey drift in Zone III Soil II Graph



	Top 0 Base	Top 2.75 Storey1	Top 5.75 Storey2	Top 8.75 Storey3	Top 11.75 Storey4	Top 14.75 Storey5	Top 17.75 Storey6	Top 20.75 Storey7	Top 23.75 Storey8	Top 26.75 Storey9
X- Direction	0	0.0074	0.0047	0.0043	0.0037	0.0032	0.0029	0.0025	0.0019	0.0018
Y- Direction	0	0.0074	0.0047	0.0043	0.0037	0.0032	0.0029	0.0025	0.0019	0.0018

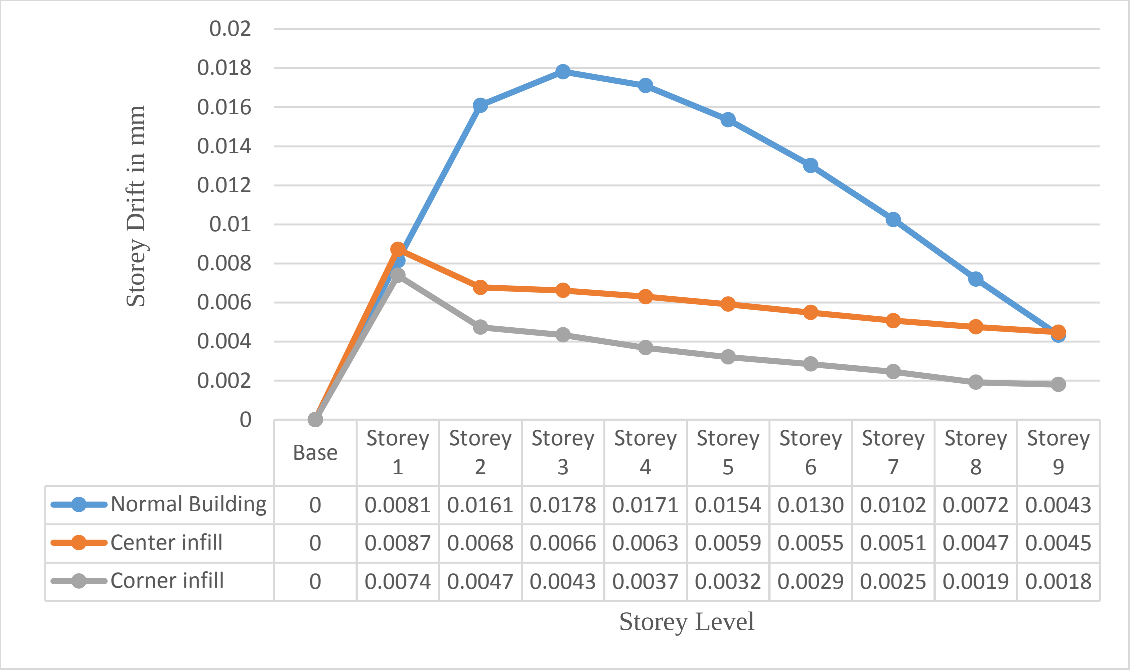
Fig.5.8 Storey drift in Zone III Soil II Graph

The below graph shows the Storey Drift of a normal building, position of a masonry infill wall at center and corner of a building. Here the maximum drift occurs in normal building compare to location of a Masonry in fill at center and corner of a buildingto the Unit Weight of Member. The Below Graph Show the Drift in X-Direction and Y- Direction of a Normal Building, Location of masonry at center and corner of a building. And the Maximum drift was occur in Normal Building.



	Base	Storey 1	Storey 2	Storey 3	Storey 4	Storey 5	Storey 6	Storey 7	Storey 8	Storey 9
Normal Building	0	0.0081	0.0161	0.0178	0.0171	0.0154	0.0130	0.0102	0.0072	0.0043
Center infill	0	0.0087	0.0068	0.0066	0.0063	0.0059	0.0055	0.0051	0.0047	0.0045
Corner infill	0	0.0074	0.0047	0.0043	0.0037	0.0032	0.0029	0.0025	0.0019	0.0018

Fig.5.9 Story drift of Zone III Soil II Graph in X- Direction



	Base	Storey 1	Storey 2	Storey 3	Storey 4	Storey 5	Storey 6	Storey 7	Storey 8	Storey 9
Normal Building	0	0.0081	0.0161	0.0178	0.0171	0.0154	0.0130	0.0102	0.0072	0.0043
Center infill	0	0.0087	0.0068	0.0066	0.0063	0.0059	0.0055	0.0051	0.0047	0.0045
Corner infill	0	0.0074	0.0047	0.0043	0.0037	0.0032	0.0029	0.0025	0.0019	0.0018

Fig.5.10 Story drift of Zone III Soil II Graph in Y- Direction

From the above Graphs I concluded that the Provision of Masonry in fill Wall at Corner Gives the less Drift compare to normal building and location of infill wall at center.

VI.CONCLUSIONS

Following conclusions can be drawn for Normal Building, Position of Masonry infill wall at center and corner of building from the results obtained in chapter5:

1. As the mode number is getting increased the time period of the structure is getting decreased and frequency of the building is increasing.
2. As the time period is decreasing the acceleration in X and Y direction is increasing and at some points the acceleration became constant (frommode-4 to mode-9).
3. In present Study the Normal Building, Position of Masonry infill wall at center

   And Corner of buildings are analyzed in Zone III medium soil (Soil Type II).
4. The Position of a masonry infill wall center and Corner is more Flexible

   Comparative Normal Building in Zone III, medium Soil (Soil Type II).

It can be summarized that the response of Normal Building, Position of Masonry infill wall at center And Corner of buildings under Response spectrum analysis. Storey Displacement and Storey Drift Performance is observed to be with in the permissible limits in Position of a Masonry infill wall at Corner is the preferable in Zone III, Medium Soil (Soil Type II)

VII.REFERENCES

[1] Hossain Mohammad Muyeed- Ul-Azam and Khan Mahmud Amanat [1] (2005). Effect of Infill As a Structural Component on the Column Design of Multi-storied Building. UAP Journal of Civil and Environmental Engineering Vol. 1, No. 1, 2005.

[2]. J. Dorji and D.P. Thambiratnam [2] (2009). Modeling and Analysis of Infilled Frame Structures Under Seismic Loads. The Open Construction and Building Technology Journal, 2009, 3, 119-126.

[3]. Kashif Mahmud, Md. Rashadul Islam and Md. Al-Amin [3] (2010). Study of the Reinforced Concrete Frame with Brick

[4]. Masonry Infill due to Lateral Loads. International Journal of Civil & Environmental Engineering IJCEE-IJENS Vol. 10, No. 04.

[5]. Kodur, V.R.; Erki, M.A.; Quenneville, J.H.P. [4] (1995). Seismic design and analysis of Masonry Infilled frames. Canadian Journal of Civil Engineering, 22, (3), pp. 576-587, June 01, 1995.

[6]. P.G. Asteris, M.ASCE (2003). Lateral Stiffness of Brick Masonry Infilled Plane Frames. Journal Of Structural Engineering © ASCE / August 2003 / 1071.

[7]. P.M. Pradhan, P.L. Pradhan, R.K. Maskey (2012). A Review on Partial Infilled Frames Under Lateral Loads. Kathmandu University Journal of Science, Engineering and Technology Vol. 8, No. 1, February, 2012, pp. 142-152.

[8]. Mulgund G.V. and Dr.Kulkarni A.B. (2011). Seismic Assessment of RC Frame Buildings with Brick masonry infill. Mulgund GV Et Al. / (IJAEST) International Journal of Advanced Engineering Sciences And Technologies Vol. 2, Issue No. 2.

[9] “The effect of masonry infill's on the seismic response of a four- storey reinforced concrete frame A Deterministic assessment”, Journal of Engineering Structure., 168-172.

[10] Kasim Armagan Korkmaz, and Mustafa (2007)” Earthquake Assessment of RC Structures with Masonry Infill Walls. International Journal of Science & Technology”, Volume 2, No 2, 155-164, 2007.

[11] B.Srinivas and B.K.Raghu Prasad. “The Influence of Masonry Infill in Reinforced Concrete Multi-Story Buildings to Near-Fault Ground Motions”, Department of Civil Engineering, Indian Institute of Science, Bangalore Karnataka-560012, India.

[12] George C Manos, Jafar Thaumpta and Bilal Yasin (2000). “Influence of masonry infill’s on the Earthquake response of multi-story reinforced concrete structures”, Journal of WCEE.

[13] Bryan Stafford Smith (1967). “Methods for Predicting the Lateral Stiffness and Strength of Multi-Storey Infilled Frames, Building and science”, Vol. 2, pages. 247-257.

[14] Diptesh Das and C.V.R. Murty (2004) “Brick masonry infill’s in seismic design of RC frame Buildings”, Part 2 Behavior. Indian concrete journal, pages. 374-387.

[15] Fakhredin Danesh and Vahid Behrang (2004) “The influence of masonry infill walls on dynamic Behavior of concrete structures”, 13th World Conference on Earthquake Engineering Paper No. 1984.

[16] Mehmet Metin Kose (2008). "Parameters affecting the fundamental period of RC buildings with

Infill walls, Engineering Structures", pages. 240-250.

[17] Matjaz Dolsek and Peter Fajfar, "On seismic behavior and mathematical modelling of infilled

RC frame structures", Journal of WCEE.

[18] Laura Liberatore, Luis D. Decanini and Domenico Liberatore (2004). "Seismic Lateral

Deformation and energy demands in bare and infilled RC frames", 13th World Conference on

Earthquake Engineering Page no 7007.

[19] Harpal Singh, D. K. Paul, V. V. Sastry (1998) "Inelastic dynamic response of reinforced concrete

Infilled frames,

[20] Mehmet M Kose and Ozge Karslioglu (2009) "effects of infills on high-rise buildings: a case

Study", pages. 123-135

[21] M. Sobaih and M. M. Abdin (1988), "Seismic analysis of infilled reinforced concrete frames,

Computers and structures" Vol. 30, No. 3, pp. 457-464.

[22] Smith, S. B. and Carter, C. (1969), "A method of analysis of in-filled frames Proceedings,

Institution of Civil Engineers, London", Vol. 44, pp. 31-48.

[23] Konuralp Girgin and Kutlu Darılmaz, "Seismic Response of Infilled Framed Buildings Using

Pushover Analysis, ARI the Bulletin of the Istanbul Technical University" Volume 54,

[24] IS 456-2000" Plain and Reinforced concrete. Code of practice".

[25] "Federal Emergency Management Agency" codes no 356.

[26] IS-1893 (Part1)-2002 "Criteria for Earthquake Resistant Design Of Structures".