Effect of Partial and Central Opening of Masonry Infill Wall in Multi-Storey Building

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Abstract— In RC frames buildings the masonry infill walls will be better for resisting the lateral forces during seismic forces. The lateral force of the building is reduced by providing the infill walls in RC frames the openings may be in the form of windows, doors etc. which are unavoidable.
For the most part the brick work infill dividers are is considered as non-structural component in basic investigation and just the commitment of its mass is viewed as and it's auxiliary properties like quality and firmness is by and large not considered. Notwithstanding this present infill's have an impressive quality and solidness and they have noteworthy impact on the seismic reaction of the auxiliary frameworks. In office or private building external side focal opening are utilized. In this study seismic analysis has been performed using Equivalent static Method and response spectrum method for different reinforced concrete (RC) frame building models that include bare frame, in filled frame and with central and partial opening. By considering infill's wall in RC structure, lateral displacement is reduces 60% to 70% as compare in bare frames. Due to opening in the infill's walls is significantly reduces of lateral displacement of about 60% of central opening in infill's is increases 10% increase in lateral displacement. In this paper also includes that the time history at different mode shape with bare frames and infill's frames.

Key words: Infill Wall, Reinforced Concrete (RC)

I. INTRODUCTION

In reinforced concrete frame structure the masonry wall is like just architectural points of view, it provides facility as partition and other aspects. In high rise building frames is vertical load and live load do not cause much of an effects, but the lateral loads due to wind and earthquake load are a matter of great concern and they required special consideration in the design of RC frames. The seismic force may produce the critical stress in structure. In many country research in this seismic region, reinforced concrete infilled frames with and without opening in masonry infill wall. Masonry infill panels are significantly enhanced in the lateral strength of structure.

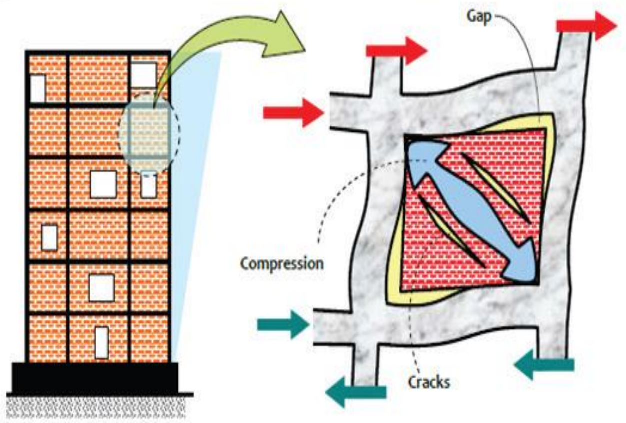


Fig. 1: Behaviour of the infill wall

II. OBJECTIVES

A. *The objectives of present work are:*

1) To study the seismic behavior of reinforced concrete frame with masonry infill walls with central and partial opening.
2) Study the effect of masonry infill wall on the stiffness of structure.
3) To analyze the effect of infill wall on displacement of reinforced concrete frame under seismic loads.
4) The use of materials such as bricks and stones can increase the thermal mass of a building.
5) To determine the exact non-linear behavior of building structures.
6) To determine location of opening in infill's wall where the displacement is get minimum.[4]

III. METHODS OF SEISMIC ANALYSIS

A. *Equivalent Static Method:*

The equivalent static lateral force method is a simplified technique to substitute the effect of dynamic loading of an expected earthquake by a static force distribution laterally on a structure for the design purposes.

$$V_b = A_h \times W$$

B. *Response Spectrum Method:*

Response spectrum is one of the useful technique of earthquake engineering for analysing the performance of structures especially in earthquakes, if you can find out the natural frequency of the structure, then the peak response of the building can be estimated by reading the value from the ground response spectrum for the appropriate frequency. In most construction laws in seismic locales, this worth structures the premise for ascertaining the strengths that a structure must be intended to oppose (seismic investigation). There are computational focal points in utilizing the RESPONSE SPECTRUM METHOD of seismic examination for forecast of removals and part compels in auxiliary frameworks. The technique includes the figuring of just the most extreme estimations of the removals and part drives in every method of vibration utilizing smooth outline spectra that are the normal of a few tremor movements.

IV. ANALYTICAL MODELING

A. Description of The Models;

The study was done on overall 8 models. The plan layout for all the models is same as shown in the figure below. Model 3 to Model 8 are same as Model 2 but only the percentage of opening and its location in masonry infill's walls.

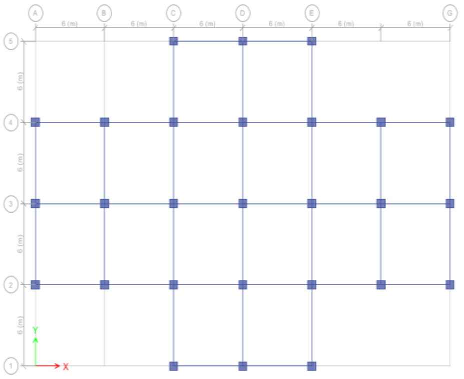


Fig. 2:.Plan Layout

B. Types of Models:

Model 1: Bare frame with ground soft storey.

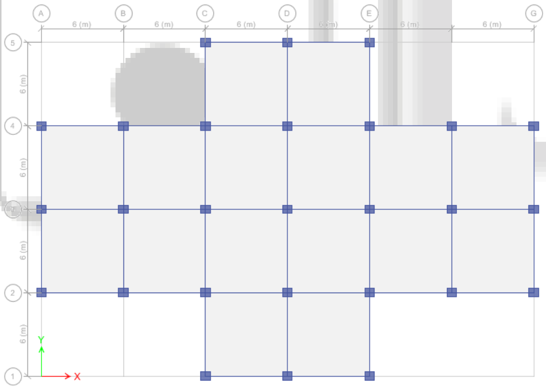


Fig. 3: Plan (Model 1)

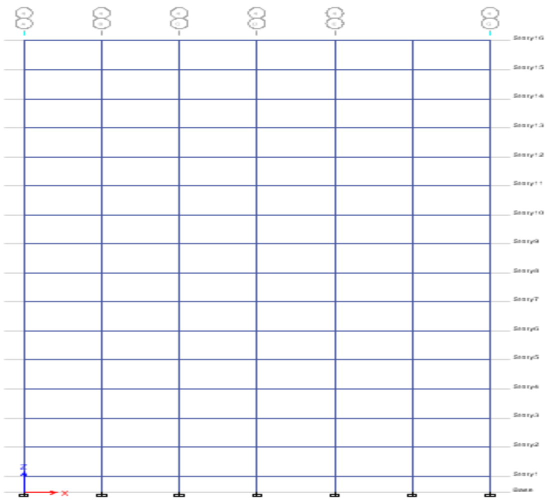


Fig. 4: Elevation (Model 1)

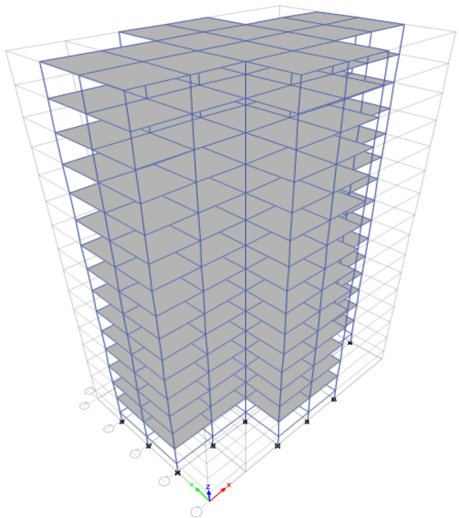


Fig. 5:
Model 2: Infill's frame ground soft storey without opening.

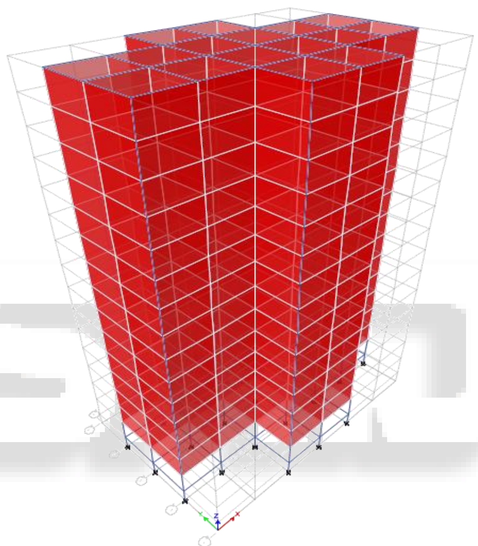


Fig. 6:
Model 3: Infill's frame with ground soft storey with 20% central opening.

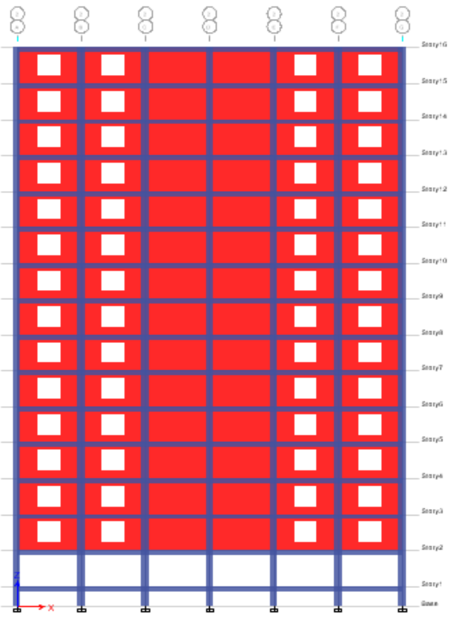


Fig. 7:

Model 4: Infill's frame with ground soft storey with 40% of central opening.

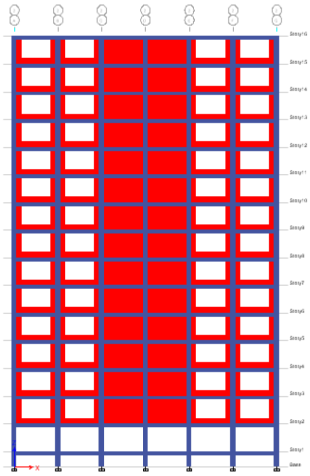


Fig. 8:

Model 5 : Infill's frame with ground soft storey with 60% of central opening.

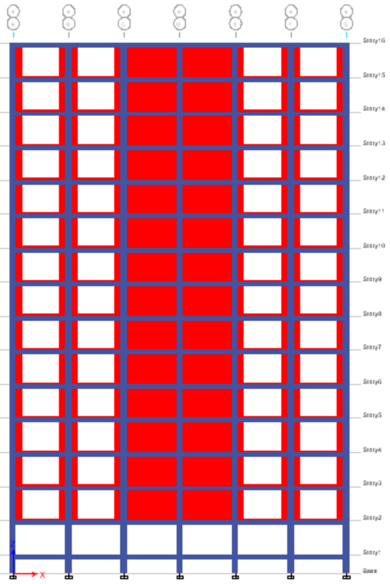


Fig. 9:

Model 6 : Infill's frame with ground soft storey with 20% of partial opening.

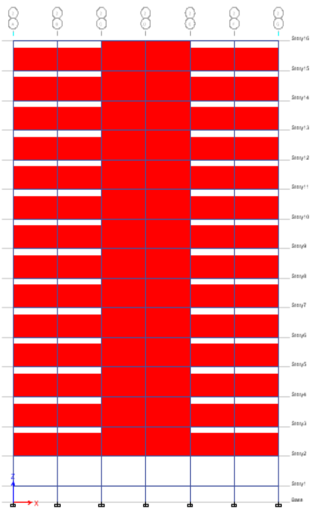


Fig. 10:

Model 7: Infill's frame with ground soft storey with 40% of partial opening.

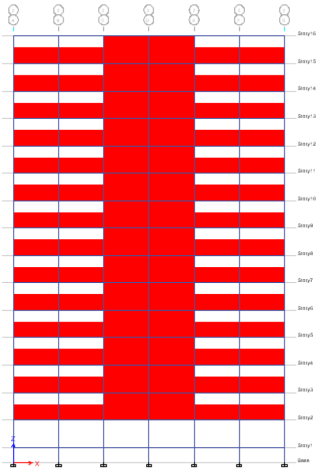


Fig. 11:

Model 8 : Infill's frame with ground soft storey with 60% of partial opening.

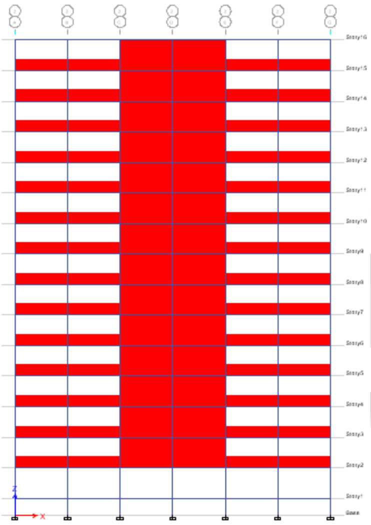


Fig. 12:

V. Details of the Building

The plan of the RC earthquake resisting frame structure of 16 storey building as shown in figure .4.5.In the present paper lateral load analysis as per the seismic code IS 1893 –Part1 -2002 of the multi-storey building with different percentage of opening in masonry infill's walls.

VI. Design Data

A. *Material Properties:*

Storey
= G+16
Tpical storey height
= 3.5m
Bottom storey height
= 2.0m
Young's modulus of [M40] concrete,E = 30KN/m^3
Poissons's ratio of concrete
= 0.2
Modulus of elasticity of brick masonry= 3500x10^3 KN/m^2

Density of brick masonry= 20 KN/m^3
Steel grade
= Fe 415
Poissons's ratio of masonry
= 0.15
Floor finishes
= 1 KN/m^2
Live load
= 3 KN/m^2

B. Member Properties:

Thickness of RC slab
= 0.15 m
Column size
= 0.6m X 0.6m
Beam size
= 0.4m X 0.5m
Thickness of brick masonry wall= 0.230 m

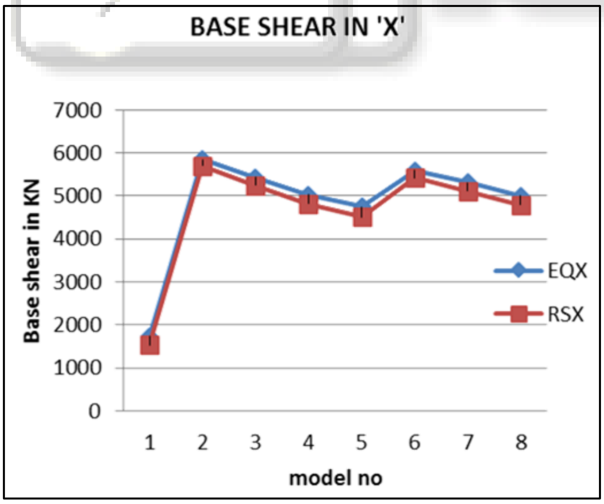
C. Load Calulations:

Wall load on roof level= 1x0.23x20 = 4.6KN/m
Wall load on all other levels
= 4x0.23x20 = 16.10KN/m

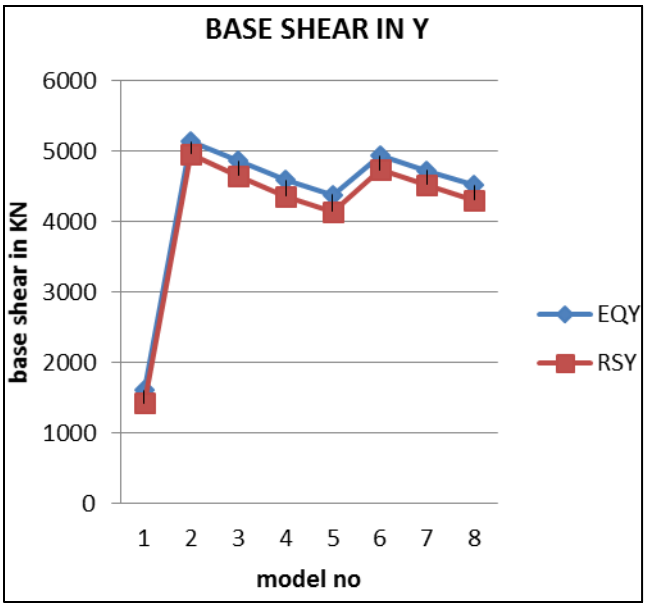
D. Seismic Data:

Zone factor (table 2 of IS 1893-2002)
= 0.36 (Zone V)
Importance factor (table 6 of IS 1893-2002)
= 1 (Important factor)
Response reduction factor (table 7 of IS 1893-2002)
= 5 (SMRF)
Soil type (figure 2 of IS 1893-2002)
= Type I (Hard soil)

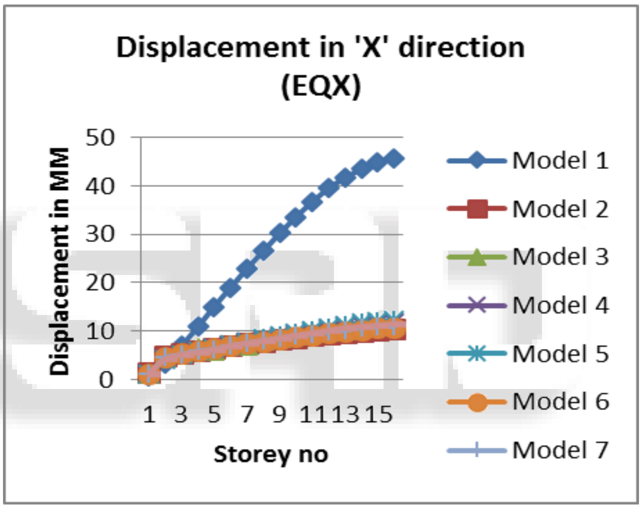
VII. RESULTS



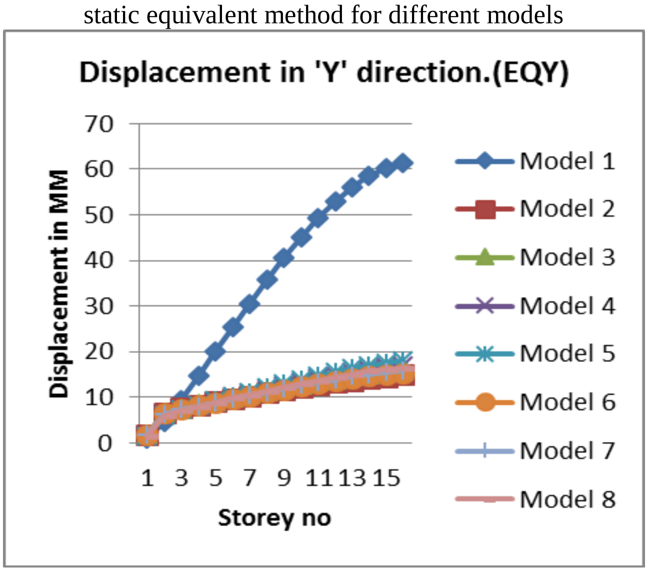
Graph 1 Correlation of base shear for different Models in X direction.



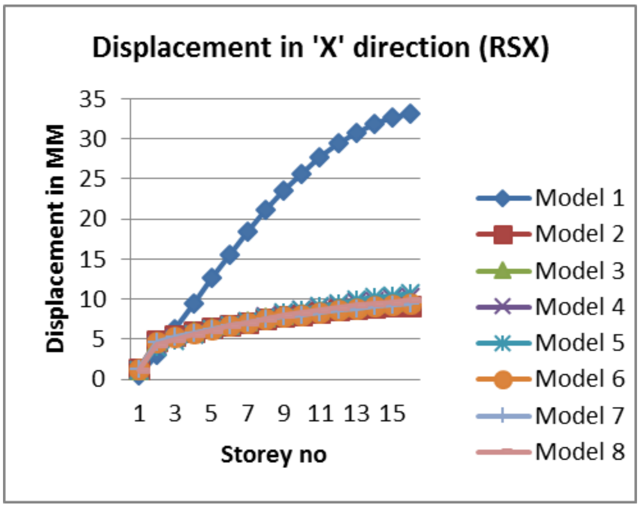
Graph 2: Correlation of base shear for different Models in Y direction.



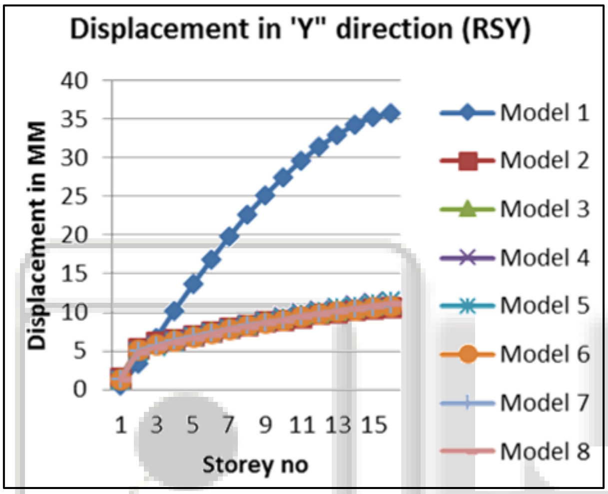
Graph 3 Correlation of displacement along X direction in static equivalent method for different models



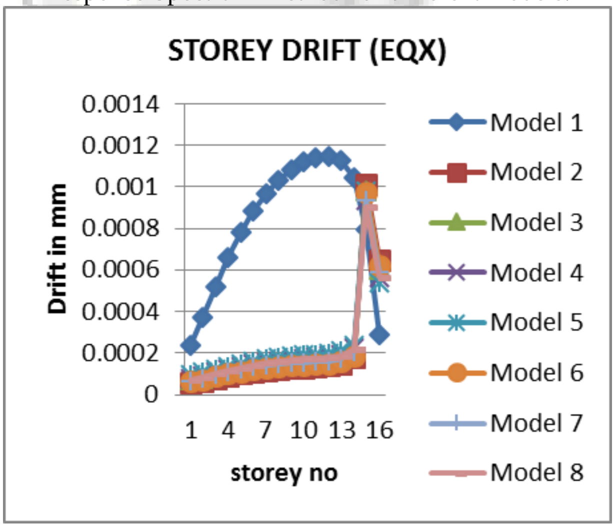
Graph 4 Correlation of displacement along Y direction in static equivalent method for different models



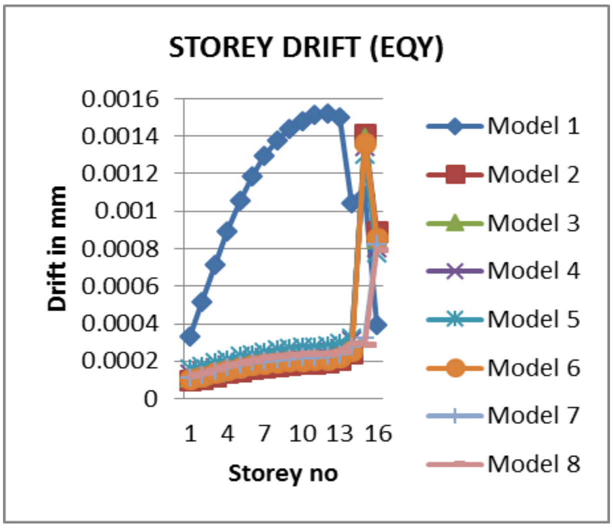
Graph 5 Correlation Of Displacement Along X Direction In RESPONSE SPECTRUM METHOD For Different Models.



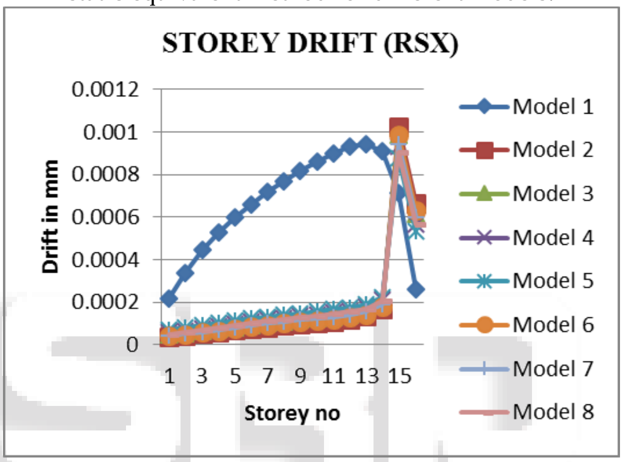
Graph 6 Correlation of displacement along Y direction in Response Spectrum Method for different models.



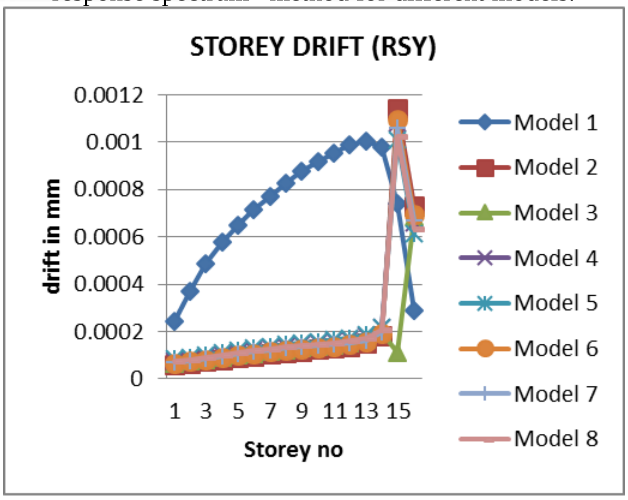
Graph 7 Correlation of storey drift along X direction in static equivalent method for different models



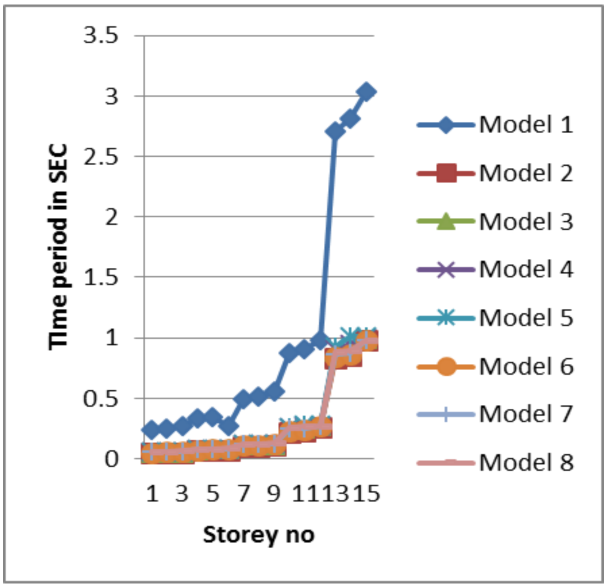
Graph 8 Correlation of storey drift along Y direction in static equivalent method for different models.



Graph 9 Correlation of storey drift along X direction in response spectrum method for different models.



Graph 10 Correlation of storey drift along Y direction in response spectrum method for different models.



Graph 11 Graphical representation of time period of different models for different mode shapes.

VIII. CONCLUSIONS

1) From Graph 1 and 2, base shear got increased with the introduction of infill walls
2) As a result of opening in infill wall time period was increased slightly
   3. The presence of infill wall enhances the stiffness as well as strength of the structure.
3) From Graph 3 to 6 it is concluded that lateral displacement of bare frame (model 1) to infill frame (model 2) get reduced by 77% to 80% at all stories
4) From Graph 3 to 6 (inferring model 3 and model 8) due to the presence of openings in infill wall lateral displacement increases as compared to complete infill frame.
5) Stiffness of structure is influenced greatly by the position of openings in infill wall also stiffness decreases with the increase in percentage of opening
6) From Graph 3 to 6 (model4) it can be interpreted that 60% Central opening in infill wall resulted in 20% increasing lateral displacement
7) From Graph 3 to 6 it can be concluded that 60% openings (model 8) in infill wall caused only 10% increase in displacement
8) In soft storey structure (no walls) story drift is comparatively higher than the upper storey that can result in the collapse of structure during seismic tremor.
9) From Graphs 7 to 10 the story drift of infill panel model is drastically reduced as compared to bare frame hence significant effect of infill observed
10) From Graph 11 it is observed that time period got reduced by 68% from bare frame (model 1) to infill frame (model 2)
11) Consequently the openings in infill wall resulted in decrease in base share
12) Thus it can be concluded that the RESPONSE SPECTRUM METHOD of analysis gives more accurate results as compared to equivalent static method of analysis.

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