"DYNAMIC ANALYSIS OF MASONARY INFILLED R.C. BUILDING COMPARING WITH DISTINCT OPENING PRAPORTION"

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Abstract - Present study RC framed building (G+10) with distinct stiffness multi-storey located in Seismic Zone- IV and V is considered. The main objective of present study is the study to understand variation in the stiffness & performance multistory buildings with various opening percentage according to various cases such as: (a) bare frame building (b) building with complete infill in all storey (c) building with 15% opening (d) Building with 25% opening percentage. The separate models were generated using commercial software ETABS. Infill stiffness was modeled using an equivalent diagonal strut approach. Parametric studies on displacement, storey drift, Axial force and base shear have been carried out using equivalent static analysis to investigate the influence of this parameter on the behavior of building with SS. This paper has a detail introduction of the stiffness parameter with a summarized methodology of the titled topic project.

Keywords – stiffness, infill wall, equivalent diagonal strut, opening percentage

I. INTRODUCTION

Many urban multistory buildings in all over the world today have opening for windows and doors for mobility and architectural and unavoidable feature. This leave the opening of masonry infilled reinforced concrete frame building primarily to generate parking or reception lobbies in the first storeys. It has been known for long time that masonry infill walls affect the strength & stiffness of infilled frame structures. There are plenty of researches done so far for infilled frames ,however partially infill frames are still the topic of interest .Though it has been understood that the infill's play significant role in enhancing the lateral stiffness of complete structures. Infills have been generally considered as non-structural elements & their influence was neglected during the modeling phase of the structure leading to substantial inaccuracy in predicting the actual seismic response of framed structures. The performance of the structure can be significantly improved by the increase of strength and dissipation capacity due to the masonry infill's even if in presence of an increasing in earthquake inertia forces.

II. Infills Frame With Opening:

Area of opening, A_{op} is normalized with respect to area of infill panel, A_{infill} and the ratio is termed as opening percentage (%)

$$\text{Opening percentage }(\%) = \frac{\text{Area of openning }(A_{op})}{\text{Area of infill}(A_{infill})}$$

Figure shows the opening influence for three different positions (upon the diagonal case B, outside and down left of the diagonal-case A, and outside and up right of the diagonal-case C).

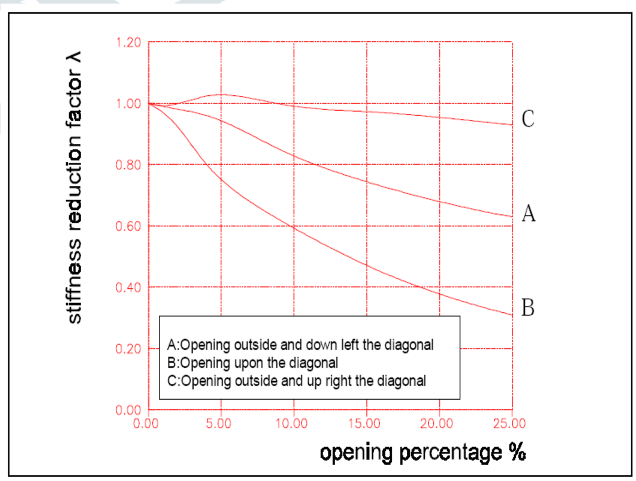


Fig. (A)Frame with Opening
(B)Stiffness reduction factor λ' of the infilled frame in relation to the opening percentage (a,b,c)

III OBJECTIVE OF THE STUDY

Based on the literature review the salient objectives of the present study have been identified as follows:

- To study the behavior of frame with brick masonry infill by modeling masonry infill as a diagonal strut.
- To Check the stiffness, strength and ductility of building With & Without Openings for different analytical model.
- To compute parameters of model with and without infill wall, with different % of opening with the help of structural analysis software ETABS.

IV. STRUCTURAL MODELLING

Models are develop a computational model on which analysis is performed. In this regard, ETBAS software has been considered as tool to perform. Hence we will discuss the parameters defining the computational models, the basic assumptions and the geometry of the selected building considered for this study. A detailed description on the modeling of RC building frames is discussed. Infill walls are modeled as equivalent diagonal strut elements.

An framed building located at India (Seismic Zone IV, and V) is selected for the present study. The building is fairly symmetric in plan and in elevation.

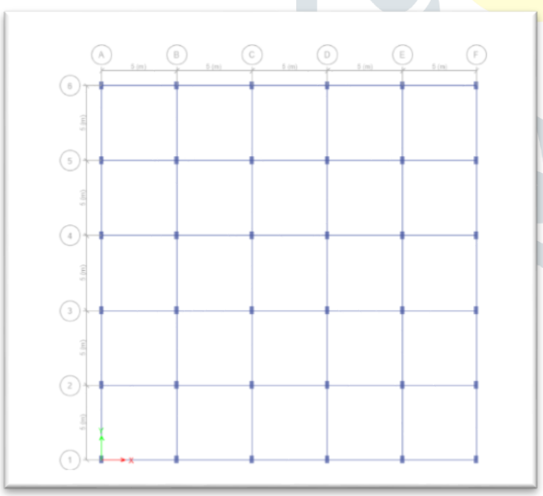


Fig 1 - Typical floor plan of the selected building

In the present study different building components are modeled as described below Using Software. In this study the three models are studied as described below.

(A) Building with complete Infill.
(B) With 15% Infill
(C) With 25% Infill

BUILDING DESCRIPTION

Plan dimensions	: 25 m x 25m
Number of Storey	: G+10
Total height of building	: 33.45 m
Floor height	: 3 m
Beam sizes	: 300 x 500 mm
Column sizes	: 300 x 500 mm
Slab thickness	: 150 mm
Floor Live Load	: 3 kN/m2
Roof live load	: 1.5 kN/m2
Floor Finish Load	: 0.5 kN/m2
Concrete grade	: M25
Steel	: Fe415

Earthquake parameters

Seismic zone	: IV and V
Response Reduction Factor	: 5
Importance Factor	: 1
Type of soil	: Medium
Damping of structure.	: 5%

Modeling of Infill Walls

- **Width of strut at all floor**

$$\lambda = \sqrt[4]{\frac{E_i \ t \sin(2\theta)}{4 \ E_f I_c h}}$$

$$W = 0.175(\lambda H)^{-0.4} D$$

Where,

E_i = the modules of elasticity of the infill material, N/mm^2

E_f = the modules of elasticity of the frame material, N/mm^2

I_c = the moment of inertia of column, mm^4

t = the thickness of infill, mm

H =the center line height of frames

h = the height of infill

L =the center line width of frames

l = the width of infill

D = the diagonal length of infill panel

θ = the slope of infill diagonal to the horizontal.

W=658.74mm

Width of strut with 15% center opening

Width of strut =stiffness reduction factor λ x (W) without opening

=0.48x658.74

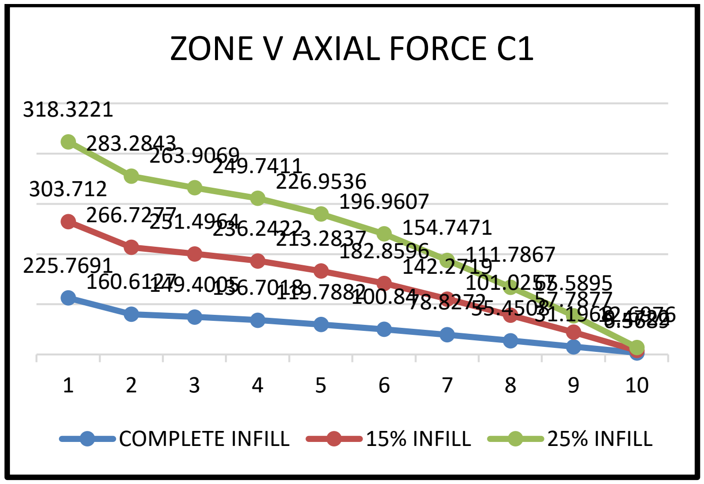
W =316.19mm

Width of strut with 25% center opening

Width of strut = stiffness reduction factor λ x (W) without opening

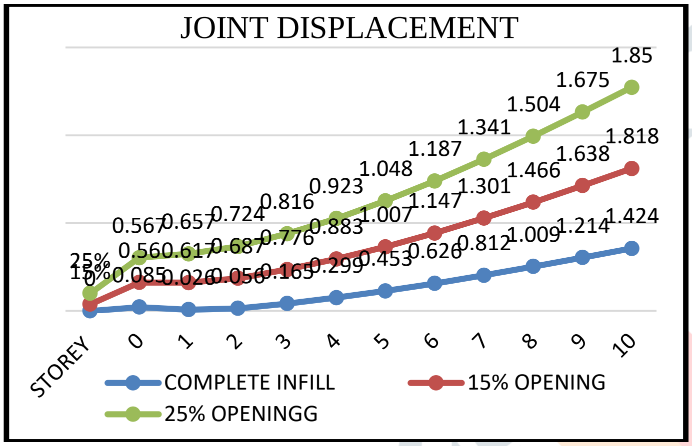
=0.3x658.74

W = 197.62 mm

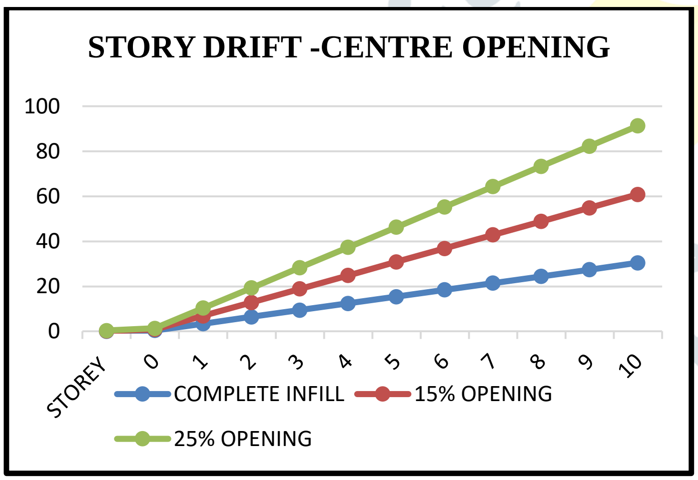


Graph: AXIAL FORCE

V. RESULT & CONCLUSION



Graph: Displacement



Graph: STORY DRIFT

1. For easy comparison of the lateral displacement of the selected building, plots of the story level displacement in longitudinal or transverse versus height are made for the three cases, all imposed on the same graph. Displacement is inversely proportional to the stiffness.
2. From the above graphs displacement profiles it is observed that displacement is occurred in case of 25% opening case. On the other hand if there is uniform infill in all the story there is higher stiffness is observed meanwhile displacement is reduced due to higher stiffness.
3. These are present in the displacement observed in case 1 i.e. bare frame case there is much more displacement as compare to other analytical cases, so we can analyze that stiffness in the frame building is essential which is provided with the help of infill wall.
4. An abrupt change in displacement profile indicates the stiffness irregularity. There is sudden change in the slope at first story. The graph shows the story drift is maximum as opening percentage increases.
5. However, the story drift profile becomes smoother right for all cases indicating large stiffness and less ductility demand.
6. The use of stiffer columns also reduces the story drift at first floor level i.e. stiffer the column less drift will be observed.
7. It is observed that axial force gradually decreases from ground floor to top floor.

VIII. REFERENCES

Journal paper:

- P.G. Asteris, (1996), "A Method For The Modelling Of Infilled Frames" (Method Of Contact Points). Proc. Of The 11th World Conference On Earthquake Eng, Acapulco, Mexico, Pp 953
- K.C. Stylianidis And C. N. Michailidis (1998) "Analytical Models For Brick Masonry Infilled R/C Frames Under Lateral Loading", Journal Of Earthquake Engineering, 2(1), Pp 59-88.
- C V R Murty And S. K Jain, (2000), "Beneficial Influence Of Masonry Infill Walls On Seismic Performance Of Rc Frame Buildings" 12wcee 1790.
- D.K. Bell And B.J.Davidson, (2001) "Evaluation Of Earthquake Risk Buildings With Masonry Infill Panels" Nzsee Conference.
- P. G. Asteris, M.Asce, (2003), "Lateral Stiffness Of Brick Masonry Infilled Plane Frames" Journal Of Structural Engineering © Asce.
- Robin Davis, Praseetha Krishnan, Devdas Menon, A. Meher Prasad, (2004) , ―Effect Of Infill Stiffness On Seismic Performance Of Multi-Storey Rc Framed Buildings In India‖ 13th World Conference On Earthquake Engineering Vancouver, B.C., Canada August 1-6, Paper No. 1198.
- C. A. Syrmakezis And P. G. "Influence Of Infilled Walls With Openings To The Seismic Response Of Plane Frames" 9th Canadian Masonry Symposium.
- Kasim Armagan Korkmaz, Fuat Demir And Mustafa Sivri, (2007), "Earthquake Assessment Of R/C Structures With Masonry Infill Walls" International Journal Of Science & Technology Vol. 2, No 2, 155-164.
- G. Mandal And S. K. Jain (2008) "Lateral Stiffness Of Masonry Infilled RC Frame With Centre Opening"
- Holmes (1961) In Their Paper Presented Under Lateral Loading The Frame And The Infill Wall
- Teresa Guevara-Perez(2012) "Soft Story" And "Weak Story" In Earthquake Resistant Design:A Multidisciplinary Approach"
- Praseetha KRISHNAN (2004)
- Narendra pokar, prof. B. J. Panchal "small scale modelling on effect of soft storey"
- Dande P. S. , Kodag P. B. "Influence Of Provision Of Soft Storey In RC Frame Building For Earthquake Resistance Design"
- Neelima Patnala, Pradeep Kumar Ramancharla "Effect Of Soft Storey In A Structure Present In Higher Seismic Zone Areas"
- Vipin V. Halde, Aditi H. Deshmukh (2015) "Review On Behavior Of Soft Storey In Building"
- Abhishekarora "Alternative Approach To Soft Storey In Seismic Analysis Of R.C.C Building Structures" (2015)
- Hasan, M.M, Bhuiyan(2017)
- D. J. Chaudhari , Prajakta T. Raipure(2015)
- Nusfa Karuvattil, Priyanka Dilip(2016) 1
- Bureau Of Indian Standards: IS-456:2000, "Plain And Reinforced Concrete -Code Of Practice", New Delhi, India.
- Bureau Of Indian Standards: IS-1893, Part 1 (2002), "Criteria For Earthquake Resistant Design Of Structures: Part 1 General Provisions And Buildings", New Delhi, India.
- Bureau Of Indian Standards: IS13920:1993,Ductile Detailing Of Reinforced Concrete Structures Subjected To Seismic Forces - Code Of Practice, New Delhi, India.
- C.V.R Murty, Indian Institute Of Tecnology Kanpur, Earthquake Tips, India.
- ETABS - 2016 Integrated Software For Structural Analysis And Design. *Computers & Structures, Inc.*, Berkeley, California.

Books:

P. Agrawal, M. Shrikhande(2009) earthquake resistant design of structures (PHI Learning Pvt.Ltd. New delhi,

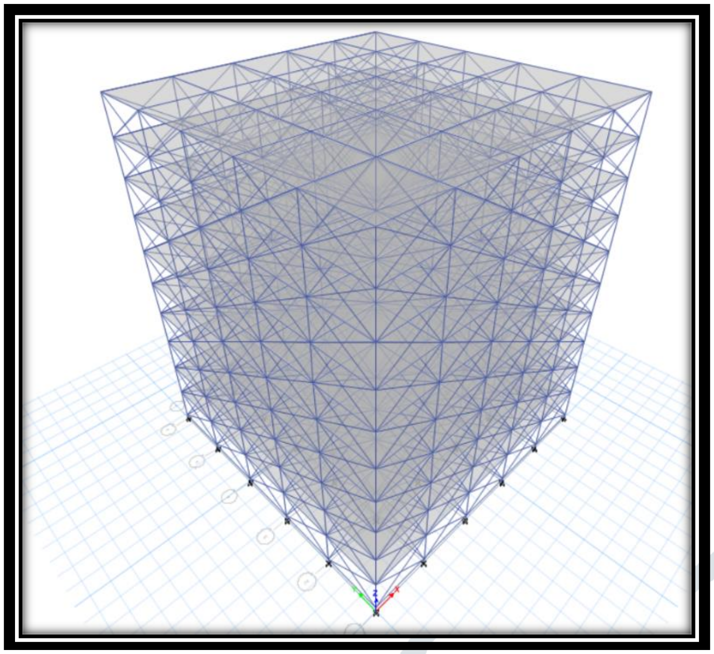


Fig. Diagonal Strut

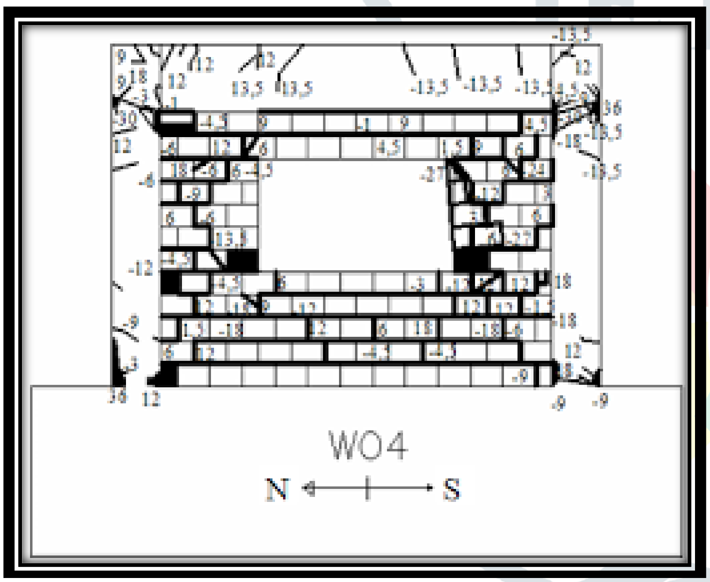


Fig. Opening