Structure Analysis of Multistorey RCC Structure with Strut and Various Types of Bracing System

Harprit Singh Chhabada[1], Anisha Mire[2], Lokesh Singh[3], Varsha Sahu[4]

[1]*PG Scholar,* [3]*Professor and Head of Department,* [24]*Assistant Professor*
Department of Civil Engineering, RSR Rungta College of Engineering and Technology, Bhilai, INDIA.

ABSTRACT

The structure in tall seismic hazard area may be liable to assist damage in major earthquake. In urban areas, the multi storey open ground open building is generally open for parking space. Due to this the building are collapse during earth quake. In this present work, used the RCC strut and two different braced model i.e. cross and chevron type. For seismic analysis and obtained the behaviour of structure, STAAD.Pro structure analysis software is used. The response spectrum technique used for seismic analysis and the feasibility of possible immediate implementation of some recent developments both in analysis and design of strut frame model and bracing frame model for structure analysis have been done. In this work, show that the significant model type which are improve the performance of structure with respect to bending moment and shear for in selected column and beam. In present work also considered the magnification factor of the building structure for under consideration as per IS standard. Finally, the present work compared the all results with literature.

Keywords: *Open ground building, Multi Storey building structure, Bracing System, Magnification factor.*

I. INTRODUCTION

Estimation of seismic response on structures is an important aspect for earthquake resistant design of structures. Various important structures and buildings are designed as per guidelines specified in IS 1893 (Part I): 2002. IS code 1893:2002 allows to analyzed open ground storey RC framed building without considering infill stiffness but with a multiplication factor of 2.5 to compensate stiffness discontinuity generated due to open ground storey. But, the multiplication factor proposed by IS 1893:2002 and selected international codes are not consistent. Therefore, it calls an assessment of multiplication factors by static nonlinear analysis considering infill stiffness and strength.

Bracings are the structural components which are used as compression or tension member to resist lateral loads from wind or from earthquake. These bracings can be installed either as a RC frame structure or Steel frame structure. There are many types of bracings namely V Braces, Inverted V or Chevron braces, K braces, X braces, Eccentric Braces etc., In this present study we use chevron bracings to resist the lateral loads.

II. PROBLEM IDENTIFICATION

In the present scenario open ground stories (story stiffness less than 70% of that in the story above or less than 80% of the average lateral stiffness of the three stories above) to be designed for 2.5 times the seismic story shears and moments, without considering the effects of model in any story. The factor of 2.5 is specified for all the buildings with soft stories irrespective of the extent of irregularities and the method is quite empirical and may be too conservative and thus there is a need for detailed study on Magnification factor.

III. METHODOLOGY

The building model is as shown in the Figure 4.1 having number of bays according to different models and cases in the X and Y directions with a bay width. The building is a residential building having multi-storey floors with first floor- 3.8 m and Above first floor 3.5m storey height. Infill walls of thickness 300mm are located in the outer frames in each floor except the ground floor [17]. The detailed features of the normal building are given below Table 1.

Table 1. Details of model for analysis [17]

S. No.	Content	Detail
1.	Type of Structure	Multi-storey rigid jointed plane frame (SMRF)
2.	Seismic Zone	V
3.	Number of stories	Four (G+3)
4.	Floors Height	3.0m
5.	Infill wall	300mm thick brick masonry wall along X-direction and Y-direction
6.	Type of soil	Medium
7.	Size of column	300 mm X 450mm
8.	Size of Beam	300 mm X 450mm
9.	Depth of Slab	120 mm
10.	Live load	3.0 KN/ m^2
11.	Floor Finishes	6 mm thick
12.	Material	M 20 Grade concrete & Fe 415 Reinforcement
13.	Unit weights	a) Concrete = 25KN/Cum b) Masonry = 20KN/Cum
14.	Total Height of Building	12m for G+3
15.	Clear Cover of Beam	25 mm
16.	Clear Cover of Column	40 mm
17.	Damping in Structure	5%
18.	Importance factor	1.5

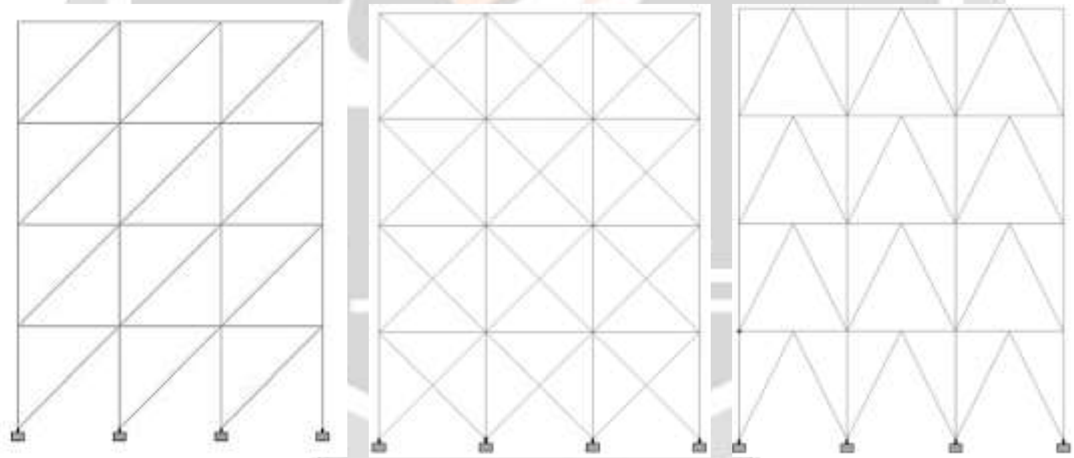

(a) (b) (c)

Figure 2. Modeling of OGS (a) strut structure, (b) cross braced structure and (c) chevron braced structure

IV. RESULT AND DISCUSSIONS

In this present work deals with the comparison of bending moment, shear force and its magnification factor for different structure types. The comparison of dynamic analysis for a structure with infill (strut), cross braced and chevron braced open ground structure frame in seismic zones is carried out.

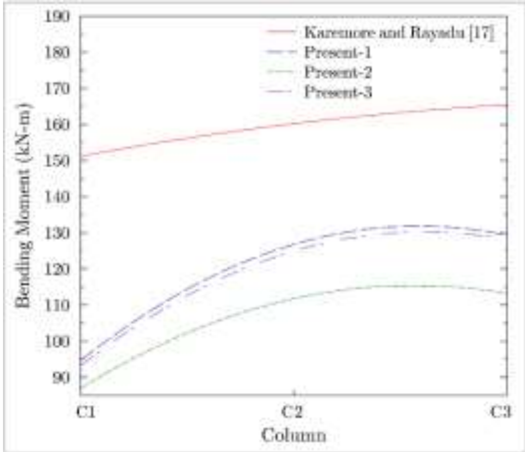


Figure 3. Graph plotted between maximum bending moment for column in Karemore and Rayadu [17] and proposed model

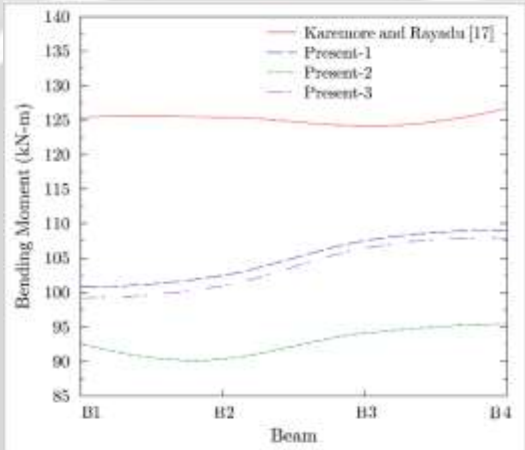


Figure 4. Graph plotted between maximum bending moment for beam in Karemore and Rayadu [17] and proposed model

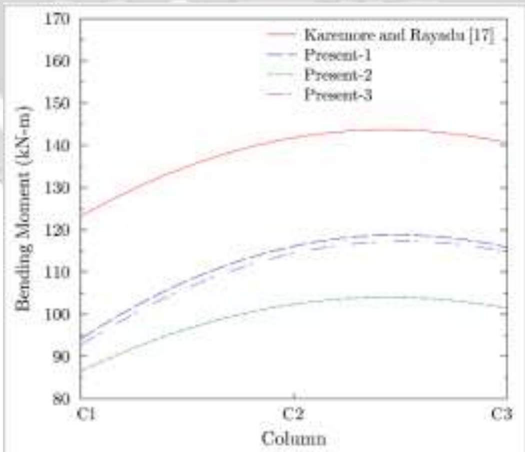


Figure 5. Graph plotted between maximum shear force for column in Karemore and Rayadu [17] and proposed model

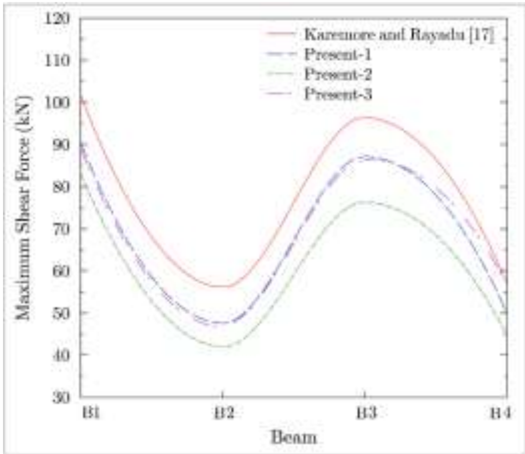
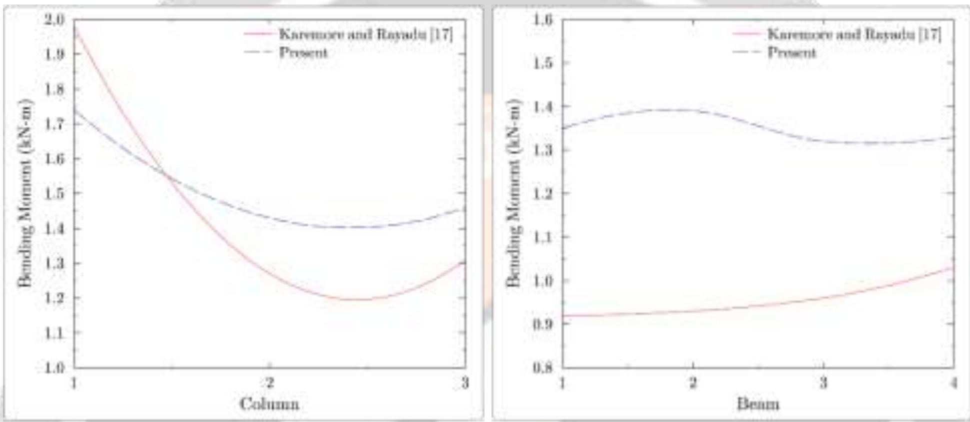
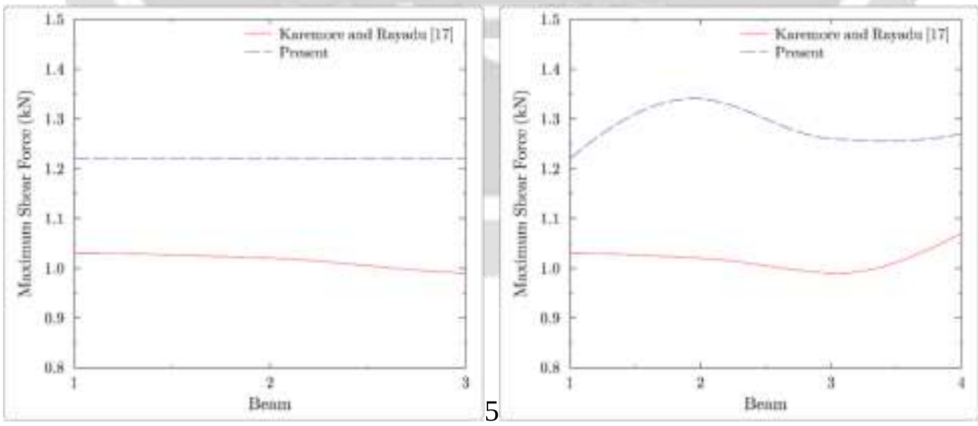


Figure 6. Graph plotted between maximum shear force for beam in Karemore and Rayadu [17] and proposed model



(a) (b)

Figure 7. Magnification factor for maximum bending moment in columns (a) and beam (b)



(a) (b)

Figure 8. Magnification factor for maximum shear force in columns (a) and beam (b)

From considering and discussing the all results ad comparison between present and literature [17] results, the bracing system minimize the deformation, bending moment and shear force in the column and beam. The bracing system has been transferred lateral load via axial to the foundation. The performance of cross bracing is significantly improved than the literature structure as well as other specified strut and bracing.

V. CONCLUSIONS

- In this work it is also concluded that the minimum bending moment in cross bracing structure frame were obtained as 86.92, 111.78, and 113.21 kN-m for column C1, C2 and C3; and 92.59, 90.34, 94.11 and 95.42 kN-m for bean B1, B2, B3 and B4 respectively.
- And the minimum shear force in cross bracing structure frame were obtained as 86.47, 102.38 and 101.42 kN for column C1,C2 and C3; and 83.25, 42.01, 76.29 and 44.71 kN for bean B1, B2, B3 and B4 respectively
- For maximum bending moment, the magnification factor for columns and beams are range under 2.0 for both column and beam. For maximum shear force, the magnification factor for columns and beams are range from 1.39-1.74 for column and 1.22-1.39 for beam.
- From these analysis results, it is concluded that, the magnification factor (M.F.) for maximum bending moment and shear force for column and beam was under 2.5, which was suitable for future application.

REFERENCES

[1] W.W. El-Dakhakhni, M. Elgaaly, and A.A. Hamid, "Three-Strut model for concrete masonry-infilled frames", J. Struct. Eng. ASCE, vol. 129(2), pp. 177-185, 2003.
[2] M.M. Kose, "Parameters affecting the fundamental period of RC buildings with infill walls", Eng. Struct., vol. 31, pp. 93-102, 2009.
[3] B.S. Smith, "Behavior of square infilled frames", J. Struct. Div. ASCE, ST1, pp. 381-403, 1966.
[4] M.H. Santhi, G.M.S. Knight, and K. Muthumani, "Evaluation of Seismic performance of gravity load designed reinforced concrete Frames", J. Perform Construct. Facil., vol. 19, no. 4, pp. 277-282, 2005.
[5] T.C. Liauw, and K.H. Kwan, "Nonlinear behaviour of non-integral infilled frames", Comp. Struct., vol. 18, pp. 551-560, 1984.
[6] P.G. Asteris, "Lateral stiffness of brick masonry infilled plane frames", J. Struct. Eng. ASCE, vol. 129, no. 8, pp. 1071-1079, 2003.
[7] P.G. Asteris, "Finite element micro-modeling of infilled frames", Electron. J. Struct. Eng., vol. 8, pp. 1-11, 2008.
[8] P.G. Asteris, C.Z. Chrysostomou, I.P. Giannopoulos, and E. Smyrou. "Masonry infilled reinforced concrete frames with openings", 3rd International Conference on Computational Methods in Structural Dynamics and Earthquake Engineerin, COMPDYN 2011, Corfu, Greece, 2011.
[9] H.A. Moghaddam, and P.J. Dowling, "The State of the Art in Infilled Frames", ESEE Research Report No. 87-2, Imperial College of Science and Technology, Civil Eng. Department, London, U.K, 1987.
[10] P.G. Asteris, S.T. Antoniou, D.S. Sophianopoulos, and C.Z. Chrysostomou, “Mathematical macromodeling of infilled frames: state of the art”, J. Struct. Eng. ASCE, vol. 137, no. 12, pp. 1508- 1517, 2011.
[11] Nitesh Singh, V.K. Verma, “Seismic Evaluation of RC Frame with Brick Masonry Infill Walls”, IJRET, 2015.
[12] Ms. KajalGoel, “Influence of Masonry Infill Walls on Seismic Performance of RC Framed Structures-A Comparison of AAC and Conventional Brick Infill”, IRJET, 2015.
[13] C V R Murty and Sudhir K Jain, Beneficial Influence of Masonry Infill Walls on Seismic Performance of RC Frame Building, 12WCEE2000,1790.
[14] Robin Davis, Praseetha Krishnan, Devdas Menon, Meher Prasad, “Effect of Infill Stiffness Performance of Multi-Storey RC Framed Building in India”, 13th world Conference on Earthquake Engineering, Vancouver, B.C. Canada, 2004.
[15] M.R. Wakchaure, S.P. Ped, Earthquake Analysis of High Rise Buildings with and without Infill Walls, International Journal of Engineering and Innovative Technology, 2012.
[16] IS:1893 (Part-1): 2002 Criteria for Earthquake Resistant Design of Structures Part 1 General Provisions and Buildings., 2002.
[17] Amol Karemore, Shrinivas Rayadu, “Study on Effect of Zone on Magnification Factor for Open Ground Storey Buildings”, International Journal of Innovative and Emerging Research in Engineering, Vol. 02, Issue 5; 58-65, 2015.