International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 07 | July-2016 www.irjet.net p-ISSN: 2395-0072

Seismic analysis of an R.C. multistorey building frame with varying sizes of openings in shear wall

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Abstract - *The effect of seismic forces over a building may cause destructions. To prevent the same cause of failure there are many preferences such as bracings with different geometry and shapes, heavy foundation or shear walls to keep structure safe. Among all other choices we have provided the shear wall to check the suitability of the structure and to analyze the same due to seismic loads. In this work, a G+5 R.C. multistory building frame has been analyzed for different shapes of openings in shear walls at ground floor. This work has been done in a bentley software package i.e., STAAD PRO. (V8i) SERIES 4, an analysis and design software. Is 1893 (part-1)-2002 code has been used in this work to calculate the seismic forces. Hard rock type is used & the work has been done for seismic zone-II. This work concludes on the basis of two parameters are maximum node displacement and maximum reaction. Among all models the most effective opening size is 1.8m x 1.8m i.e., model-IV.*

Key Words: *Shear wall, Staad-pro. v8i (series 4), hard rock type, Is 1893 (part-1)-2002.*

I. INTRODUCTION

Generally civil engineering structures are designed to resist static loads. Usually the effects of dynamic loads are not considered in the design of structure consequently, sometimes it becomes a main cause of disaster. The disaster of Bhuj earthquake on Jan.26, 2001 shows such mishappenings. After this the interest in dynamic consideration has grown up much and the improvement in structural design has been done. There are mainly two parameters i.e., strength and stiffness of any structure on which the design of civil engineering structure is based.

1. **STRENGTH:** It is related with ultimate limit state, which assures that when a seismic load act on structure, forces developed in structure will not get exceed the elastic range. It means, the structure will have enough strength to resist seismic loads.
2. **STIFFNESS**: It is related with serviceability limit state, which assures that when a seismic load act on structure, displacement occurred in structure will be in permissible limit. It means, the structure will have enough stiffness.

To provide the access inside the building frame for the purposes of cables, pipe lines and all, we need to provide openings in shear walls. In this work, it is done with openings with varying sizes at ground floor to analyze the effect of increasing opening sizes.

II. GEOMETRY AND MODELLING

Loads acting on the structure :

- Dead Load (DL) and Live load (LL) : As per IS 875 (Part 1) (1987) and IS 875 (Part 2) (1987), respectively.
- Seismic load (SL) : As per IS 1893 (Part 1) (2002) approach.
- DL : Self weight of the structure, Floor load and Wall loads.
- LL : Assumed Live load 3 kN/sq.m is considered for all floors (except floor level 3) and 1.5 kN/sq.m for floor level 3.

The preliminary data as taken for this study are given in table 1 and the screenshot of Input seismic parameters is shown in fig 1.

Table.1. Preliminary Data

Number of storey	G+5
Plan size	9m x 9m (Each grid size 3m x 3m)
Size of all columns	400mm × 400 mm
Wall thickness (including Plaster)	230mm
Size of beams	300mm × 230 mm
Total height	18m
Floor to floor height	3.0m
Ground storey height from Foundation	3.0m
Depth of slab	125 mm
Support condition	Fixed
Sizes of openings	1. MODEL-I: NO OPENING 2. MODEL-II: 0.6m x 0.6m 3. MODEL- III: 1.2m x 1.2m 4. MODEL-IV: 1.8m x 1.8m
Number of storey	G+5

III. LITERATURE REVIEW

Research works has been done in the direction of seismic forces on multistorey buildings. There are some of them are given as literature reviews. Anshuman. S, Dipendu Bhunia , Bhavin Ramjiyani [1] found the Solution of Shear Wall Location in Multistorey Building. Sachdeva Gourav, Jain Rajesh, Chandak Rajeev [5] analyzed the seismic behaviour of an R.C. multistorey frame with R.C. rectangular shear walls at different location. Ashis Debashis Behera, K.C. Biswal [4] studies 3D Analysis of building frame using Staad Pro. However the study related to R.C Shear walls with openings of different sizes has not been yet done much.

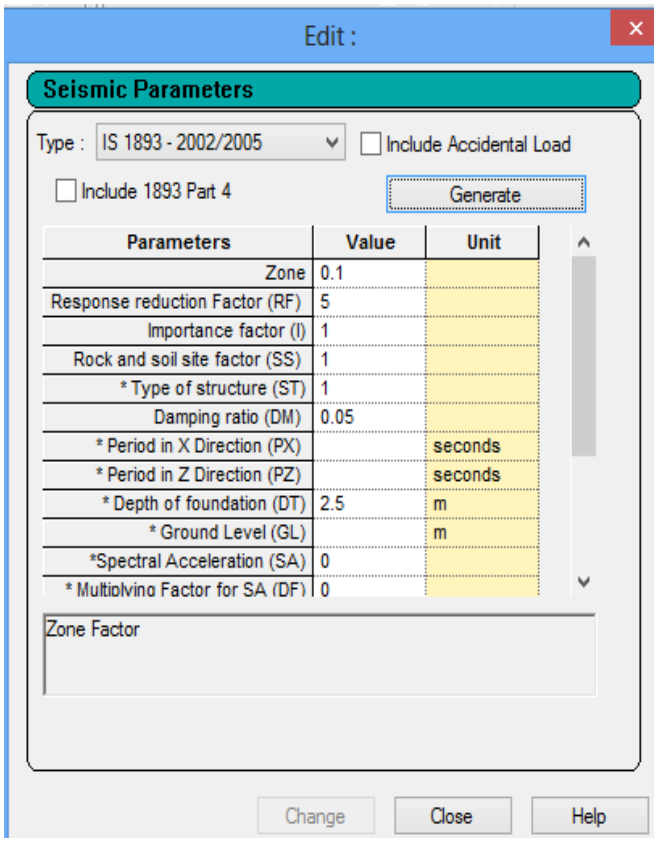


Fig. 1. Screenshot of Input Seismic Parameters

IV. OBJECTIVE OF STUDY

1) To judge the effect of openings size on an R.C. shear wall in an R.C. Building frame.
2) To investigate an R.C. multistorey building frame using STAAD-pro.
3) To study the results of maximum node displacement and maximum reactions for different opening sizes on a shear wall.
4) To understand the purpose of using shear wall using STAAD-pro. through this work .

To know the variation of considered parameter's results when openings sizes are different.

V. PROBLEM STATEMENT

The 3D views of R.C. building frames with openings in shear walls at ground floor are shown in Fig.2., has been considered to carry out the present study. The size of the openings is varying for different models. The dimensions of all models are same which is shown in Fig 3.

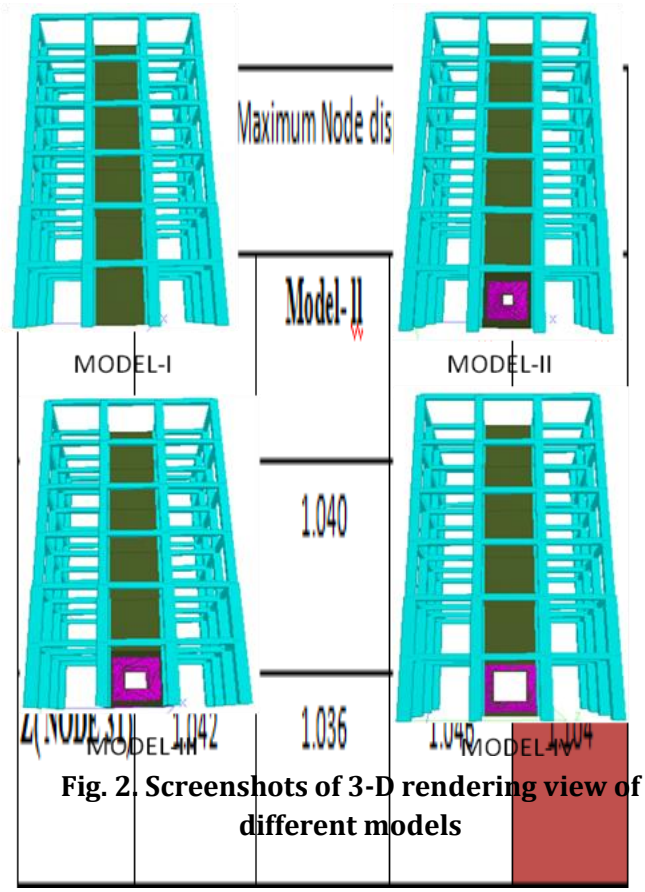


Fig. 2. Screenshots of 3-D rendering view of different models

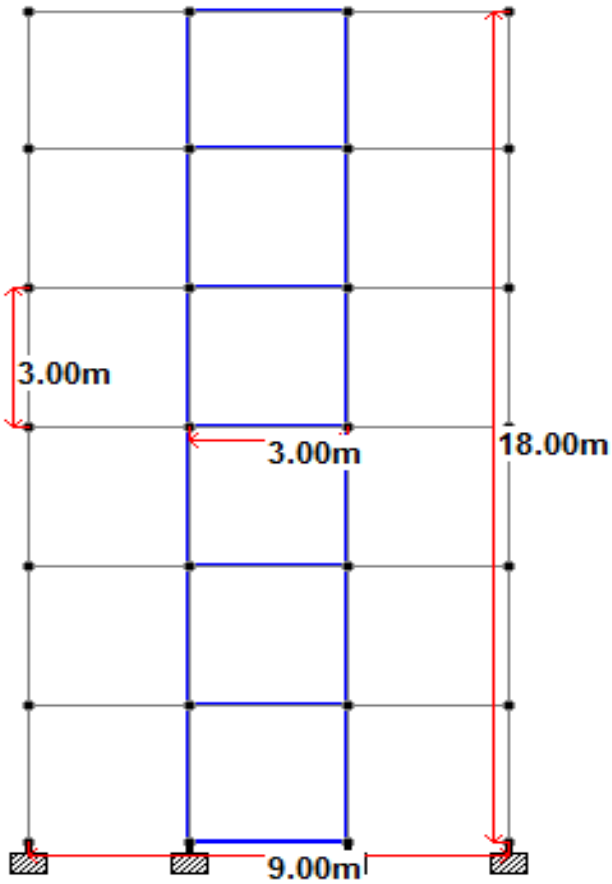


Fig. 3. Screenshots of a model showing dimensions

VI. METHODOLOGY

Steps to model and analyze the R.C. building frame.

Firstly go to run structure wizard and select bay frame.

Then follow the following steps given in Fig.4.

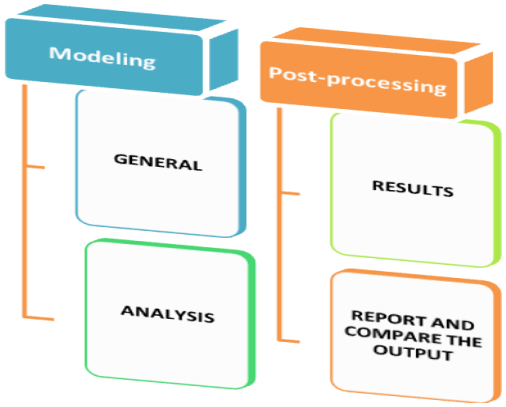


Fig-4:Analysis steps

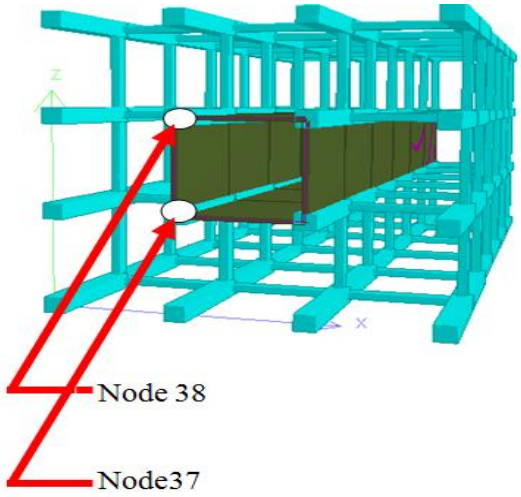
VII. RESULT AND GRAPHS

1. Maximum Node Displacement:

The node displacement in a building frame implies that the connection between beams and columns is suitable or not, to consider the safety point of view of a building frame. The maximum node displacement results are given in Table 2

The variation of node displacement found in such a way that as the size of opening is increasing, the node displacements are also increasing. The whole work for node displacement for node 31 is done. The maximum values of node displacements i.e., 1.108 (along X direction) & 1.104 (along Z direction) are found for Model-IV. The position of node 31 is shown in figure 6 and the graph for the same is shown in figure 5.

Table.2.Maximum Node Displacement (mm)



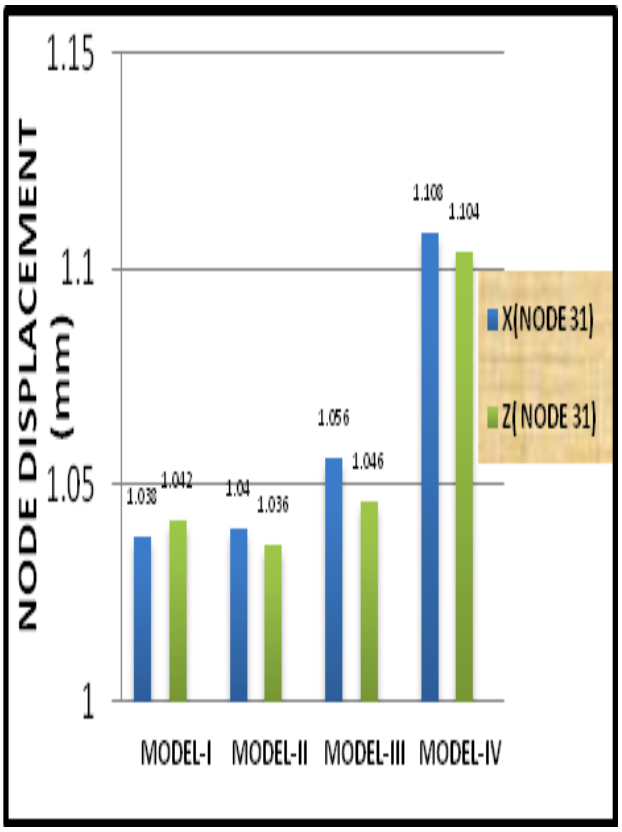


Fig 5: Graph for Node Displacement for all models in X & Z direction

2. MAXIMUM REACTION

The reaction at supports implies that the rigidness of support and to ensure that the capability of a column to transfer the load without settlement of support. The maximum reaction is given in Table 3

It is found that as the size of opening is increasing, the maximum reactions are decreasing. The minimum values of reactions are found for Model-IV i.e., 73.879 (for node 37 along X direction), 1149.885 (for node 38 along Y direction), 73.644 (for node 38 along Z). The nodes 37 & 38 are shown in fig 7. The graphs for maximum reactions are shown in fig 8.

Table 3: Maximum Reaction (KN)

Maximum Reaction (KN)				
Direction	Model-I	Model-II	Model-III	Model-IV
X(NODE-37)	115.644	110.650	97.496	73.879
Y (NODE-38)	1169.341	1166.751	1160.631	1149.885
Z(NODE-38)	115.619	110.316	98.187	73.644

It is found that as the size of opening is increasing, the maximum reactions are decreasing. The minimum values of reactions are found for Model-IV i.e., 73.879 (for node 37 along X direction), 1149.885 (for node 38 along Y direction), 73.644 (for node 38 along Z). The nodes 37 & 38 are shown in fig 7. The graphs for maximum reactions are shown in fig 8.

Fig. 7. Screenshot of 3D-Rendering view (bottom view) of model-I to show Node 37 & 38.

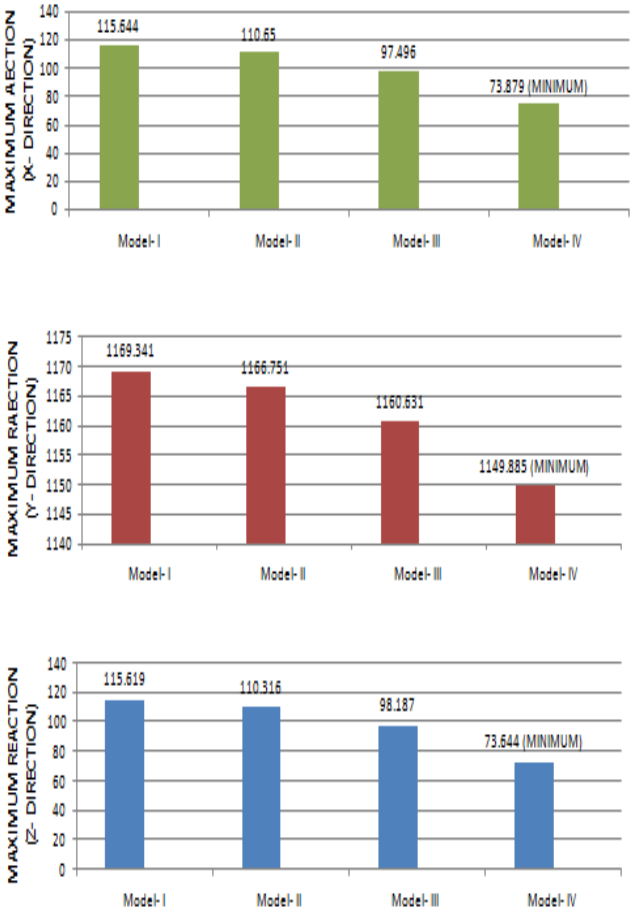


Fig 8 : Graph for Maximum Reaction for all models in X, Y & Z direction

VIII. DISCUSSIONS & RESULTS

A. Node Displacement

The variation of node displacement found in such a way that as the size of opening is increasing, the node displacements are also increasing. The whole work for node displacement for node 31 is done because maximum node displacement was found at node 31. The maximum values of node displacements i.e., 1.108(along X direction) & 1.104(along Z direction) were found for Model-IV.

B. Maximum Reaction

The most reduced reaction values are to be found for model-IV for all nodes i.e., 37, 38 & 38. It is found that as the size of opening is increasing, the maximum reactions are decreasing. Therefore this work concludes that the model-lV is more effective than other models.

IX. CONCLUSION.

The behavior of an R.C. building was analyzed with shear walls having openings of varying sizes. There are the following parameters considered and concluded as follows:

A. Node Displacement

Node displacements are found max. at top floor. Node displacement of node no. 31 was found maximum when Model-IV was used. Therefore this work concludes that the model-lV is more effective than other models because the variation are not much with respect to Model-I and at the same time bigger size opening can provide access to structure in different terms.

B. Maximum Reaction

Therefore openings in a shear wall when provided in an R.C. building frame for Model-IV, fulfilled the requirements better than other models.

REFERENCES

[1] Anshuman. S, Dipendu Bhunia , Bhavin Ramjiyani, “Solution of Shear Wall Location in Multistorey Building”, International Journal of Civil and Structural Engineering,Volume 2, No 2, 2011,493-506.

[2] Bureau of Indian Standards: IS:875-1987, (part 1), Dead Loads on Buildings and Structures, New Delhi, India.

[3] IS: 1893-2002 (part-1) “CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES”fifth revision, Bureau of Indian Standards, New Delhi.

[4] Ashis Debashis Behera, K.C. Biswal “3D ANALYSIS OF BUILDING FRAME USING STAAD PRO.” NIT ROURKELA

[5] Sachdeva Gourav, Jain Rajesh, Chandak Rajeev, “SEISMIC BEHAVIOUR OF AN R.C. MULTISTOREY FRAME WITH R.C. RECTANGULAR SHEAR WALLS AT DIFFERENT LOCATION”, IJIRST, Volume 2, Issue 05, October 2015,ISSN (online): 2349- 6010

[6] Dr. Sudhir K Jain (IIT Kanpur) and Dr. R.K. Ingle (VNIT, Nagpur) “ EXPLANATORY EXAMPLES FOR DUCTILE DETAILING OF RC BUILDING” IITK-GSDMA-EQ22- V3.0

[7] IS: 875-1987 (part-2) for Live Loads or Imposed Loads, code practice of Design loads (other than earthquake) for buildings and structures.

[8] Prof. Sarita Singla, Megha Kalra, Rahul Kalra and Taranjeet Kaur," BEHAVIOUR OF R.C FRAMED BUILDING WITH DIFFERENT LATERAL BRACING SYSTEMS", DOI: 02.AETACE.2012.3.16

[9] P.C.Varghese, "Advanced Reinforced Concrete Design", Second Edition.

[10] Pankaj Agrawal and Manish Shrikhande Earthquake resistant design of structure" Third Printing

[11] Bureau of Indian Standards: IS:875-1987, (part 1), Dead Loads on Buildings and Structures, New Delhi, India.