Seismic Behaviour of an R.C. Multistorey Frame with R.C. Rectangular Shear Walls at Different Locations

Sachdeva Gourav
M. E. Scholar
Department of Structure Engineering
Jabalpur Engineering College, Jabalpur

Jain Rajesh
Associate Professor
Department of Civil Engineering
Jabalpur Engineering College, Jabalpur

Chandak Rajeev
Professor
Department of Civil Engineering
Jabalpur Engineering College, Jabalpur

Abstract

Food, clothing and shelter are basic human needs. Beside food & clothing, shelter is a challenging task because according to KMPG, 11 crore houses will likely be required by 2022. To achieve this figure the speed of construction should be good enough. To avail the rapid construction, the most effective way is to provide shear walls instead of masonry walls. The main focus of this work is to analyze a R.C. building frame with R.C. shear walls at different locations of a building to know its the most efficient location. Shear wall is a specially designed structural walls incorporated in building to resist lateral forces that are produced in the plane of the wall due to seismic, wind and other forces. In this work, a 6 storey R.C. building frame has been analyzed for seismic zone-lll using staad pro. v8i (series 4) package. Special moment resisting frame (SMRF) and hard rock types are used in this work. There are some parameters considered such as node displacement, Maximum reactions and total weight of reinforcement to compare the results for different models. It has been judged that the model-IV is most efficient than other models.

Keywords: Shear wall, staad pro. v8i (series 4), SMRF, node displacement & Maximum reactions

I. INTRODUCTION

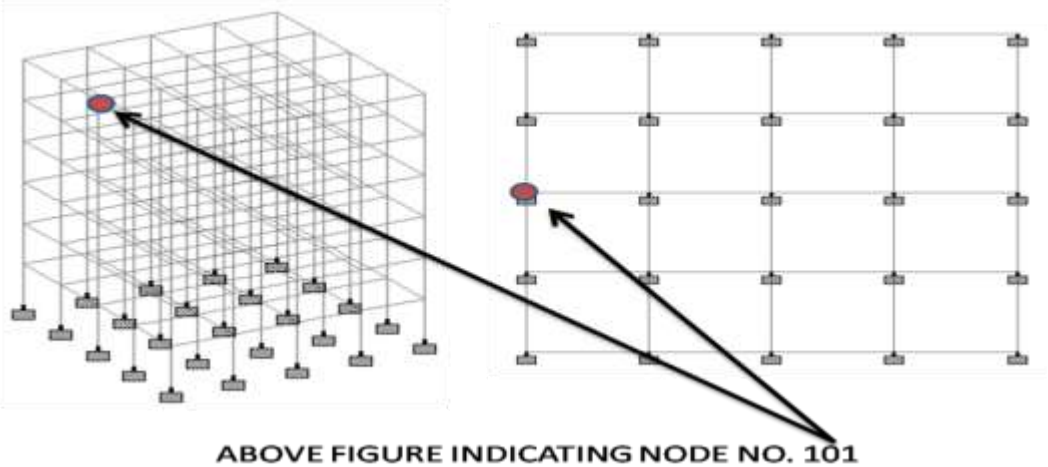
Now a days people preferring Vertical System (high rise building due to shortage of area).In high rise buildings we should concern about all the forces that act on a building. If we will do so much calculation for a high rise building manually then it will take more time as well as human errors can be occurred. So the use of any software example , STAAD-PRO. will make it easier. Shear walls are vertical elements of the horizontal force resisting system. Shear walls are constructed to counter the effects of lateral load acting on a structure. In the last two decades, shear walls became an important part of mid and high-rise residential buildings. When shear walls are designed and constructed properly, they will have the strength and stiffness to resist the horizontal forces. Hence, this paper has been described to determine the proper location of shear wall. An RCC medium rise building of 6 stories subjected to an earthquake loading in Zone III has been considered.The results of this work revealed that an improvement is noticed in considered R.C. building frame when shear wall locations are changed. The most efficient location found of shear wall is for model-IV.

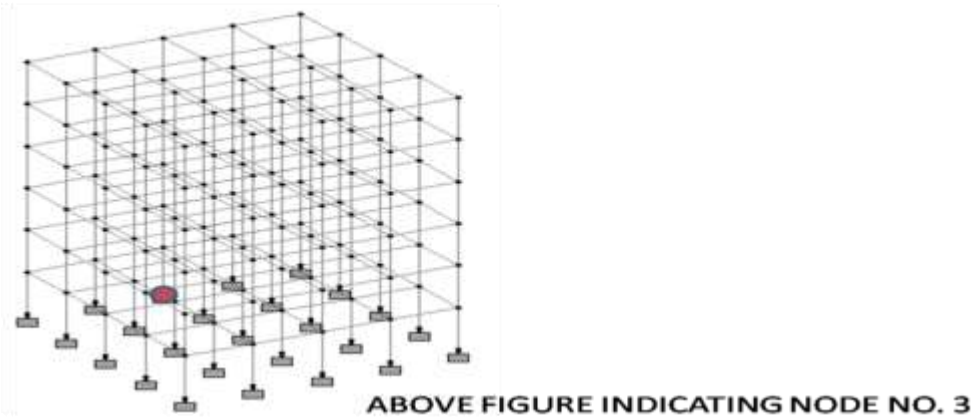
II. LOADING CONSIDERATION

Loads acting on the structure are:

- 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 top floor) and 1.5 KN/sq.m for top floor
- SL: Zone : III (Z=0.16)
- Rock/ soil type : Hard
- Rock and Soil site factor : 1
- Response reduction factor: 5

- Importance factor: 1
- Damping : 5%





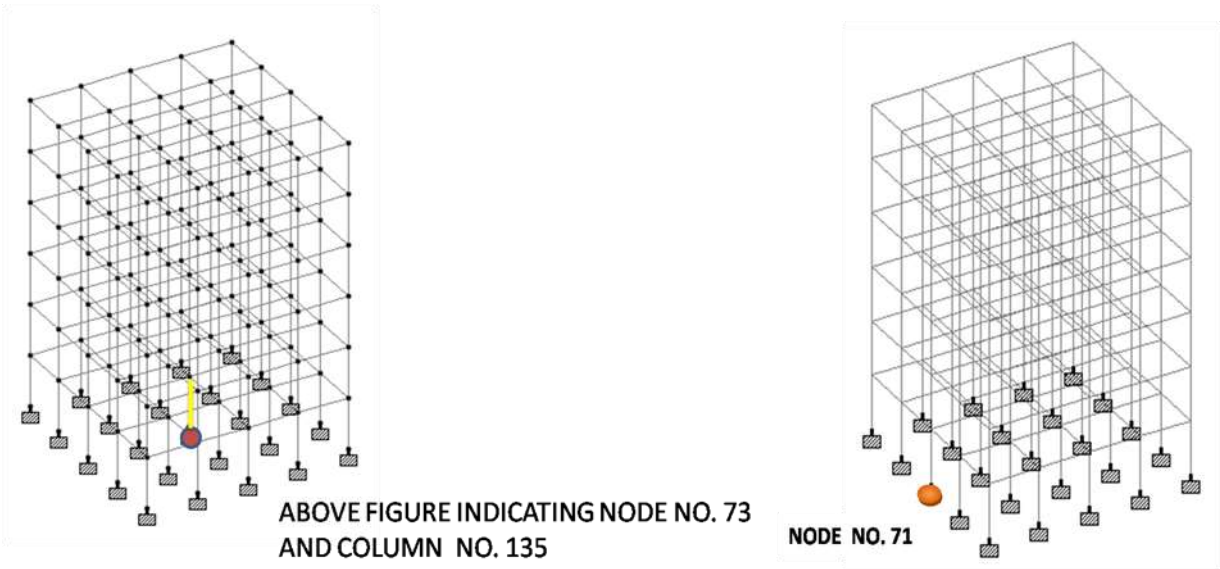


Fig. 1: Position of nodes and beams

The preliminary data as is taken up for this study.

- Wall thickness (including Plaster) -230mm
- Number of storeys - G+5
- Plan size -12m x 12m (Each grid size 3m x 3m)
- Size of ground floor and first floor columns - 500mm × 500 mm
- Size of 2nd, 3rd, 4th & 5th floor column - 400mm × 400 mm
- Size of beams - 300mm × 230 mm

- Shear wall thickness -200 mm
- Depth of slab -125 mm
- Ground storey height From Foundation -3.0m
- Total height18m
- Floor to floor height -3.0m
- Grade of Concrete and steel -M30 and Fe 415
- Ductility design -IS: 13920
- Support condition -Fixed

III. LITERATURE REVIEW

A lot of research work has been done in the direction of shear wall multistory building. Arvind Vinayakrao Achole, Dr. G.N. Ronghe [6] studied the behavior of building frame with steel plate shear walls. Dr. Sudhir K. Jain and Dr. H.J. Shah[5] gave notes on design examples of a six storey building. Alfa Rasikan(2013), M. G. Rajendran(2013) [2] analyzed Wind behaviour of buildings with and without shear wall. Ashis Debashis Behera ,K.C. Biswal [10] studied 3-D analysis of building frame using staad pro. Prashanth.P (2012), Anshuman.S(2012), Pandey.R.K(2012), Arpan Herbert(2012) [3] Compared design results of a Structure designed using STAAD and ETABS Software. However the work on shear wall most efficient location has not been done much.

IV. OBJECTIVE OF STUDY

1) To analyze an R.C. building frame using staad pro. Software setup.
2) To judge the effect of an R.C. shear walls on an R.C. Building when provided at different locations.
3) To study the results of node displacement and maximum reactions obtained.
4) To understand the purpose of using shear walls using staad pro. Through this work.

V. PROBLEM STATEMENT

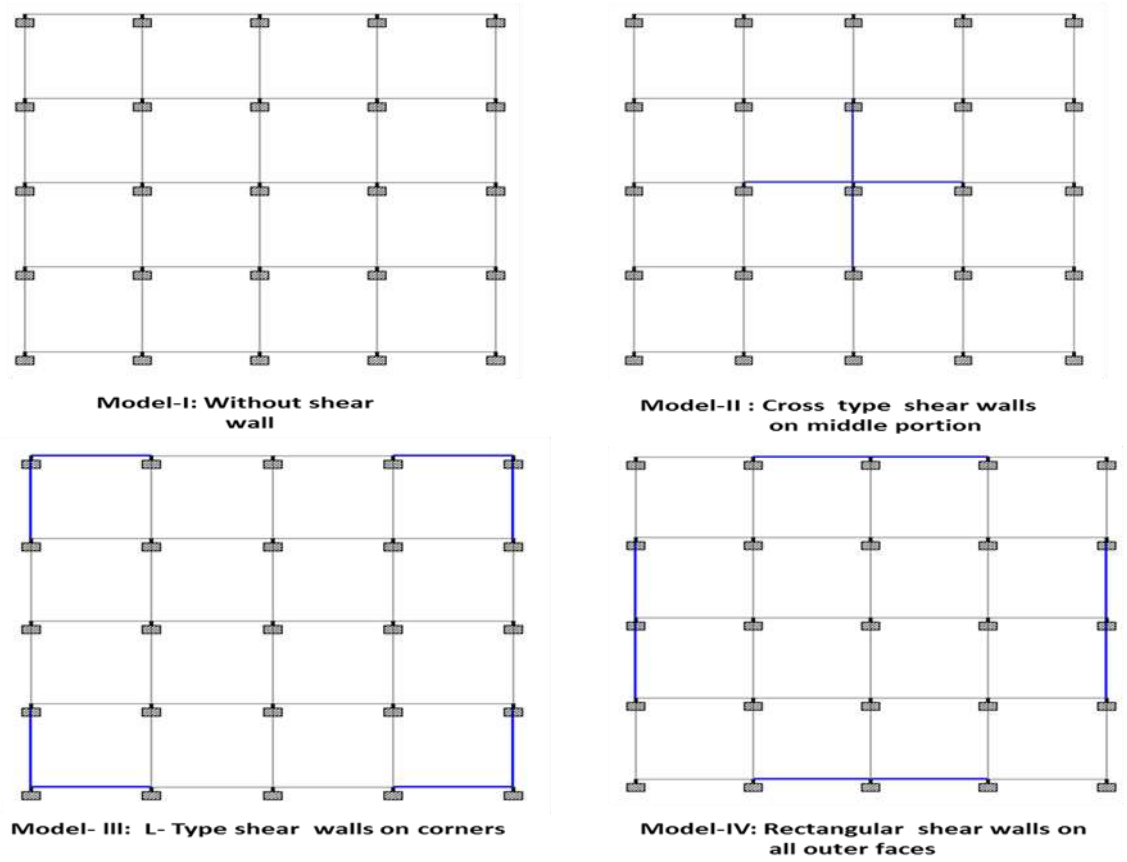


Fig .2: Plan Of Models Considered

VI. METHODOLOGY

Steps to model and analyze the R.C.C. building frame. Firstly go to run structure wizard and select bay frame. Then follow the following steps given below,

1) Modeling

→ General
→ Design
→ Analysis

2) Post – processing

→ Design of members and shear walls using surface command
→ Results
→ Report and compare the output

VII. RESULT AND GRAPHS

NOTE:
1) Minus (-) sign shows decreasing percentages.
2) Plus(+) sign shows increasing percentages.

A. Maximum Node Displacement

Table – 2
Maximum Node displacement

Direction		*Maximum Node displacement (mm) for node no. 101*			
		Model- I	*Model- II*	*Model- III*	*Model- IV*
X		*4.801*	*1.134*	*2.139*	*2.398*
Z		*4.668*	*2.141*	*1.089*	*0.726*
REMARK (MAX. VALUE AT ANY NODE ANYWHERE IN STRUCTURE)		*Node 101*	*2.171 (Node 31)*	*2.139 (Node 101 & 33)*	*2.398 (Node 101 & 33)*
PERCENTAGES W.R.T. MODEL-I	*X*	*100%*	*-76.37%*	*-55.44%*	*-50.05%*
	Z	*100%*	*-54.134%*	*-76.67%*	*-84.447%*

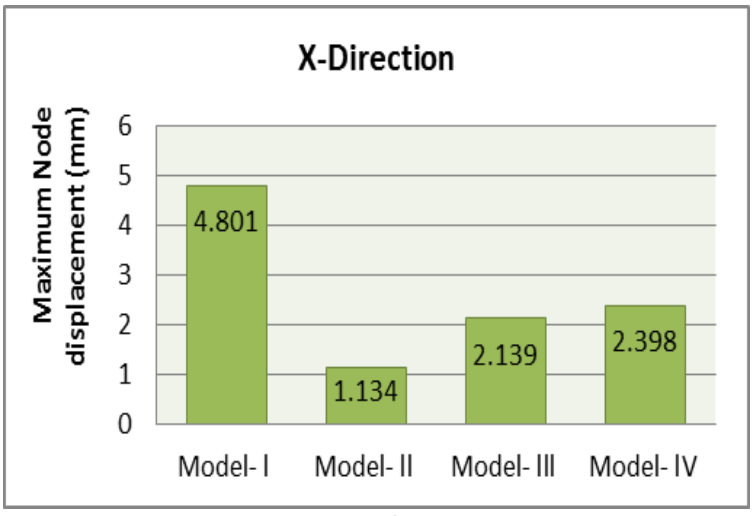


Fig. 3:

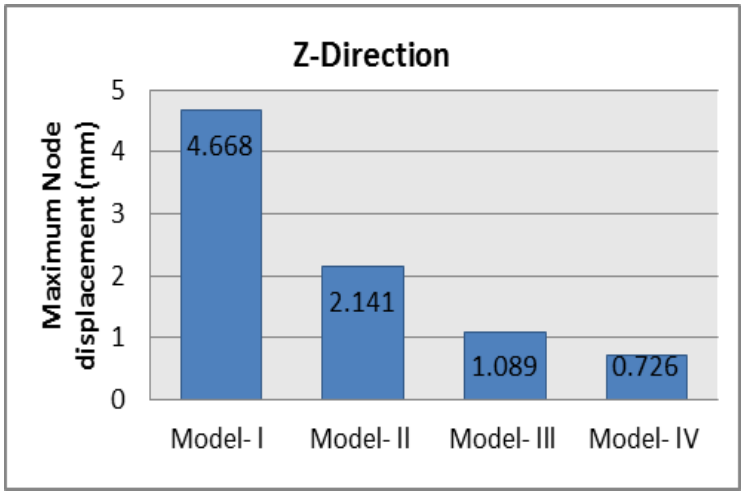


Fig. 4:

B. Maximum Reaction

Table – 3
Maximum Reaction

Maximum Reaction (KN)					
Direction	*Node no.*	*Model- l*	*Model- ll*	*Model- lll*	*Model- lV*
X	*71*	*9.305*	*6.734*	*6.770*	*5.661*
PERCENTAGES W.R.T. MODEL-I			*-27.63%*	*-27.243%*	*-39.161%*
Y	*73*	*1279.049*	*2267.328*	*1278.053*	*1250.090*
PERCENTAGES W.R.T. MODEL-I			*+77.267%*	*-0.07787%*	*-2.2641%*
Z	*3*	*9.305*	*6.734*	*6.770*	*5.661*
PERCENTAGES W.R.T. MODEL-I			*-27.63%*	*-27.243%*	*-39.161%*

1) For Node No. 71

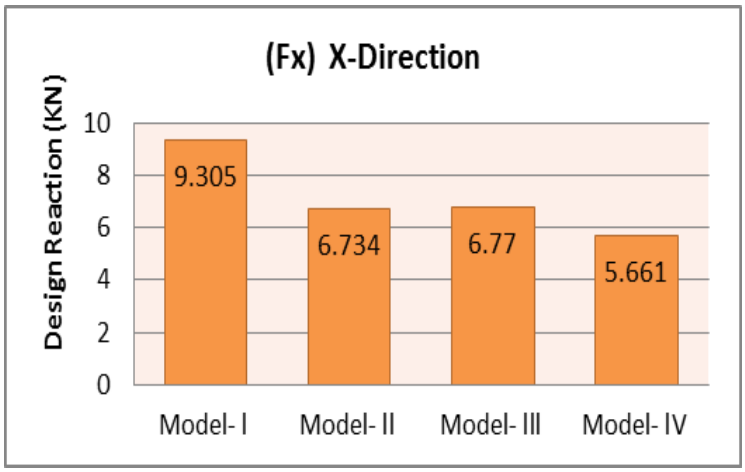


Fig. 5: For Node no. 71

2) For Node No. 73

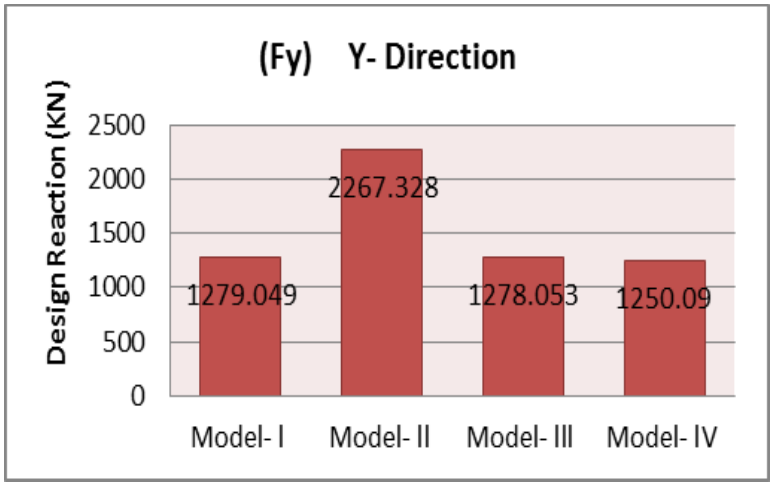


Fig .6: For node no. 73

3) For Node No. 3

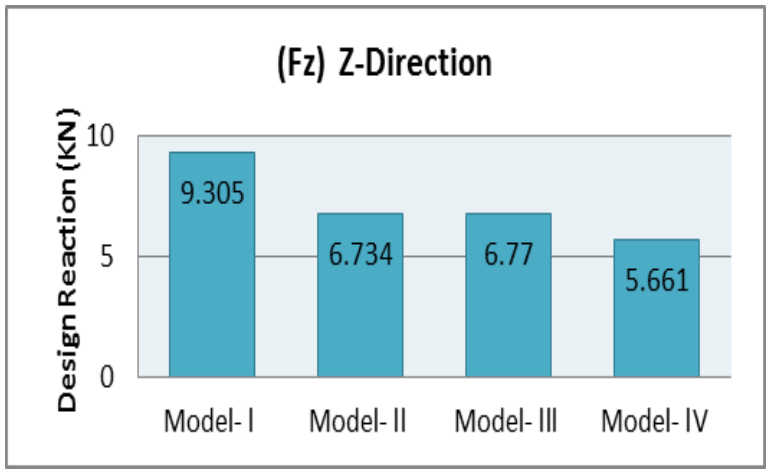


Fig. 7: For Node no. 3

VIII. DISCUSSIONS & RESULTS

A. Maximum Node Displacement

A node 101 has been selected for analysis because maximum node displacement was found at that node when model - I was analyzed. The results obtained for 101 shows that the minimum node displacement in x- direction for Model –II i.e., 1.134mm & in z - direction for Model – IV i.e., 0.726mm . It is obvious that the node displacement of node 101 will be more due to x-direction rather than z- direction & found the same results through analysis. The most reduced value of node displacement is 0.726mm due to model-IV.

In this work, the node displacement is found to be maximum at top storey and [4] also gives the same results that the maximum node displacement is at topmost storey which is identical to present work. [7] also gives the maximum node displacement at topmost storey as found in this work.

B. Maximum Reaction

It is found that the model-IV is much effective than other models. For model-IV the reaction either in x,y & z direction are found minimum i.e., 5.661KN,1250.090KN & 5.661KN respectively . For nodes 71, 73 & 3,this work is done in x,y &z directions respectively. These nodes are selected on the basis of maximum reaction obtained when model-I was analyzed.

IX. CONCLUSION

The behavior of a R.C. building was analyzed with shear wall at different locations and conclusion may be drawn from this study.

A. Node Displacement

Node displacements are found max. at top floor. Node displacement of node no. 101 was found to be minimized when shear wall used & the most effective location of shear wall is for Model-lV.

B. Maximum Reaction

The minimized reaction values is to be found for model-IV for all nodes i.e., 11,73 & 3.

Therefore this work concludes that the model-lV is more effective than other models. Therefore shear walls on edges of an R.C. building fulfill requirements better than other locations.

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