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Earthquake Analysis of Multistorey Residential Building using STAAD-Pro

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ABSTRACT: In the seismic design of buildings, reinforced concrete structural walls, or shear walls, act as major earthquake resisting members. Structural walls provide an efficient bracing system and offer great potential for lateral load resistance. Properties of these seismic shear walls dominate the response of buildings, and therefore, it is important to evaluate the seismic response of the walls appropriately. In this present study, main focus is to determine the solution for shear wall location in multi-storey building. Effectiveness of shear wall has been studied with the help of four different models. Model one is bare frame structural system and other three models are dual type structural system. An earthquake load is applied to a building of 15 stories located in zone III. Parameters like the displacement, bending moment and shear force have been studied or calculated throughout the project.

And checked the displacement of structure at different positions of shear wall. In this project different positions as follows

- 1.No shear wall
- 2.At centre
- 3.At corners
- 4.At centre of geometry

KEYWORDS: STAAD PRO., RCC structure, Seismic analysis, Shear wall.

I. INTRODUCTION

In the present era of growing population in 21st century, the necessity of more flexible civil engineering structures such as the high-rise buildings and metro bridges are increased and they are subjected to undesirable vibration. Deformation and accelerations due to strong earthquakes, blasts, wind (cyclone), moving loads, machines and large ocean waves. Excessive vibrations in the structures is an unwanted phenomenon which causes human discomfort, waste of the energy, partial collapse of the structural parts, and transmits unnecessary forces and also poses a threat to structural safety and, sometimes leads to collapse. In order to prevent the undesirable and harmful effects of the unstable structures, then it is necessary to define the loads like wind load and earthquake load. It is a challenge for structural engineer to understand the behaviour and response of structural system to dynamic loads. High-rise buildings are a special class of structures with their own particular characteristics and requirements. High-rise buildings are then often occupied by the number of people.

II. AIM AND OBJECTIVE

Aim of the present study is to compare the behavior of High-rise multistoried residential building with shear wall to analyze and design the effect of building height on the performance under earthquake forces. Using STAAD-PRO SOFTWARE. Study of shear forces, bending moment, seismic forces and Node displacement during assigning process and restrain them by applying suitable property and material and again assigning



III. LITERATURE REVIEW

1]Literature 1

P.pchandurkar (may-june 2013)

paper name :- seismic analysis of rcc building with and without shear wall.

He did a detail study to determine the solution for shear wall location in multi-storey building with the help of four different models. The buildings were modelled using software ETAB Nonlinear v 9.5.0.After analysing ten storey building for earthquake located in zone II, zone III, zone IV and zone essential parameters like displacement lateral ,story drift and total cost required for ground floor were found in both the cases by replacing column with shear wall and conclusion was drawn that shear wall in short span at corner is economical as compared with other models.

2] Literature 2

Keerthi Gowda, Syed Tajoddeen.(19 May 2014)

Paper Name:- Seismic analysis of multi-storied building with floating column.

In this paper authors did study on Seismic analysis of multi-storied building with floating column. In this project number of stories are G+10 with medium soil in seismic zone number 5. The main purpose of present study was to assess seismic performance of the RC building with floating columns and seismic performance of RC building with floating columns after providing lateral bracings. For this purpose response spectrum analysis (RSA) is performed considering three models (without floating columns, with floating columns and floating columns with bracings). Through the parametric study of storey drift, storey shear, time period and displacement, it was found that the multi-storey buildings with floating columns performed poorly under seismic excitation. Thus to improve seismic performance of the multi-storey RC building, lateral bracings were provided. The bracings improved seismic performance of multi-storey building considerably as different parameters such as storey drift, storey shear, time period and displacement improved up to 10% to 30%.

IV. METHODOLOGY

In our project we referred various IS-Code like IS-1893:2002/2005 and IS-456:2000 for design purpose. Required architectural plan, the sizes of beams and columns for analysis and design purpose is collected from a construction site of a multistorey building.

1. Topic selection
2. Review
3. Modelling of building
4. Assigning property
5. Design beam
6. Design column
7. Provide shear wall
8. Design shear wall
9. Conclusion

Sr.no	Specifications	Information
1	Building type	Residential building
2.	No of storeys	G+14
3.	Building shape	Rectangular
4.	Geometrical details (floor to floor height)	3m
5.	Type of construction	RCC framed structure
6.	Software used	STAAD-PRO V8i

Table 1:Parameter of Building

Software Used :-

Auto CADSTAAD PRO

This software is used for drawing and drafting

. This Software is used for structural analysis

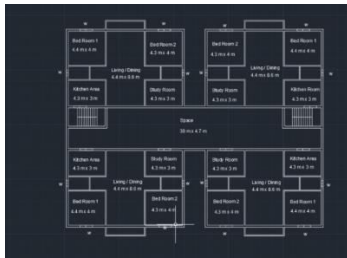


Figure 1 : AutoCAD plan

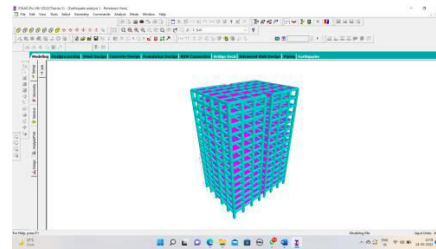


Figure 2 : 3 D rendering view

Steps for Modelling In Software

STEP 1 :MODELLING :-Create new project then click on space and set the units. Then finish by selecting add beam. With respect to consideration of type of structure modelling has been done using geometry and structural wizard tool.

STEP 2: Generation of nodal point :-As per the planning with respect to the positioning of column in building, their respective nodal point has been created on that model. Then default grid liner is opened, then edit and select the plane and put the values as spacing for construction line. Open the snap mode beam command.

STEP 3: Construction of whole structure :- After the completion of geometry, draw the whole structure with add beam command using given nodes. After completion of base plan use the command translational repeat by assigning the height up to the requirement of floors of building (G+14).Each floor and stair case draw the plates by using plate command.

STEP 4: Assign the properties :-After the whole structure add property for beam, column and floor under define. And also give plate element thickness and surface thickness using thickness geometry.

STEP 5: Add support :-For adding support, select the fixed support from create option. Then select the node and assign support to selected nodes.

STEP 6: Shear wall surface :-After the construction of whole model structure, take add surface command and draw the surface. Select the position node at top and bottom of the model of the structure and add surface. Assign the property of shear wall and assign the thickness.

STEP 7: 3D-Rendering view:-After assigning the member property to structure the 3-D view of the structure can be shown using 3-D Rendering command.

STEP 8: Load and definition• Definition :- In definition requirement of project we add seismic definition and wind definition. In seismic definition, using the IS-Code 1893: 2002/2005 part4, generate the parameters. Parameters such as zone, reduction factor, Importance factor, soil type, type of structure, damping ratio. Then add selfweight and member weight are added. Wind definition :- In this give the details about intensity as per height of the structure and assign exposure to all view of structure.

DETAILING AND MODELLING

No	Specifications	Information	No.	Specifications	Information
1.	Structure type	RCC Frame structure	12.	Steel grade	Fe500
2.	Number of stories	G+14	13.	Concrete density	25 N/mm ²
3.	Seismic zone	III	14.	Poissons ratio of concrete	0.3
4.	Floor height	3m	15.	Z factor	0.16
5.	Size of Column	850mm X700mm	16.	RF	5 (SMRF)
6.	Size of Beam	700mm X 600mm	17.	Importance factor	1
7.	Thickness of slab	150 mm	18.	Damping ratio	5%
8.	Live load	2 kN/m ²	19.	Modulus of elasticity	2000 N/mm ²
9.	Floor Finish	3.75 kN/m ²	20.	Grade of concrete	M30
10.	Types of soil	Medium Soil Type II	21.	Support Type	Fixed support
11.	(Fck)	30 N/mm ²			

Table 2 :Detailing and modelling

SHEAR WALL

Shear walls are used in many buildings primarily to resist efficiently the action of lateral loads and to participate as much as possible in carrying gravity loads. They are usually conceived as vertical plates supported at the foundation and are expected to function only under the action of in-plane horizontal and vertical forces. However, depending upon the architectural and structural layout of building, shear walls may have complex shape. Often the walls are of a central core forming boxes, or are cast between two columns leading to I or dumbbell shapes.

Location of Shear wall in our project :-

1. Building with shear walls on periphery at the center.
2. Building with shear walls on periphery at the corner.
3. Building with shear walls on periphery at the center of geometry.

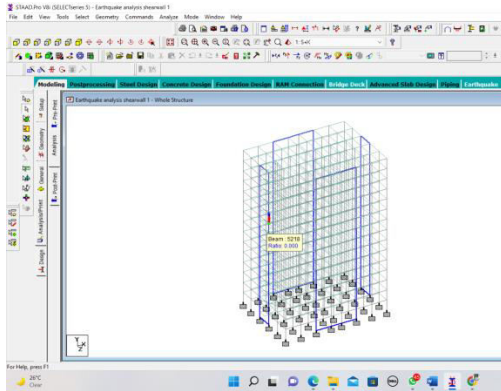


Figure 3 :Shear wallat Centre

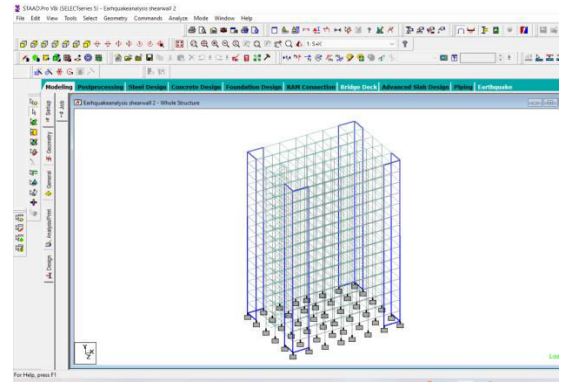


Figure 4: Shear wallat Corner

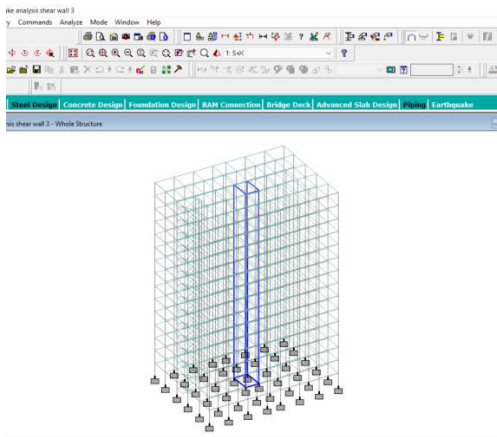


Figure 5 : Shear wallat centre of geometry

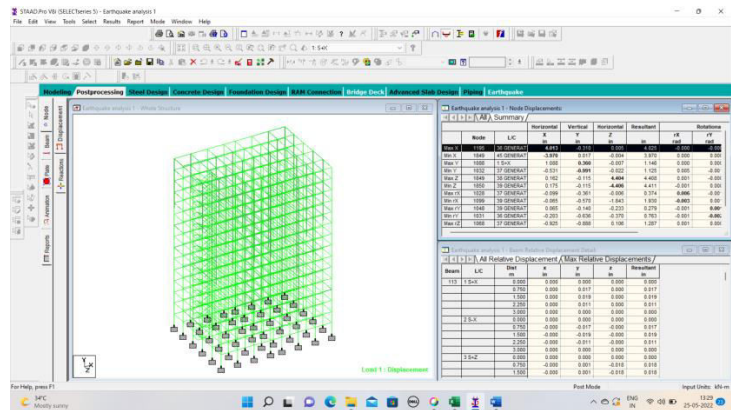


Figure 6 : Displacement on Software

Below figures shows the resultant displacement with various positions of shear wall structure results . For node displacement with Max X and Max Y .

Below graphs shows the result between shear wall position and resultant displacement value in X , Y and Z direction .

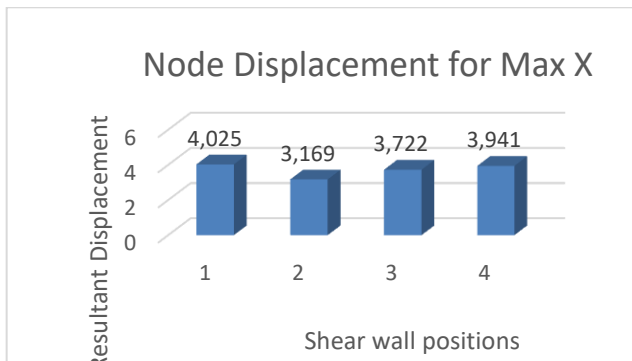


Figure 7 :Node displacement at X

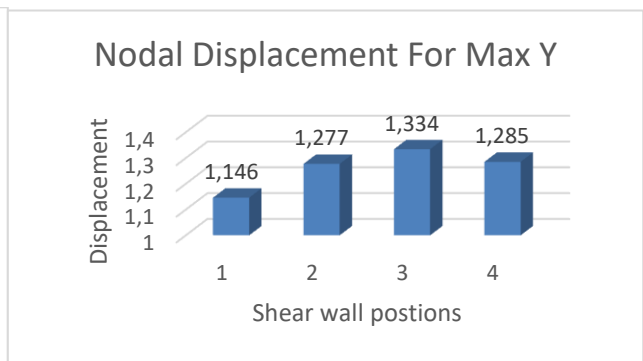


Figure 8 : Node displacement at Y



V. CONCLUSION AND FUTURE WORK

The main purpose of this present study was to assess the seismic effect on high rise building with or without the shear wall. Also provide the different positions of shear wall structure for decrease the lateral displacement. Positions of shear wall in structure are shear wall at centre, at corners and at centre of geometry. Through the parametric study of displacement, it was found that high rise building with shear wall is more stable than than the no shear wall structure. Thus to improve the seismic performance of the high rise building provide the shear wall at good position. Conclusion After this study STAAD PRO is effective software for Structural Analysis. Lateral displacement is more for no shear wall structure than the Shear wall provided structure. In this project we change the positions of shear wall, and check the displacement for node and beams. get the results shear wall provided at the centre is very stable and less displacement compare to the others structures.

REFERENCES

- 1) IS 1893-1 (2002) :- For Seismic analysis purpose .
- 2) IS 875 (PART 1, PART 2,PART 3, PART 5) for design the loads and load combination.
- 3) STAAD PRO manual.
- 4) P.P. Chandurkar (May-June 2013C Paper Name:- Seismic analysis of RCC building with and without shear wall.
- 5) Keerthi Gowda, Syed Tajoddeen. (19 May 2014) Paper Name:- Seismic analysis of multi-storied building with floating column.
- 6) Prasad, R. V. (2014) Paper Name:- Seismic analysis of building with shear wall on sloping ground.



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