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Structural Analysis of Asymmetrical Multistory Building with Watertank Act as a Seismicdamper

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ABSTRACT:Overhead water tank commonly used in buildings for various requirements. Overhead water tank is not only for water supply which also control the displacement of building during the earthquake force acting on structure. RCC over head water tank which gives the certain mass to the building this mass reduce the lateral movement of the building during seismic force on structure. In multi story structure, water tank also will lead the important factor for reducing the seismic response of the building. Using this technique overhead water tank placed on asymmetrical multi story building at different places. In that one particular location reduce the seismic response more that place is choose for placing water tank. The advantage of this method is overhead water tank is used for water supply as well as controlling of seismic response. Response spectrum analysis are used for analysis the structure in ETABS software. This software is used to checking the particular location for fixing the overhead water tank. IS standards are used for this analysis. In this experiment purpose the G+10 building is analysed in this study. This method is very economical it save the extra money for strengthening the building.

KEYWORDS:Overhead water tank, response, displacement, earthquake, important factor.

I. INTRODUCTION

The vibration occurred on the earth surface it is called as earthquake which is a natural phenomenon, the tectonic are always slowly travelling but it sometimes stuck at the corner because of friction. The stress are developed due to these friction, during that time there is an energy released by earthquake, these energy creates the earthquake wave, which passing the earth's crust and cause swaying of earth.

Two method of analysis usually done in all civil engineers these two methods are main analysis one is response spectrum analysis and another one is time history analysis. From the past data gives the information about many buildings which are collapse due to the seismic action. Which made more economical loss and loss of human being.

The main purpose of this project is reducing the seismic action on asymmetrical building having overhead water tank with fluid viscous damper. Which control the seismic intensity of the building and fluid viscous damper is also used for this experiment which is also dissipating the energy caused by the earthquake force. So in that ETABS software are used to analysing the asymmetrical multi story structure using the response spectrum analysis method.

In this asymmetrical multi story building having overhead water tank with FVD act as a displacement controller. Water tank with FVD placed on a different location on top floor, and which place suitable for reducing the seismic intensity, that place is selected for placing the overhead water tank on top floor.

2.1 Working procedure for water tank worked in high rise building

- 1) The placing of reinforced overhead water tank with fluid viscous damper on roof top of the asymmetrical building, which gives the certain mass to the building.
- 2) The overhead water tank placed in different location on roof top of the asymmetrical building.
- 3) In this experiment one particular location of overhead water tank reduce the seismic intensity more.
- 4) Simply overhead water tank placed on that particular location where the water tank location reduced the seismic intensity.



- 5) This method is controls the seismic action acting on the building like mass damper.
- 6) This method is economical method to saving the extra cost.

2.2 Objectives of the study

The main objectives of the present study on a

- 1) To study the analysis of asymmetrical multi story structure using ETABS software.
- 2) To carry out analysis of asymmetrical multistory structure having the overhead water tank with fluid viscous damper using the response spectrum analysis.
- 3) To study the proper place for placing the overhead water tank on asymmetrical multi story building.
- 4) Compare the seismic analysis of all different location for keeping the overhead water tank with fluid viscous damper act as damper.
- 5) To study the story displacement, story drift, story shear and story stiffness with respect to response spectrum analysis.

II. LITERATURE REVIEW

3.1 General

In this section, we summarize the investigations of various authors working in the field of Structural control as part of the literature survey.

Joseph Asha and Joseph Glory(2018)They research mainly done investigation on the water tank by the method of finite element method. The output of the result may be depends upon the geometry, property of liquid and action of load. This method worked on the liquid in the water tank gives the certain mass to the structure. The result showing good and better the water tank are reduces the seismic response of the structure.

Vipul N Khola ,Atul B Pujari and Deepak P (2019)This author reviewed that efficiency of mass on the structure which minimize the wind and lateral movement of the structure. They took 2,3 and 5% mass for their investigation. When mass increase with increase the stiffness of the structure And they conclude that mass will reduce the displacement of building. It will give best result for analysis in any software.

Sandip Kumar Saha, S.M.ASCE and Hitesh Kumar (2020)This authors studied on the overhead water tank undergoes lateral loading , water tank worked like to reduces the displacement and base shear and drift and gives the stiffness to the building. So they concluded that overhead water tank is also behaves as seismic intensity controller.

III. METHODOLOGY

4.1 Following methodology is adopted to analyses,

1. Multi story building having the overhead water tank on a top terrace portion which modelled in the ETABS software.
2. 4 type of models are to be taken, all models having the overhead water tank at different location.
3. All models having the dead load, live load, earthquake load and load combination.
4. Applying all loads to the models and check the model error and then all model are error free again go for design check and conform all members are passed in all models.
5. So models are passed applied the response spectrum analysis using ETABS software.
6. The result are to be taken from each model.
7. In this ETABS software analysis which gives the story displacement, story shear, story drift and story stiffness.
8. Using the above parameter create the tabular column , graphs and results are in excel.
9. After that results are discussed in and results and comparison section.

Table -1: Table 4.1 Description of models and its height

Serial No.	Name of the model	Description	Height of the building in m
1	Model A	Water tank placed at centre top side.	33
2	Model B	Water tank placed at left bottom side.	33
3	Model C	Water tank placed at right side bottom.	33
4	Model D	Water tank placed at centre bottom side.	33

4.2 Material property which is used in this models are following;

Grade of concrete = M35

Grade of steel = Fe550

Young's modulus of concrete = 25000Mpa

Young's modulus of steel = 200000Mpa

Unit weight of concrete = 78.0KN/m³

Unit weight of steel = 25 KN/m³

4.3 Geometry of model

Depth and width of beam = 460x600mm

Depth and width of column = 600x600mm

Slab thickness = 200mm

Shear wall thickness = 200mm

Floor height = 3m

Multi Story building total height = 33m

4.4 Load consideration in this plan are;

1. Dead load.

Dead load is permanent load which cannot vary, which is constant load which include the beam, column and slab weight. This dead load assigned according to codal provision as per IS 875-Part 1(1987).

2. Live load

Live load is the load. Load is not a permanent load. Which is like a temporary load which load is any time add or remove from any situation. This live load is also assigned according to codal provision as per IS 875-Part 2(1987).

3. Earthquake Load (EL)

Which is also called as dynamic load this load is sudden in nature and caused vibration to the building. Agitation are created in building which is caused by the earthquake. The earthquake or horizontal load is assigned according to as per the IS 1893- 2002(Part1).

The details to be considered for earthquake load is

- 1) Zone factor take into = 0.16 (zone 2)
- 2) Importance factor consider = 1.5
- 3) Response reduction factor in this all models = 3
- 4) Condition of soil = Medium
- 5) Damping percentage = 5%

Modelling and analysis

Model A

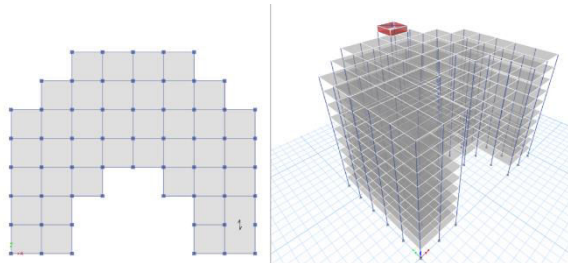


Fig:- 4.1 Model A plan and 3D view

Model B

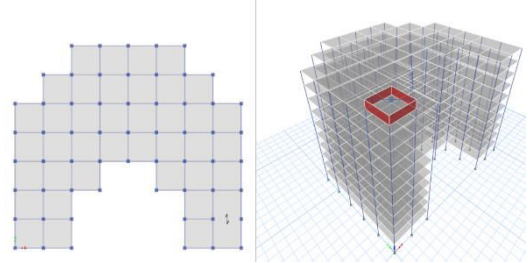


Fig:- 4.2 Model B plan and 3D view

Model C

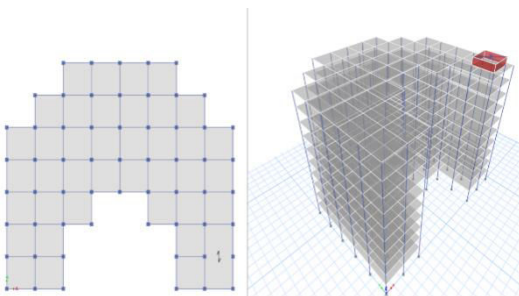


Fig:- 4.3 Model C plan and 3D view

Model D

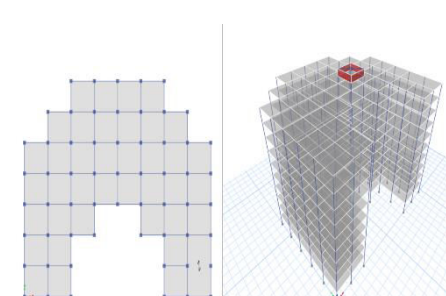


Fig:- 4.4 Model D plan and 3D view

IV. EXPERIMENTAL RESULTS

The below table and bar chart are shown the result of all 4 models along the X and Y direction. This table and bar chart are compared all the 4 models maximum story displacement, maximum story drift, story shear and story stiffness along the X and Y direction.

Maximum story displacement



Fig-4.1 Max story displacement along X and Y direction of all 4 models

Maximum story drift

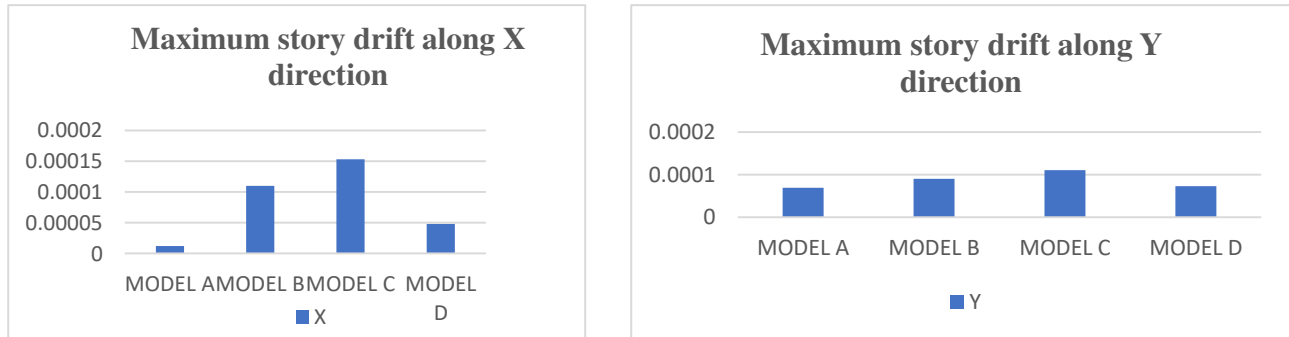


Fig-4.2 Max story drift along X and Y direction of all 4 models

Story shear

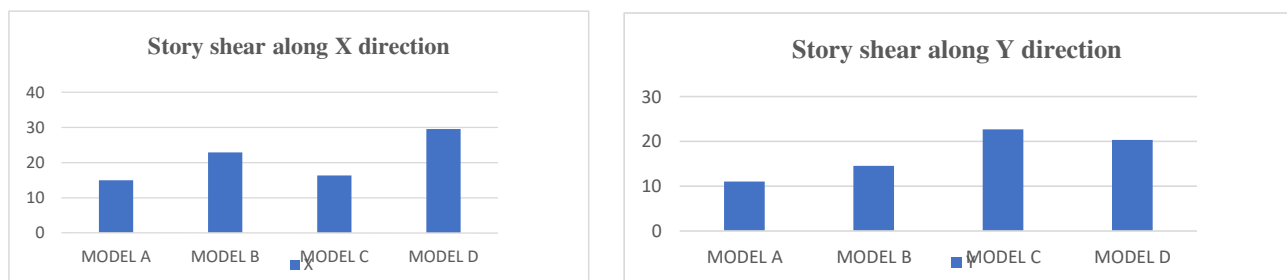


Fig-4.3 Story shear along X and Y direction of all 4 models

Story stiffness



Fig-4.4 Story stiffness along X and Y direction of all 4 models

V. CONCLUSION

1. By comparing all the 4 models for displacement, drift, shear and stiffness all models performing well and better.
2. Considering all the values from the tables and graph we know that Model A performs well compared to Model B, Model C and Model D
3. Considering the Model A compared to Model B, Model C and Model D performs well in displacement, drift, story shear and story stiffness along X and Y direction.
4. By the results and comparison overhead water tank are placed, where Model A is positioned the overhead water tank that place is good for placing the overhead water tank. Which is act as a damper and reduce the seismic response of the building.
5. In symmetrical multi story structure water tank placed might be easy because of it just depending upon centre of gravity but asymmetrical building we do not know the proper position like centre of gravity so



tried different location for placing the overhead water tank, in that one particular position is controlling the seismic action on the multi story structure more. This method helped for placing the position for overhead water tank on asymmetrical structure.

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