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Comparative Seismic Analysis of Multi-Storeyed Building with Shear Wall, Bracing System and Combination of Both

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ABSTRACT: Seismic analysis is a subset of structural analysis and is the calculation of the response of a building (or non-building) structure to earthquakes. It is part of the process of structural design, earthquake engineering or structural assessment and retrofit in regions where earthquakes are prevalent. A building has the potential to 'wave' back and forth during an earthquake. This is called the 'fundamental mode', and is the lowest frequency of building response. To reduce the seismic forces, generally, Shear wall or Bracing system can be used. In this paper, a 20 storeyed building is analysed by using Response Spectrum method for seismic zone III for ten different cases using Shear wall, Bracing system and combination of both. The final results and conclusion will be based on the behaviour of building to the seismic forces and the comparative seismic parameters like base shear, lateral storey drift, displacement etc. of all ten cases.

KEYWORDS: Shear wall, Bracing System, Response Spectrum Method, Base Shear, Lateral storey drift, Displacement.

I. INTRODUCTION

Earthquake engineering has developed a lot since the early days, and some of the more complex designs now use special earthquake protective elements either just in the foundation (base isolation) or distributed throughout the structure. A shear wall is a structural component provided to multi-storeyed or tall buildings or ordinary buildings in high wind velocity areas. These walls usually begin from the foundation level, along the length and width of buildings. Their thickness can be above 150 mm or below 400 mm in tall buildings; they are like vertical-oriented wide beams that carry the earthquake load towards the foundation. A braced frame is a structural system commonly used in structures subject to lateral loads such as wind and seismic pressure. The members in a braced frame are generally made of structural steel, which can work effectively both in tension and compression.

II. LITERATURE REVIEW

The present work is aimed at comparative study of analysis of Multi-Storeyed Buildings with Shear walls and Bracing Systems and combination of both. Various studies has been carried out till date for buildings with shear wall and bracing system but none of them compared them using both in the building.

Athira & Vineetha (2018) analysed a (20x20)m, G+19 building with shear wall at all four corners. The aim of this work was to find out the effect of lateral loads on building having shear wall with prismatic and non-prismatic coupled beam. Non prismatic beam used are stepped haunch cubical, haunch and parabolic haunch, then compare the behavior these beams on the buildings are studied They analysed two similar bldgs., With shear wall but in case 1 they used only shear wall, and in case 2 they used only coupling beam to connect shear wall.(stepped, linear, & parabolic coupling beam). They concluded linear and parabolic beam are more efficient in terms of stiffness, storey drift, displacement and time period.

Donthi Reddy & Sreenivasa (2019) carried out Structural Analysis of G+14 building with shear wall of W,U,H and T shape in all four zone using ETABS. In these work a high rise building with different shapes of shear walls is



considered for analysis. The multi store building with G+14 storey's are analyzed for storey drift story displacement and base shear using ETABS software. For the analysis of these building for seismic loading with all Zones (Zone-II, III, and IV & V) is considered. The analysis of these building is done by using dynamic method (Response spectrum analysis). The result shows W and U shape shear wall shows better performance on storey drift. H was better on storey drift in Y direction & T shows better result in base shear value.

Abdul Karim&Srinivasa (2015) carried out analysis of G+20 structure in E-TABS. This work contains a comparative study on regular building with and without outrigger and irregular building with and without outrigger with centrally rigid shear wall and steel bracings as outrigger. The modeling of the structure is done using "ETABS" program. The analysis of the model is carried out by equivalent static method and response spectrum method. They used four structure, two structure with and without shear wall and two structure with and without outrigger bracing in vertically irregular building. They carried out following analysis, 1. Equivalent static analysis 2. Dynamic analysis method (Response spectrum) and found that there was reduction in time period, Overall stiffness, Minimized story drift due to outrigger system and also found that comparatively outrigger is more effective than steel x-bracing.

Diliprao&Kalurkar (2020) Used an existing structure and made it seismic resistant by application of methods like FRP, Jacketing etc. The computer software program E-TABS is utilized for dynamics analysis strategy is applied to look at the functionality of a reinforced concrete building. The various retrofitting techniques including steel and concrete application and jacketing of fiber reinforced polymer (FRP) composites that happened to be utilized to enhance the load bearing capacity of specific structure elements are highlighted and techniques including shear wall space plus shear cores that enables you to improve general balance of buildings. Most retrofitting techniques are going to result a rise in stiffness as well as somewhat enhance in mass that causes in return a shorter period. Shortening in period of vibration quite often results an increased ductility and strength of retrofitted structure. They analyzed a 12 story building in E-TABS and based on the analysis result they provided a suitable retro fitting method. After providing retrofitting with enhanced strength they analyzed the same building and compared the result in the terms of base shear story drift, (Intermediate and top), deflection.

III. METHODOLOGY

In this study, a comparative seismic analysis is done for multi-storeyed building of 20 storeys, for different cases of shear wall and Bracing System and combination of both. The result of this analysis will include base shear, lateral drift and displacement, the conclusion will be findings of most suitable case of shear wall, Bracing System and combination depending on their analytical results. 1. In present research we have used different model of Multi-Storeyed Building including shear wall and Bracing System 2. Model the structure in E-TABS 3. Seismic analysis is done as per IS 1893-2016. 4. Running the model in E-TABS. 5. Obtaining seismic parameters like base shear, lateral drift and displacement. 5. Observation and comparison of result. 6. Conclusion

IV. STRUCTURAL MODELLING

In this study, structure will be model for the following cases: 1. 20 storeyed building without shear wall and bracing. 2. Analysis and conclusion of same structure by using response spectrum method with X type bracing at corners. 3. Analysis and conclusion by using response spectrum method with X type bracing at edges. 4. Analysis and conclusion by using response spectrum method with shear wall at corners (L) shape. 5. Analysis and conclusion by using response spectrum method with shear wall at edges (T shape). 6. Analysis and conclusion by using response spectrum method with shear wall at core (I shape). 7. Analysis and conclusion by using response spectrum method with combination of shear wall and bracing with shear wall at corner and bracing edges. 8. Analysis and conclusion by using response spectrum method with X combination ----with bracing at corner and shear wall (T) at edge. 9. Analysis and conclusion response spectrum method components for double - combination with bracing at corner and shear wall at core (I). 10. Analysis and conclusion response spectrum method components for II with bracing at corner shear wall at edge (T) and core (I).



V. PRELIMINARY DATA

Following are the data assumed for carrying out this study, 1. Length in X direction=20m. 2. Length in Y direction=20m. 3. Typical storey height=3m. 4. Ground storey height=3.5m. 5. No. of storey =20. 6. Height of bldg. =60.5m. 7. Bay spacing in X direction= 4m

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