Seismic Analysis of Multistory Building with Symmetric Plan

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Abstract - *A building with several floors above ground is referred to as multi-story. The goal of multi-story buildings is to save money by expanding the building's floor space without expanding the surrounding land area. An Earthquake can cause damage or collapse of buildings if not designed for lateral loads. The Shear walls are the structural elements which counters the effect of lateral loads such as with a symmetric distribution of stiffness and strength in plan undergo coupled lateral and tensional motions during earthquakes stiffness. The necessity to assess seismic performance buildings was highlighted by the recent earthquakes, which resulted in significant damage or collapse of numerous reinforced concrete structures.*

Keywords **: Seismic Analysis, Multistoried Building, STAAD Pro.**

1. INTRODUCTION

When creating a structure that can withstand an earthquake, one of the most crucial factors is not just making sure that it can withstand the force acting on it, but also making sure that the building to be ductile enough to transfer this energy and dissipate it. Structural engineers must do both static and dynamic analysis when designing structures in accordance with qualitative seismic design guidelines. While their objectives differ, seismologists and earthquake engineers both use seismological data to better understand earthquakes and their impacts. It is important to make modifications to the seismic behavior forecast of currently constructed buildings. For this reason, studies on the seismic susceptibility of buildings have been created in order to assess the predicted level of damage in various building types. A few things are taken into consideration when designing earthquake-resistant constructions. The elements include the structure's inherent frequency, damping factor, kind of foundation, building significance, and ductility. Seismological data from numerous earthquakes were gathered and examined in order to map and comprehend the earthquake events. Seismologists concentrate on the worldwide problems associated with earthquakes and are primarily interested in geological elements, which includes earthquake prediction.. Simple regularly shaped buildings sustain far less damage than those with irregular configurations. The primary goal of structural analysis is to determine how a structure will behave in response to a given action. One of the main causes of a building's poor performance under high seismic loading is structural symmetry. One important factor contributing to a building's poor performance under high seismic loading is structural asymmetry. Structural asymmetry can be a major reason for the poor performance of buildings under severe seismic loading. In this paper the analysis of seismic behavior of symmetric plan of multi-storied buildings by using STAAD Pro.

2. OBJECTIVE OF STUDY

I. To study the seismic parameters Analysis of Building.

II. To analyze the parameters of building to seismicanalysis in symmetric plan.

III. To study the results of analysis due to seismic analysis.

3. LITERATURE REVIEW

[1] B K Raghuprasad1, Vinay S2, Amarnath.K3 ; Studied "Seismic Analysis of Symmetric and Asymmetric Buildings in Plan: An asymmetric spring model's natural frequencies are higher than a symmetric spring model's, and the rotations about the vertical axis through the mass centre of an asymmetric model are lesser than those of symmetric model. Maximum displacement of asymmetric column model due to an earthquake ground motion (eccentricity 17%) is greater than that of symmetric column model. Simple regularly shaped buildings sustain far less damage than those with irregular configurations. The base shear of an asymmetric 11 story building (eccentricity 11%) is larger than that of a symmetrical 11 story building.

[2] Mr.Hardik Mandwe1, Simran Kagale2, Pooja Jagtap3 Kalyani Patil4 ; focused on the "Using STAAD Pro, do a seismic analysis of a multistory building with a shear wall toexamine how the shear wall affects the response of the RC- framed structure. The ensuing deductions are made from the conducted seismic analysis based on the findings: The RC framed building with a shear wall has strong earthquake resistance and can withstand seismic

vibrations, according to the seismic analysis results. The following ideas are summed up based on the research of seismic analysis:

1. 1. Compared to bare frames, it is noticed that shear walls have a much smaller maximum displacement againstearthquakes.

2. STADD. Pro is versatile software having the ability to Analyze the loads on each concrete section to estimate thenecessary reinforcement, and calculate the nodal deflectionsagainst lateral forces.

3 3. It analyzes the structure both statically and dynamically and provides the necessary, precise results. Shear walls, thus, can be employed to lessen lateral displacement and increase the structure's stiffness in the event of an earthquake in RC-framed buildings.

[3] G Reeba Mary Cherian1, Aswathy S Kumar2 Studied "Seismic Analysis of Multistory Symmetrical Building Based on Shear Wall Positions: This work aims to investigate the dynamic behavior of a structure with four separate locations for shear walls: the sides (full height of the building), the center (full height of the building), and the sides (soft storey). The investigation yielded three parameters: storey displacement, storey shear, and storey drift. The analysis yields the optimal shear wall location. The analysis's finest findings outweigh the devastation brought about by an earthquake. Placement of the shear wall at the sides (soft storey as well as full height of the structure) and in the core (full height of the building) results in increased maximum storey displacement and maximum storey shear. Compared to shear walls located at the core (full height of the building), maximum storey drift is lowest when the shear walls are situated at the sides. (full height of the building) when compared to shear walls placed at the core(full height of the building, soft storey) and sides(soft storey). Shear walls provided at core (soft storey) will give the best results to overcome the destruction occurring duringan earthquake

[4] Prof. A.S.Pawar Deshmukh1 Ruturaj Rajendrab2, Patil Pratik Ramgondac3, Lad Niranjali Mohand4, Jadhav Vandana Ramchandrae5 ; focused on the "Seismic Analysis of Symmetric and Unsymmetric Buildings in Plan"

1. Compared to buildings on plains, those built on steep, sloping terrain exhibit very erratic building configurations and behaviors.

2.Presence of infills have overall effect on the behavior of buildings when subjected to the seismic forces. Displacements are considerably decreased in Model-3 as a result of taking the impact of infill walls into account.

3.According to results of RSA, the storey shear force was found to be maximum for the first storey and it decreased to a minimum in the top storey in all cases.

4.Large displacement was observed in the T shape building. It suggests that severely irregular buildings exhibit greatest displacement and storey drift.

5. The stiffness uneven building had bigger inter-story driftsand less foundation shear, per the RSA data.

6. As a result of comparison between time history method and response spectrum method it has been observed that the values obtained by base shear and top storey displacement response spectrum analyses are more advanced than time history analysis.

7.From the results it is recommended that time history analysis should be performed as it predicts the structural response more accurately than the response spectrum analysis

8.Displacements in buildings with heavy loading of data centre are higher compare to the buildings with normal loading for response spectrum Method.

[5] Sojwal R. Amrodiya[1], Nikhil H. Pitale[2] ; Studied "Seismic Analysis of Multi-Storey Building Using STAAD.Pro & Comparison between Manual and software Calculation" The aim of the project was planning, designing & analyzing a multi-storey, earthquake resistant structure. We were able to complete the project in a successful & efficient way by considering all the factors.

Designing with software such as STAAD.pro expedites design work and minimizes labor costs. STAAD.pro has information about each and every member and component. Calculations are more accurate when software analysis is used. Design base shear calculated Manually = 2057 KN. Design base shear (STAAD.pro) = 2196.495 KN. The G+10 residential building is designed and analyzed using STAAD.pro. Seismic forces were considered while designing and the structure is aimed as Earthquake resistant structure.

G3, Prakash T M4; carried out "Seismic Behaviour of Plan- Symmetric and Plan- Asymmetric Buildings" From the past earthquakes it has been observed that the asymmetric building plans have not done well. Hence to understand the behavior of the structure performance based analysis like pushover analysis is very useful. Also it is observed that the lateral displacement values for rigid and semi rigid diaphragm roof modelling conditions are almost same for the Push-X load case for both boxshaped and L-shaped buildings. Whereas for Push-Y load case a huge reduction in lateral displacement may be noticed in the case of models with

semi rigid roof modelling as compared to the lateral displacement values of the models with rigid roof modelling for both box shaped and L-shaped buildings. Thus from this,it mayconcluded that the buildings with semi rigid roof modelling/diaphragm condition are more stable than those with rigid roof modelling/ diaphragm condition It is also observed that the L shaped building experiences a slight lateral displacement in Y direction even though the Push-X load is applied in X direction.This may be attributed to the fact that the longer direction of the columns is oriented along the X-X direction. When the longer dimension of the column is oriented along the direction of the applied load, the lateral displacement is less as when compared to that in the case when the shorter dimension of the column is oriented along the direction of applied load; from which it can be concluded that the orientation of the columns plays a major role in the stability of the structure. This also shows that the behaviour of the plan asymmetric buildings is different than that of the plan symmetric buildings.

[7] Sammelan Pokharel1, S. Lakshmi Ganesh2, G. Sabarish3 ; focused on the "Seismic Performance of Symmetric and Asymmetric Multi-Storeyed Buildings" Asymmetric buildings are more susceptible to damage during earthquakes. The extent of damage will increase with the height of the structure. The seismic coefficient method is found to be more conservative than the response spectrum method for all the shapes of the building although the IS code recommends the use of response spectrum method in asymmetric buildings with a height greater than 12 sm. Shear walls can be used in order to decrease lateral loads in columns, but the selection of the position of the shear wall has to be done carefully. Shear walls do not reduce axial load carried by columns.

[8] Mukesh Sharma1, Girish Sharma2, Ankush Tanta3; carried out "Comparative Study And Seismic Analysis Of Multi-Storey structure With And Without Shear Walls Using Staad. Pro" The current work compares and performs a seismic analysis on a number of RC multi-story structure models that include and do not include shear walls. The study has been carried out using STAAD. Pro software. The main aim of performing this comparative study and analysis is to find out difference between building model without shear walls and building models with shear walls at different locations in terms of lateral load resisting capability and seismic performance.

[9] Mohammed Irfan1, Dr. Sunandan Reddy2, K.Mythili3; focused on the "Evaluation of Seismic Response of symmetric and Asymmetric Multistoried Buildings" Fundamental natural period of the structure decreases when effect of infill wall is considered. Storey drifts of the structure in both linear dynamic and nonlinear static analysis are determined to be within the bounds given by code (IS: 1893-2002, part-1). In contrast to symmetric buildings, asymmetric buildings have reduced base shear and displacement at the first hinge. When masonry infill is present, lateral forces have an impact on how a structure behaves overall. Joint displacements and storey drifts are significantly decreased when the infill brick wall's contribution is considered. For bare frame constructions, the ductility ratio is at its highest and decreases with the impact of an infill wall. It suggests that before collapsing, bare frame buildings will provide sufficient warning. When comparing infill frame structures to bare frame structures, the response reduction factor of the former is higher. It shows that even after the initial hinge construction, bare frame structures can withstand forces.

4. CONCLUSIONS

1. The analysis and design is done for hospital building and various results of bending moment, shear force ,torsion and stresses etc,. are discussed. Using STAAD, the analysis and design were completed in accordance with standardspecifications.

2. Good for both dynamic and static loads. The structural components' dimensions are provided, and the loads—including dead, live, and wind loads—are applied.

3. The natural frequencies of an asymmetric spring model are greater than those of symmetric spring model while the rotations about the vertical axis through the mass centre of an Less than symmetric models are asymmetric models.

4. Large displacement was observed in the T shape building. It suggests that the largest displacement and story drift are seen in severely irregularly constructed buildings.

5. A comparison between the results of time history analysis and response spectrum analysis of base shear and top storey displacement revealed that the former produced values that were higher than the latter.

6. Maximum storey shear and maximum storey displacement is lowest when the shear wall is placed in the core position and greater when the shear wall is placed at the sides and also the core.

7. Shear walls provided at core (soft storey) will give the best results to overcome the destruction occurring during an earthquake.

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