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DESIGN AND ANALYSIS OF HIGH-RISE BUILDING WITH SHEAR WALL AND BRACINGS

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ABSTACT - *Reinforced Concrete Frames are the most widely accepted building construction techniques in India. Along with an economic boom, increasing urbanization and scarcity of land and agriculture space driving up land costs and also increasing demand for agriculture space, tall structures that spread have emerged highly favored in the Indian buildings market especially in metropolitan areas. While a high rise construction presents both gravity load as well as lateral loads on a building. Many critical Indian cities fall in high risk seismic zones, thus the buildings have to be strengthened for lateral forces.*

In the present study, an attempt is being made to investigate the response of a high-rise structure to the ground motion by using Response Spectrum Analysis. Here, three different models are considered - bare frame, brace frame and shear wall frame in Staad Pro. and change in the time period, stiffness, base shear, storey drifts and top-storey deflection of the building is observed and compared.

KEY WORDS: **High-Rise Structures, Seismic Zones, Spectrum Analysis, Staad Pro**

1. INTRODUCTION

Earthquake has always been a threat to human civilization from the day of its existence, devastating human lives, property and man-made structures. The very recent earthquake that we faced in our neighboring country Nepal has again shown nature's fury, causing such a massive destruction to the country and its people. It is such an unpredictable calamity that it is Very important for survival to ensure strength of structures against seismic forces. Therefore, there is constant research work going on in the world, which is revolving around development of new and better techniques that can be incorporated in structures for better seismic performance. Obviously, buildings designed with special techniques to resist damages during seismic activity have much higher cost of construction than normal buildings but for It must be a prerequisite to safety against failures under seismic forces.

1.1 Objectives

- The objective of present work as follows:
- To analyze the building with different ground motions, namely, IS code compatible ground motion, Imperial Valley ground motion and San Francisco ground motion.
- To model building with different lateral stiffness systems and study the change in response of the building to compare and get a better and get a better and efficient lateral stiffness system.

1.2 SCOPE

This study concerns analysis of reinforced concrete moment resisting open frame, open frame with braces and open frame with shear walls only, using Staad Pro program. The effect of brick infill is ignored.

This study involves a theoretical 12 storey building with normal floor loading and no infill walls.

TABLE 1.1: Specifications of the building

Specifications	**Data**
Storey Height	3.5m
No. Of bays along X direction	3
No. Of bays along Z direction	4
Bay Length along X direction	5m
Bay Length along Z direction	5m
Concrete grade used	M 30
Columns	0.45m X 0.25m
Longitudinal Beams	0.40m X 0.25m
Transverse Beams	0.35m X 0.25m
Slab Thickness	0.1m
Unit Weight of Concrete	25 kN/m³
Live Load	3.5kN/m³
Zone	IV
Soil Conditions	Hard Soil
Damping Ratio	5%

2. LITERATURE REVIEW

Chandurkar, Pajgade (2013) investigated the response of a 10 story building with seismic shear wall using ETAB v 9.5. The main aim was to compare the variation in response by changing the position of shear wall in the multi-storey building. Four models were studied- one was a bare frame structural system and the other three were of dual type structural system. The findings were excellent for shear wall in short span at corners. Larger dimension of shear wall was found to be ineffective in 10 or below 10 stories. Shear wall is an effective and economical option for high-rise structures. It was observed that changing positions of shear wall was found to attract forces, hence proper positioning of shear wall is vital. Major amount of horizontal forces were taken by shear wall when the dimension is large. It was also observed that shear walls at substantial locations reduced displacements due to earthquake.

2.1 SHEAR WALL AND BRACINGS

Shear Wall is actually a term referring to a wall panel to resists horizontal forces and loads that affect the building. Working together, lots of shear walls are known as wall Bracing. Shear walls, in essence, represent vertical forces, and The steel beams and cables usually cause resistance with the triangulation of braced frames. Shear Wall is considered to be quite economical yet effective for a structure to be high-rise in structure. It was seen that changes in positions of shear wall attracted forces, and hence the proper positioning of shear wall is necessary. The major amount of forces had taken by shear wall while the dimension is large. Further to this, it was seen that walls

at significant sites lower the displacement caused by earthquakes.

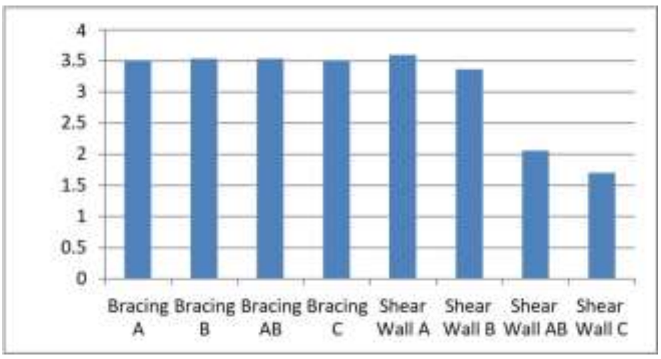

Figure: 2.1 Variation of time periods

3. MODELLING

For braces angle section ISA 60 X 40 X 6 is used. There are four trial locations in the building where braces are located and investigated for their influence on lateral rigidity. Braces are modeled as axial force members with pinned end connections. Bracings are of X-type modeled throughout the height of the building. The four locations are as follows: Location 1: Bracing A- at the exterior side of the frame along X-direction. Location 2: Bracing B- along the exterior side of the frame along Y-direction. Location 3: Bracing AB- along the exterior side of the frame along X and Y-direction. Location 4: Bracing C- along the exterior side of the frame around the corners.

3.1 Response Spectrum Analysis

Response Spectrum is a linear dynamic analysis. Response spectrum is a plot of the maximum response of a SDOF system to a ground motion versus time period. It is derived through time history analysis of ground motion using maximum response for every time period.

Under Earthquake load, after assigning self-weight, floor load and live load in X, Y and Z directions, Response Spectra was defined. For Indian Code compatible earthquake already defined IS 1893-2002 is chosen. For Imperial Valley Earthquake and San Francisco Earthquake the response spectrum values are entered. Acceleration values for the corresponding time Periods of the building for Imperial Earthquake and San Francisco earthquake has been taken by multiplying 9.81* Sa/g of their respective response spectrum. The Sa/g is the response spectrum values that were taken from the results of MATLAB program for generating Response Spectrum from time history of ground motion of the earthquake considered.

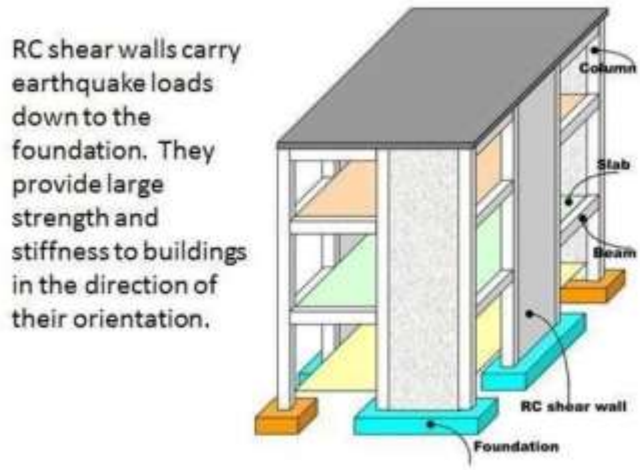

Figure 3.1. Building Showing a shear Wall

3.2 Modelling of Shear Wall Frame

The four locations are as follows:

Location 1: Shear wall A- at the exterior side of the frame along X-direction.

Location 2: Shear wall B- exterior edge of the frame in direction Y.

Location 3: Shear wall AB- exterior edge of frame along both directions X, and Y.

Location 4: Shear wall C- exterior edge at the corners.

Figure 3.2 3D modelling of the building with shear wall at location 1

CONCLUSION

This project work was a small effort towards perceiving the how introducing bracing or a shear wall in a building can make in difference in protecting the building in earthquakes. Almost all the buildings in India are RC frame, and earthquake tremors are felt every now a then in some or the other part of the country. Hence through this project it was tried to appreciate the effectiveness and role of this small extra structural elements that can save both life and property, at least for most of the earthquakes.

There is a stepwise reduction in time period of the bracing and shear wall systems the time period of bare frame, which indicates the increase in stiffness. Time Period in case of Shear Wall C is highest, hence is the stiffest and better choice for strengthening the structure Base Shear produced in the Bare Frame is highest for Imperial Valley Earthquake.

In case of bracing system, Bracing System C (with braces at the corners) are the most effective one than other bracing systems, effectively reducing top-storey drift and inter storey drifts in both X- and Z-directions. There is hardly any reduction in drift along Z- direction due to Bracing B, for all the ground motions. Shear Wall A is effective in reducing drifts along X- direction only, and Shear Wall Effective for the drifts along Z- direction only, for all ground motions. Above all Shear wall C is the best one among all stiffening cases considered.

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REFERENCES

[1] IS 1893 (Part 1): 2002 Indian Standard Criteria for Earthquake Resistant Design of Structures, Part 1 General Provisions and Buildings, (Fifth Revision).

[2] Anil K. Chopra [2003] "Dynamics of Structures, Theory and Applications to Earthquake

[3] Dr. Venu Malagavelli Expert in nonlinear analysis of braced frames and pushover analysis for high-rise buildings. Published work on G+10 RC frame structures.

[4] Dr. S.K. Madan Known for works on structural stability with shear walls and bracings under seismic

loads. STAAD.Pro-based computational design methods.

[5] Prof. Pankaj Agarwal Author of Earthquake Resistant Design of Structures. Shear wall and bracing systems for earthquake-prone regions.

[6] Dr. Manish Shrikhande Co-author with expertise in seismic response simulation of high-rise structures.

[7] Dr. S. Ravichandran Research on optimized bracing configurations in steel and RC buildings.

[8] Dr. Akthem Al-Manaseer, San Jose State University - Expertise in high-performance concrete, including the design of concrete structures and innovative materials.

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[10] Dr. Mariagiada Maiorana - Studies high-rise structural systems with a special focus on lateral force resistance, safety design, and green concepts in super-tall building designs.