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Anaysis and Design Of Shear Wall Using STAAD.PRO

Kota Srinivas[a], Markanti Abhinay[a], N Akshaya[a], P Ramesh Chanti Kumar[b]

[a] U.G. Student, Department of Civil Engineering,, Guru Nanak Institutions Technical Campus, Ibrahimpatnam, Telangana, India.
[b] Assistant Professor, Department of Civil Engineering, Guru Nanak Institutions Technical Campus, Ibrahimpatnam, Telangana, India.

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ABSTRACT

Reinforced Concrete frames are the most commonly adopted building construction practices in India. With growing economy, urbanization and unavailability of horizontal space increasing cost of land and need for agricultural land, high-rise sprawling structures have become highly preferable in Indian buildings scenario, especially in urban. With high-rise structures, not only the building has to take up gravity loads, but as well as lateral forces. Many important Indian cities fall under heavy risk seismic zones, hence strengthening of buildings for lateral forces is a prerequisite. The primary objective is to emphasizing the shear wall contribution to structural stability. The process involves creating a detailed 3D model, assigning appropriate material properties and applying loads based on IS codes and standards. The study explores parameters such as deflection, axial forces shear forces and moments to analyze the structural performance. The placement and design of shear walls is significant as they influence the overall lateral stiffness and stability of building. The results prove that the shear walls enhance the resistance of High-rise building to lateral forces, minimizing deflection and improving performance. The findings provide valuable insights into optimizing the design of High-rise structure using STAAD. Pro contributing to safe and efficient construction practice.

1. INTRODUCTION

High-rise buildings have become an integral part of urban development, addressing the growing demand for space in densely populated areas. The design of such structures requires meticulous attention to structural integrity, especially in resisting gravity loads and lateral forces induced by wind and seismic activities. Among the various structural systems used in high-rise buildings, shear walls play a pivotal role in enhancing stiffness and stability. These vertical structural elements efficiently counteract lateral loads, ensuring safety and serviceability.

The advent of advanced structural analysis tools, such as STAAD. Pro, has revolutionized the process of designing high-rise buildings. STAAD. Pro offers powerful modelling capabilities, enabling engineers to perform detailed structural analysis, evaluate load distributions, and optimize designs in compliance with relevant codes and standards. The integration of shear walls into the structural framework can be efficiently modelled and analysed using this software, providing insights into their impact on overall building behaviour.

This study focuses on the analysis and design of a high-rise building with shear walls using STAAD. Pro. It highlights the importance of shear walls in enhancing structural performance and explores their influence on parameters such as lateral deflection, stiffness, and stress distribution. By leveraging STAAD. Pro's capabilities, this research aims to provide a practical framework for designing safe and efficient high-rise buildings, ensuring they meet both functional and safety requirements.

2. LITERATURE SURVEY

G. Nagesh Kumar et al., this discussion mainly focus on analysis & design of shear wall. in zone-III that resist the lateral forces in optimization way of 45 multi-storey structure. This technique was applied on frame many times that can oppose the forces apply the structure and assuming the strength. In this there are two cases i.e., dimension of shear

wall and another is dimensions of shear wall is increased according the result of case, the conclusion is sudden change in plan of structure above IVth floor in small lateral forces can change two factors rigidity and torsional irregularities that depend on seismic force.

Ehsan Salimi and Dr. K.R.M. Rao discuss about the seismic configuration of Shear wall. applied on structure. it was observed that the top storey drift can be reduce by swift the position of Shear wall. and suggested that the quantity of shear wall could not affect the seismic behaviour of buildings. Different position of shear walls can decrease twice the top story drift which means 100% drift in building is reduced from high to low value. The quantity of shear walls will increase to afe the structure.

Manjeet dua et al., discuss about the Effect on Deflection by use of Shear wall. in multi-storey by STAAD. Pro. And conclusion that observe that displacement without Shear wall. is maximum comparison about the different-different location of Shear wall. and the position of shear wall in multi-story is near the origin of structure and get finally result that seismic behaviour will be affected, rigidity and the strength of the structure will be increased.

A. Ahmad et al., about the 'Effect Of Shape Of S.W. On Mid-Rise Structure Under Seismic Load' and conclusion about the various types of shear wall L, T, C, H and I walls of 20 storey building and discussion about the role of shear wall in a seismic zone rectangular and l shaped wall are more resisting seismic forces along direction orthogonal and reduce vseismic forces.

3. METHODOLOGY

a) Specifications of the building

Table-1

Specifications	Data
Storey Height	3.5m
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	3.5 kN/m3
Zone	IV
Soil Conditions	Hard Soil
Damping Ratio	5%

The perusal are related to "Effect of shear wall on are Rectangular building" firstly we observe the seismic zone of a rectangular building and we collect data of that building and compare the building to the another building in same zone. Using the software Stadd.pro. This software is used to creating, optimizing and modifying 3-D designs of building.

b) Modelling

A rectangular building of G+10(10 Storey) structure have size 15m*21m of plan 315 square metre means 377 square yard with typical floor height 3m and thickness of slab 4 inch is considered for analysis and designed the building in the software stadd.pro.

In Staad Pro, Response Spectrum Analysis is done as follows:

1. After preparing the bare model, seismic definition for IS 1893-2002 was created by giving the required input of time period, zone factor, R factor, etc. Then under seismicdefinition self-weight and floor weights of 2.5kN/m2 and 3.5 kN/m2 were given.

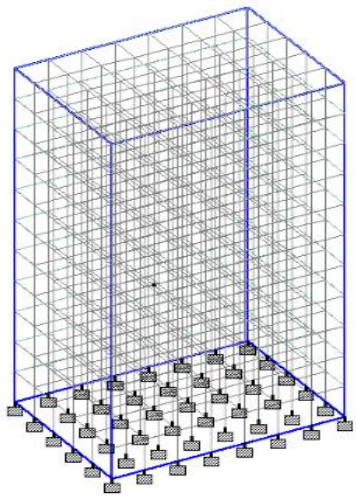

Fig-1 without shear wall

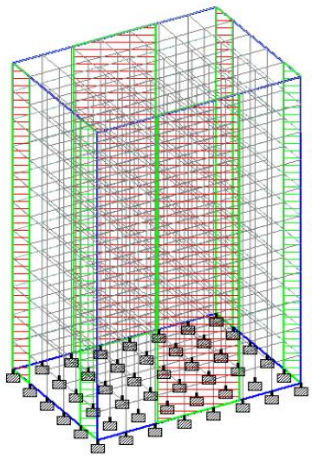

Fig-2 With Shear wall

In Staad Pro, Response Spectrum Analysis is done as follows:

1. After preparing the bare model, seismic definition for IS 1893-2002 was created by giving the required input of time period, zone factor, R factor, etc. Then under seismic definition self-weight and floor weights of 2.5kN/m2 and 3.5 kN/m2 were given.
2. Under Load Definition Earthquake load, Dead load, Live load and various loadcombinations were created.
3. Under Earthquake load, after assigning self-weight, floor load and live load in X, Y andZ 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 forthe 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. The time period and their corresponding acceleration values are given in the tables below.

4. Greater Noida authorities this zone is earthquake – ready. The district administration and development authorities emphasized that although the region falls in zone 4, all the buildings that have constructed or designed in this zone according to seismic zone 5using the code 1893 even as the risk of living in high-risk seismic zones persist. The following parameters are given below according to Indian code: 1893-2002/2005.

c) Modeling Of Shear Wall Frame

Shear Wall considered is of 250mm thickness, and placed along the entire height of the structure. Shear wall has been modelled as rectangular column section by increasing width to5m i.e, the spacing between two columns. The shear walls are placed in the exact locations asthat of bracings, and the analysis is done.

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 - at the exterior side of the frame along Y-direction.

Location 3: Shear wall AB- at the exterior side of the frame along X and Y-direction.

Location 4: Shear wall C- at the exterior side of the frame around the corners.

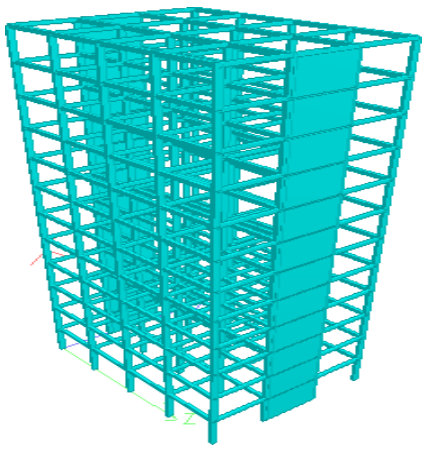

Fig-3 3D Model of the building with shear wall

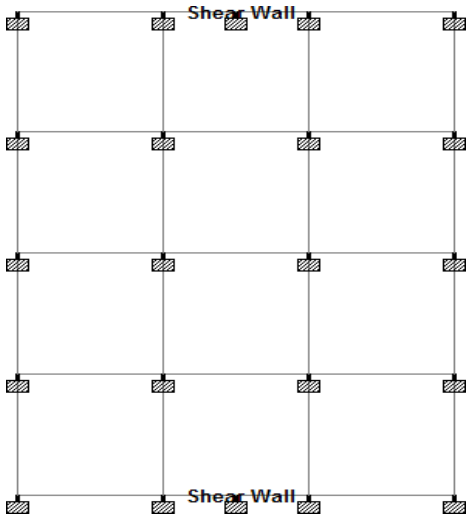

Fig-4 Layout of the building in staadpro

4. SUMMARY OF REVIEW

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 bothlife and property, at least for most of the earthquakes.

The following conclusions were drawn at the end of the study:

- There is a gradual reduction in time periods of the shear wall systems from the time period of bare frame, indicating increase in stiffness.
- Time Period in case of Shear Wall is the highest, hence is the most stiff and better option for strengthening the structure.
- Base Shear produced in the Bare Frame is maximum for Imperial Valley Earthquake.

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