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SEISMIC PERFORMANCE EVALUATION OF G+13 RCC SYMMETRIC STRUCTURE WITH G-3 BASEMENT DESIGN USING STAAD.PRO

Shubham Kumar Rahul, Pawan Dubey, Hirendra Singh, Rakesh Sakale

PG Scholar, Assistant Professor, Associate professor

School of Research and Technology,

People's University, Bhopal, India

Abstract: This study examines the seismic analysis of a high-rise building in the city of Patna, located in the earthquake zone. The building is a 13-storey, roller-compacted stone symmetrical structure with one underground floor and three underground floors. Implement Indian Standard requirements for various seismic zones in India using STAAD.Pro v8i. Severe earthquakes are the most dangerous and destructive events in nature that cause great damage. It is very difficult to prevent earthquakes, but the damage to the building can be reduced with proper design and expansion. Therefore, seismic analysis must be performed and appropriate structures must be designed to prevent explosions. Constructing buildings to mitigate earthquakes can be costly and ineffective because earthquakes are unpredictable and occur rarely during the life of the building. This study aims to understand the results obtained by STAAD.Pro v8i software when subjected to gravitational loads specified in IS 456:2000. According to IS Code 1893: 2016, the results must comply with all standards to prevent rejection after analysis and increase accuracy.

Key words- Seismic Analysis, STAAD.Pro, Base Shear, Equivalent Static Method and Response Spectrum Analysis.

I. INTRODUCTION

There are skyscrapers all over the world. As skyscrapers continue to grow in height and size, dynamic wind and earthquake analysis play an important role in determining the design of tall superstructures. Nowadays, thanks to the advancement in computer technology, most designers design tall superstructures using computer software. This means that once plans and outlines are established, safety validation for all material used in industry done using a software model does not require demonstrating knowledge of best practices. However, it is safe to say that much of the success of tall superstructures comes from the design and layout of the superstructure during the initial processing phase. Earthquake design generally requires the structure to withstand small and frequent shaking. Preventing shock damage ensures that the structure remains usable after an accident.

This causes excessive force, unwanted torques and deflections in the structure. Multi-story superstructures often need concrete walls such as elevator shafts or perimeter walls. Balancing the mass and stiffness of the superstructure location is a superstructure recommendation. Installing shear walls is a good strengthen the plan of a superstructure because its purpose is to make it strong to withstand external force. Curtain walls are becoming increasingly popular, especially in construction of high-rise superstructures such as service centres an office, commercial towers. Considering the earthquake resistance of shear walls. Design; strength, life, life cycle, hardness, pressure, tension, time, change, shear, etc. It is used in many aspects such as curtain wall system is the best way to increase the strength of the plan. It is now used in many high-rise superstructures as shear walls, core-type shear walls or as lifting cores for load-bearing walls. Shear walls are generally defined as vertical structures that can transfer shear, moment and axial loads from transverse and vertical loads transferred to the wall from other elements.

In the past, research results have been consistent in determining the behaviours of AI. The use of shear wall techniques in superstructures is according to different behaviours levels. Multi-story superstructures often need concrete walls such as shear wall. It is important to place the shear walls symmetrically in the superstructure to reduce the negative distortion of the superstructure. They can be the same on both of the plan. SW are most effective when placed on the outer edge of a superstructure so they can resist torsional forces. The ideal structure to withstand many factors such as wind, earthquake activity, twisting and physical movement will be a reinforced concrete superstructure with a load-bearing system (shear walls). The analytical part of the design context is often difficult to understand. For this reason, some methods are used to control it. In terms of economic functionality, the design is much better thanks to pre-walls.

The goal of earthquake analysis is to evaluate how the structure responds to dynamic loads and excitations acting on its foundation. Loads can vary from the weight of people, wind, furniture, snow, etc. to ground shaking such as earthquakes or ambient explosions causing ground movement. A static load is slow and constant on a time-velocity graph. Furthermore, if force changes rapidly over time, it falls into the category of dynamic analysis. In dynamic analysis, displacement and acceleration are primarily used to express the results, as opposed to static analysis where the force acts instantaneously as a function of time. When an earthquake hits the base of a plan, the plan responds to ground motion. Plan is usually higher compared to the ground motion. Dynamic strengthening is a term used to describe the increased structural response during an earthquake compared on ground. Gain factor is depending on design Specs. such as natural vibration time, damping, type of foundation and construction.

RESEARCH METHODOLOGY

The objective of this study is to analyze a G+13 superstructure with three basement levels in earthquake zone iv (City-Patna) to verify in a case study how the structure behaves under DL, LL, WL and earthquake force. Calculation will perform using STAAD Pro analysis software.

LOADING CONDITION

Dead Load

IS 875 (PART-1) is used to calculate the unit weight of structural materials for dead load calculations.

Slab Weight Calculation

Thickness of slab=0.150m Density of concrete= 25kN/m3

Self-Weight of slab= Density of concrete x Thickness of slab

= 25x0.150

= 3.75kN/m2

Floor Finish at floor level = 1.5 kN/m2

Total Slab Weight at floor level= 5.25 kN/m2

Live Load

IS 875 (PART-2) is used to calculate the value of floor live load and roof live load.Live Load Intensity specified (Public superstructure) = 4 kN/m2 Live Load at roof level =1.5 kN/m2.

Wind load

Basic wind speed of Patna (Terrain 2)- 47 m/s

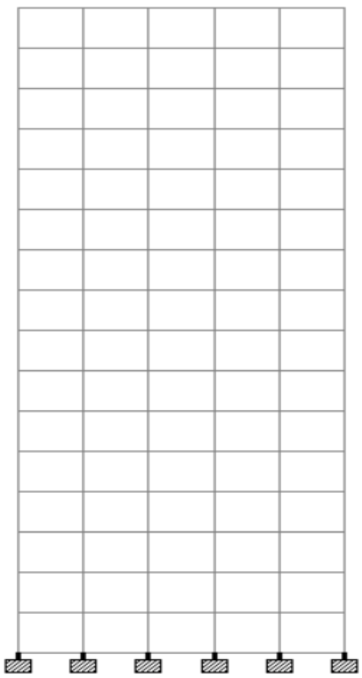
Earthquake Load

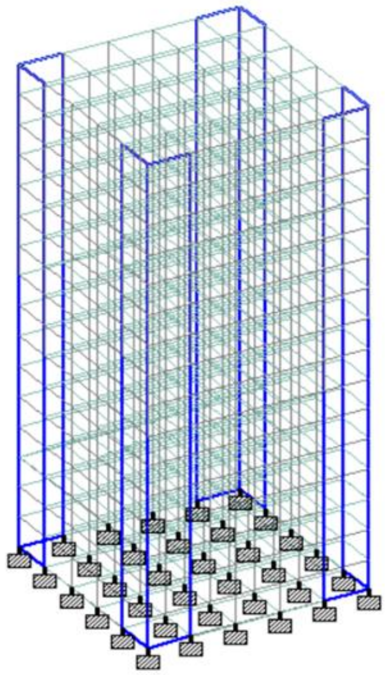
Earthquake force of the superstructure is defined the total DL from IS 1893 (part 1): 2016. In Zone iv (Patna)

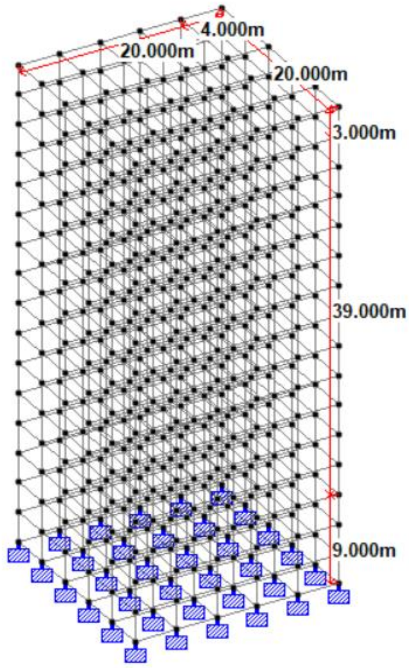
W1 = earthquake Weight of Ground Story = DL + LL = 472.5 + 532.44 + (2 X 174) + (0.5 X 174) = 1440.375 KN.

W2 = DL + LL = 472.5 + 532.44 + (13.8 X 174) + (2 X 174) + (0.5 X 174) =3841.575 KN.

As from W2 to W10 earthquake weight will be same as there is symmetry

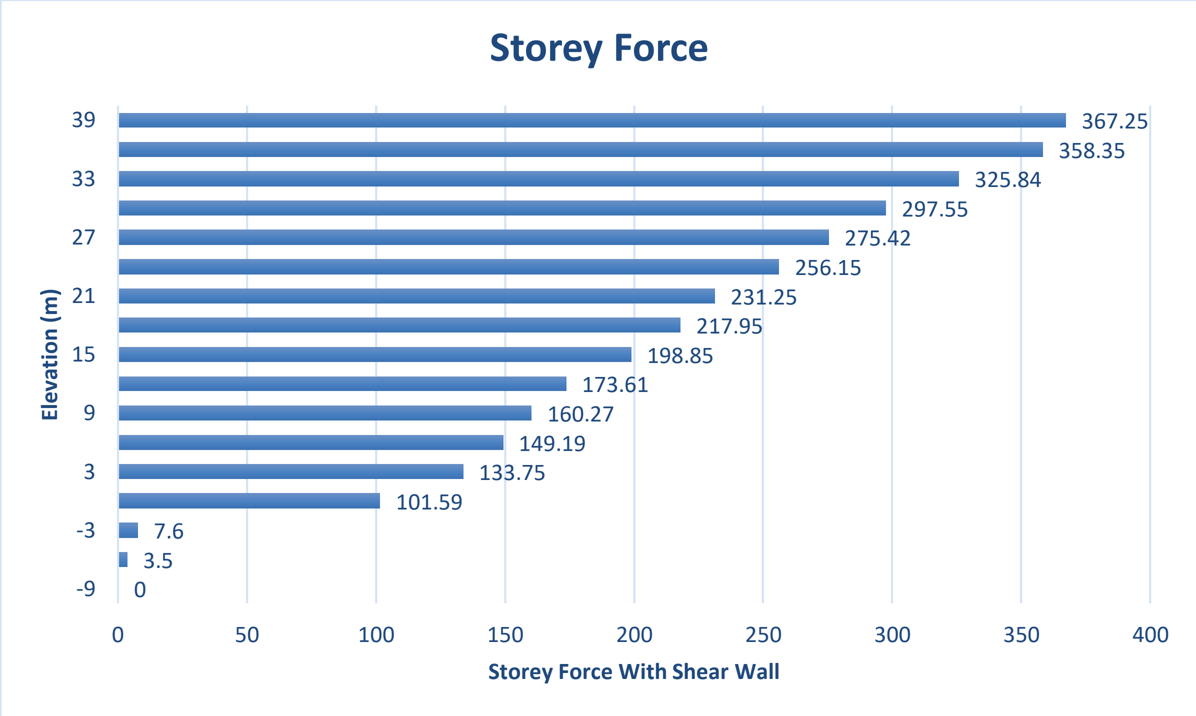


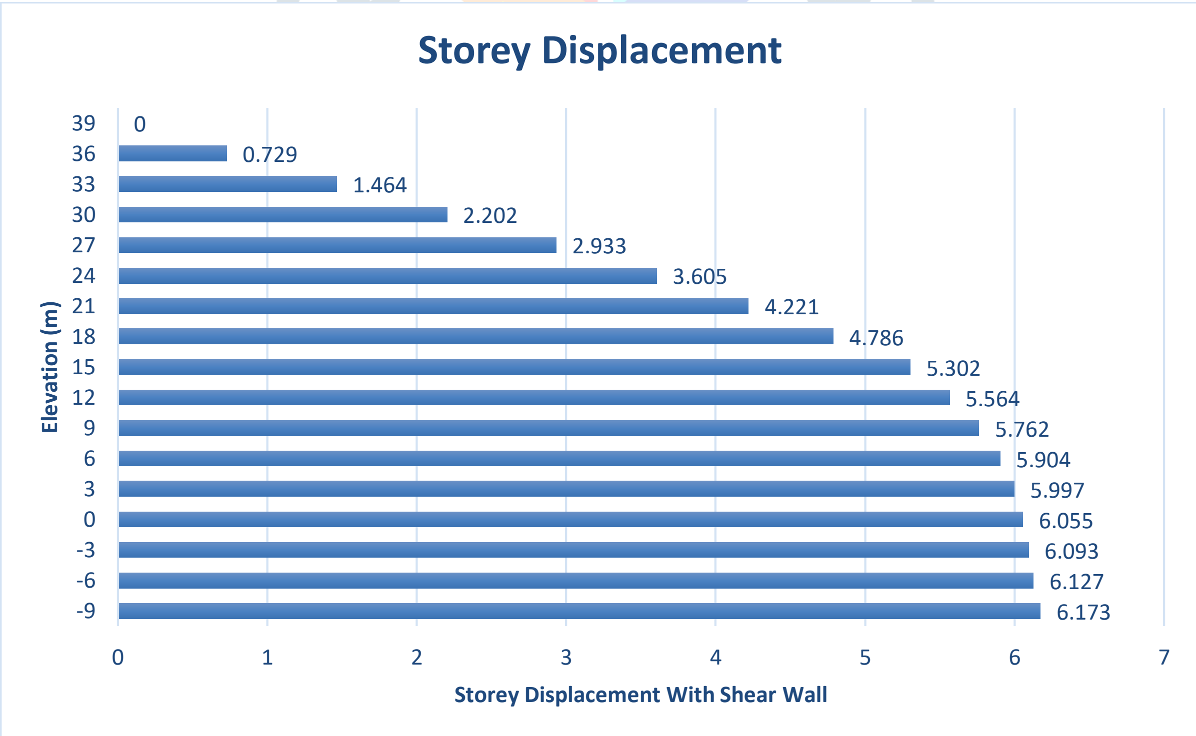


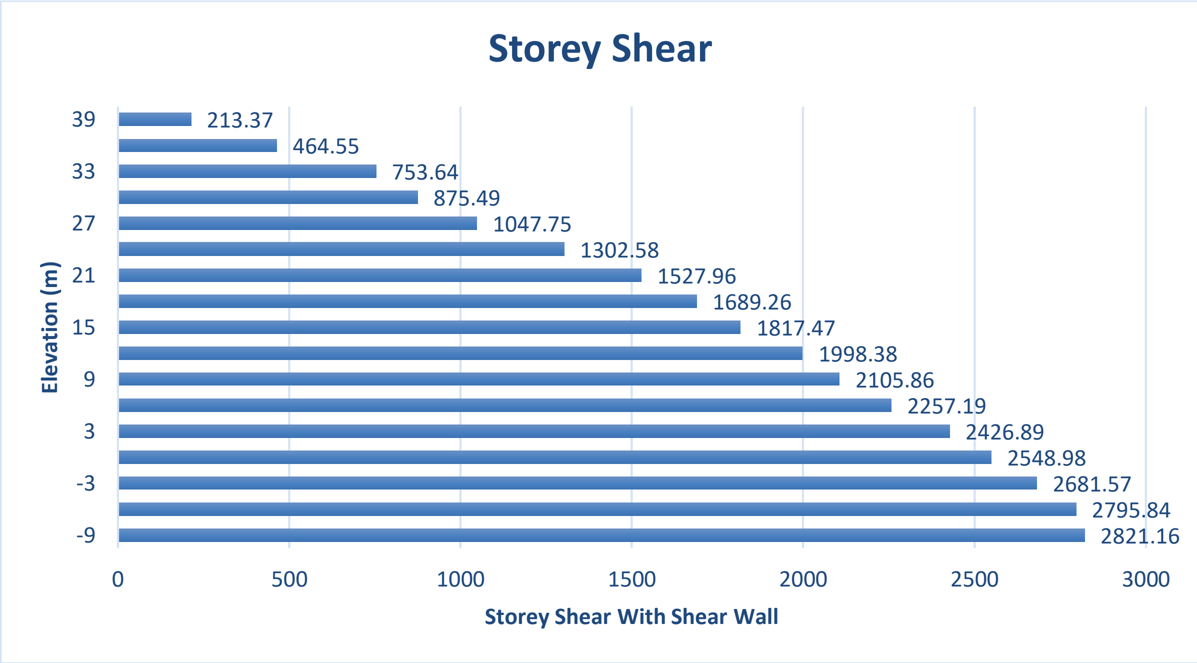


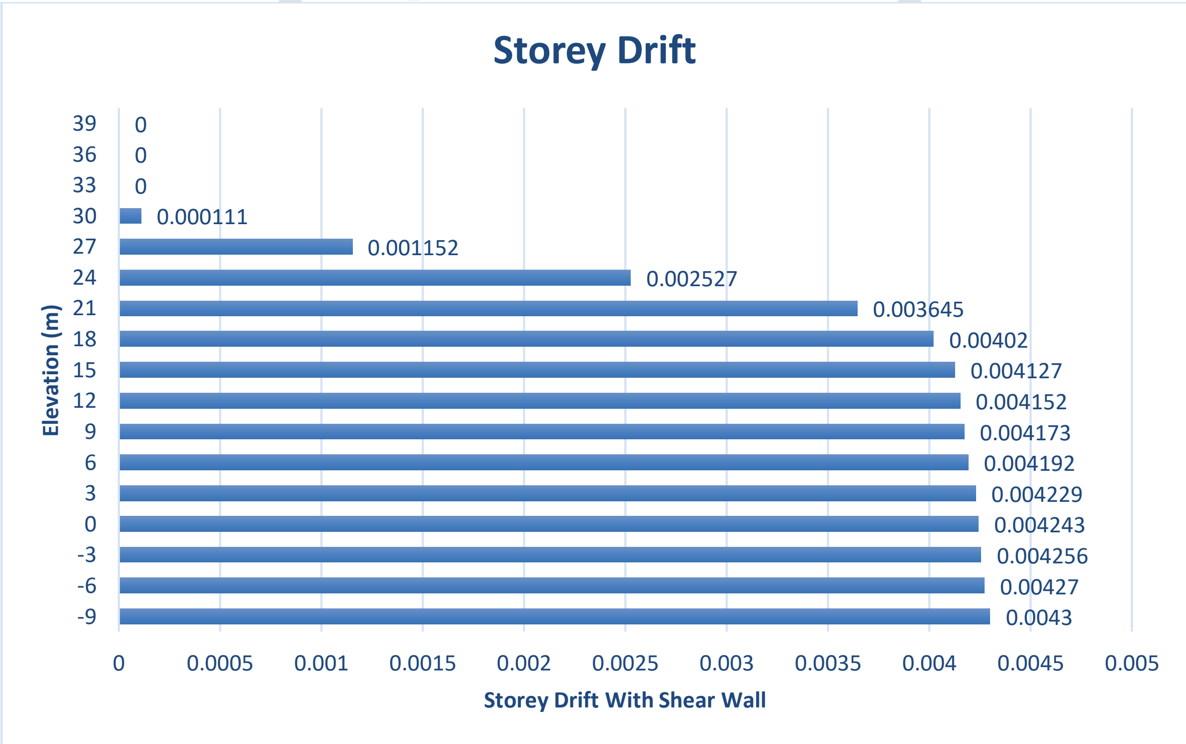
Type of structure	Multi-story special moment resisting plan
Number of stories	G-3+13 story superstructure with shear wall
Number of basements	3
Number of Grid in X-Direction	5
Number of Grid in Y-Direction	5
Floor to floor height	3m
External walls	230 mm
Internal walls	150 mm
Size of verticle member	450 x 600 mm
Size of beams in longitudinal and transverse direction	300 x 450 mm
Thickness of slab	150 mm
Slab Type	Thin Shell
Thickness of basement wall	200 mm
Thickness of shear wall	200 mm
Floor Diaphragm	Rigid
Verticle member Shape	Rectangular

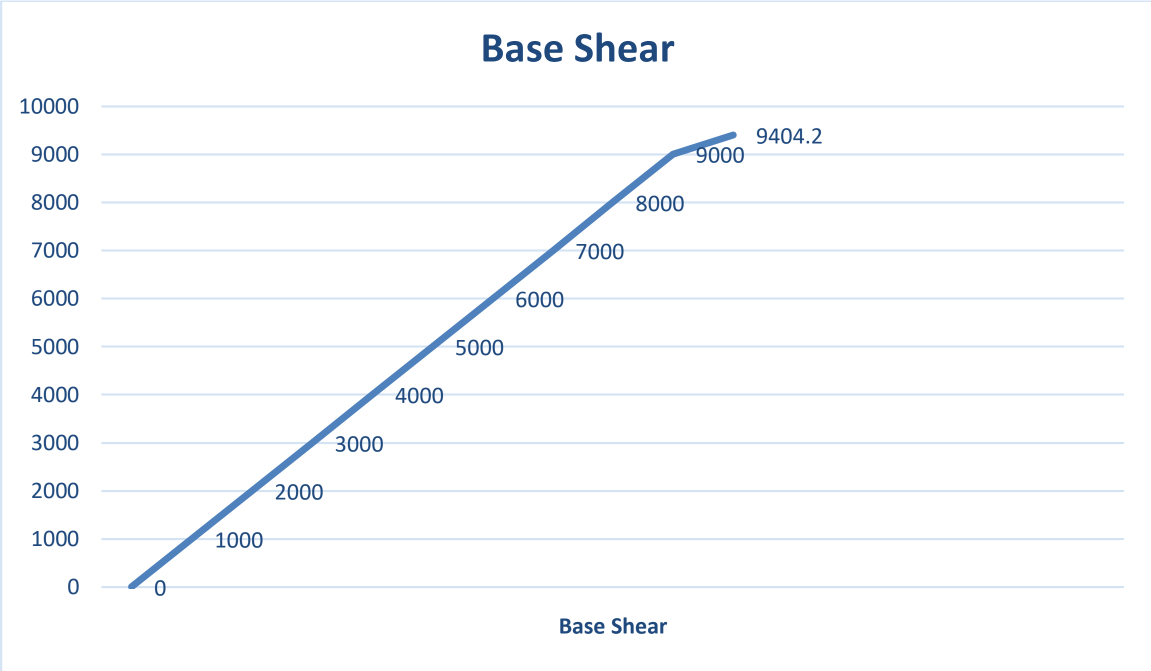
Beam Shape	Rectangular






Storey Shear
Elevation (m)
39
33
27
21
15
9
3
-3
-9
213.37
464.55
753.64
875.49
1047.75
1302.58
1527.96
1689.26
1817.47
1998.38
2105.86
2257.19
2426.89
2548.98
2681.57
2795.84
2821.16
0
500
1000
1500
2000
2500
3000
Storey Shear With Shear Wall


Storey Drift
Elevation (m)
39 0
36 0
33 0
30 0.000111
27 0.001152
24 0.002527
21 0.003645
18 0.00402
15 0.004127
12 0.004152
9 0.004173
6 0.004192
3 0.004229
0 0.004243
-3 0.004256
-6 0.00427
-9 0.0043
0
0.0005
0.001
0.0015
0.002
0.0025
0.003
0.0035
0.004
0.0045
0.005
Storey Drift With Shear Wall



FUTURE SCOPE

Due to the limited movement and the nature of our research, we could not pay attention to many cases. Several possible directions can be considered in upcoming projects:

- Shear wall dimensions should be changed and checked for minimal deflections.
- Different types of shear walls such as L-shaped, O-shaped, I-shaped shear walls should be tested for their properties.
- the effect of core shear walls should be investigated. The superstructure is analysed without a basement. Thus, their responses to loading are not included in the research.

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