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# Seismic Analysis and Retrofitting of an Existing Multi-Storey Building

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**ABSTRACT:** seismic analysis of an existing building is done to find out the building is safe from earthquake or not. seismic analysis is done to find out the weak and most vulnerable component and deficiencies during an earthquake. Its is done to ensure that building doesn't collapse and the risk of the death and injury to human kind is less and economic loss will be less. Seismic rehabilitation process is aim to improve seismic performances of building by increasing strength , stiffness and improving connection. So retrofit implementation can be apply to enhance the structure by increasing in strength and ductility capacity of the structures.

In this research project will give brief knowledge about the seismic analysis and retrofitting measures. A G+8 storey building is analysed for zone IV as per IS 1893(part 1):2016 by using STAADPRO 2018 software in present study.

**KEYWORDS:** Seismic Study, STAADPRO, Retrofitting, Strengthening

## I.INTRODUCTION

Nepal is one of the most earthquake-prone countries in the world and has experienced several large or moderate earthquakes in the last 50 years. Approximately 80-90% of the country is vulnerable to earthquakes of various sizes. An earthquake is an earthquake caused by the movement (direction and magnitude) of tectonic plates. This creates horizontal forces in the structure, called seismic forces. To prevent this, the structure must be designed to withstand seismic loads. As design requirements increase due to advances in engineering knowledge, seismic deficiencies may develop in existing buildings. Therefore, existing structures must be earthquake resistant through a combination of various seismic strengthening methods to comply with current codes and regulations.

The main purpose of this study is to develop knowledge and skills in seismic design and seismic repair of existing structures and to know how to use computer software for modeling and analysis of seismic loads on the building. The purpose of this study is:

1. To examine the effects of seismic force on buildings and to seek information on seismic design
2. To evaluate the feasibility and quality of seismic assessment of buildings using retrofit measures designed for reinforcement.
3. using structural analysis software to model real buildings and study the seismic effect of different seismic resistance specified in codes and standards, and prepare appropriate tests according to performance. recovery process.

Table -1: DESCRIPTION OF THE BUILDING

Types of frames	Reinforcement concrete frame
RC Building	G+8 storey building
Storey Height	3.048 m
Base storey height	2.134 m
Beam size	400mm*350mm
Column size	550mm*500mm
Thickness of slab	150mm
Live load	8.64 KN/m <sup>2</sup>
Floor finish	2 KN/m <sup>2</sup>
Compressive strength of concrete	25 N/mm <sup>2</sup>

Yield strength of concrete	500 N/mm <sup>2</sup>
Seismic zone	IV
Zone factor	0.24
Sub soil factor	Medium
Importance factor	1
Response reduction factors	5
Method of analysis	Dynamic analysis methods

## II. MODELLING IN STAADPRO

Seismic analysis is carried out by using STAADPRO software of 2023 with M20 grade of concrete. The 3D model of building such as plan, elevation, geometry ,shear, moment and wind load is shown below:

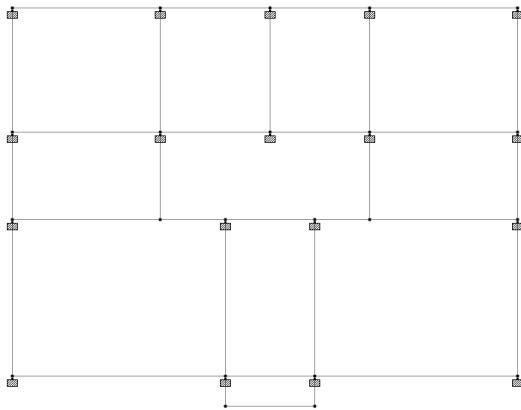


Fig.1. Top view of building

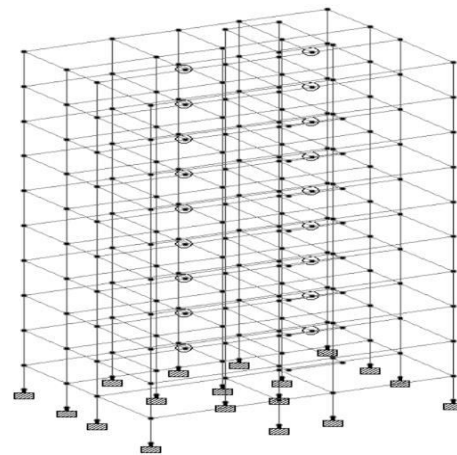


Fig.2. 3D Geometry of building

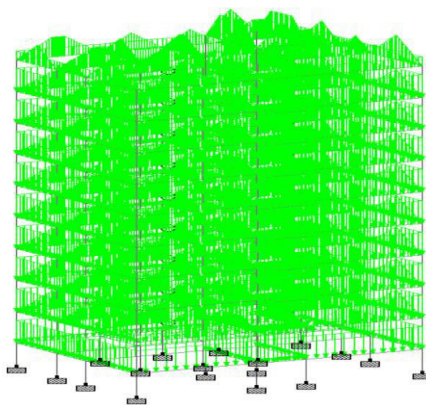


Fig.3. dead load

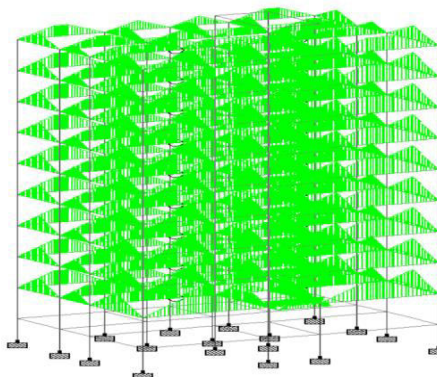


Fig.4. live load



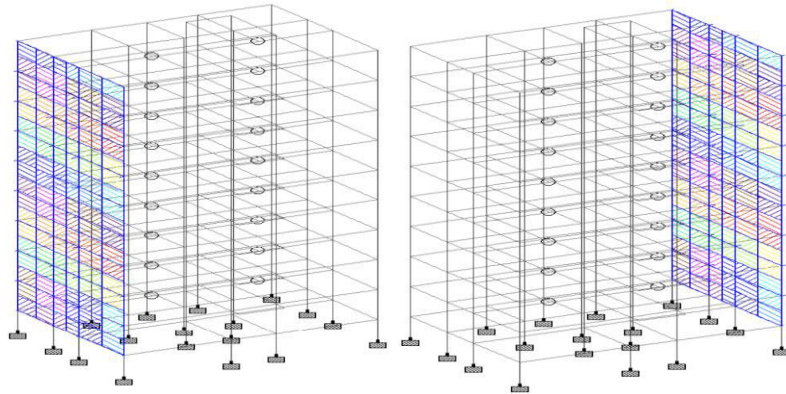


Fig.5. wind load in x+ direction

Fig.6. wind load in x- direction

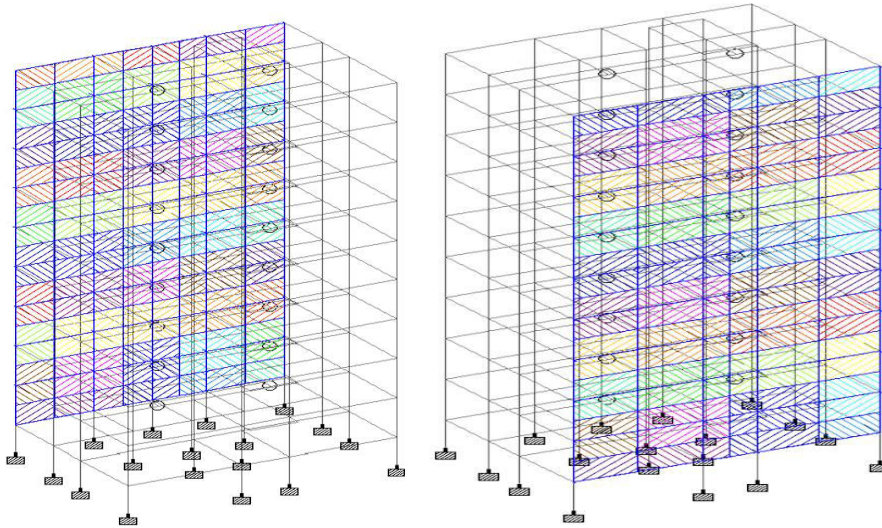


Fig.7. wind load in z+ direction

Fig.8. wind load in z- direction

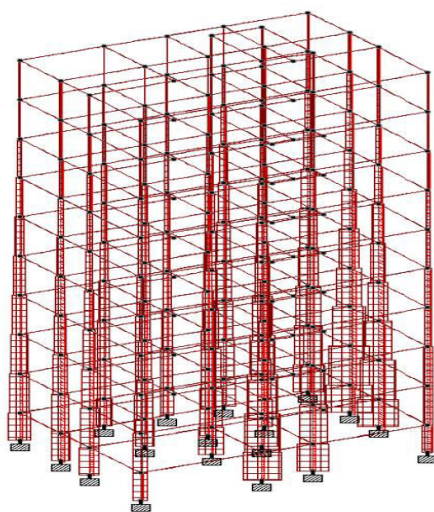


Fig.9. shear force on building

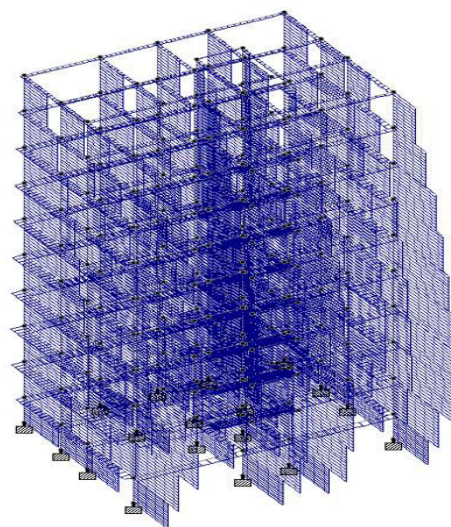


Fig.10. moment on building

### III.RESULTS AND DISCUSSIONS

Response spectrum analysis is performed with linear elastic response spectrum using the peak modal response calculated by dynamic analysis of the mathematical model. Only models that contribute significantly to the intervention should be considered. The peak modal response of the adequate type must cover at least 90% of the building's membership group in each of the building's two orthogonal principal horizontal directions. Peak member forces, displacements, story oil, story truncation and reaction for any type of reaction should be determined by the SRSS (Sum of Square Roots) law or CQC (Complete Quadratic Combination).

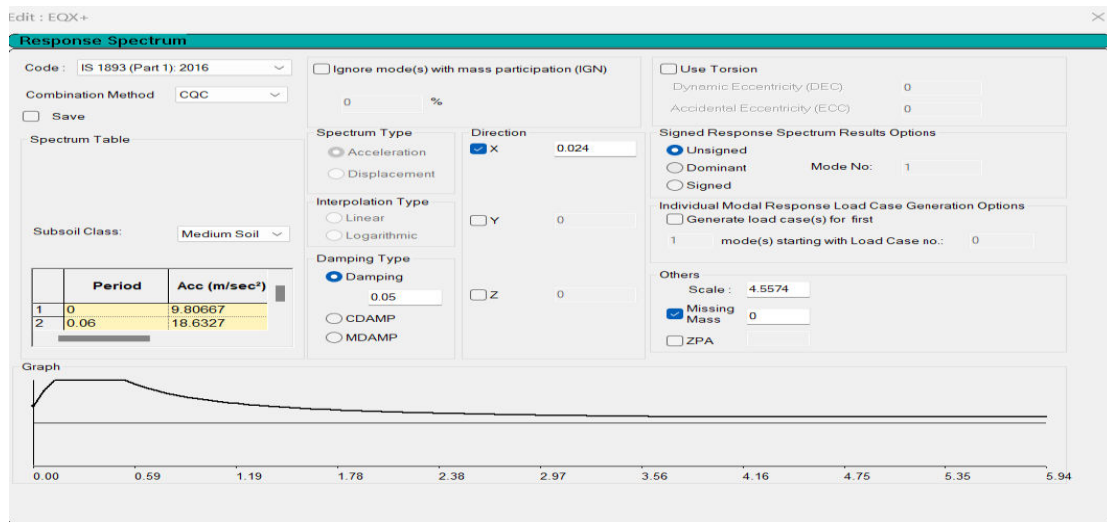


Fig.11.Response spectrum in x direction

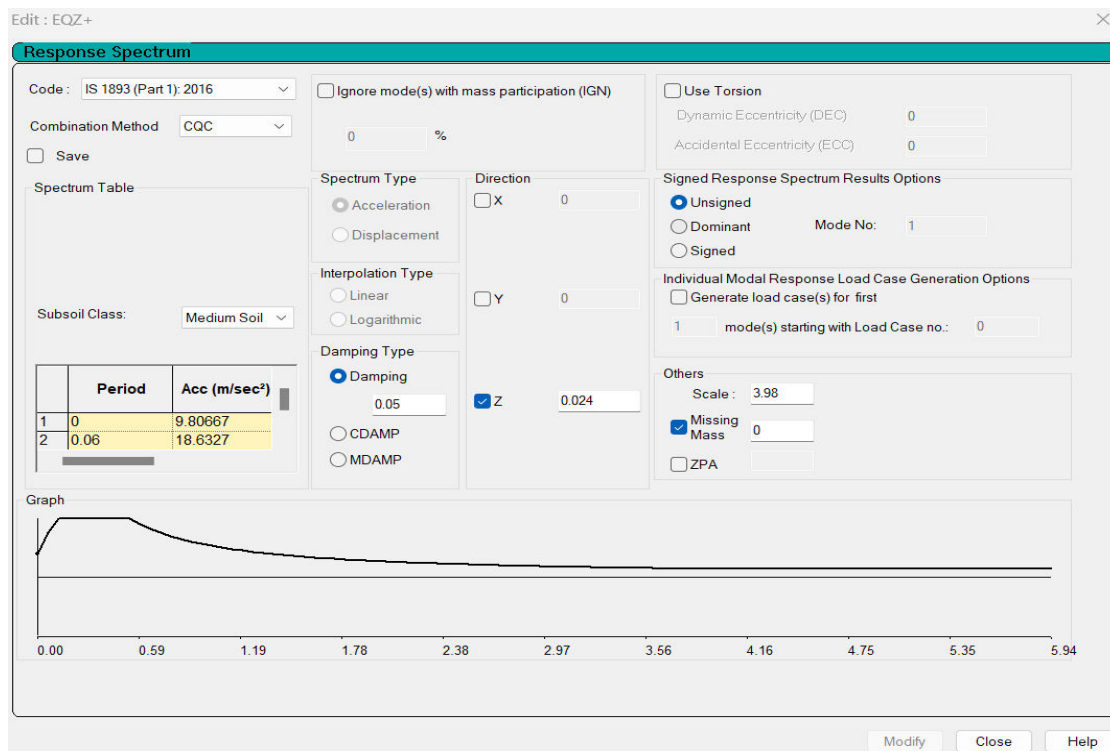


Fig.12. Response spectrum in z axis



BASE SHEAR AND TIME PERIOD:

Base shear force is the total lateral force applied to the foundation of a structure due to earthquake ground motion. Seismic analysis method such as equal lateral force (ELF) method or area spectrum analysis method.

Time period, also known as natural time or critical time, is the measure of the time it takes for a sample to complete a complete cycle of vibration when subjected to lateral forces. Inverse proportion. It was created because it affects the dynamic response of structures to seismic ground movements.

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TOTAL SRSS SHEAR  922.45  0.00  0.00  * UNITS - KN  METE
TOTAL 10PCT SHEAR 922.45  0.00  0.00  * TIME PERIOD FOR X 1893 LOADING =  0.68667 SEC
TOTAL ABS SHEAR   2056.43  0.00  0.00  * SA/G PER 1893=  1.981, LOAD FACTOR= 1.000
TOTAL CSM SHEAR   922.45  0.00  0.00  * FACTOR V PER 1893=  0.0475 X 21799.77
TOTAL CQC SHEAR  1036.21  0.00  0.00  * VB Min based on Clause 7.2.2 =  348.80
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Total complete quadratic combination

Time period in x direction

Level in M	Peak storey shear in x direction
30.48	23.78
27.43	188.6
24.38	387.44
21.34	528.3
18.29	616.7
15.24	667.36
12.19	742.66
9.14	823.29
6.1	901.35
3.05	950.64
0	957.87
-2.13	957.87

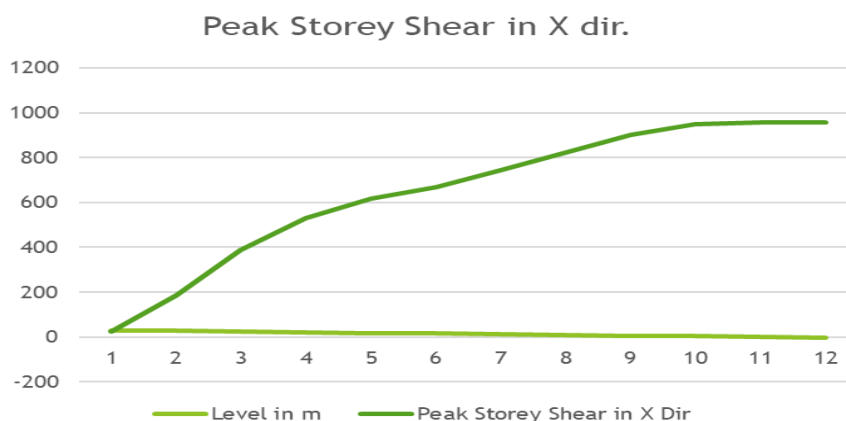


Fig.13. peak storey in x direction

Level in M	Peak storey shear in z direction
30.48	18.81
27.43	159.7
24.38	329.02
21.34	448.05
18.29	521.23
15.24	571
12.19	625.34
9.14	694.23
6.1	761.78
3.05	804.64
0	810.83
-2.13	810.83

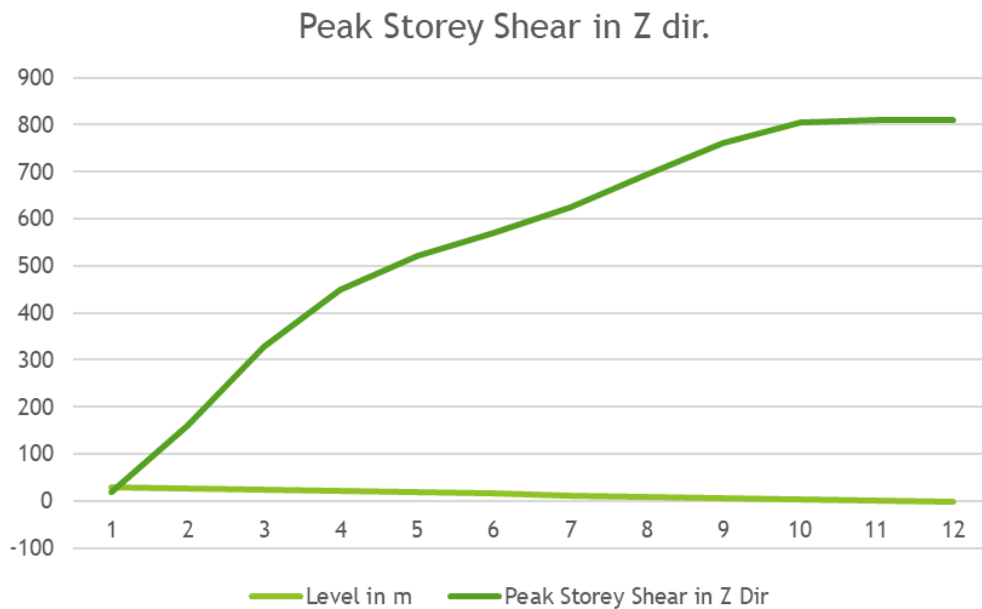


Fig.14. peak storey in z direction

#### IV. CONCLUSION

The multi-story buildings I inspected were found to be safe and did not require re-evaluation. This indicates that the structure is solid and can withstand seismic forces without requiring additional support or modifications. If the building needs to be renovated in the future, the following measures will be taken:

- Adding New Shear Walls: To increase the lateral stiffness and strength of the building.
- Steel Bracing: To enhance the building's ductility and energy dissipation capacity.
- Wall Thickening: To improve the load-bearing capacity of existing walls.
- Base Isolation Technique: To reduce seismic forces transmitted to the building.
- Mass Reduction Technique: To decrease the seismic demand on the structure.
- Jacketing Method: To increase the strength and ductility of columns and beams.
- Fiber Reinforced Polymer (FRP): To enhance the strength and deformation capacity of structural elements.



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