RESEARCH PAPER

RESPONSE SPECTRUM ANALYSIS OF G+6 BUILDING WITH AND WITHOUT WALL LOAD USING WITH ETABS

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Abstract Now a days an earthquakes are more affected on concrete structures have been severely damaged or collapsed. So there is a need of to evaluate the seismic adequacy. We can't avoid the future earthquakes but we can manage or prepare the building to safe construction, and to reduce the extent damage and loss. Earthquake is the disturbance that happens at some depth below the ground level which causes vibrations at the ground surface. A braced frame is a structural system commonly used in structures subject to lateral loads such as wind and seismic pressure. The members in a braced frame are generally made of structural steel, which can work effectively both in tension and compression. The buildings which do not designed for seismic force, may suffer extensive damage or collapse if shaken by a severe ground motion.

In the present study a G+6 story building is modeled by using ETABS software and analyzed in Response spectrum analysis and the comparison is made between the buildings without walls and with walls, The results like story drift, story shear, story moment, building torsion, time period, were compared.

Key words: Earthquake, Response spectrum analysis, story drift, story shear, story moment, building torsion, time period,

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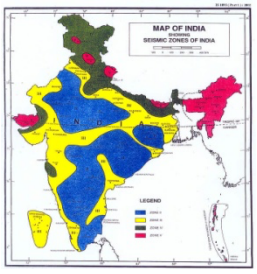
Introduction

In last decades Steel structure plays an important role in the construction industry. It is necessary to design a structure to perform well under seismic loads. Shear capacity of the structure can be increased by introducing Steel bracings in the structural system. Bracings can be used as retrofit as well. There are „n" numbers of possibilities are there to arrange Steel bracings. Such as D, K, and V type eccentric bracings. Design of such structure should have good ductility property to perform well under seismic loads. To estimate ductility and other properties for each eccentric bracing Push over analysis is performed.

A simple computer-based push-over analysis is a technique for performance-based design of building frameworks subject to earthquake loading. Push over analysis attains much importance in the past decades due to its simplicity and the effectiveness of the results. The present study develops a push-over analysis for different eccentric steel frames designed according to IS-800 (2007) and ductility behaviour of each frame.

Different zones in INDIA

Every nation carries out mapping of its territory based on all natural disasters like earthquake, cyclone, flood and volcano etc.. This mapping is done on the basis of past history and factors responsible for such disaster of present in that area. This mapping helps people to design their home and other infrastructure so that they don't become the victim of such disaster and can withstand disasters with as minimum as possible loss of life and property. Code of practice of all nations for design of buildings and other structure recommended design guidelines based on such mapping or zoning.



Seismic zone map in India

Hence one who is designing a home must take into consideration the effect of such disaster and make suitable provision in its structural design. One must consult his/her architect/structural designer to include such provision based on the zoning.

In India, the country has been divided into 4 zones. Earlier there were 5 zones however after Bhuj Earthquake of 2001, the zone I have been eliminated. Each country in the world has such zoning for all such natural disasters. India is divided into 4 seismic zones i.e. Zones II, III, IV and V. These zones are divided on the basis of Maximum Considered Earthquake and service life of structure in each seismic zone.

Seismic zone have been categorized as follows:

1. ZONE V

The areas of this zone have the highest risk of effects by an earthquake. The earthquake intensity for this zone is MSK-IX or greater. The zone factor for this zone is 0.36, which is indicative of effective (zero period) level earthquake in this zone. This zone is called as Very High Damage Risk Zone. Some of the regions which fall under this zone are Rann of Kutch, Eastern regions etc.

Difference between Intensity & Magnitude of Earthquake

Intensity is number written in Roman numeral describing the severity of the earthquake in terms of its effect on earth surface, and on human and their structure. The higher the number, the higher the intensity of the effect/damage. While magnitude indicates amount of energy released at the source i.e. epic center. Intensity is measured as MMS (modified Meracallie Scale) while magnitude is measured on richter scale.

2. Zone VI:

The areas of this zone have the lesser risk to effects by an earthquake as compared to zone V. The earthquake intensity for this zone is between MSK VIII to MSK-IX. The zone factor for this zone is 0.24. This zone is called as High Damage Risk Zone. Some of the regions which fall under this zone are Northern regions, North Eastern regions, Delhi etc.

3. Zone III:

The areas of this zone have the lesser risk by an earthquake. The earthquake intensity for this zone is MSK VII. The zone factor for this zone is 0.16. This zone is called as Moderate Damage Risk Zone. Some of the regions which fall under this zone are some parts of Gujarat & Maharashtra, Andaman Nicobar Islands etc.

4. Zone II:

The areas of this zone have the least risk of an earthquake. The earthquake intensity for this zone is MSK VI. The zone factor for this zone is 0.10. This zone is called as Low Damage Risk Zone. Larger parts of India come under this zone.

One can see that in zone II, the intensity is VI on M scale while in zone V it is iX or greater, i.e. the damage and effect would be higher.

Objectives of the study

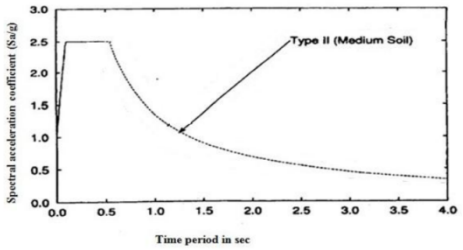
The following are the main objectives of the project

1. To study the seismic behavior of building by using IS 1893:2016
2. To design the earth quake resistant structure by using walls in zone V.
3. To compare the results of story drift, shear force, bending moment, building torsion of buildings for earth quake resistant buildings with and without using walls.
4. To study the multi story buildings in ETABS V9.7.4 in Response spectrum analysis.

METHODOLOGY

RESPONSE SPECTRUM METHOD

The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2002 (part1). Here type of soil, seismic zone factor should be entered from IS 1893-2002 (part1). The standard response spectra for type of soil considered is applied to building for the analysis in ETABS 2013 software. Following diagram shows the standard response spectrum for medium soil type and that can be given in the form of time period versus spectral acceleration coefficient (Sa/g).



Response spectrum for medium soil type for 5% damping

This approach permits the multiple modes of response of a building to be taken in to account (in the frequency domain). This is required in many building codes for all except very simple or very complex structures. The response of a structure can be defined as a combination of many special shapes (modes) that in a vibrating string correspond to the "harmonic" computer analysis can be used to determine these modes for a structure. For each mode, a response is read from the design spectrum, based on the modal frequency and the modal mass, and they are then combined to provide an estimate of the total response of the structure. In this we have to calculate the magnitude of forces in all directions i.e. X, Y & Z and then see the effects on the building. Combination methods include the following:

- absolute - peak values are added together
- square root of the sum of the squares (SRSS)
- complete quadratic combination (CQC) - a method that is an improvement on SRSS for closely spaced modes

The result of a response spectrum analysis using the response spectrum from a ground motion is typically different from that which would be calculated directly from a linear dynamic analysis using that ground motion directly, since phase information is lost in the process of generating the response spectrum.

In cases where structures are either too irregular, too tall or of significance to a community in disaster response, the response spectrum approach is no longer appropriate, and more complex analysis is often required, such as non-linear static analysis or dynamic analysis.

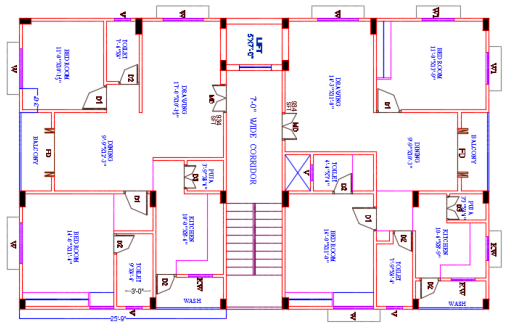
MODEL SPECIFICATIONS

In the present study, analysis of G+ 6 stories building in Zone V seismic zones is carried out in ETABS.

Basic parameters considered for the analysis are

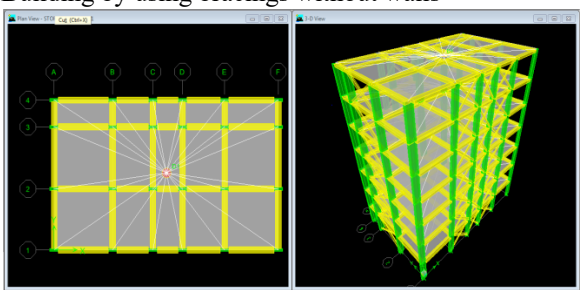
1. Grade of concrete : M40
2. Grade of Reinforcing steel : HYSD Fe550
3. Dimensions of beam : 230mmX460mm
4. Dimensions of column : 230mmX690mm
5. Thickness of slab : 150mm
6. Walls thickness : 230mm
7. Height of bottom story : 3m
8. Height of Remaining story : 3m
9. Live load : 2.5 KN/m^2
10. Dead load : 2 KN/m^2
11. Density of concrete : 25 KN/m^3
12. Seismic Zone : Zone 5
13. Site type : II
14. Importance factor : 1.5
15. Response reduction factor : 5
16. Damping Ratio : 5%
17. Structure class : C
18. Basic wind speed : 44m/s
19. Risk coefficient (K1) : 1.08
20. Terrain size coefficient (K2) : 1.14
21. Topography factor (K3) : 1.36
22. Wind design code : IS 875: 1987 (Part 3)
23. RCC design code : IS 456:2000
24. Steel design code : IS 800: 2007
25. Earth quake design code : IS 1893 : 2002 (Part 1)

G+6 Building Plan

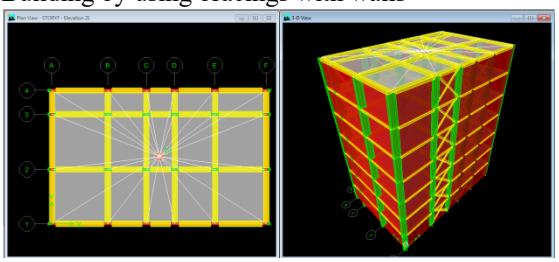


Building models in ETABS Software

Building by using bracings without walls



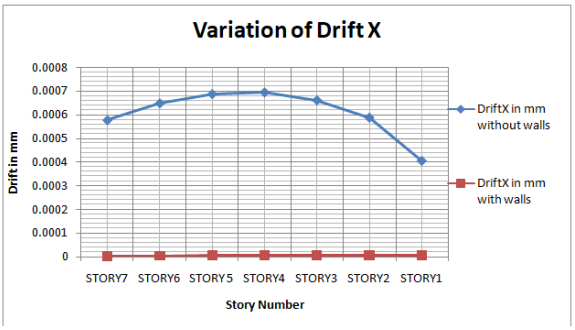
Building by using bracings with walls



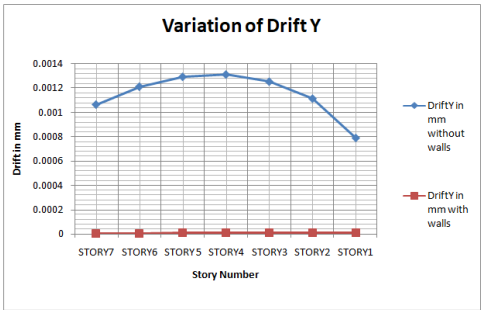
RESULTS AND ANALYSIS

Story Drift

X Direction

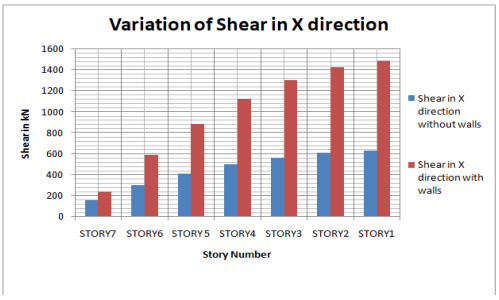


Y Direction

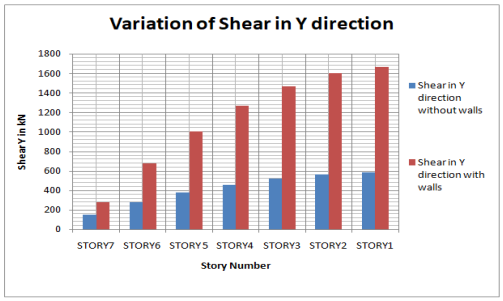


Story Shear

X Direction

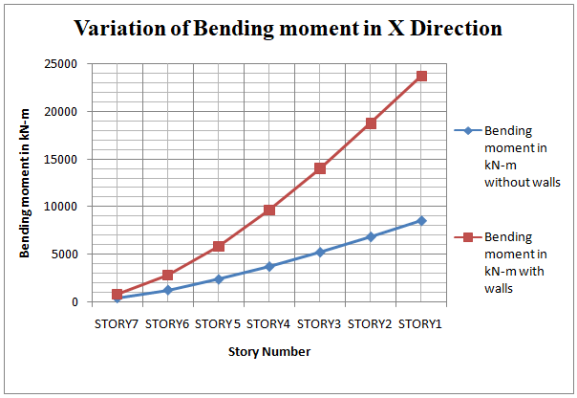


Y Direction

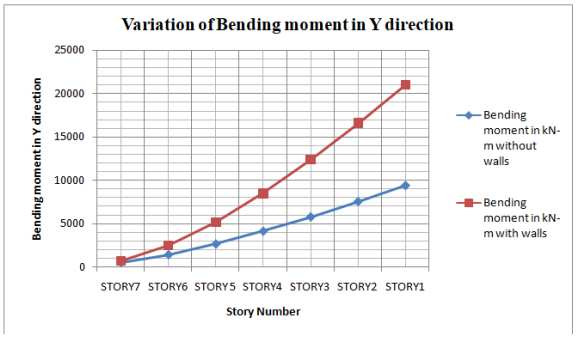


Bending moment

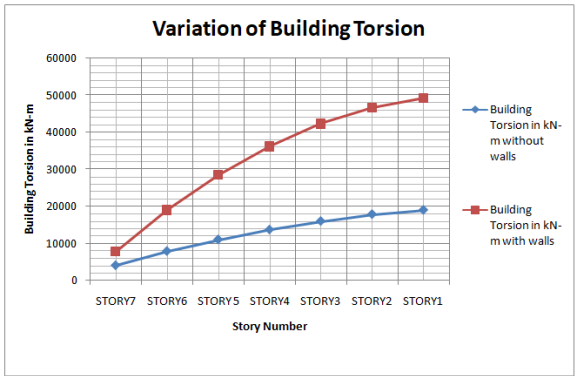
X direction



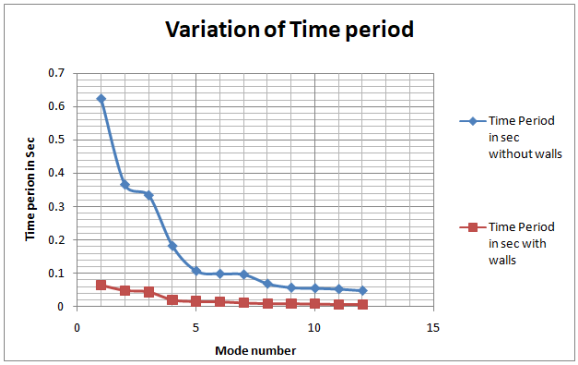
Y Direction



Building Torsion



Time period



Conclusions

From this study the following conclusions were made

1. Bracing indicated that the structures with bracing have performance points at less vulnerable damage states than structure without bracing.
2. The provision of walls enhances the base shear carrying capacity of frames and reduces roof displacement undergone by the structures.
3. The story drift X, drift Y (lateral displacement) has less values in building with walls than building without walls. So the effect of earth quack load is less building with walls than building without walls.
4. The story shear in X, Y direction has less value in building without walls than building with walls and the value of time period has less value for building with walls than building without walls.
5. The Building moment in X, Y direction has less value in building with walls than building without walls.
6. It is observed that the walls reduces the storey displacement as well as storey drift while it shows maximum storey shear.

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