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Seismic Analysis of Multistory Building with Symmetric Plan by Using STAAD Pro.

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Abstract: A building with several floors above ground is referred to as multi-story. The goal of multi-story buildings is to save money by expanding the building's floor space without expanding the surrounding land area. An Earthquake can cause damage or collapse of buildings if not designed for lateral loads. The Shear walls are the structural elements which counters the effect of lateral loads such as with a symmetric distribution of stiffness and strength in plan undergo coupled lateral and tensional motions during earthquakes stiffness. The necessity to assess seismic performance buildings was highlighted by the recent earthquakes, which resulted in significant damage or collapse of numerous reinforced concrete structures. Analysis of multi storey building using response spectrum method or analysis in STAAD Pro. Software using IS Code 13920 for RSA.

Index Terms **- Seismic Analysis, Multistoried Building, STAAD Pro. , RSA.**

I. INTRODUCTION

When creating a structure that can withstand an earthquake, one of the most crucial factors is not just making sure that it can withstand the force acting on it, but also making sure that of the building to be ductile enough to transfer this energy and dissipate it. Structural engineers must do both static and dynamic analysis when designing structures in accordance with qualitative seismic design guidelines but in this analysis we are using RSA method for analyze building While their objectives differ, seismologists and earthquake engineers both use seismological data to better understand earthquakes and their impacts. It is very important to modify the prediction of the seismic behaviour of existing structures. This is the reason why studies of Seismic vulnerability of Buildings have been developed to evaluate the expected damage in the different types of buildings. A few things are taken into consideration when designing earthquake-resistant constructions. The elements include the structure's inherent frequency, damping factor, kind of foundation, building significance, and ductility. In order to map and comprehend the phenomena of earthquakes, seismological data from numerous earthquakes were gathered and analyzed. The primary goal of structural analysis is to determine how a structure will behave under specific conditions. One major cause of a building's poor performance under severe seismic loading is structural symmetry, and another is structural asymmetry.

II. OBJECTIVE OF STUDY

- To study the seismic parameters of building structure.
- To analyze the behaviors of multi-storey building with symmetric plan.
- To study the results of various parameters such as displacement, torsion and deflection in Symmetric plan.

III. LITERATURE REVIEW

[1] S.M.Hashmi et.al, "A Comparative Study on Analysis of Symmetric and Asymmetric Building Structure" - In recent years, due to the demand in aesthetical view and architectural designs, people want uniqueness in the building so the buildings are designed with irregularities, Irregularities such as change or discontinuity In the construction process, irregularities are incorporated into the design of the buildings. These irregularities can include changes or discontinuities in the horizontal plan or in the vertical plan with regard to the stories above. Because these irregularities can pose a risk during earthquakes, it is crucial that structural engineers investigate and provide the necessary design for these irregularities. In this study, a comparison between symmetric and asymmetric reinforced concrete structures is made.

[2] Prof. A.S.Pawar et.al, "Seismic Analysis of Symmetric and Unsymmetric Buildings in Plan" - Structural analysis is mainly used for finding out the behaviour of a structure when subjected to some action. when subjected to the seismic forces. Displacements are considerably reduced in Model-3 because the effect of infill walls is considered.

[3] Lekkala Harish Kumar et. al, "Seismic Analysis And Design Of A Multi Storied Building Of (G+15) By Using Staad Pro" - A multi storey building is a building that has multiple floors above ground in the building. The goal of multi-story buildings is to save money by expanding the building's floor space without expanding the surrounding land area. Analyzing multi-story building frames requires a great deal of intricacy and bold computations using traditional techniques.

[4] M. T. Raagavi et.al, "ANALYTICAL STUDY ON SEISMIC PERFORMANCE OF PLAN IRREGULAR STRUCTURES" - The structures with plan irregularities are modeled and analysed using STAAD Pro V8i by Time history analysis method. The perfectly symmetric structure about X- direction and Z- direction has been chosen as standard reference structures. The output results are discussed as follows: The behaviour of building during the earthquake is depend upon many conditions like stiffness, strength, ductility and most probably on configuration of structure. Building irregularities lead to an eccentricity between the stiffness centers and building mass, which can be detrimental to the structure. In earthquakes, structures with uneven floor plans can sustain significant damage. Response spectrum analysis is the generally used method for analysis and design of earthquake resistance structures.

[5] Rohan Duduskar et.al, "Seismic Analysis of Multi-Storey Building with and without Floating Column and Shear Wall" - From linear static and dynamic analysis of building subjected to floating column and shear wall, following conclusions are drawn Seismic analysis of G+20 storey structures is done by both equivalent static and response spectrum method to obtained the parameters storey displacements, storey shear, storey drift, time period for seismic zone IV. Considered the storey displacements comparing to model-I, increased 8% in model-II, decreased 46% in model III, decreased 38% in model IV.

[6] Kanhaiya Kumar Jha et.al, "Analysis Of Asymmetric Cantilever Structure With Shear Wall At Different Locations For High-Rise Buildings" - The seismic reaction relies on a seismic zone, importance factor, ground type, behavior component and on the magnitude in addition to the distribution of stiffness and loads of constructing. The way that space is used in urban areas has changed recently, leading to uneven buildings as we demand more capacity in smaller spaces., this could cause homes with irregular distributions of their mass, stiffness and power alongside the height of building and purpose interruption of pressure waft and strain concentrations. Select a regular building and compare it with irregular building. Perform Response spectrum analysis for regular building models taken in this study. Pushover analysis is done for irregular building.

[7] Mohd Abdul Aqib Farhan et.al (14) "Seismic Analysis of Multistoried RCC Buildings Regular and Irregular in Plan": Based on the graphical depictions, we deduce that, in comparison to the regular building, the story shear variation is less. The average range for the G+6 structure when compared to the regular building decreases by 12% and in asymmetrical decreases by 34%.The average range for the G+9 structure when compared to the regular building decreases by 13% and in asymmetrical decreases by 35%.The average range for the G+14 structure when compared to the regular building decreases by 18% and in asymmetrical decreases by 36%. Drawing conclusions from the graphical representations, we find that, in comparison to the regular construction, the tale drift variation lowers for the irregular case and increases for the asymmetrical case.

[8] G.V.S. Siva Prasad et.al, "Seismic Response Analysis of Symmetrical and Asymmetrical High Rise Structures in Seismic ZoneII" - From the analysis results and comparative study made among the Symmetric and Asymmetric structures using equivalent static and dynamic earthquake analysis the following set of conclusions are drawn. An attempt is made in this study to understand and perceive the behaviour of building frame system. The main distinction between symmetric and asymmetric tall buildings is the ability to prevent deformation by limiting the building's story drift into something more stiff and stable and enhance stability. Performance of Symmetrical building is better than Asymmetrical building.

IV. RESEARCH METHODOLOGY

Various IS Codes like IS 1893:2002(Part 1) and IS 456:2000 was referred for design purpose. The required architectural plan, sizes of beams and columns for analysis and design purpose is collected from a construction site of a multistory building.

4.1 General Information About Building Model

Nos. of storey	G+12
Storey height	3 metre
Concrete strength	M25
Unit Weight of concrete	25 N/mm2
Steel grade	Fe500
Column dimension	450 x 450mm
Beam dimension	300 x 300mm
Slab thickness	125mm
Bays dimension	12Nos.
Live Load	1 KN
Dead load	2.25 KN

Element Load	3.125 KN

Table 1 General information about building

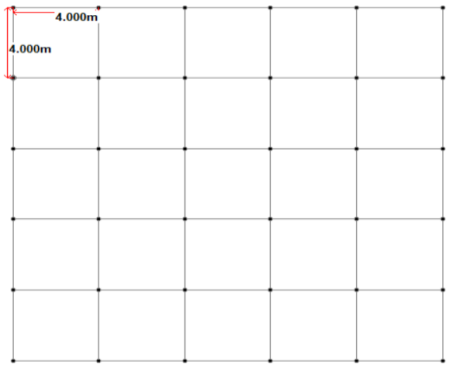


Figure. No. 1 Top View of Building

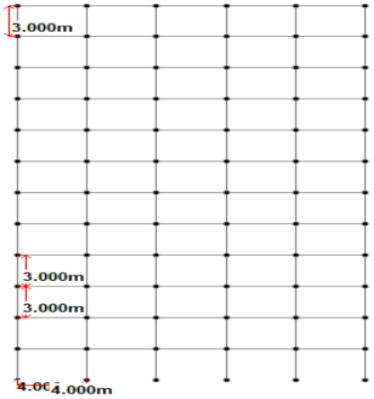


Figure. No. 2 Side View of Building

4.2 Seismic Analysis of Multi-story Building

In this project analyze G+12 Multi-storey building by using Response Spectrum Method in Symmetrical plan. Analysis of building with the parameters of Displacement, Deflection and Torsion of building

Following steps given Below

Step 1 – Run Structure Wizard

Using Frame Model

Contents	Dimension	No. of Bays
Dimension of Building	20m X 20m	-
Total height (h)	36m	12
Total Width (b)	20	5
Total length (l)	20	5

Table 2 Structure Wizard Information of building

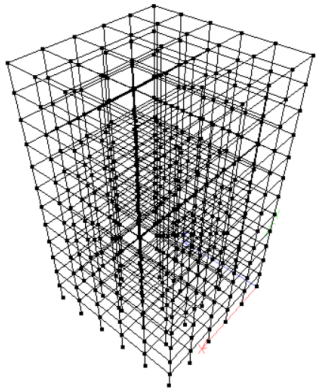


Figure. No. 3 Structure Wizard View

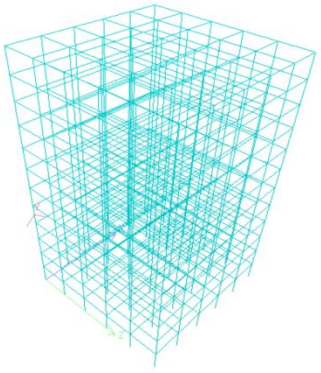


Figure. No. 4 Structure Wizard Rendering Vi

Step 2 – Cut Section and Add Plate

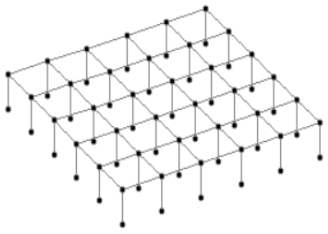


Figure. No. 5 Section cutting

Add same plate in other floors by using Translation Repeat.

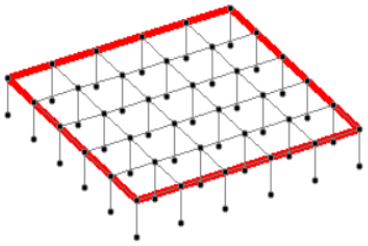


Figure. No. 6 Adding Slab Plate

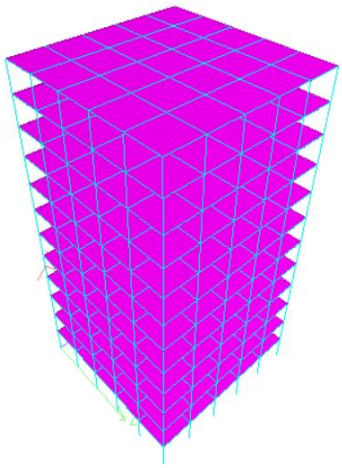


Figure. No. 7 Rending View After adding plate

Step 3 – Define, add and Assign Beam Column and Slab Thickness

Define Rectangular column rectangular is nothing but considering square column.

Column dimension	450 x 450mm
Beam dimension	300 x 300mm
Slab thickness	125mm

Table 3 Information for Beam Column and Slab Thickness

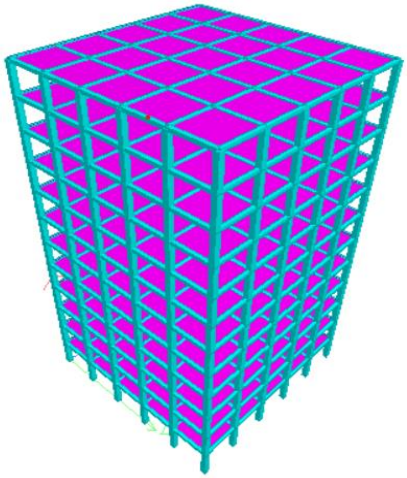


Figure. No. 8 Assigning Beam, Column and Slab Thickness

Step 4 – Create Support

Using Fixed Support in Building

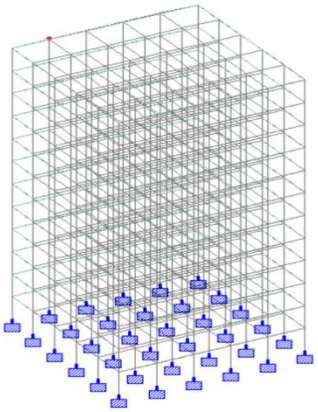


Figure. No. 9 After Assigning Fixed Support

Step 5 Material Assigning

Using M25 Grade of Concrete it's unit weight is 25 N/mm2

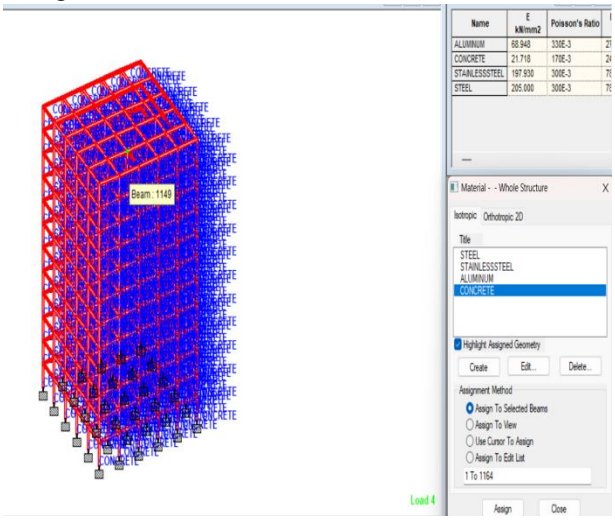
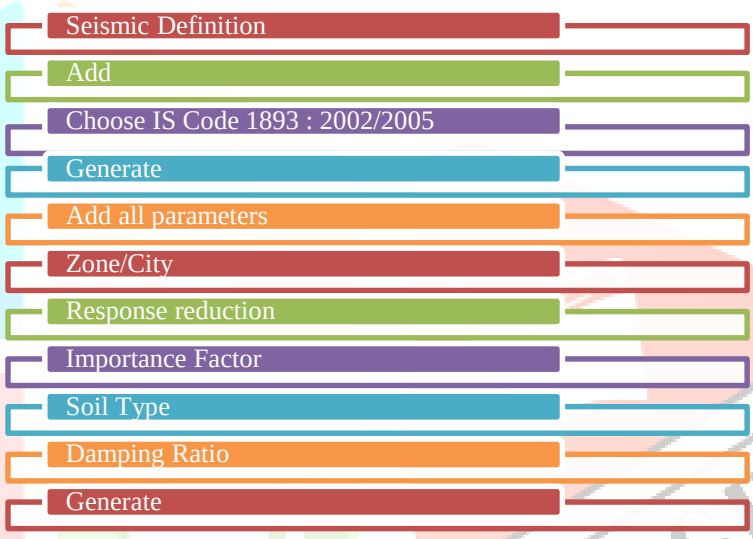


Figure. No. 10 Material Assigning

Step 6 – Load And Definitions



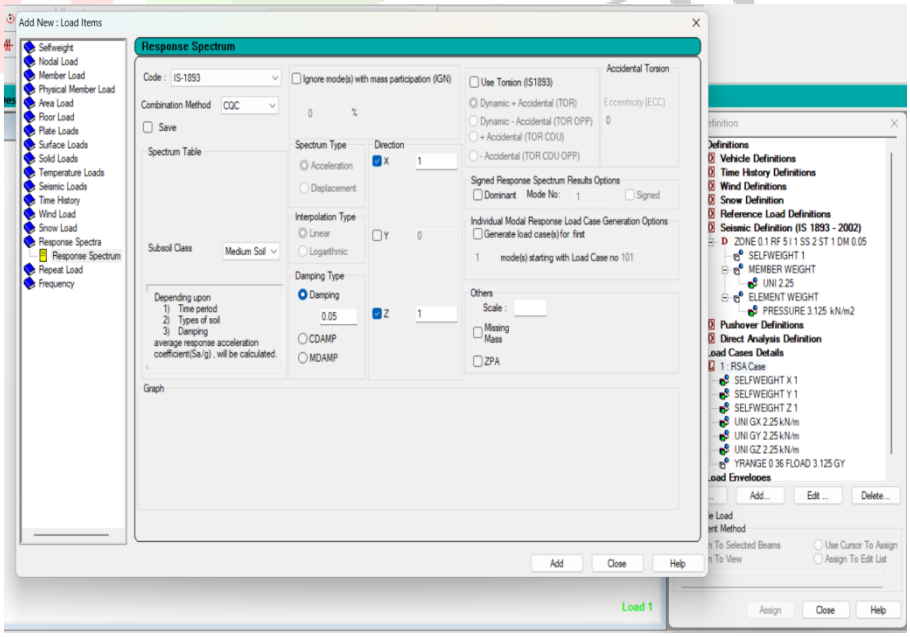


Figure. No. 11 Response Spectrum Details

Step 7 –Analysis/ Print

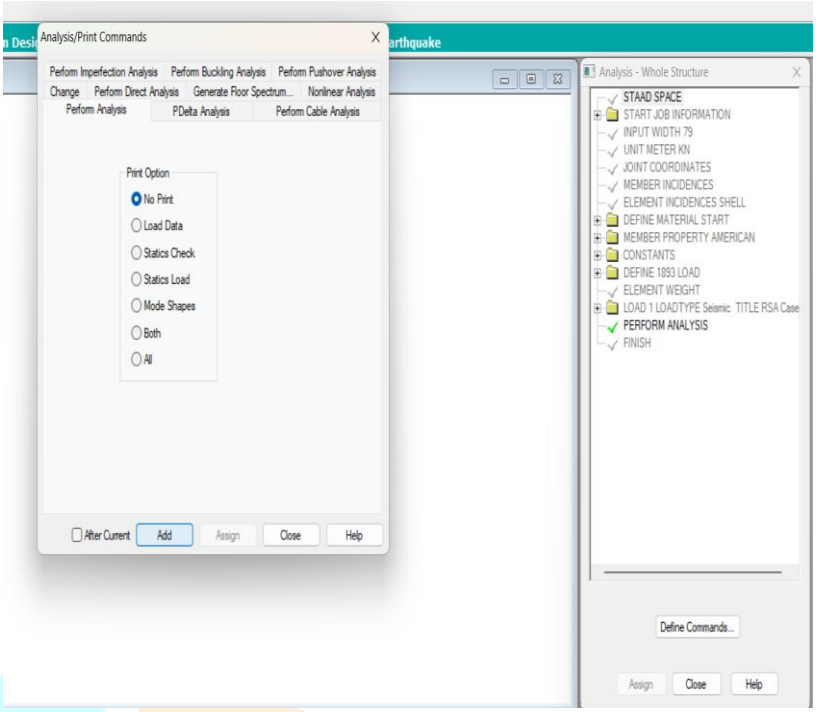


Figure. No. 12 Analysis And Print

V. RESULTS AND DISCUSSION

5.1 Displacement

			Horizontal	Vertical	Horizontal	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	78	1 RSA CASE	**959.646**	0.000	959.646	1357.144	0.008	0.000	0.008
Min X	1	1 RSA CASE	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Max Y	73	1 RSA CASE	959.524	**23.531**	959.524	1357.176	0.008	0.000	0.008
Min Y	1	1 RSA CASE	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000
Max Z	78	1 RSA CASE	959.646	0.000	**959.646**	1357.144	0.008	0.000	0.008
Min Z	1	1 RSA CASE	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Max rX	24	1 RSA CASE	288.008	0.000	288.008	407.304	**0.036**	0.000	0.036
Min rX	1	1 RSA CASE	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Max rY	156	1 RSA CASE	930.770	9.305	959.261	1336.638	0.007	**0.010**	0.008
Min rY	391	1 RSA CASE	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Max rZ	24	1 RSA CASE	288.008	0.000	288.008	407.304	0.036	0.000	**0.036**
Min rZ	1	1 RSA CASE	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
Max Rs	73	1 RSA CASE	959.524	23.531	959.524	**1357.176**	0.008	0.000	0.008

Figure. No. 13 Node Displacement Summary

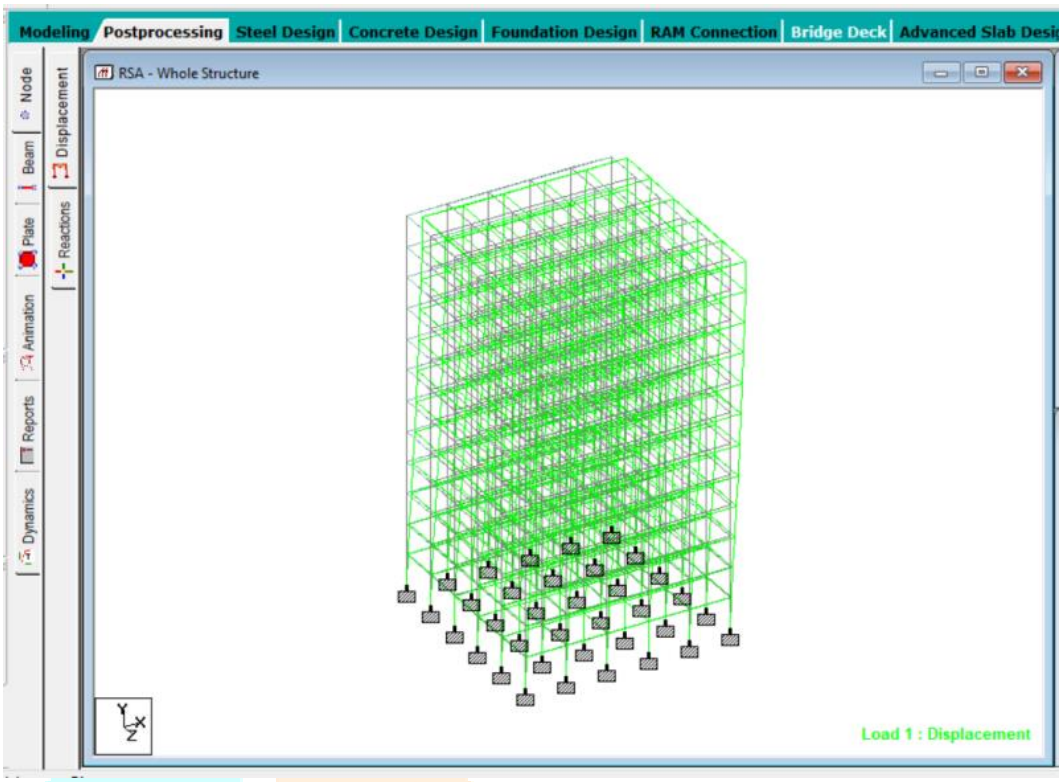


Figure. No. 14 Displacement of Building Due RSA

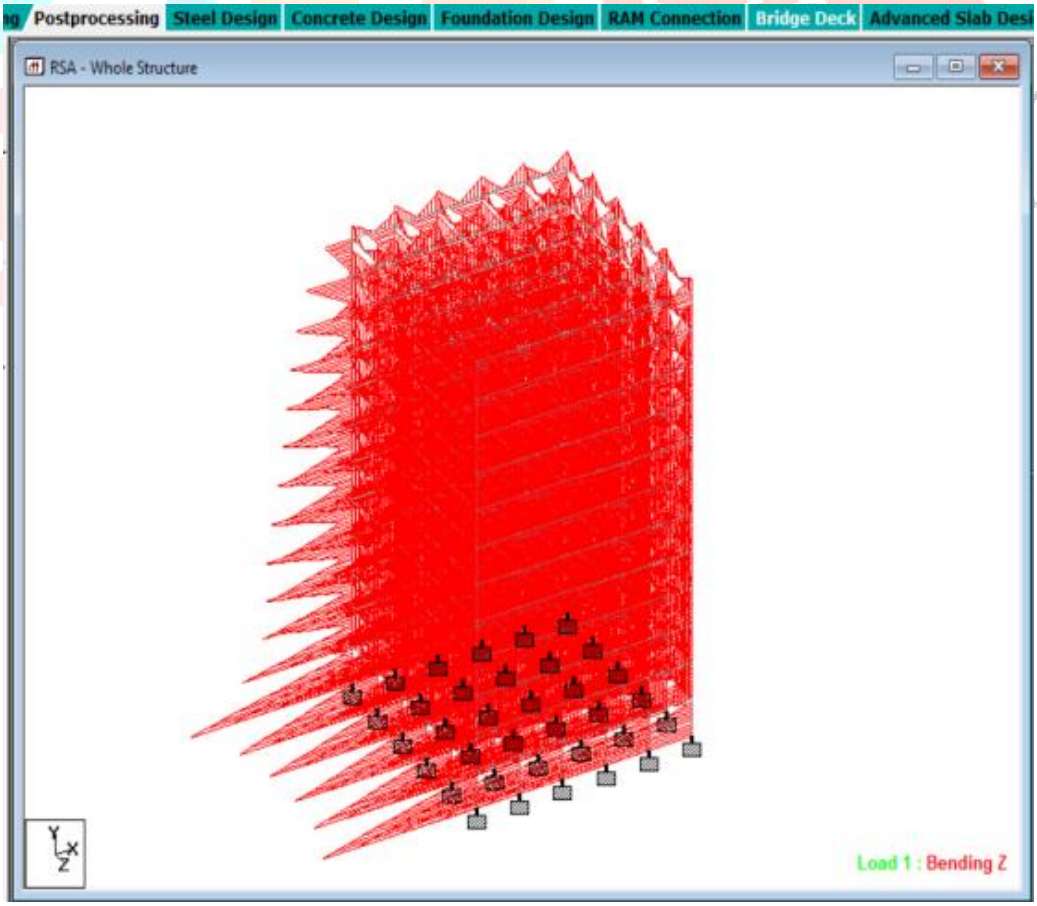


Figure. No. 14 Bending moment at Z Direction

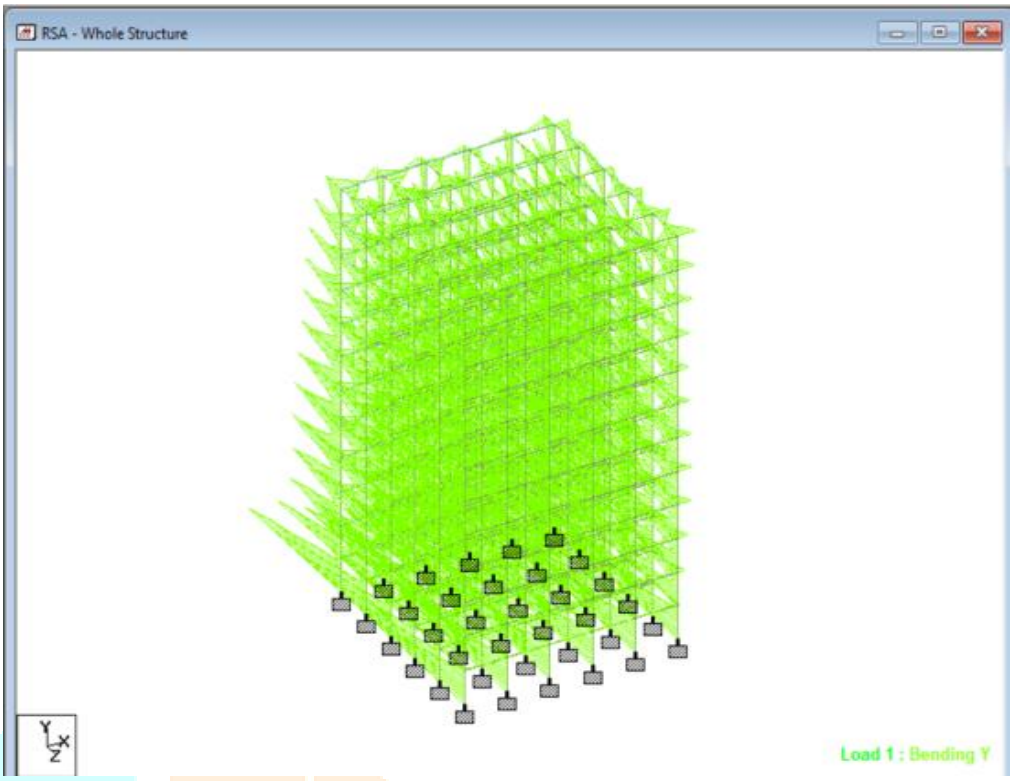


Figure. No. 15 Bending moment at Y Direction

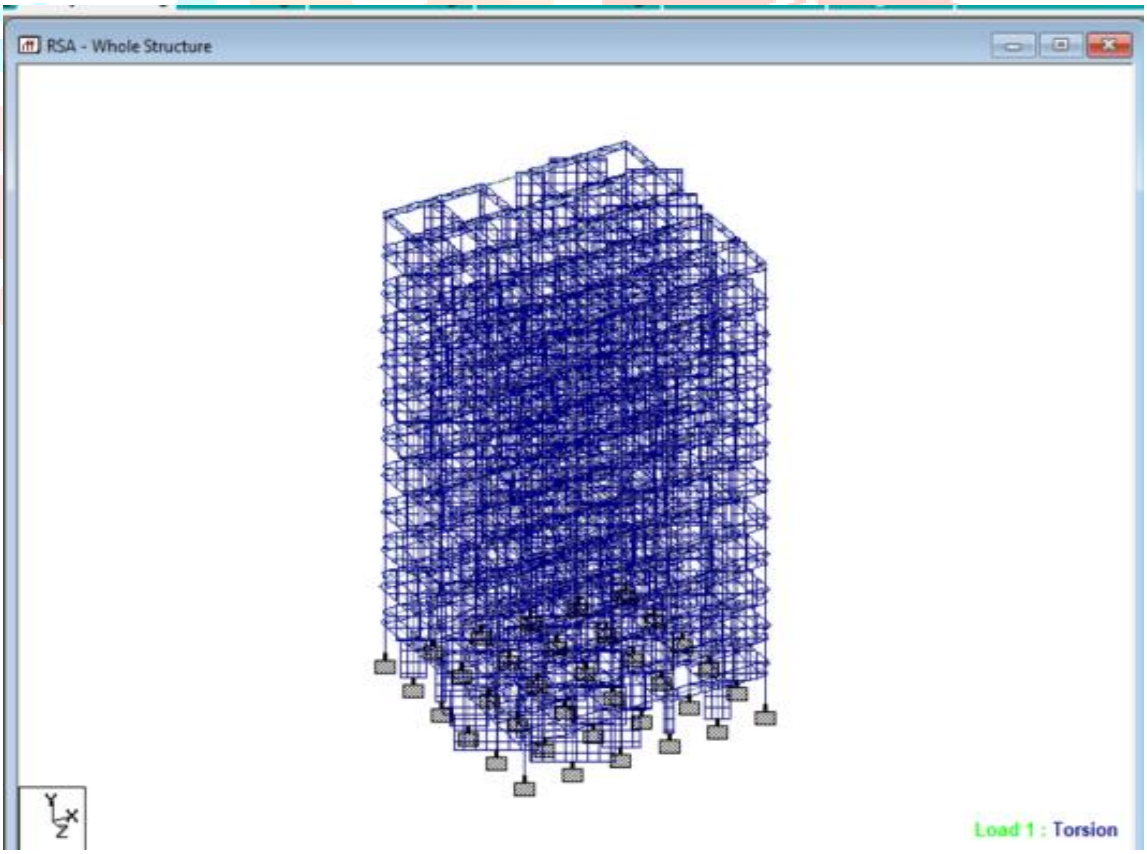


Figure. No. 16 Torsion of building

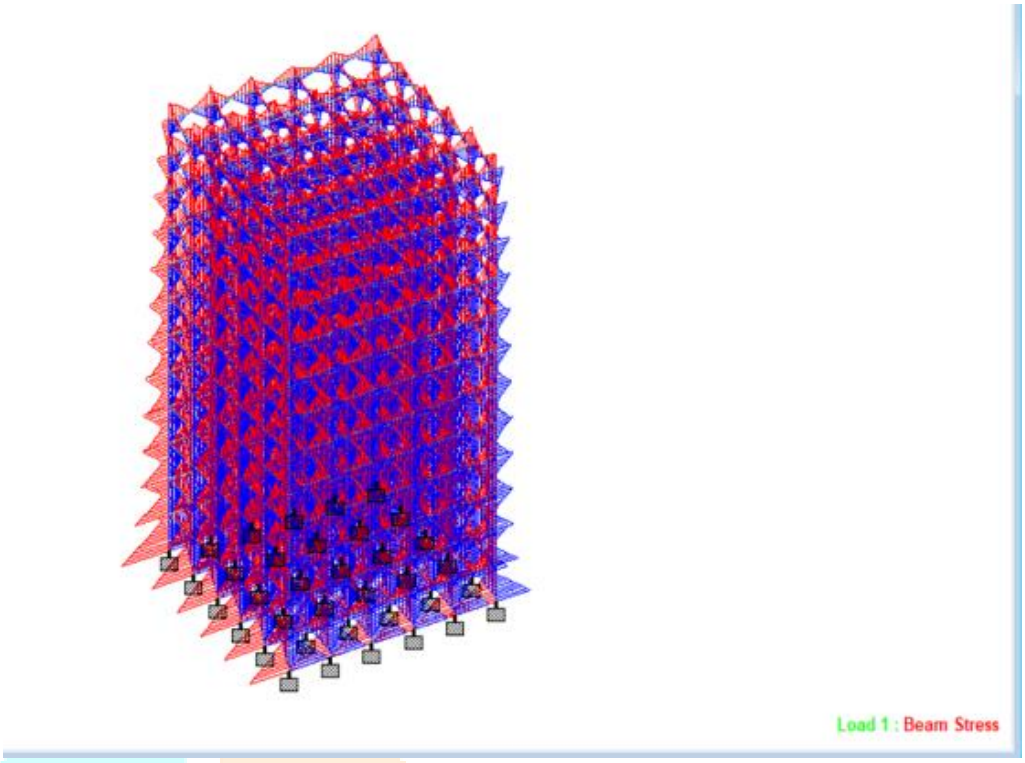


Figure. No. 17 Beam Stress

VI. CONCLUSION

- Displacement is more in Top floors as compare to lower in symmetrical plan.
- The plan configurations of structure has significant impact on the seismic response of structure in terms of displacement, story drift, story shear.\
- The maximum story displacement, overturning moment obtained from response spectrum method is lesser than those obtained by equivalent static lateral force method.
- The floor plan of the structure has significant impact on the seismic behavior of the structure in terms of displacement, storey drift and storey shears.

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