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Planning, Analysis and Design of Apartment Building in Different Seismic Zone Conditions by Response Spectrum Method Using SAP 2000

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ABSTRACT:

The present project is to reduce the time period of the residential G+7Building which in turn reduces the modal value, so that the sudden collapse of the building can be resisted. Dynamic load cases which include both wind and seismic loads should be applied, and non-linear analysis should be performed. The phenomenon can affect the stiffness and strength of the structural system. Due to lack of time, any rehabilitation action is impractical. Thus, the building may experience greater damage due to several repeated tremors. This project gives a brief idea about the non-linear behaviour of generic reinforced concrete building under excitation of single and repeated earthquake. Current practices in earthquake engineering only apply single earthquake on building structure during modelling and analysis. However, in real earthquake event, the tremors always occur repeatedly until two (or) three times after the first tremor.

1. INTRODUCTION:

The aim of this project is to perform an analysis and design for a multi-storey building G+7 using SAP 2000. The design process involves manual load calculations and the comprehensive analysis of the entire structure using SAP 2000. The analysis methods employed in SAP 2000 adhere to the Indian standard code of practice, specifically the limit state design principles. SAP 2000 offers a state-of-the-art user interface, visualization tools, and powerful analysis and design capabilities. It is used for analysis and design, (structural analysis program) SAP 2000 name has been synonymous with state-of-the-art analytical methos since introduction over 45 years ago. Civil engineering software ideal for the analysis and design of any type of structural system. The structural elements like beam, column, and trusses etc. SAP2000 provides a fully customizable graphical user interface for users to efficiently carry out modelling, analysis, design, and reporting tasks. Engineers can manipulate models with unparalleled flexibility by utilizing dock able windows, floating forms, and multiple views. The enhanced DirectX graphics offer lightning-fast performance, full 2D and 3D drafting capabilities, and seamless selection options. In a single screen, users can view moment diagrams, load assignments, deflected shapes, design output, and reports. The "Assign" and "Select" menu forms have been upgraded to include an "Apply" button for repeated use. Users can customize windows to meet their requirements, with unlimited model windows, views for model manipulation, and data views. Structural engineers designing buildings can benefit from the unmatched range of tools provided by Sap2000, regardless of whether they are working on one-story industrial structures or the tallest commercial high-rises. Sap2000 has long been recognized for its exceptional capabilities and ease of use, and the latest release upholds this standard by offering engineers the technologically advanced and intuitive software they need to maximize their efficiency.

2. RESEARCH OBJECTIVES:

1. To study and draw the plan of apartment building G+7 stories with proper specifications.
2. To carry out complete analysis and design of the main structural elements of a apartment building including beams, columns, slab, foundation etc.
3. Applying different loading conditionfor Seismic Zone-III.
4. To analyse the dynamic analysis of the structure one of the methods by using response spectrum method.
5. Modelling of the building for structural analysis and detail structural analysis by using SAP2000.

3. LITERATURE REVIEW:

3.1 Adhirey A Wadekar and Ajay Dhake - (2020)

Their study was about the response to the earthquake load (G + 40) of the high RCC. The structure is analyzed for basic shear and shift of the roof and is determined to be within the appropriate boundaries. It was also found that vertical analysis requires better reinforcement at higher beams than dynamic analysis. The deviation and bending of the shear decrease in the static analysis compared with the dynamic analysis.Ifasteelcolumnisfacingadryload,itsarearemainssmaller thanwhenitisundera flexible load.

3.2 Mohd. Tabrez Khan and Prof. Suhail Ahmed Qureshi - (2018)

They studied about the pushover analysis in 4 storeys building in sap 20000 and alsovarious resultsmaximum deflectionatthebase,firstfloor, second**,**Averagetopdrift,howthebehavioroftheframehas been working at linear value of baseshear.

3.3 GhusenKafri1,Md.ShahnewazSarkar,Md.Shaizuddinsa - (2018)

The earthquake ranks as one of the most destructive natural disasters recorded all over theworld. It has taken millions of lives and caused vast damages to infrastructures throughthe ages. Since the earthquake forces are random in nature and unpredictable, the engineering tools are needed to be sharpened for analyzing structures under the action of theseforces. This paper deals with the comparison of static and dynamic analysis of four RCmultistoreybuildingmodelswithdifferentheightinhighseismiczone.Fromtheresultsofthe study, it is found that Response Spectrum Analysis is an important dynamic analysistool,anditdoesnotrequirehighlevelofmodellingandatthesametimeitprovidebetterresultscomparedtostaticanalysis.

4. REASERCH METHODOLOGY:

1. Study of literature review.
2. Draw the plan in AUTO CAD.
3. Importing the plan in SAP2000.
4. Modelling in SAP2000.
5. Define and assigning of materials.
6. Loading, design using response spectrum analysis.
7. Analysis results
8. Conclusion.

Table 1: Data taken for proposed building.

Parameters	**Data**
Height of each story	3 m
Beam Size (RCC .)	230x400 mm
Column Sizes (RCC and Composite)	430x500 mm 400x450 mm 350x450 mm
Thickness of slab	150 mm
Live Load	0.25kN/m^2
Dead Load	1kN/m^2
Seismic Zones	III
Seismic Zones Factor	0.16
Wind Speed	55 m/s
External wall Load	13.8kN/m
Internal wall Load	7.5kN/m
Parapet wall Load	3kN/m
Floor Finishing Load	1.5kN/m^2
Wind Pressure Co-efficient	0.8
Soil Type	II (medium)
Response reduction factor	5

Importance Factor	1
Model Combination	CQC
Faction Damping ratio	0.05
Mass source: Dead load Live load	 1kN/m^2 0.25kN/m^2

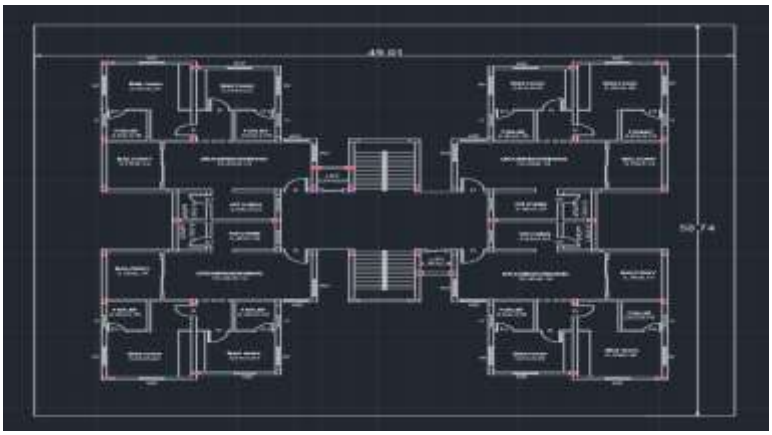

Figure 1 plan of proposed structure

4. RESULT:

The current chapter focuses on the analysis results of seven residential building stories in terms of shear force, bending moment, and torsion, utilizing the response spectrum analysis method.

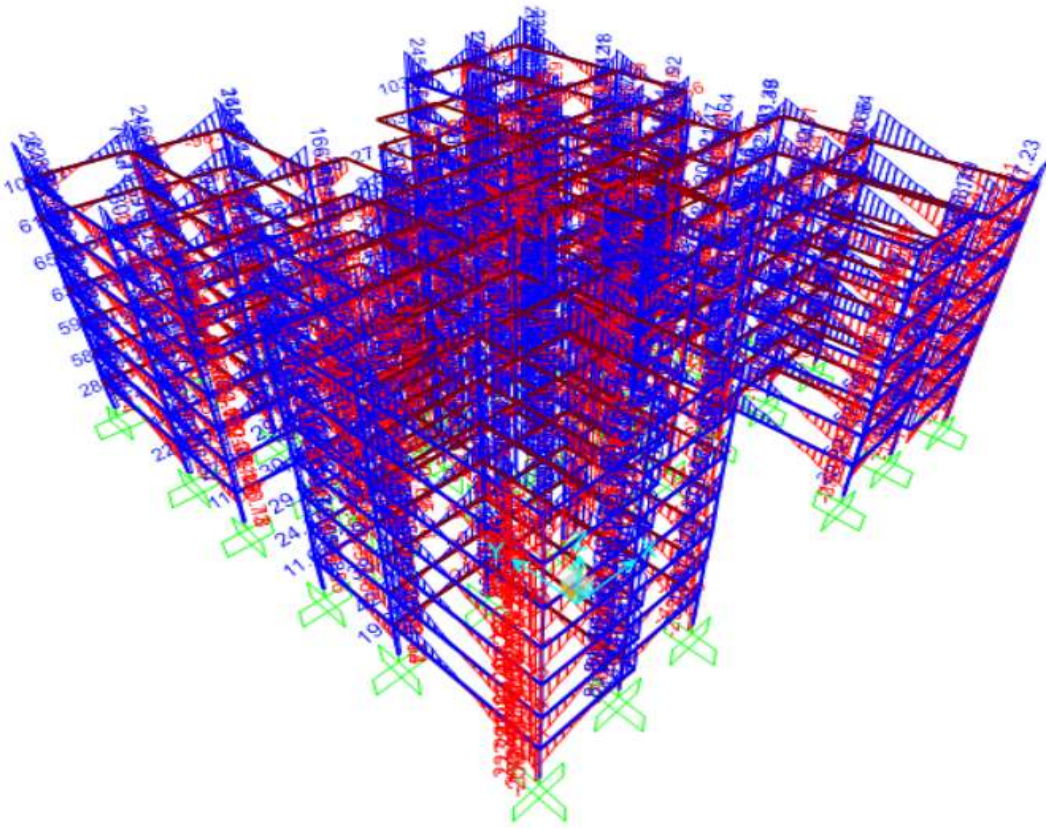

Figure 2: 3D model of shear 2-2 indead load

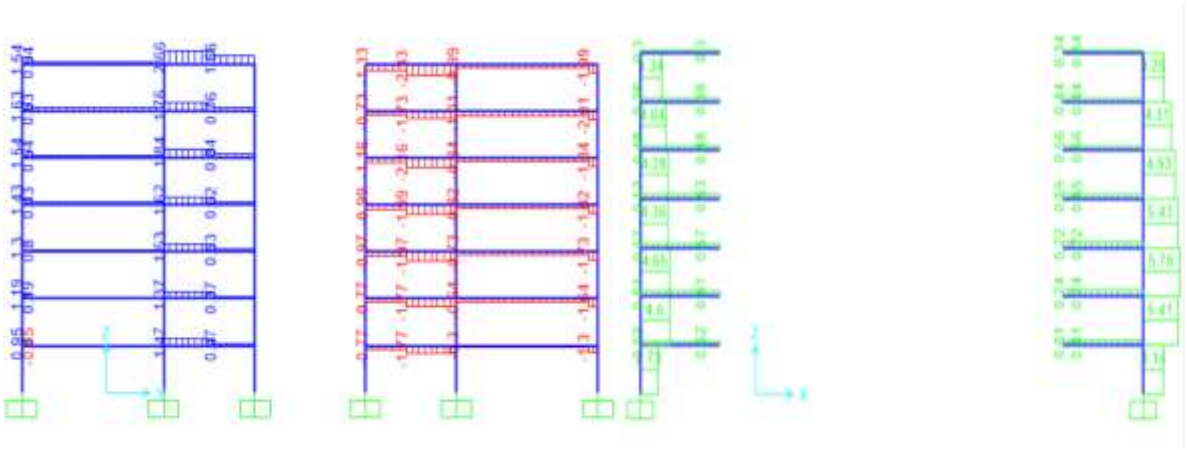

Figure:3 2D(YZ)model of torsion in dead load

Figure:4 2D(XZ) model of torsion in RS Y

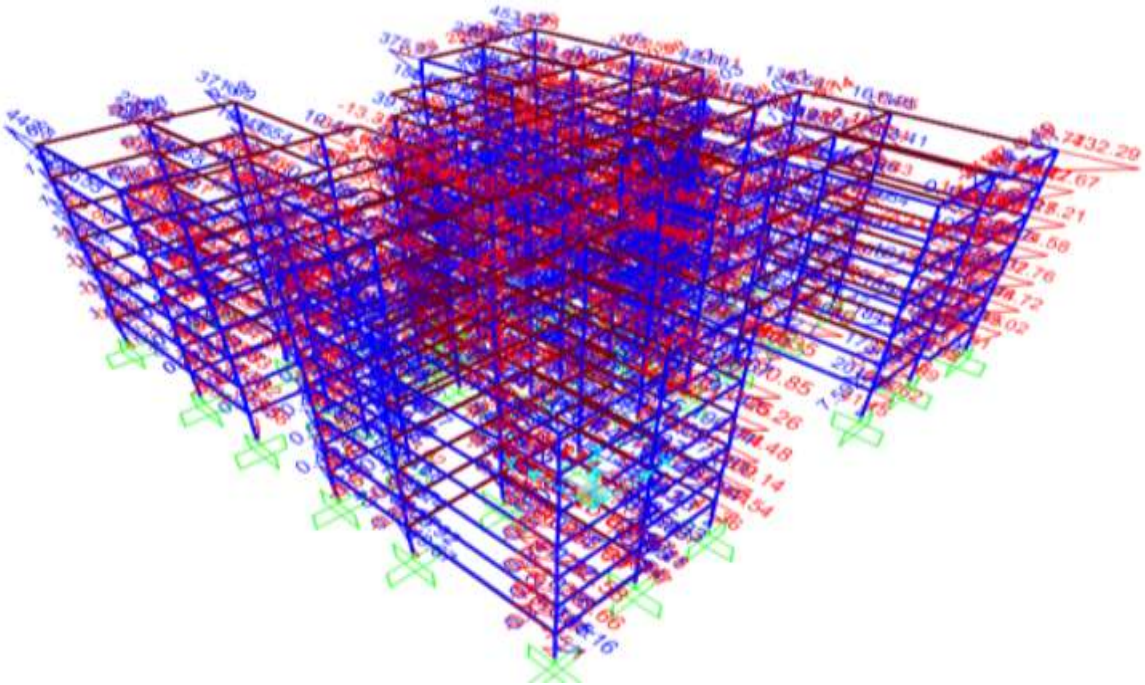

Figure:5 3D model of moment 2-2 in dead load

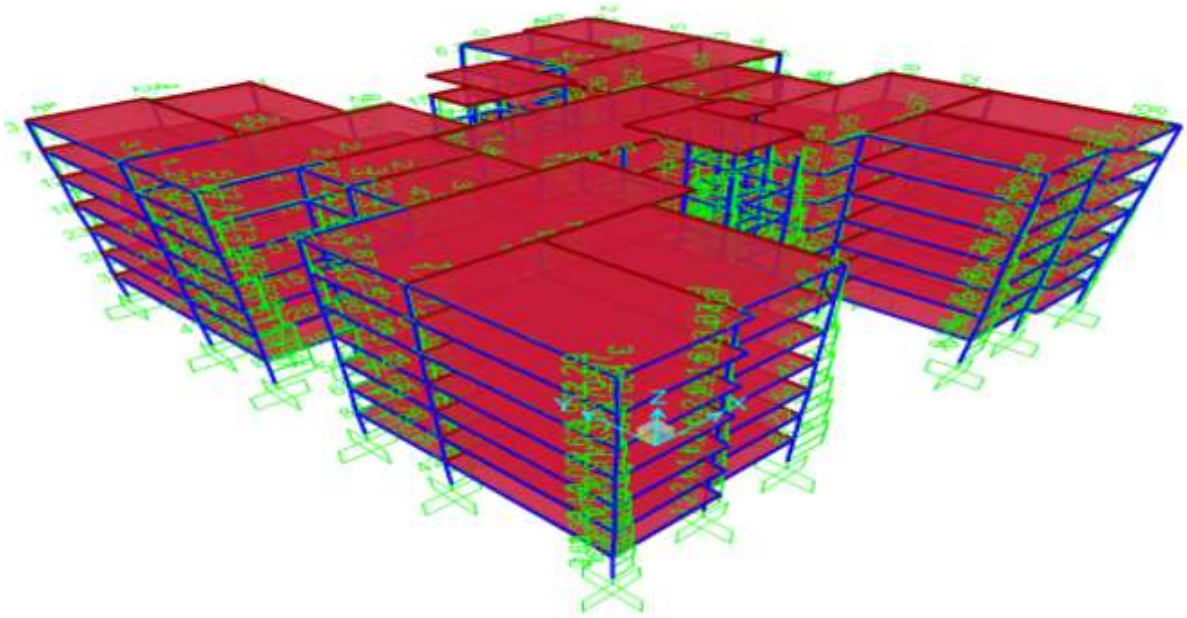

Figure:6 3D model ofaxial force in RS X

5. CONCLUSION:

The findings from the analysis and design of the Apartment building suggest that the project is primarily focused on delivering a seismic-resistant structure that is financially efficient.

1. The current project focuses on providing an earthquake-resistant structure that is cost-effective.
2. Seismic analysis was conducted using SAP 2000 software and manually verified in accordance with IS 1893-2016.
3. The drift values vary differently for each zone.
4. The values for maximum storey displacement, maximum storey drift, and maximum centre of mass displacement obtained from response spectrum analysis are lower at lower stories than at higher stories.
5. According to IS 1893, the storey drift should not surpass 0.004 times the storey height. The results obtained are below 0.004 times the storey height, ensuring the building's safety in terms of displacement.

6. REFERENCES:

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