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DESIGN AND ANALYIS OF FLOORING SYSTEM AND FOUNDATION USING CSI SAFE SOFTWARE.

Aniket Patale[1], Ramzan Shaikh[2], Rehan Shaikh[3], Mrs. Shubhra Dhamande[4]

[1]Department of civil engineering, New Horizon Institute of Technology & Management, Thane, Maharashtra, India
[2]Department of civil engineering, New Horizon Institute of Technology & Management, Thane, Maharashtra, India
[3]Department of civil engineering, New Horizon Institute of Technology & Management, Thane, Maharashtra, India
[4]Department of civil engineering, New Horizon Institute of Technology & Management, Thane, Maharashtra, India

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ABSTRACT

This study explores the application of CSI SAFE, a sophisticated software tool for foundation design, emphasizing its capabilities in analyzing and designing various foundation types. The research highlights the integration of load analysis, soil-structure interaction, and support conditions, showcasing how SAFE streamlines the design process through its user-friendly interface and robust calculation algorithms. Case studies demonstrate the effectiveness of SAFE in optimizing foundation performance while ensuring compliance with industry standards. By utilizing SAFE, engineers can enhance accuracy, reduce design time, and improve overall project efficiency, ultimately leading to safer and more cost-effective foundation solutions. The findings suggest that adopting advanced software tools like CSI SAFE is essential for modern civil engineering practices, particularly in complex projects where precision and reliability are most crucial.

Keywords: Soil Pressure, Deflection, Punching Shear, Safe Design, Software.

1. INTRODUCTION

Seismic Design and Analysis of Multi-Storey Building Using Etabs and CSI Safe Software Play a Critical Role Ensuring the Structural Integrity and Safety of Structures Located in Different Seismic Zones. In This Comparative Analysis, We Will Design and Analysis of Building and Its Foundation in Seismic **Zone ii** and **Zone v** of INDIA, Using **ETABS** And **CSI SAFE** Software. CSI SAFE Is Widely Use for Foundation Design and Analysis, Provides Engineers with Powerful Tools for Modelling, Analysing and Designing Buildings Subjected to Seismic Forces. The Use of CSI SAFE Software in Both Seismic, **Zone ii** and Seismic **Zone v**. Allows Engineers to Conduct Comprehensive Structural Analysis and Design,

Considering Factors Such as Seismic Load Combinations, Material Property and Geometric Constraints. CSI SAFE Provides the Necessary Tools for Modelling, Analysing and Designing of Foundation, Their Performance Under Seismic Loads and Ensuring Compliance with Local Building and Regulations Specific to Each Seismic Zones.

The comparative analysis will delve into specifics of using CSI SAFE software to design reinforced concrete slabs and foundations in Seismic **Zone II** and Seismic **Zone V**, highlighting the software's capabilities.

1.1 EARTHQUAKE

Earthquake Can Be Understood as Earth-Surface Shaking Because Of Energy Which Is Suddenly Released by Reason of Earth's Movement. This Earth's Movement Is Consequence of Plates Are Termed as Tectonic-Plates. The Crust of the Earth Is Surrounded by Large-Number of Very Big Size Bodies Called Tectonic-Plates, They Are Constantly Under Motion with Respect To One Another, Due to Their Unexpected Collision With One Another-Leading to Release of Energy Which Travels Towards the Earth -Surface in the Form of Waves.

1.2 DIFFERENT SEISMIC ZONES IN INDIA

Indian Plate Is Responsible for Earthquakes of High Intensities and Frequency Reading Indian Subcontinent to Catastrophic Earthquakes Around 53% Indian Land Mass Is Vulnerable to Earthquakes, Based on Indian Geographical Statistics. According To Estimations Based on Report of World Bank and United Nations, around 200 million Indian Population to Be Affected from Storms and Earthquakes Around 2050. According To Latest Design Practice Code (Is: 1893: Part-1:2016), India Is Divided into 4 Zones Based on Seismicity Observed of Indian Land Mask This Zones Are Namely Zone II, III, Iv, V Which Covers Entire Country. Before The Present Code This Divisions of Zones Is of S To 6 Types for Entire Country Which Is Now Reduce Two Only Four Ranging Between Zone V To Zone II Associated with Highest to Lowest Seismicity Respectively.

- **Zone II: -**

This Zone Attracts Less Intensities of Earthquakes and Classified Under Low Damage Risk Zone, As Per Is Code Assigned Factor Of 0.10 As Only 10% Of Gravitational

Acceleration Is Experienced by Structure as Maximum Horizontal Acceleration.

- **Zone III: -**

This Zone Classified as Moderate Damage Risk Zone with Factor Of 0.16 As Per Is Code. Regions Included Are Some Parts of Himalayas and Kashmir, Andaman and Nicobar.

- **Zone IV: -**

This Zone Attributed with High-Risk Damage with Factor Of 0.24 As Per Is Code. The Zone Income Passes Gangetic Plains, National Capital Delhi, State of Jammu and Kashmir, Faltan Area of Maharashtra, Northern Regions of Bihar and Border of Nepal and India.

- **Zone V: -**

This Zones Attracts Earthquake of High Intensity with Highest Risk Involved Attributed with Very High-Risk Damaged. Zone Factor Indicates Effective Level of Earthquake I.E. For Zero Period Which Is Used for Designing of Earthquakes Resistance Structures by Structural Engineers. Earthquake Prone Areas Generally Consists of Trap and Basalt Rocks, Regions Under This Zones Are Kashmir and Himalayan Regions, North East States, Northern Areas of Bihar and Region of Gujrat State Mainly Kutch.

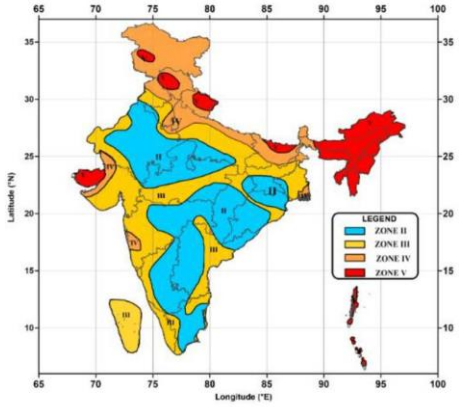
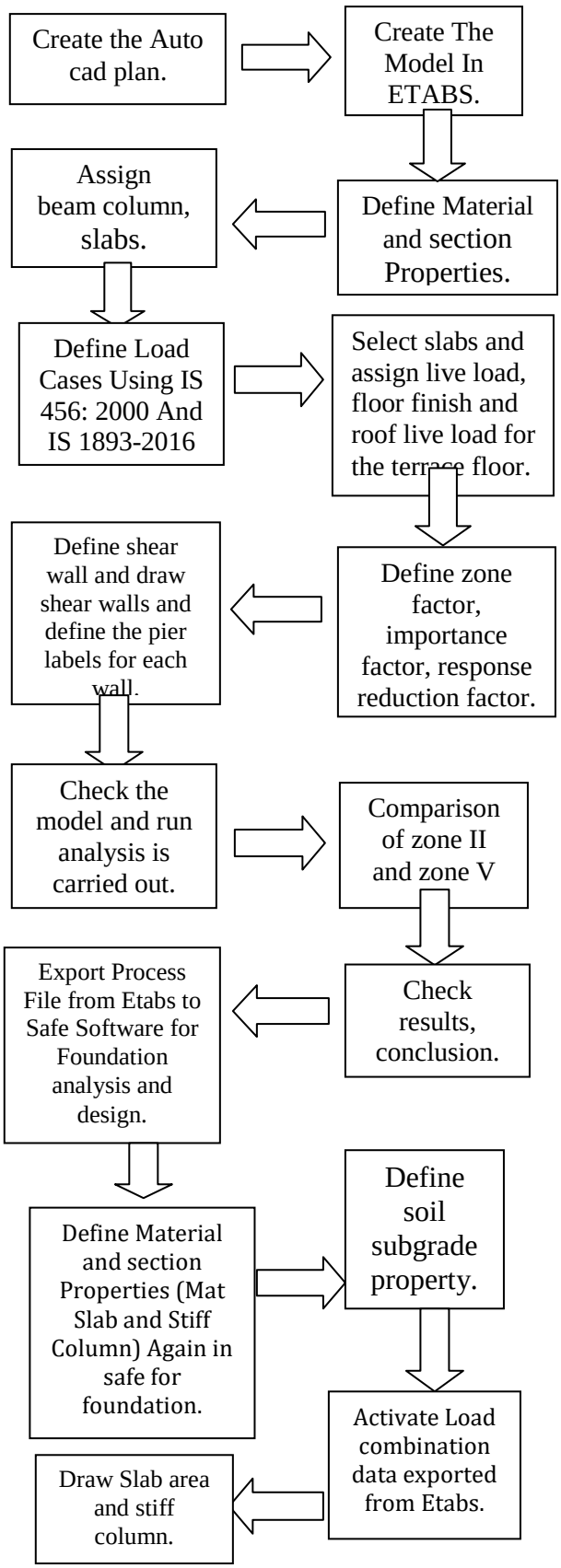
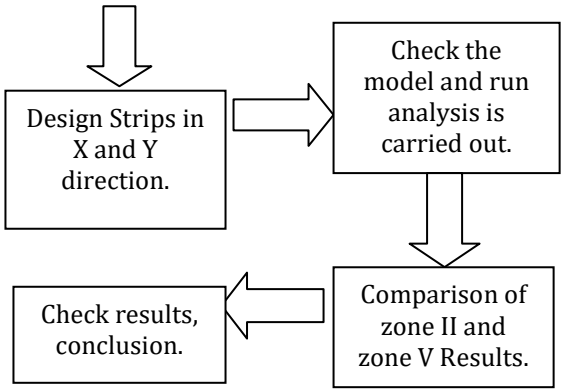


Fig 2: - Seismic zones in India

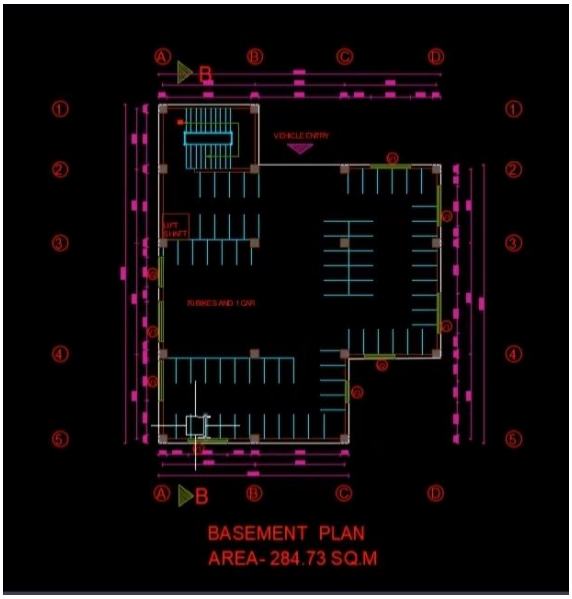
3. METHODOLOGY





4. SPECIFICATION OF BUILDING.

4.1 DEVELOPMENT OF PLAN IN AUTOCAD.



4.2 BUILDING PROPERTIES

PARTICULARS	VALUES
Types of building	Public
Height of Structure (M)	30 M
Number of Stories	G+8
Height of each floor in (M)	3.6 M
Grade of Concrete Used	M25
Steel Grade Used	HYSD 500
Beam Dimension (mm)	300×400, 600×800
Column Dimension (mm)	500×500, 800×800
Concrete Density	24 KN/M
Density of Steel	78.5 KN/M
Type of Soil	Medium
Seismic Zone Factor	0.10,0.36
Shear Wall Thickness (mm)	200
Slab Thickness (mm)	125,175

5. MODEL GENERATES IN ETABS AND SAFE.

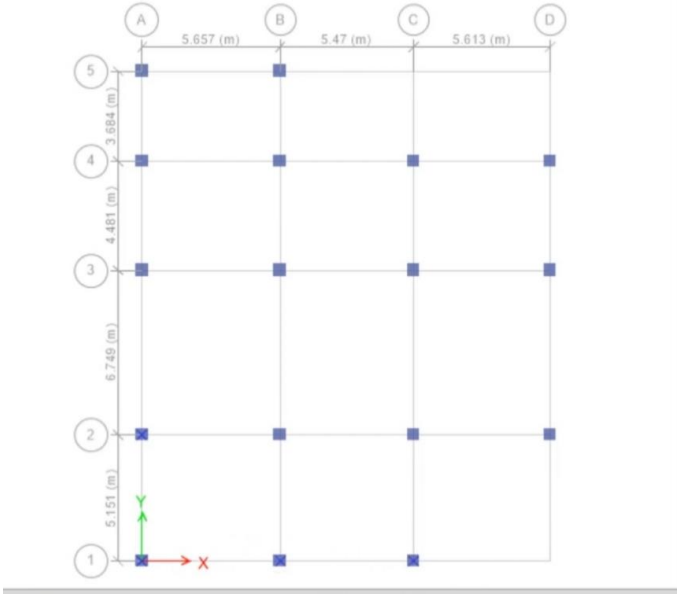


Fig 3: - Centre line diagram.

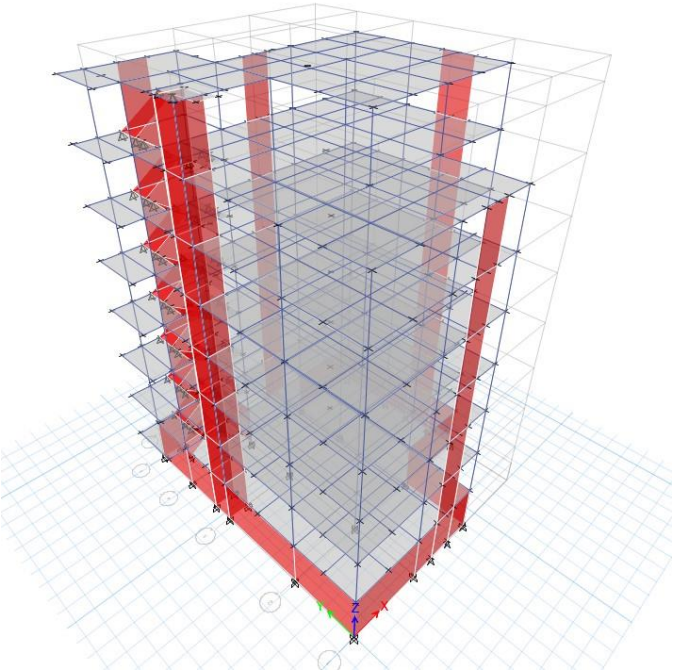


Fig 4: - Model Of Structure.

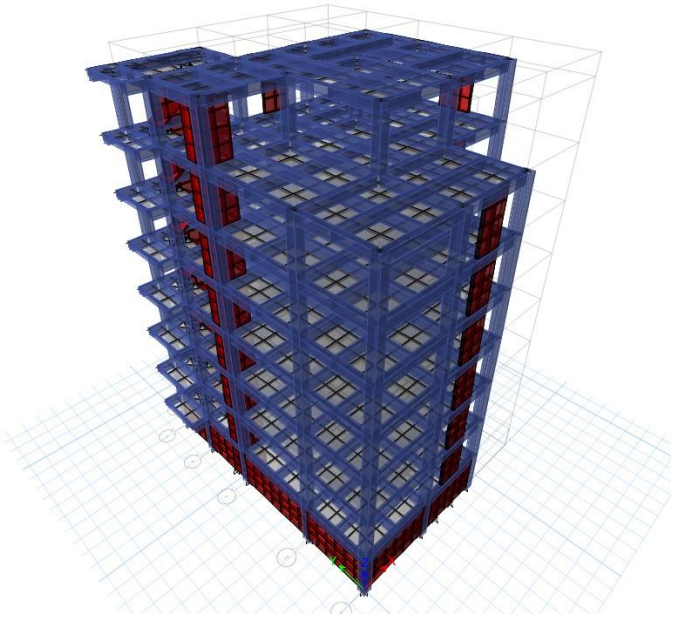


Fig 5: - rendering view of structure

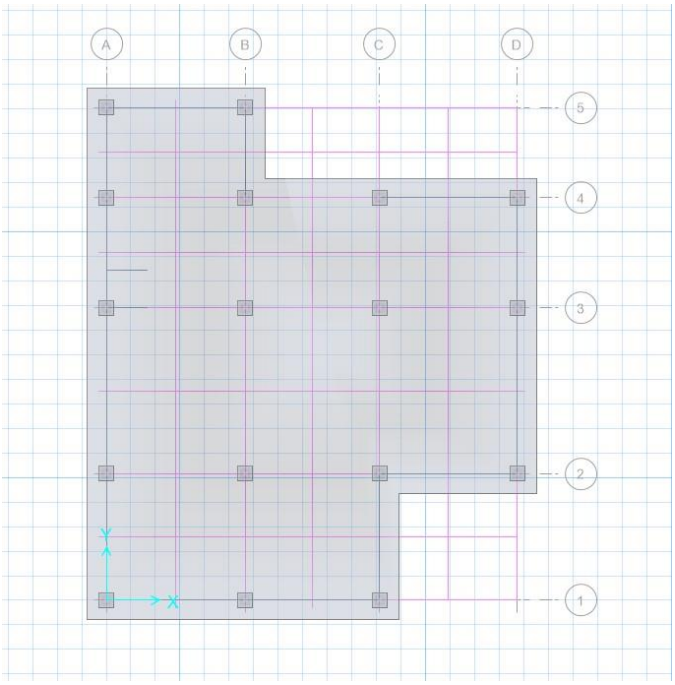


Fig 6: - Foundation Diagram.

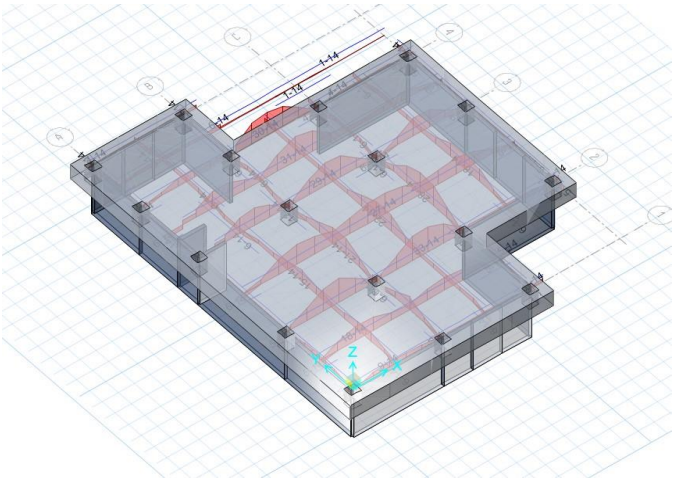


Fig 7: - 3D view Of Foundation.

6. RESULT AND DISCUSSION

➢ **For Zone ll**

Fig 8: - Displacement Graph

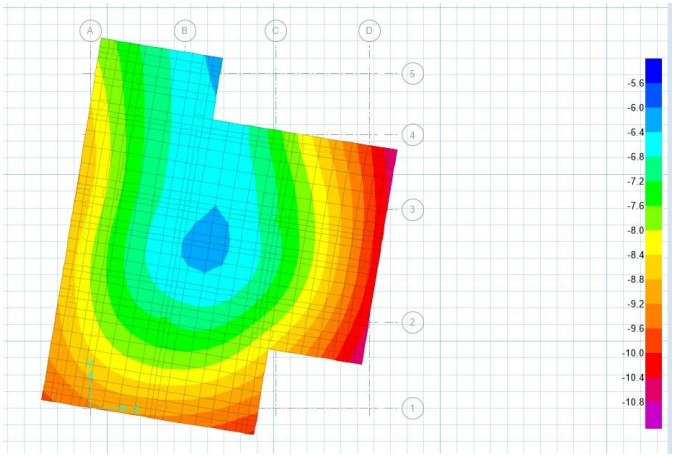
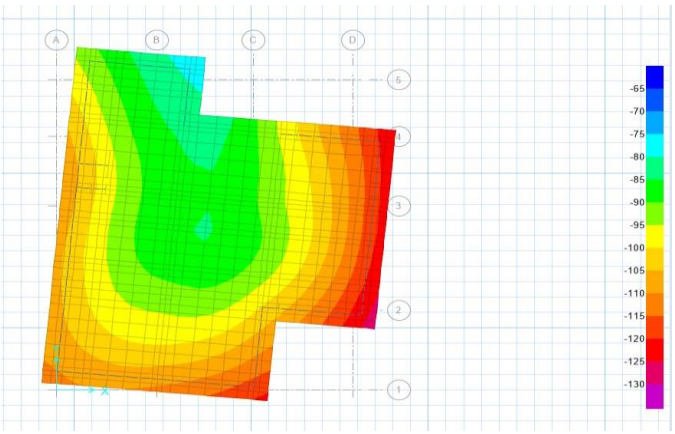


Fig 9: - Soil Pressure Graph



➢ **For Zone v**

Fig 10: - Displacement Graph.

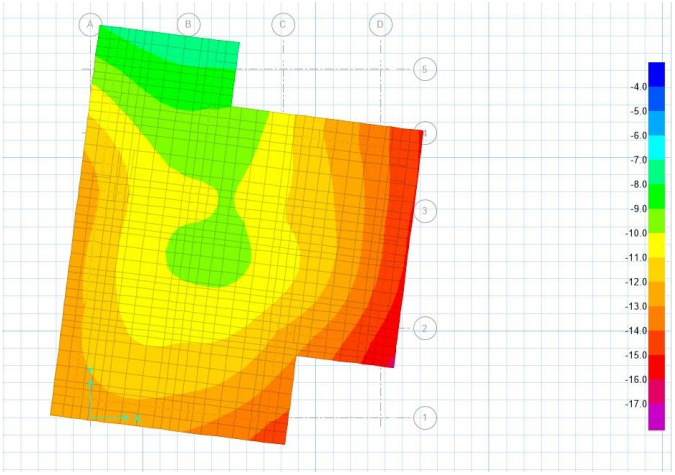
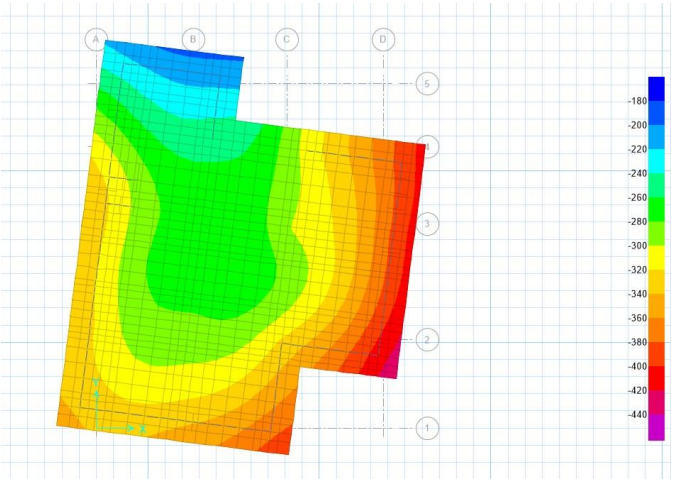


Fig 11: - Soil Pressure Graph.



Foundation	ZONE II	ZONE V
Settlement	10.8mm	17mm
SBC of Soil. (Taken)	250KN/M²	450KN/M²
Soil Pressure	130 KN/M²	440KN/M²

Permissible Limits: -

1) Settlement: - 50 mm for service condition as per IS Code 456:2000

2) SBC of Soil is 250 KN/M² for Zone II and 450 KN/M² for Zone V we Taken. According to Geotechnical Conditions.

➢ **ZONE II vs ZONE V**

Zone II: -

Building Details	Description
Building Type	G+8 Storey
Floor Height	3.6 m
Analysis Type	Displacement and Soil Pressure.
Displacement Range	-5.6 mm to -10.8 mm
Soil Pressure Range	-65 KN/M² TO 130 KN/M²
Foundation type	Raft Foundation.
Maximum Displacement Location	Center of the structure (blue region)
Minimum Displacement Location	Outer edges (red region)
Maximum Pressure Location	Outer Edges (Red Region.)
Minimum Pressure Location	Central Region (Green/Blue)
Structural Grid	Labelled A to D and numbered 1 to 5
Contour Colour Representation	Blue (Least displacement) to Red (Highest displacement)
Possible Cause of Displacement	Structural load, seismic activity, or wind force
Software Used.	ETABS, SAFE

Zone V: -

Building Details	Description
Building Type	G+8 Storey
Floor Height	3.6 m
Analysis Type	Displacement and Soil Pressure.
Displacement Range	-4 mm to -17 mm
Soil Pressure Range	-180 KN/M² to -440 KN/M²
Foundation type	Raft Foundation.
Maximum Displacement Location	Center of the structure (blue region)
Minimum Displacement Location	Outer edges (red region)
Maximum Pressure Location	Outer Edges (Red Region.)
Minimum Pressure Location	Outer Edges (Red Region.)
Structural Grid	Labelled A to D and numbered 1 to 5
Contour Colour Representation	Blue (Least displacement) to Red (Highest displacement)
Possible Cause of Displacement	Structural load, seismic activity, or wind force
Software Used.	ETABS, SAFE

CONCLUSION: -

- In the present work, we addressed the limitations of foundation of multi storey building using Mat/Raft Foundation, the load sharing of raft results in gradual reduction of soil settlement by large amount of area cover by raft foundation.
- By analysing multi-storey residential building foundation Using SAFE software we conclude that:
- Analysis done by SAFE is very efficient and user friendly.
- Software is developed for the analysis of raft using finite difference method, estimation of stiffness for soil.
- Mat or raft foundations are adopted primarily to distribute loads from a structure over a larger area, making them suitable for weak or compressible soils and heavy buildings, preventing excessive settlement and potential structural issues.
- When You move to lower Seismic zones to Higher seismic zones, like in our case, Zone II to Zone V.
- You need to Increase the Dimensions of Column, Beam, Slab Thickness and Bearing Capacity of soil (SBC) for Extreme Conditions, to achieve better stability, control and Safety.
- We have reduced the Settlement and Soil bearing pressure within the permissible limit as per given in IS CODE 1904:1986 and Geo- technical consideration respectively.

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7. BIOGRAPIES

Shubhra Dhamande
(Asst. Professor, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India)

Aniket Patale
(B.E Student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India)

Ramzan Shaikh
(B.E Student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India)

Rehan Shaikh
(B.E Student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Maharashtra, India)