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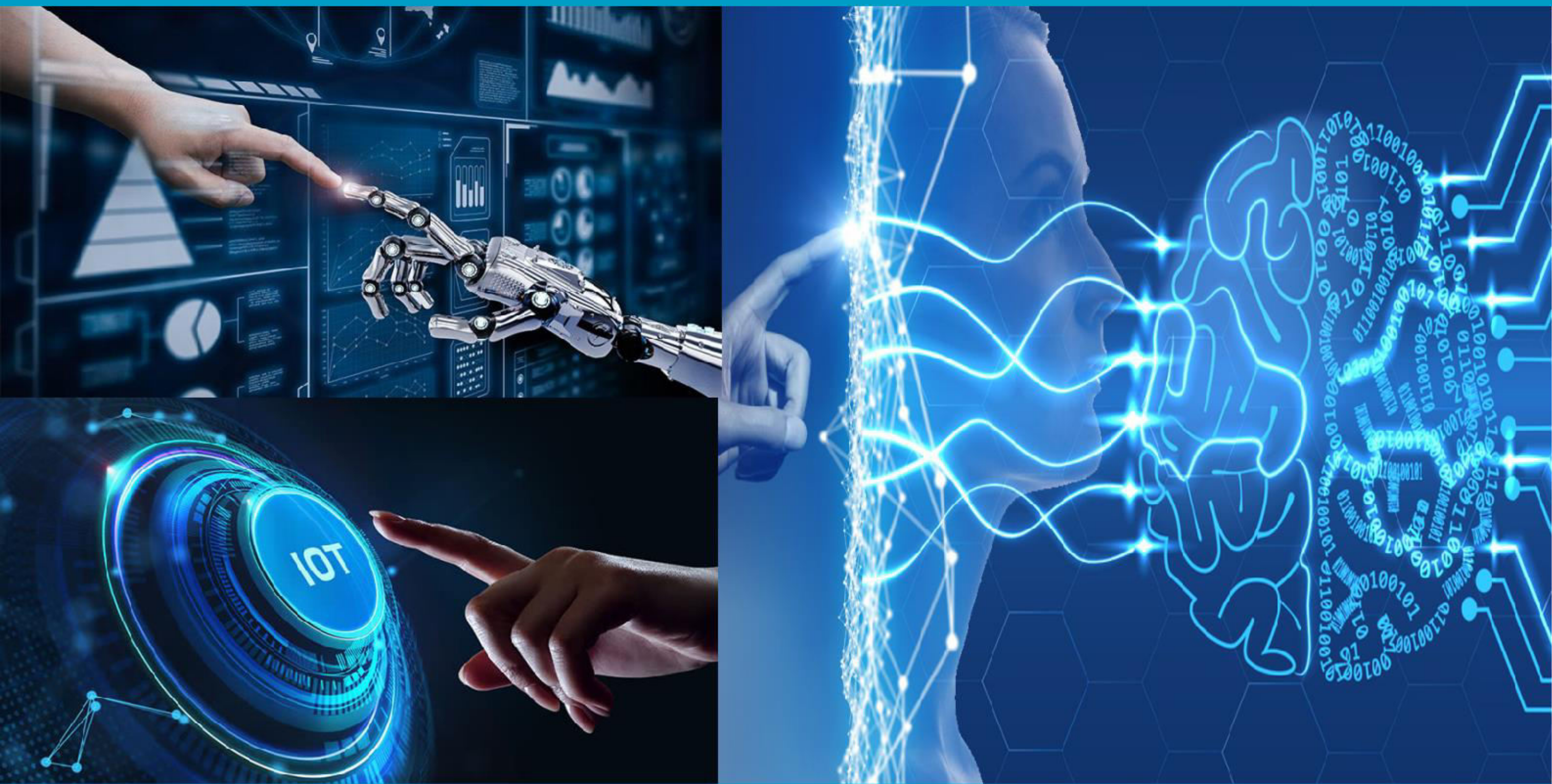

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A Review Study of Structural Behavior in Seismic Prone Area III and IV

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ABSTRACT: This analysis compares the behavior of an identical structure located in Seismic Prone Area III and IV. The study focuses on various aspects, including drifts, bending moments, shear forces, steel utilization, and column behavior. The findings highlight the significant differences between the two seismic zones. In Seismic Zone IV, the maximum drifts of columns towards the top of the structure were contrasting, indicating a higher degree of lateral displacement compared to Seismic Zone III. The bending moments in Seismic Zone IV were observed to be over 1.5 times higher than those in Seismic Zone III, indicating a higher structural demand in Zone IV. The shear forces on beams and columns were also significantly higher in Seismic Zone IV compared to Zone III, reflecting the increased seismic activity in the area. Furthermore, the percentage of steel utilized in the columns and beams was found to be greater in Seismic Zone IV, indicating the need for enhanced structural strength and ductility to withstand the higher seismic forces in this zone. The analysis also suggested differences in the swaying or deflection behavior of columns, potentially affecting the communication between P-M-M columns. These findings underscore the importance of tailoring seismic design practices to the specific characteristics of each seismic zone. Structures in Seismic Zone IV require additional considerations and design measures to ensure their stability and safety during earthquakes. Proper adherence to design codes, consultation with qualified structural engineers, and comprehensive analyses are essential to effectively address the challenges posed by seismic activity and promote the resilience of structures in high-risk areas.

KEYWORDS: Seismic Prone Area, drifts, bending moments, shear forces, steel utilization, column behavior

I. INTRODUCTION

The structure has been designed to resist all types of forces, including those caused by lateral movements and gravity. To ensure economic efficiency, the design must account for factors such as earthquakes and high winds, which generate lateral forces that create bending moments at the structure's base.

In addition to lateral forces, the structure is also subject to gravitational forces resulting from its own weight, as well as any dead or live loads it may carry. To withstand these forces, the structure must be appropriately sized, reinforced, and proportioned, with an optimal beam to depth ratio.

In summary, the design of the structure must consider a variety of factors to ensure its strength and stability, including resistance to lateral and gravitational forces, ideal member sizes, appropriate reinforcement, and optimal proportions.

Objectives Of the Study

The following are some of the goals that the research intends to accomplish:
The purpose of this study is to investigate the seismic behavior of a reinforced concrete building by means of response spectrum analysis.
In this study, the researchers compared Seismic Prone Area III and IV to one another in terms of bending moment and shear force.
It's important to evaluate the various models' findings across numerous parameters (such as Storey drift and Storey forces, or the proportion of steel that migrated from zone III to zone IV).
To get the most efficient and cost-effective setup feasible under the given conditions.

Scope of Present Study

With the assistance of the Indian seismic code IS 1893-2016 and the SAP2000 v23.1.10 software, the purpose of this study was to conduct an analysis of a G+7 reinforced concrete building located in India's Seismic Prone Area III and IV with the intention of determining the reinforcement percentage, maximum deflection, shear force, and bending moment variations. The structure will be analyzed using the Indian seismic code, and these parameters will be determined using that code.

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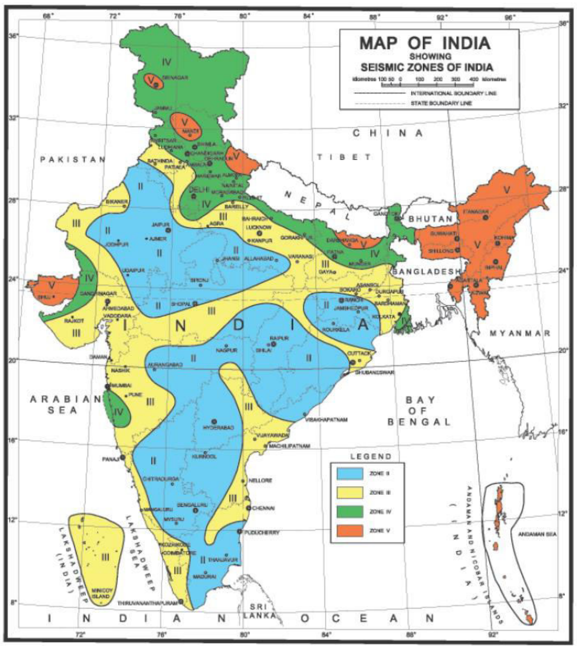
IS 1893 (Part 1) : 2016



Based upon Survey of India Political map printed in 2002.

Methodology

- A model and analysis of a G+7 reinforced concrete building located in seismic zone III in India were carried out.
- The modelling and analysis of a structure that is similar to others that are situated inside the Indian seismic zone 4 are components of this research.
- Modelling and analysis of the same structural element are both accomplished via the use of the method known as response spectrum analysis.
- A comparison of the results obtained by using the aforementioned models, including the amount of steel that was used, the amount of time that passed, the amount of storey displacement, and the amount of storey drift, as well as the identification of the method that is the most effective.

II. LITERATURE REVIEW

As a means of gathering information for the purpose of carrying out the survey, a variety of relevant books and journal articles that dealt with the response spectrum analysis of RC structures were consulted. The many different pieces of literature that were compiled are discussed in this section in a concise manner.

Review of Past Work

In 2017, Akash Panchal and Ravi Dwivedi worked together to undertake research on G+6 buildings in India by analysing and designing them in a number of different seismic zones. They carried out the research with the help of the STAAD Pro programme, and then they discussed the results with coworkers hailing from different regions of India. They noticed an increase in the percentage of steel in the environment as they moved from zone II to zone V.

Papa Rao & Kiran Kumar (2013) In addition, it was discovered that the amount of steel and the volume of concrete varied in various Seismic Prone Area across India.

III. SEISMIC ANALYSIS

In order to create a building that is risk-free and economical, it is necessary to conduct a seismic analysis and take into consideration the lateral forces that will be placed on the structure by the seismic zone in which it will be located.

Types of Analysis

The procedures for structural analysis may be arranged into the five categories that are shown in the following paragraphs.

i) Equivalent Static Analysis

ii) The Analysis of the Response Spectrum

Analysis of Nonlinear Static Data (version v). A kind of dynamic analysis known as nonlinear dynamic analysis is one that does not follow a linear progression of events.

The approach of Response Spectrum Analysis is used in the performance of this G+7 RC construction..

Modelling and Analysis

To discover how internal forces and moments are distributed across the whole of the structure or across a segment of the structure is one of the primary goals of structural analysis when it comes to the construction of structures. Another purpose of structural analysis is to find the primary design conditions at each and every point in the structure. This leads to an idealised representation of the geometry. The SAP2000 software, version 23.1.0, is used in the process of doing the response spectrum analysis of the models.

SAP2000 v23.1.0

Using a three-dimensional model and the structural design program SAP2000 v23.1.0, the structural calculation is performed in line with the global approach of analysis used for computing internal member forces and moments. This verifies that internal member forces and moments are calculated using the same global approach of analysis as the structural calculation.

This software takes use of a method of analysis known as the elastic approach, which may be applied to any circumstance. In order to develop the software, we employ methods such as matrix computing and finite element analysis in combination with the traditional linear elasticity hypothesis.

- There is a direct correlation between the amount of stress and the degree of deformation.
- The conformity of the constituent pieces of the structure.
- The global and local components of the structure must be in static equilibrium with one another.

The following sections will offer an explanation of the many different kinds of objects that are used in the computing model:

Frame element:

Every frame element may make use of its own unique set of local coordinates, which are stored in its own memory. The numerals 1, 2, and 3, in descending order, have been assigned to the three axes of this local system. In this particular instance, the local axis 1 traverses the whole length of the frame. By default, axis 2 is located in the 1-Z plane at all times. The only time this is not the case is when the frame is vertical, in which case it is aligned perpendicular to the global X axis. Right-handedness is the rule that is followed while establishing the local axes, therefore this is how it is done.

The internal forces of the frame are as follows:

The symbol for the axial force is "P."

- The applied shear force, V2, acts in the 1-2 plane.
- V3 represents the shear force acting in the 1-3 plane.
- T, which stands for "axial torque" (1-axis rotational moment of inertia);
- Moment of inertia M1 is the moment of inertia around the 2-axis; M2 is the bending moment in the plane 1-3;
- M3 is the bending moment around the y-axis that happens in the 1-2 plane;

As seen in the illustration below, the symbol convention for frame internal forces follows a logical progression.

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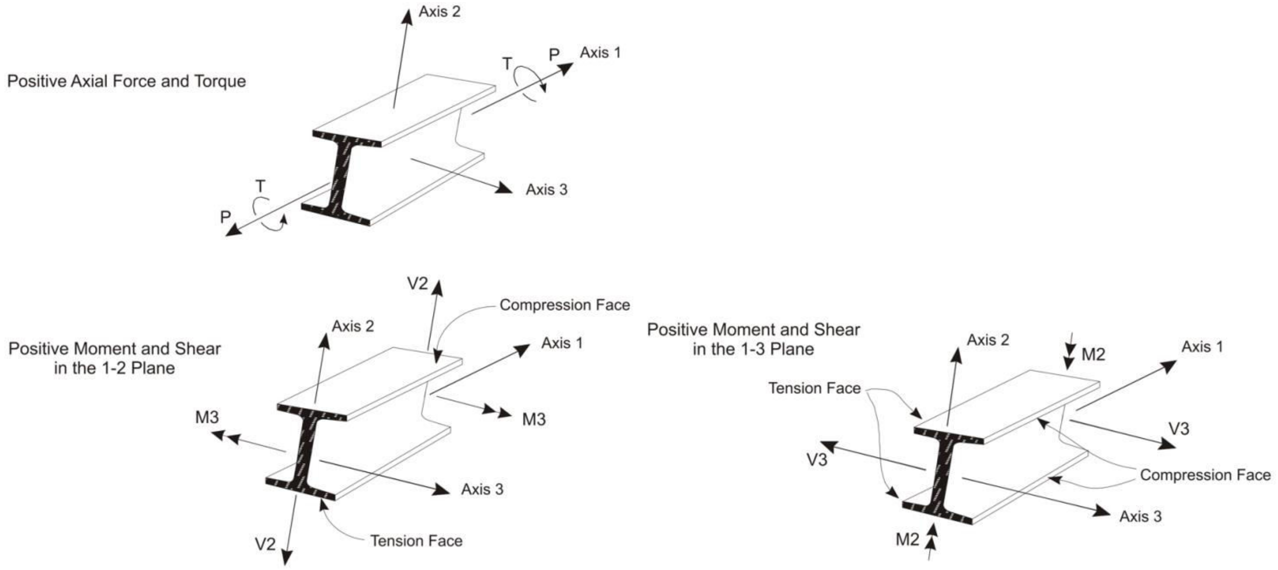

Fig. 1: Frame Element Internal Forces and Moments

Shell element

The foundation slab and the walls are both represented in the model by shell components, and these components are discretized. The following is a list of components of the shell that were used in the computing model, along with detailed descriptions of each one:

There are six degrees of freedom available at each node that makes up the shell element, and there are a total of four nodes that make up the shell element. Each node in the shell element has four degrees of freedom, allowing it to combine the different actions of the membrane and plate-bending elements: In addition to rotational stiffness components of the plate in both directions, out of plane, there is also a translational stiffness component that impacts plate bending behaviour in the direction that is normal to the plane of the element. The thick-plate formulation (which was used in this scenario for each of the floor slabs) takes into account the consequences of transverse shearing deformation. It is anticipated that the nodes will exhibit a high degree of rigidity in order to preserve compatibility with the existing deformation compatibility.

This is done so that the shell element can be properly understood.

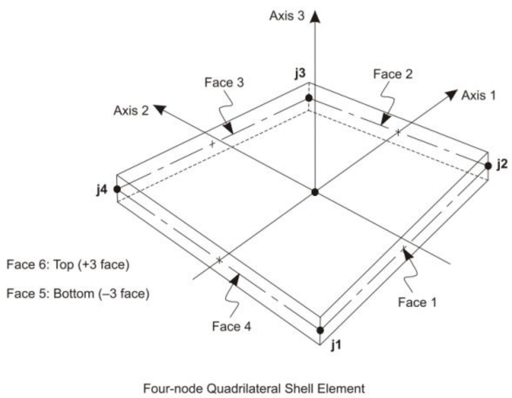

Fig. 2: Shell element local coordinate system

The figure that follows demonstrates the positive directions that the internal forces take for the shell element F11, F22, F12, V13, and V23. These directions are illustrated in the diagram.

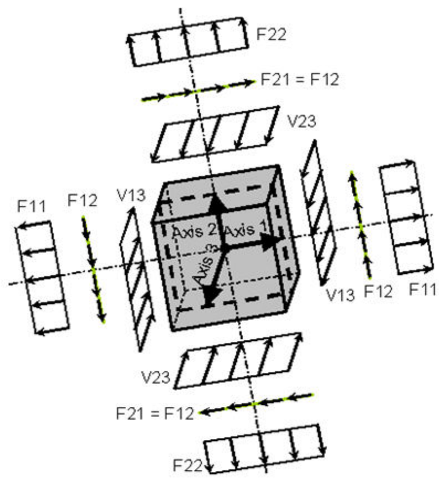

Fig. 3: Shell element internal forces

The figure below illustrates the direction in which the positive direction of the principal moments of the shell element M11, M22, and M12 should be read. These element internal moments should not be confused with moments per unit length working on the whole element.

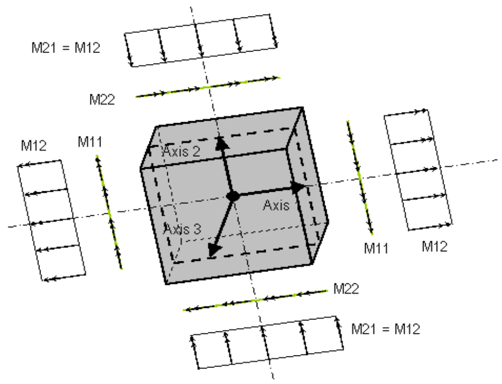

Fig. 4: Shell element internal moments

All of the calculations that are given in this part made use of a finite element model. The following is a list of the correspondences that exist between the local axes of the shell slab element and the global axes of the model:

- Local axis “1” ≡ Global axis “x”
- Local axis “2” ≡ Global axis “y”
- Local axis “3” ≡ Global axis “z”: Vertical, with positive direction upwards

IV. CONCLUSIONS

In conclusion, the analysis of an identical structure in Seismic Prone Area III and IV has revealed significant differences in various aspects. The maximum drifts of columns towards the top of the structure were found to be contrasting in Seismic Prone Area III and IV. Moreover, the bending moments in Seismic Zone IV were observed to be over 1.5 times higher than those in Seismic Zone III. Additionally, the shear forces on beams and columns were higher in Seismic Zone IV compared to Seismic Zone III. The percentage of steel utilized in the columns and beams was also found to be greater in Seismic Zone IV. The swaying or deflection of columns, as a symbol for communication between P-M-M columns, was suggested to differ between the two seismic zones.

These findings indicate the significant influence of seismic activity and ground shaking on the structural behavior and response. Structures located in Seismic Zone IV experience higher seismic forces and require additional design considerations to ensure their stability and safety during earthquakes. The differences observed in drifts, bending moments, shear forces, steel utilization, and column behavior emphasize the importance of tailoring seismic design approaches to the specific characteristics of each seismic zone.

It is crucial to consult the relevant design codes, work with qualified structural engineers, and conduct comprehensive analyses to ensure structures are appropriately designed and meet the seismic requirements of the specific Seismic Prone Area in which they are located. By considering these factors, structures can be designed to withstand the potential hazards associated with seismic activity, promoting the safety and resilience of buildings in high-risk areas.

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