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DESIGN OF EARTHQUAKE RESISTING STRUCTURE BY RESPONSE SPECTRA METHOD

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ABSTRACT

Earthquakes are one of the greatest hazards to life and infrastructure on the earth. In past history we have observed some of the greatest earthquakes on the earth as well as in the water surface level. In this report I have briefly explained the factors and effects of earthquakes. I also discussed the behavior of high rise buildings under seismic condition. In this report I have taken a case study of G+4 RC building and studied its behavior under seismic loads using **IS: 1893-2002.** The building under consideration is in Hyderabad which comes under Earthquake Zone II as per IS: 1893-2002. The analysis of the RC structure has been performed using **STAADPro**software. The stability of structure in terms of lateral deflection has been checked for earthquake loads.

KEYWORDS:Earthquakes, seismic condition

INTRODUCTION

Earthquake is a spasm of ground shaking caused by a sudden release of energy in the earth's lithosphere (i.e., the crust plus a part of the upper mantle). This energy arises mainly from stresses built up during tectonic processes, which consists of interaction between the crust and the interior of the earth. In some parts of the world earthquakes are associated with volcanic activity.Earthquake is a sudden release of accumulated strain energy within a limited rock mass underneath, where the rock of irregular shape and huge dimensions ruptures. The location above the focus is known as 'epicenter' and the distance from epicenter to any point of interest is called 'epicenter distance' as shown in (fig. 1). A number of smaller size earthquakes take place before and after a big earthquake (i.e., the main shock). Those occurring before the big one are called fore shocks, and the ones occurring after are called after shock.

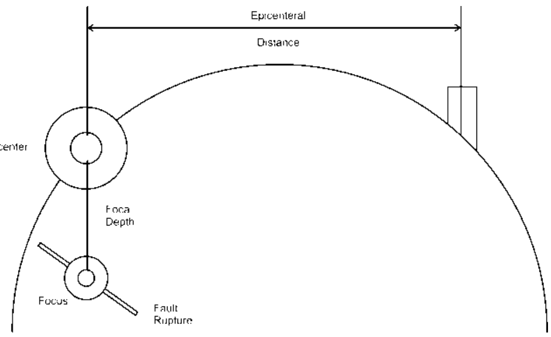

Fig 1 Graphical representation of occurrence of earthquake Classification of earthquakes based on their focus

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Type	Depth
Deep focus earthquakes	Exceeding 300 km
Intermediate focus earthquake	Between 55 – 300 km
Shallow focus earthquake	Less than 55 km

METHODS

Response Spectrum Method

This code of practice recommends only one method of design the response acceleration is obtained for the natural period and damping of the structure and the design value of horizontal seismic coefficient is computed using the following expression.

$$A_h = \left(\frac{Z}{2}\right)\left(\frac{S_a}{g}\right)\left(\frac{I}{R}\right)$$

Where,

A_h = Average Horizontal Acceleration

Z = Zone factor.

$\left(\frac{S_a}{g}\right)$ = Average response Acceleration co-efficient for soil (see Fig 1.2)

I = Importance Factor

R = Response Reduction Factor

There are only four zones according to the revised code.
They are Zone II, Zone III, Zone IV, and Zone V
The values of Zone factors 'Z' are as follows:
Zone II 0.10
Zone III 0.16
Zone IV 0.24
Zone V 0.36

Base Shear is given by the following formula.

$V_B = A_h \times W$, Where, $A_h = \left(\frac{Z}{2}\right)\left(\frac{S_a}{g}\right)\left(\frac{I}{R}\right)$

W = Seismic weight of structure

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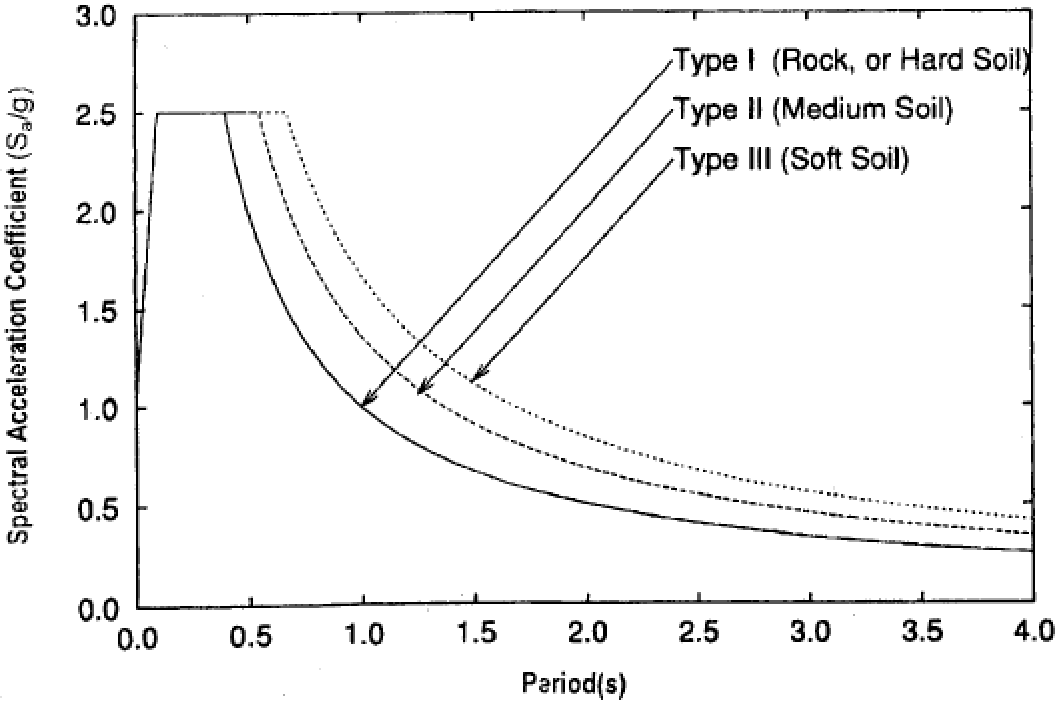

Fig 1 Response Spectra for Rock and Soil Sites for 5 Percent Damping

Design Live Loads for seismic Weight Calculations
For various loading classes as specified in IS: 1893-2002, the horizontal Earthquake force shall be calculated for the full dead load and the percentage of live loads as given below:

Load Class	**Percentage of Design**
Up to & including 3.0 kN/m^2	25
More than 3.0 kN/m^2	50

For calculating the earthquake force on roofs, the live load may not be considered.

CONCLUSION

Earthquake is one of the greatest hazards to life and property on earth. The nature's most awesome and destructive forces shake the morale of people. Amongst all natural disasters earthquakes are feared most as it may occur at any hour of the day during the entire year. Some of the previous earthquakes i.e. Japan earthquake, Indonesia, Bhuj earthquake, tsunamis caused by earthquakes in Indian Oceans are the recent examples of such devastations. Geological and geo-technical investigations play a very pivotal role in assessing the strength of the soil underlying the structure.It is not possible and economical to design and construct earthquake proof building structures particularly to withstand very severe earthquakes of magnitude above 8.0, but it is possible to design and construct earthquake resistant buildings, though they may suffer minor damages which is repairable.In the present study, we studied and performed seismic analysis and design of multi-storied buildings. Following points have been observed in the study.

1. Orientation of structural elements plays an important role in minimizing the damage to the structure. This has been studied by analyzing the structure by changing the column orientations to different directions. The columns should be oriented in such a way so that the stiffness is equal in both orthogonal directions.
2. Study of weak beam-strong column and strong beam-week column has also been studied and found that first case is more stable. The calculated deflections are less in first case than in second case.
3. Dead Load and Live Load is calculated using IS: 875.
4. Earthquake Loads are calculated in the form of base shear and storey shear using IS: 1893 – 2002. Load combinations are considered from the IS: 875 and IS: 1893.

5. The seismic response spectrum analysis is performed considering medium soil.
6. The structural analysis shows that the vertical and horizontal deflections are within the permissible limits as mentioned in the code. All structural elements i.e. foundations, beams, columns, slabs, stair-case have been designed using IS: 456 and detailing have been done using IS: 13920

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