International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 07 | July -2017 www.irjet.net p-ISSN: 2395-0072

# TO STUDY THE EARTHQUAKE RESISTANT DESIGN OF STRUCTURE

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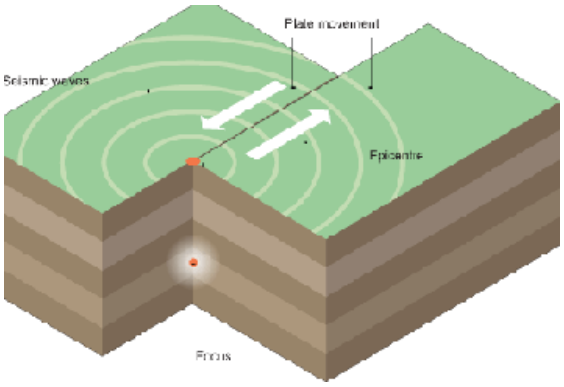
**Abstract:** *The scientific study of earthquakes and the propagation of seismic wave, the waves generated from the energy caused by the sudden breaking of rocks within the earth or an explosion that moves through and around the earth is known as seismology. Earthquakes occur when two tectonic plates move suddenly against each other. The rocks usually break underground and due to this breaking of rocks the earth shakes resulting in an earthquake. Designing of such buildings which can withstand earthquake is called as earthquake resistant designing of the structure and the building thus constructed is known as the earthquake resistant structure. The present paper deals with the advantages and the future trends in earthquake resistant design of the structures.*

## INTRODUCTION

The violent vibration caused by the sudden movement of the tectonic plates in the earth's crust following the release of tremendous amount of heat is known as earthquake. In the diagram shown, the two tectonic plates which are in the earth's crust moves to and fro because of which an epicenter is created on the surface of earth. At this epicenter the intensity of that vibration is the maximum resulting in the release of seismic waves which moves in a way of making concentric circles and the intensity of vibrations gradually decreases.In spite of great advancement in science and technology, earthquake is one natural disaster which cannot be predicted




The design of earthquake resistant structure is an initiative from where many new developments are possible in future. The following are some of the developments which can be made in near future.

(a) A complete probabilistic analysis;
(b) Performance-based design codes;
(c) Multiple annual probabilities for the response of spectral accelerations and peak ground accelerations.

The new structural system and materials are used which reduces the seismic risk. The structure designed to withstand the effect of earthquakes is referred to as earthquake resistant structure. The main objective of earthquake resistant construction of buildings is basically to make structures that are strong enough to withstand earthquake or any other seismic activity.

## EARTHQUAKE PRONE ZONES IN INDIA

Generally, the areas having trap rock or basaltic rock are prone to earthquakes. Basically , our country India has been divided into the following four zones:

### (a) Zone 5

This zone covers the areas with the highest risks that suffers earthquakes of intensity MSK IX or greater.Zone 5 is associated with the highest level of seismicity.It is referred to as the Very High Damage Risk Zone. The region of Kashmir, the western and central Himalayas, North and Middle Bihar, the North-East Indian region and the Rann of Kutch, the Andaman and Nicobar group islands fall in this zone.

### (b) Zone 4

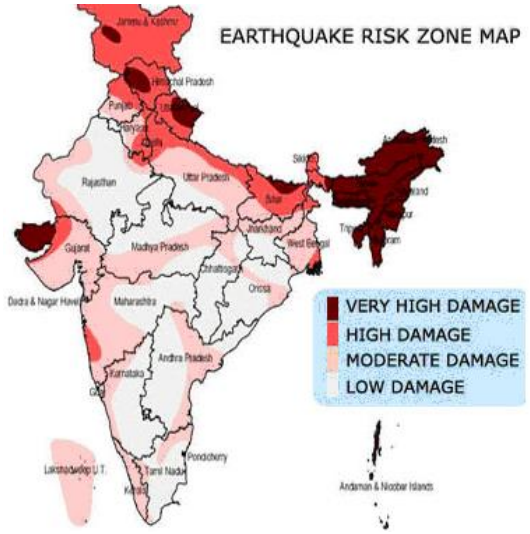
Zone 4 is liable to an intensity of MSK VI to MSK IXIt is referred to as the High Damage Risk Zone. The Indo-Gangetic basin and the capital of the country (Delhi), Jammu and Kashmir fall in Zone 4. In Maharashtra, the Patan area (Koyananager) and in Bihar the northern part of the state like- Raksaul, near the border of India and Nepal, also in zone 4.

### (c) Zone 3

This zone is liable to an intensity of MSK VI. The Andaman and Nicobar Islands, parts of Kashmir, Western Himalayas fallunder this zone. This zone is referred to as Moderate Damage Risk Zone

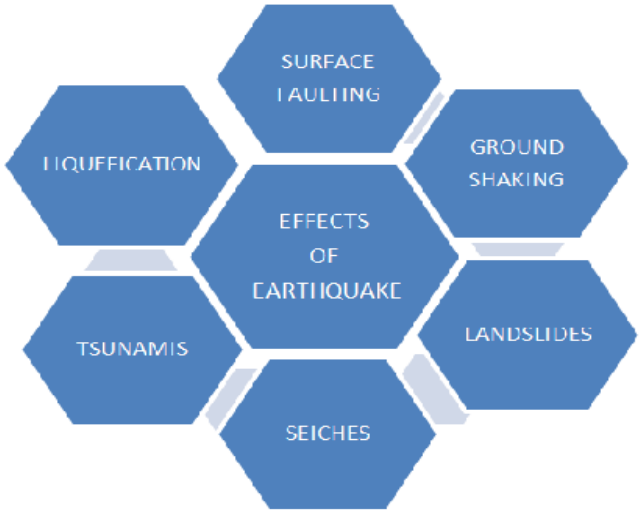
**(d) Zone 2**

This region is liable to MSK VI or less and is referred to as the Low Damage Risk Zone. This zone is associated with the lowest level of seismicity.




**EFFECT OF EARTHQUAKES**

The occurrence of earthquakes is unpredictable and they are characterized by widespread loss of life and damage. Some of the effects of earthquakes have been depicted by the following flowchart:




Broadly seismic effects have been divided into two categories:

(a) Direct effects

- Surface faulting
- Ground shaking
- Liquefaction
- Structural vibration

(b) Indirect effects

These may occur either alone or in combination to add to the damages during an earthquake. The following are some of the seismic effects:

- Tsunamis
- Landslides
- Floods and fires

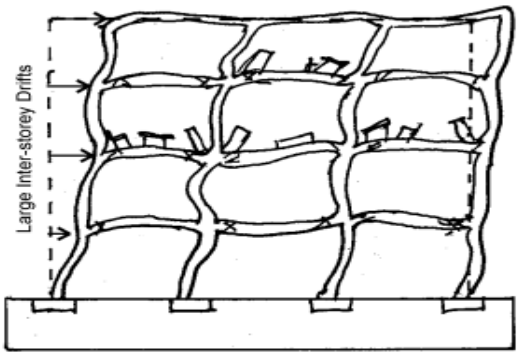
**NEW STRUCTURAL SYSTEMS AND MATERIALS**

A number of new systems and devices has been developed using non-conventional
Civil engineering materials broadly for the following two reasons:

(a) To reduce the earthquake forces acting on a structure
(b) To absorb a part of the seismic energy released during the movement of the tectonic plates .

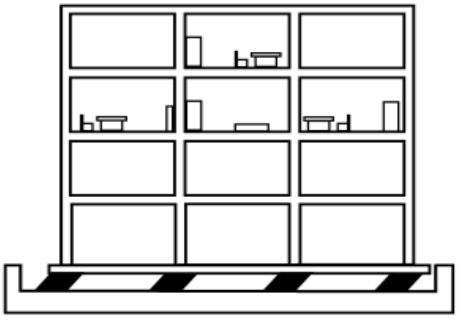
The following new techniques are being developed, evaluated and implemented to make the buildings to withstand the shaking and vibrations caused by earthquake:

(a)Fixed base system



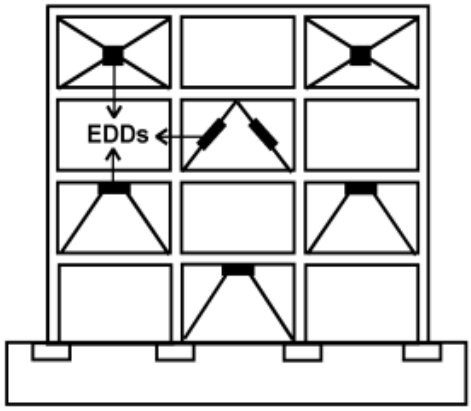

**(a) Fixed-Base Systems**

(b)Seismic isolation system



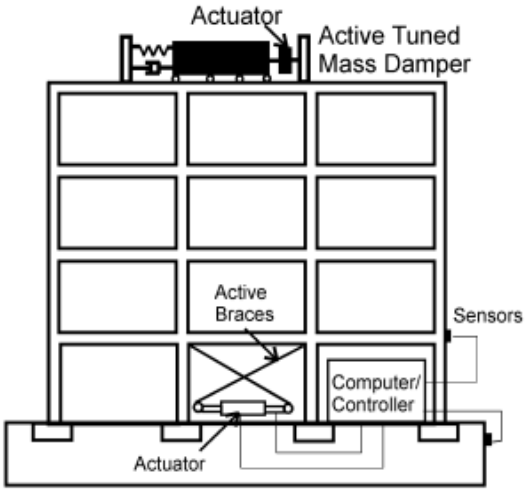
**(b) Seismic Isolation Systems**

(c)Energy dissipation system




**(c) Energy Dissipation Systems**

(d)Active control system




**(d) Active Control Systems**

## CONCLUSIONS

In the coming years, the field of Earthquake Resistant Designing of structures is most likely to witness the most reliable structure which could withstand the effect of earthquake in all kinds of zones.

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