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EARTHQUAKE RESISTING STRUCTURES

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Abstract

Earthquake resistant construction practices are sometimes considered to be a burden on the owners due to increase in cost. This is due to lack of information on cost implication and lack of incentive for good design and detailing. Earthquake proof building should be design so that it do not damage even during rare and strong earthquake, such building will be too robust and expensive. Instead, earthquake resistant buildings are designed to resist the effects of ground shaking, although they may get damaged severely but will not collapse during a strong earthquake. Thus, safety of people and content is assured in earthquake resistant building thereby a disaster is avoided. Proper design considerations and construction techniques should be adopted to build an earthquake resistant building.

Index Terms: *Introduction*
Terminology
Factors causing earthquakes
Impact of earthquake
Design considerations and construction techniques

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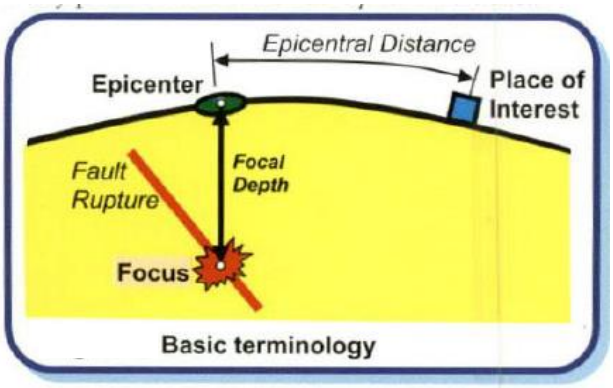
1. INTRODUCTION.

An earthquake is sudden, rapid shaking of the earth cause by the release of the energy stored in the rocks. It is the vibration, sometimes violent to the earth's surface that follows a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of segments of the crust, by a volcanic eruption or even by a manmade explosion. The dislocation of the crust causes most destructive earthquakes. The crust may first bend and then the stresses exceed the strength of rocks, they break. In the process of breaking, vibrations called seismic waves are generated. These waves travel outward from the source of the earthquake along the surface and through the earth at varying speeds depending on the material through which they move. These waves can cause disasters on the earth's surface.

No structure on the planet can be constructed 100% earthquake proof; only its resistance to earthquake can be
increased. Treatment is required to be given depending on the zone in which the particular site is located. Earthquake occurred in the recent past have raised various issues and have forced us to think about the disaster management. It has become essential to think right from planning stage to completion stage of a structure to avoid failure or to minimize the property. Not only this, once the earthquake has occurred and disaster has taken place; how to use the debris to construct economical houses using this waste material without affecting their structural stability.

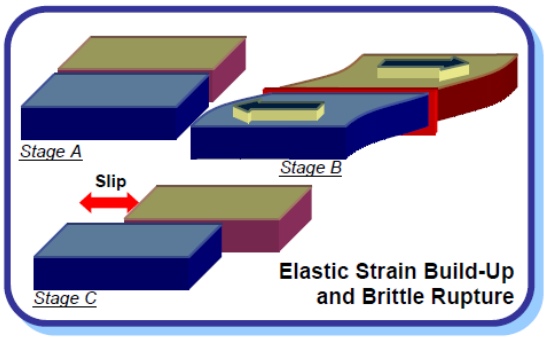
1.1 TERMINOLOGIES.



Focus is the point on the fault where slips starts and the point vertically above this on the surface of earth is the **Epicenter.**

The distance from the epicentre to any point of interest is called **Epicentral distance**. The depth of focus from epicentre is called the **Focal depth**

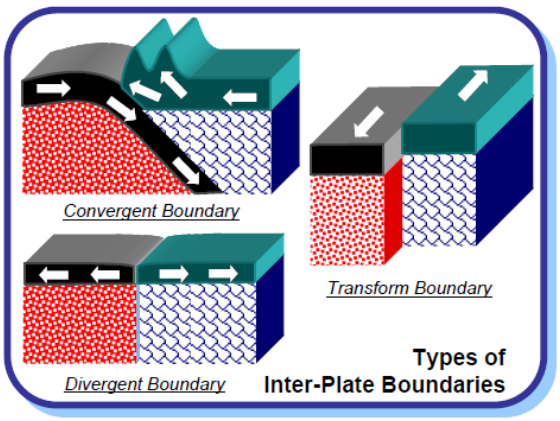
3.FACTORS CAUSING EARTHQUAKE.



Tectonic plates are made of elastic but brittle rocky material. And so, elastic strain energy is stored in them during the relative deformations that occur due to the gigantic tectonic plate actions taking place in the Earth. But, when the rocky material along the interface of the plates in the Earth's Crust reaches its strength, it fractures and a sudden movement takes place there, the interface between the plates where the movement has taken place (called the fault) suddenly slipsand releases the large elastic strain energy stored in the rocks at the interface.

The sudden slip at the fault causes the earthquake a violent shaking of the Earth during which large elastic strain energy released spreads out in the form of seismic waves that travel through the body and along the surface of the Earth. And, after the earthquake is over, the process of strain build-up at this modified interface between the tectonic plates starts all over again .

3.1 TYPES OF INNER PLATE BOUNDARY



The sliding of Earth's mass takes place in pieces called tectonic plates. The plates moves in different direction and at different speeds, from those of neighbouring ones. The three types of inner plates are:

Convergent, Divergent, Transform boundaries.

4. IMPACT OF EARTHQUAKES

A severe earthquake can have very damaging consequences upon a region's development and economy.

It also damages human life. Lifeline facilities likes hospitals, health care centers have a major role in natural catastrophe like earthquake. Hence, additional care while designing such structures is needed.

Table-no. 1 : Some past Earthquakes in India.

Place	Magnitude	Intensity	Death (Year)
Sumatra	9.3	XI	10,823 (2004)
Assam	8.7	XII	1,500 (1897)
Kangra	8.6	X	19,000 (1905)
Assam	8.5	X	1,530 (1950)

4.1. SEISMIC ZONES OF INDIA

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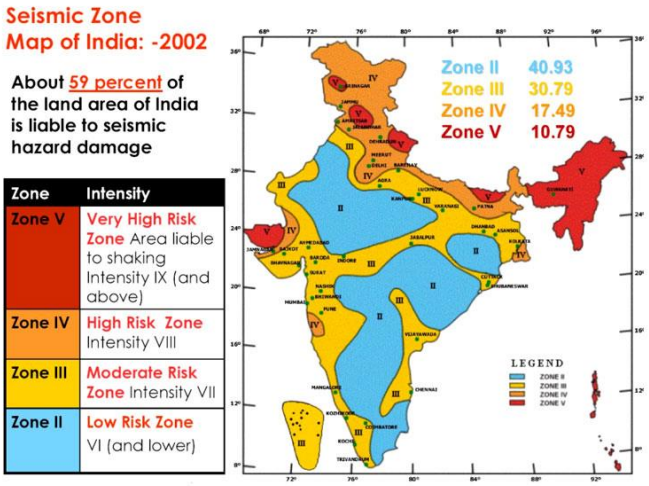

Fig. 1 Seismic zonation and intensity map of India

6. DESIGN CONSIDERATIONS AND CONSTRUCTION TECHNIQUES.

An earthquake resisting building has four virtues:

a) Good structural configuration : It's size, shapes and structural system carrying load are such that they ensure direct and smooth flow of inertia forces to the ground.
b) Guranteed lateral strength: The maximum lateral that is horizontal force that it can resist is such that the damage induce in it does not result in collapse.
c) Adequate stiffness: Its lateral load resisting system is such that the earthquake induce deformation in it do not damage its content under low to moderate shaking.
d) Good ductility: It's capacity to undergo large deformations under severe earthquake shaking even after yielding, is improved by favourable design and detailing strategies.

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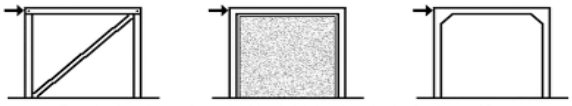


Three basic methods of assuring lateral stability of simple structural assemblies: diagonal bracing, shear planes, and rigid joints

IMPORTANCE OF ARCHITECTURAL FEATURES

The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. Hence, at the planning stage itself, architects and structural engineers must work together to ensure that the unfavorable features are avoided and a good building configuration is chosen.

SIZE OF BUILDING

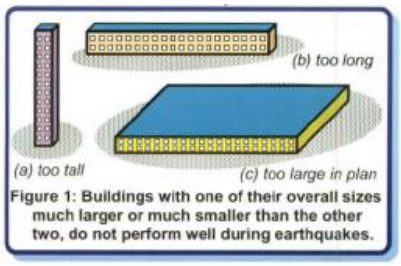
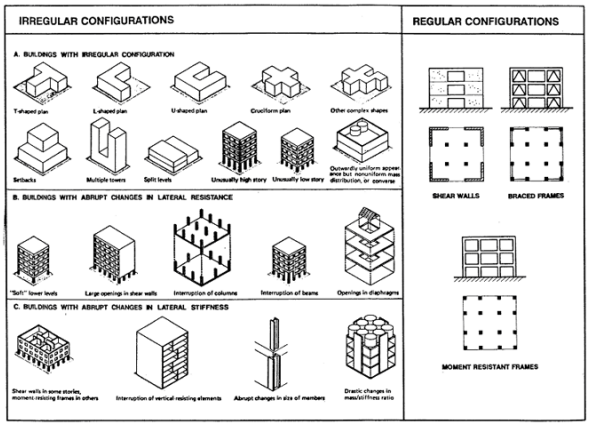


Figure 1: Buildings with one of their overall sizes much larger or much smaller than the other two, do not perform well during earthquakes.

In tall buildings with large height-to-base size ratio , the horizontal movement of the floors during ground shaking is large. In short but very long buildings , the damaging effects during earthquake shaking are many. And, in buildings with large plan area like warehouses , the horizontal seismic forces can be excessive to be carried by columns and walls.

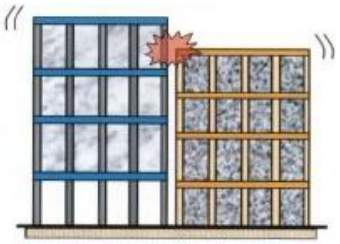
CONFIGURATION

Buildings with simple geometry in plan Have performed well during strong earthquakes. Buildings with re-entrant corners, like those U, V, H And + shaped in plan , have sustained Significant damage. Many times, the bad effects of These interior corners in the plan of buildings are Avoided by making the buildings in two parts. For Example, an L-shaped plan can be broken up into two Rectangular plan shapes using a separation joint at the Junction



ADJACENCY OF BUILDING

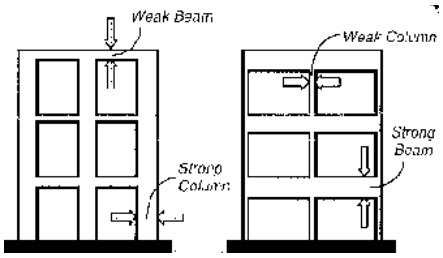
When two buildings are too close to each other, they may pound on each other during strong shaking. With increase in building height, this collision can be a greater problem. When building heights do not match (Figure 4), the roof of the shorter building may pound at the mid-height of the column of the taller one; this can be very dangerous.



STRUCTURAL CONFFIGURATION

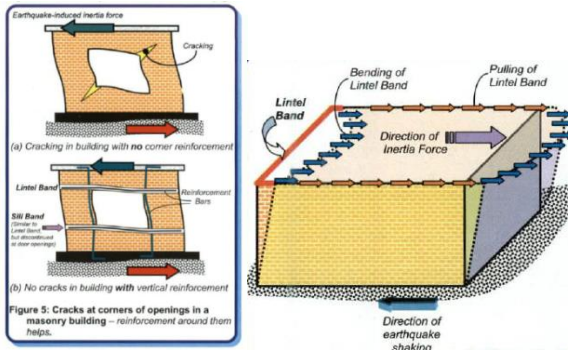
Buildings should be designed like the ductile chain. It consists of horizontal and vertical members, namely**beams** and **columns.** The seismic inertia forces generated at its floor levels are transferred through the various **beams** and**columns** to the ground. The correct building components need to be made ductile. The failure of a column can affect the stability of the whole building,

but the failure of a beam causes localized effect. Therefore, it is better to make **beams** to be the ductile weak links than **columns.** This method of designing RC buildings is called the **strong-column weak-beam** design method



DESIGN OF LINTEL BEAM

During earthquake shaking, the lintel band Undergoes bending and pulling actions). To Resist these actions, the construction of lintel band Requires special attention. Bands can be made of wood or of reinforced concrete; the RC bands are the best. The straight Lengths of the band must be properly connected at the Wall corners. This will allow the band to support walls Loaded in their weak direction by walls loaded in their Strong direction. Small lengths of wood spacers (in Wooden bands) or steel links (in RC bands) are used to Make the straight lengths of wood runners or steelbars act together. In wooden bands, proper nailing of straight lengths with spacers is important. Likewise, in RC bands, adequate anchoring of steel links with steel bars is necessary.



OPENING SIZE

In general, openings in walls of a building tend to weaken the walls, and fewer the openings less the damage it will suffer during an earthquake. If it is necessary to have large openings through a building, or if an open first floor is desired, then special provisions should be made to ensure structural integrity.

RIGIDITY DISTRIBUTION

The rigidity of a building along the vertical direction should be distributed uniformly. Therefore, changes in the structural system of a building from one floor to the next will increase the potential for damage, and should be avoided. Columns or shear walls should run continuously from foundation to the roof, without interruptions or changes in material.

CONCLUSION

A building that is poorly configured will never perform well in damaging earrhquake. Unfortunately many architectural decision can have a huge and detrimental affect on a buiding's performance. Thus by proper design considerations, construction techniques and structural configurations a building performs well during the earthquakes.

REFERENCES

[1]. Earthquake design concepts by C.V.R Murthy and Andrew W. Charleson

[2]. http://civilenggseminar.blogspot.in/2011/09/earthquake-resistent-building.html