

# Earthquake Resistant Structure Failure and Overcoming

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**ABSTRACT:** Earthquake is the shaking of the ground caused by the sudden movement, breaking and shifting of section of Earth's crust. It may also be defined as the vibration of the earth's surface releasing energy in the earth's crust. Earthquakes does not kill people directly instead many deaths and injuries are result from the collapse of buildings, bridges industrial shades and other structures. We cannot prevent natural disasters from striking but we can prevent their impact by making buildings more strong to resist their destructive forces. This can be achieved by earthquake resistant structures.

This paper deals with 1) The different type of failures that due to earthquakes forces 2) Analysis of failure due to earthquake 3) remedial measures for failures

**KEYWORDS:** Earthquake resistant structures, The soil failure, Soft floor failure, Foundation Failures, structural failure, remedial measures.

## I. INTRODUCTION

The earthquake does not kills the people but the unsafe buildings are responsible for the deaths and injuries of human life and property. so keeping in view the great loss of life and property. In recent earthquakes has become a current topic and all over the world lot of research is going on to understand the reasons of such failures due to earth quake.

The main approach for earthquake resistant design of structure depends on to provide the building with strength by providing reinforcement as per code, stiffness by providing bands, and in elastic deformation capacity which are great enough to withstand against the forces which are generated during earthquake. The more we all understand that it is not important that why buildings fall, but the better able we have to design the structure to avoid it.

This is achieved through the selection of an appropriate structural configurations and the careful design of important structural members such as beams and columns and the joint between them.

But more advance techniques for earthquakes resistance are not to strengthen the building, but to reduce the earthquake forces acting upon it during earthquake..

## II. MODES OF FAILURE

The earthquakes in the world which occur along the boundaries of the tectonic plates and are called "interplate earthquake"

The term interpolate earthquake refers to a variety of earthquake that occurs within the interior of a tectonic plate; this stands in contrast to an interpolate earthquake which occurs at the boundary of a tectonic plate.

The earthquakes which occurs within the plates away from tectonic boundaries these are called intraplate earthquakes. The example of intraplate earthquakes is earthquake in 1993 at Latur (India)

In both types of earthquakes, the slip generated at the fault during earthquakes is along both vertical and horizontal direction (dip slip) and lateral directions (strike slip) with one of them dominating sometimes.

DIP SLIP:

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Dip slip faults are incline fractures where the blocks are mostly shifted vertically. If the rock mass above and inclined fault moves down , the fault is turn normal, where as if the rock above the fault moves up the fault is turn reverse.

## STRIKE SLIP:

Strike slip faults are vertical fractures where the blocks are mostly moves horizontally. If the block moves right to the observer the slip style is termed right lateral , if block moves to the left the motion is termed as left lateral.

Modes and degrees of damage varied among the buildings. The intensity of damage to all the buildings is quite severe and most of the buildings are none repairable and ultimately have to be demolished.

Here are four modes of failure of building fails in an earthquake.

## Mode 1

### THE SOIL FAILS

Earthquake moves the ground side to side and up and down simultaneously. The seismic forces are so powerful that they turned soft soil instantly into quick sand , destroying its ability to bear weight. Buildings constructed on either soft soil or on steeply sloped sites in a seismic zone quickly transform into land slide or mud slide therefore they are at higher risk .Taller buildings or those built of rigid concrete may stat intact but topple over in the unstable soil both problems can be directly attributed to the soil failure.

**Remedial measure :** Avoid construction of building on precarious slopes in earthquakes zones. Sand boils, bogs or bad soils are to be avoided . If soft soil is unavoidable a buildings piers should be set as deeply as possible. The buildings foundation should be design as rigid as possible.

## Mode 2

### THE FOUNDATION FAILS

The most important that determines the foundation's ability to withstand the forces of an earthquake is the buildings mass. When buildings are not design to resist multidirectional and intense side to side load during an earthquake particularly when earthquake hit in a series of waves. In that case foundation connection failure occurs and building literally slides off its foundation . It indicates that foundation was not strong enough to pull the structure above along with it.

**Remedial measure :** The use of anchor bolts to tie the building to its foundation helps to prevent the two from separating. A foundation's load bearing capacity must be great enough to accommodate the additional load cause by inertia as the building's mass shifts during an earthquake.

## Mode 3

### A SOFT FLOOR FAILS

The floors with minimal interior sheer walls , additional floor to floor height or large open spaces with concentration of building mass above are known as soft floors . The concentration of earthquake forces is at ground floor where most floors are located these soft floors represents a break in a building's structural continuity. Soft floors are less rigid than the building constructed on top of them .

**Remedial measure :** Avoid the soft floors . The spans between coloumn should be as small as possible the column connection at ground level should be design to resist and distribute lateral forces. It is also important to provide sufficient clearance between rigid infill and adjustment structural members.

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## Mode 4

### A BUILDING JOINT FAILS

A building's shape impacts its ability to resist deflection. In older masonry buildings the building expands that share a common wall with original structure if these connections do not accommodate the natural inclination of the different structure to move independently of each other or if there is insufficient clearance between the different structures, the results can be disasters in an earthquake. Two buildings located next to one another of different heights. In the event of an earthquake the strongest part of one building may be slammed repeatedly into the weakest part of the other. As a result one building can suffer a disastrous failure simply because of its close proximity to its neighbour building.

Remedial measures: Structural engineers and architects now understand that buildings need room to move in an earthquake. Therefore expansion joints are now added between significant changes in building mass. Avoid irregular shapes and break them into regular shapes. An L shaped building be designed as three separate square structures each separated by expansion joint.

### TECHNIQUES FOR EARTHQUAKE RESISTING STRUCTURES

#### BASE ISOLATION METHOD

Base isolation is a mechanism that provides resistance to the earthquake. This technique is used for new structures. The base isolation system decouples the building from the horizontal ground motion induced by earthquake, and offers a very stiff vertical component to the base level of the superstructure in connection to substructure (foundation). Using base isolation technique you can introduce flexibility to the structures. When earthquake strikes, the building does not move.

It is suitable for hard soil only.

#### ENERGY DISSIPATION DEVICE.( SEISMIC DAMPERS)

Seismic Dampers are used in damping the motion of a building during an earthquake. There are many types of dampers for buildings and damping through friction tends to be one of the most efficient methods of dissipating seismic energy. The dampers allow the building to move elastically and dissipate the energy of the earthquake. In doing so the building is able to withstand an earthquake without sustaining significant damage to its structure. Dampers are used in the replacement of structural elements like diagonal braces. They absorb the seismic energy and reduce the damaging effect during seismic event.

### GUIDELINES FOR EARTHQUAKE RESISTANT CONSTRUCTION

- Horizontal bands should be provided at plinth, lintel, and roof level as per code.
- Grade of mortar should be as per codes specified for different earthquake zones
- Providing vertical reinforcement at important locations such as corners, internal and external wall junctions as per code.
- Irregular shapes should be avoided both in plane and vertical configuration.
- Quality assurance and proper workmanship must be ensured at all cost without any compromise.
- In RCC frame structures the spacing of lateral ties should be kept closer as per the code.
- The hook in the ties should be at 135 degree instead of 90 degree for better anchorage.
- The arrangement of lateral ties in the columns should be as per code and must be continued through the joint as well.

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## III. CONCLUSION

### “ EARTHQUAKE DONT KILL THE PEOPLE BUT THE LACK OF PLANING AND THE POOR CONSTRUCTION DO”

- There is a lack of awareness in the earthquake disaster mitigation .Avoiding non engineered structures with unskilled labour even in unimportant temporary construction can help a great way.
- state wide awareness programme have to be conducted by fully exploiting the advancement in the information technology.
- Urgent steps are required to be taken to make the codal provision regarding earthquake resistant construction undedateable.
- The builders and constructor should adopt the codal provisions in all the future construction as prevention is better then cure.

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