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DESIGN OF EARTHQUAKE RESISTANT STRUCTURE

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Abstract: In this paper we present a review of high performance damage resistant seismic resistant structure (DRSRS) system for the sustainable and resilient city. Earthquake loads are very unpredictable the magnitude, direction, and time of occurrence. Earthquake resistant structure are design to protect buildings and other constructed structures from demolish /destruction. Like Japanese model of ERB, the collapse ratio of buildings due to powerful earthquake is said to be extremely low as compared to other ordinary design buildings. We are going to analyze the building by using modern software of analysis and calculate the all types of loads (wind load, seismic load, and shear forces, bending moments) and so on. Before designing of any ERB there are some methods for calculating seismic forces (IS: 1893-2002), 1) Zone factor (Z), 2) Importance factor (I), 3) Response Reduction Factor, 4) Fundamental Natural Period (T_a). And earthquake attenuation coefficient should be 0, 3. In this article we are discussing the Bureau of Indian Standard (BIS) specifications and reviews also.

KEY WORDS; ERB (earthquake resistant building), IS (Indian standard), DRSRS, BIS (Bureau of Indian Standard), Response reduction factor

INTRODUCTION

When a structure is subjected to ground motions in an earthquake, it responds in a vibratory fashion. The random motion of the ground caused by an earthquake can be resolved in any three mutually perpendicular directions, the two horizontal directions (x and y) and the vertical direction (z). According to the Indian Specification for seismic forces the code (IS: 1893-2002) should be applicable. When an earthquake does occur, the risk to homes building depends on many different factors.

1> ground itself

2> shape of the land

3> building density among other

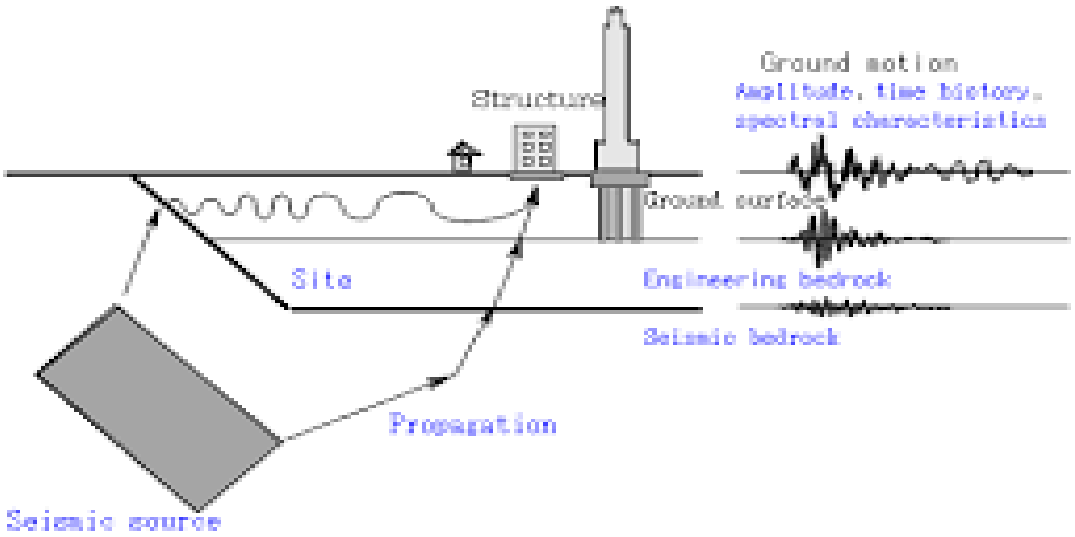

Figure – 1

The currently existing seismic design allows structure to undergo plastic deformation under large earthquakes while remaining elastic under small or moderate earthquake. Indian reviews of those buildings which are undergoing the earthquake and explain the design criteria for the structure.

The sectional committee of bureau divided to revise the standard into five parts which deals with different types of structure:-

- General provision and buildings
- Liquid retaining tanks – elevated and ground support
- Bridges and retaining walls
- Industrial structures including sack like structure
- Dams and embankments

By using staad-pro software we calculated the seismic waves penetration level and the effect of these waves on the structure and after the occurrence of earthquake, the damaged structure should be analysing.

Literature

In old model of ERB, the structure was generally accomplished through the selection of an appropriate structural configuration and the careful detailing of structural member (columns and beams) and the connection between them. But in advance techniques of ER are not strengthening the building, but to reduce the earthquake generated forces acting upon it. Most important advanced techniques are follows;-

- Base isolation
- Energy dissipation devices

In the United States in 1906, San Francisco earthquake provided the first real impetus for establishing building design code and safety standards. There is a comparison between Germany and San Francisco earthquakes.

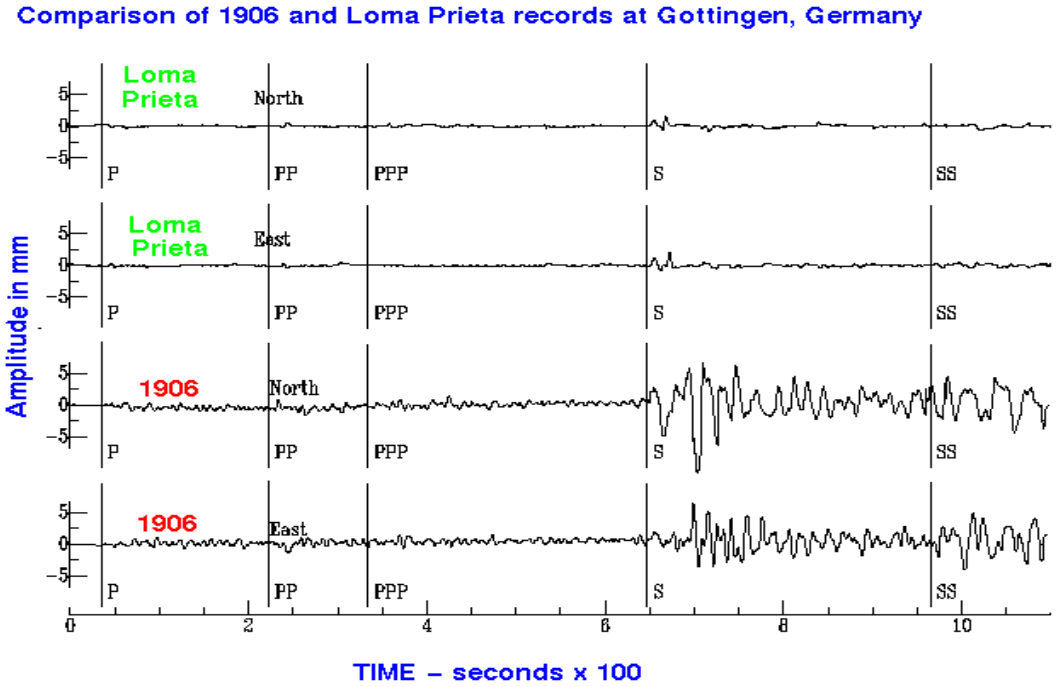

Figure-2

The Delhi Police Headquarter building houses the police commissioner's office and the police control room, as well several important offices of the Delhi PWD, including the offices of the Engineer-in-Chief and the Chief Engineers for Delhi's for administrative zones. The 14-storey building shown in figure was too constructed in three phases separated by expansion joints 6'' (150mm) wide. Phase 1 has a core with two stiff but weak H-shaped shear walls, making it very stiff in comparison to phase 2 and 3, which have flexible moment –resisting frames and no shear wall.

Figure 3

Earthquake and Basic terminology

Earthquake is defined as a sudden ground shaking caused by released of huge stored strain energy at the interface of the tectonic plates. And terminology are as follows;-

- Epicenter
- Focus
- Focal depth
- Waves (primary or secondary waves)
- Seismic station

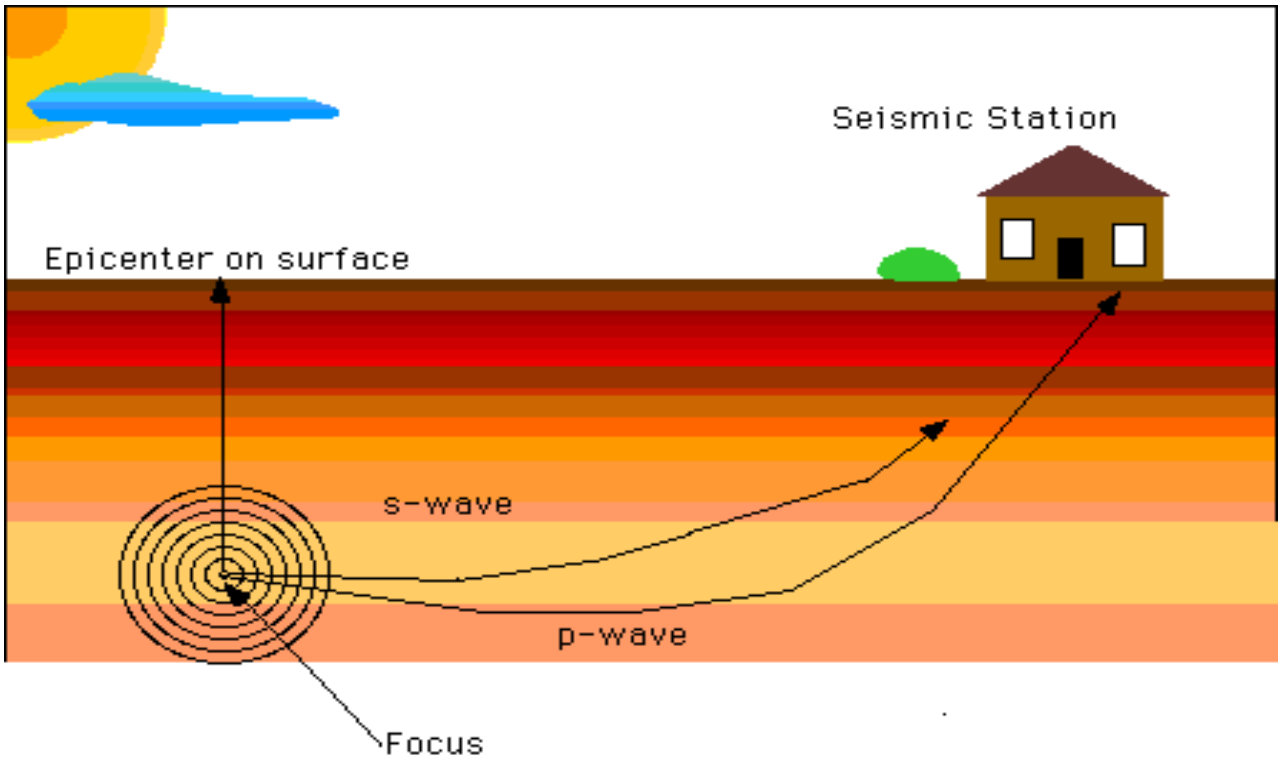

Figure 4

Effect of Earthquakes

- Liquefaction
- Tsunamis
- Ground shaking
- Landslides
- Cracks

Earthquakes Resisting Techniques

- Active and passive system
- Bracing
- Dampers
- Rollers
- Base isolation
- Lightweight material
- Bands
- Retrofitting

Seismic Load Distribution

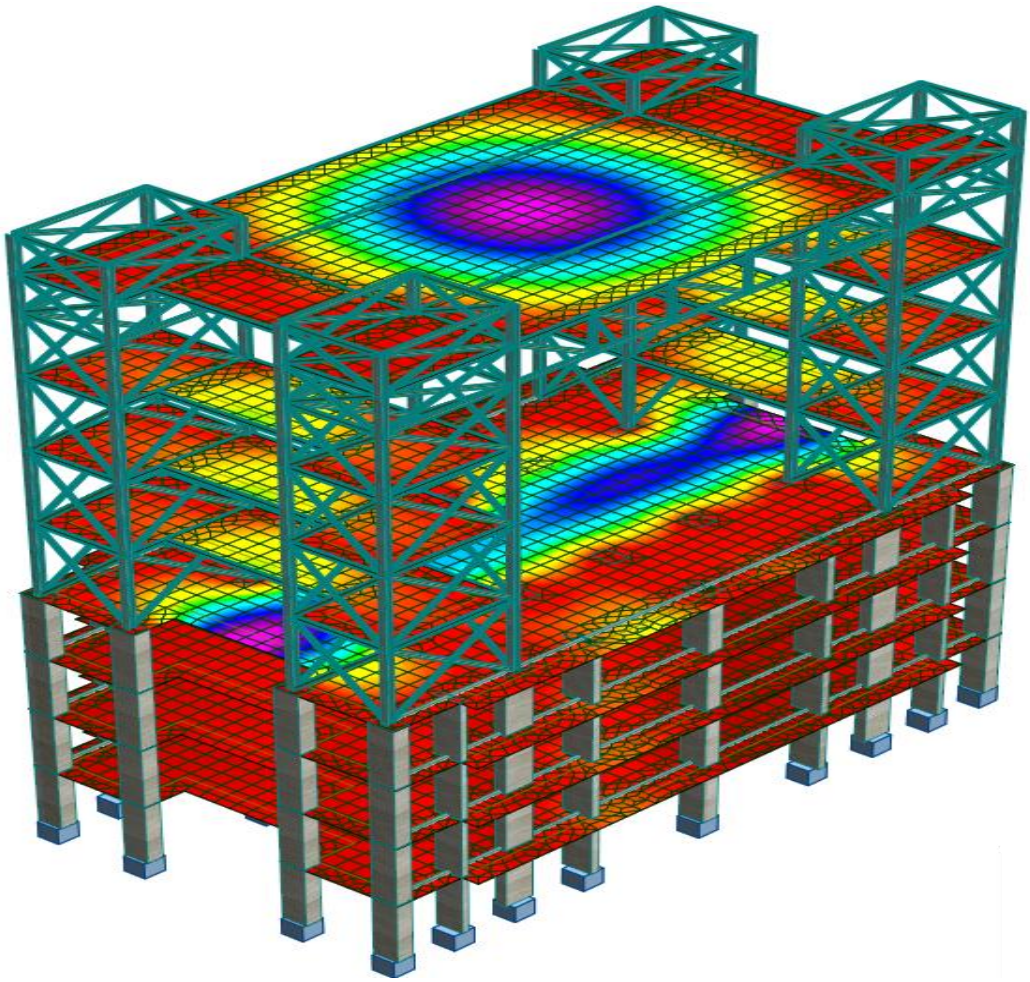

Figure 5

IS Codes for ERB

- IS 1893:1984 :- criteria for earthquake resistant design of structure
- IS 1893(part1) :-general provision and building
- IS 1893(part4) :- 2005 :-industrial structures stack like structure
- IS 4326:1993 :-ER design and construction of building code of practice

Some Important Aspects for ERB

- Stiffness and strength
- Regularity
- Redundancy
- Foundations
- Continuous load path

Stiffness and Strength

When design ERB, safety professionals recommend adequate vertical and lateral stiffness and strength –specifically lateral. Structures tend o handle the vertical movement caused by quakes better than the lateral or horizontal movement.

Regularity

If a building is irregular, then weaknesses will become apparently when the building sways. The weakness will compromise and the structure will see concentrated damage.

Redundancy

Redundancy ensures there are multiple strategies in place in case one fails. The redundancy proves their worth if/when a natural disaster such as earthquake occurs. Safety professionals advise equally distributing mass and strength throughout the structure.

Foundation

A stable foundation is a major characteristic of building a large structure regardless of natural disaster risks. Professionals have to closely observe how the ground react and moves before the earthquake. Buildings designed to withstand violent earthquakes have deep foundation and driven piles. To stabilize these drastic measures, the foundations are connected so they move as a unit.

Continuous Load Path

Structural and non structural components of a building need to be interconnected so inertial forces dissipate. If the structure is not comprehensively tied together, components will move independently and collapse will be imminent.

Conclusions

This article showed that the many areas of the world are vulnerable to natural disasters like earthquake. The earthquake caused a lot of destruction including human cost and destruction of damage of building and infrastructure. A lot of residential, official buildings, schools, health, facilities, and transportation infrastructure, and power and tourism sites faced serious damages.

According to the 2011 census of India, there are over 330M housing in the country with two third of these being rural houses. The geological survey of India has classified the country into 4 seismic zones which are mainly preferred by Indian standard for design criteria of a earthquake resistant building.

By further studies we find out that we can design or construct a building which is approximately complete earthquake resistant building if any unexceptional highly hazardous disasters will occurs.

For ERB we can choose the technique of base isolation and dampers for energy dissipaters. A seismic damper dissipates the secondary waves. We can construct a building by using carbon fibers (this technique already using in Japan). But there is also a way by which we can find out the previous earthquakes rating and by this data we can use for the further analysis.

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