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Comparative Study of Earthquake Resistant Techniques for Seismic Loading

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ABSTRACT - The effect of earthquake can be prevented or minimized by taking certain preventive measures as per standard scientific guidelines. In Earthquake prone areas, some measures may prevent the loss of lives and material. As building increases in height, the lateral displacement of the building becomes one of the primary concerns. An excessive lateral displacement or inter-story drift causes the failure of both structural and non-structural elements. In this study some earthquake resistant techniques for building has been discussed for Drift, Displacement and Base shear. In design specifications, the calculated displacement at the top of a high-rise building and inter-story drifts at the final stage of the structural design process must be checked not to exceed specified limits with respect to building height as well as individual story height.

KEYWORDS: *Displacement, Drift, Base shear*

1.1 Introduction: Hundreds of thousands of people have been killed by earthquakes despite scientists being able to predict and forewarn in advance and engineers construct earthquake-safe buildings. Unfortunately earthquakes occur often in countries which are unable to afford earthquake-safe construction. Earthquake-resistant structure, Building designed to prevent total collapse, preserve life, and minimize damage in case of an earthquake or tremor. Earthquakes exert lateral as well as vertical forces, and a structure's response to their random, often sudden motions is a complex task that is just beginning to be understood.

1.1.1 Ductility: Ductility is the ability of a material to sustain a large permanent deformation under a tensile load up to the point of fracture, or the relative ability of a material to be stretched plastically at room temperature without fracturing. A base-isolation system reduces ductility demands on a building, and minimizes its deformations. These changes improve building performance and allow much greater architectural freedom in the choice of the structural type and in its layout and detailing.

1.1.2 Storey Drift: It is defined as ratio of displacement of two consecutive floors to height of that floor. It is very important term used for research purpose in earthquake engineering

1.1.3 Storey Displacement: Total displacement of any storey with respect to ground and there is maximum permissible limit prescribed in IS codes for buildings. It is observed that story displacements in base isolated structure are more than the ones in original structure. This is due to the fact that there is a large displacement at the foundation level in the base isolated structure, while upper storey act almost as rigid bodies compared to the foundation

1.1.4 Storey Shear: It is the sum of design lateral forces at all levels above the storey under consideration.

1.1.5 Stiffness: In structural engineering, the term 'stiffness' refers to the rigidity of a structural element. In general terms, this means the extent to which the element is able to resist deformation or deflection under the action of an applied force. In contrast, flexibility or pliability is a measure of how flexible a component is, i.e. the less stiff it is, the more flexible it is.

1.1.6 Frequency: number of complete cycles of vibrations per second. It is denoted by 'f'

1.1.7 Time period: The natural period of a building is simply a time taken by it to undergo one complete cycle of oscillation. The natural period is one of the properties of building which is controlled by mass and stiffness

1.2 Methodology

1.2.1 Shear Wall: In the seismic design of buildings, shear wall act as a major earthquake resisting members. Shear wall plays a great role for lateral load resistance. The properties of these seismic shear walls give the response of the buildings, and therefore, it is essential to evaluate the seismic response of the walls appropriately.

1.2.2 Base Isolation: It can be explained as a bird flying during an earthquake is not affected. In simple words if structure is floating on its base, the movement of ground will have no effect on the structure. Base isolation is a state-of-the-art method in which the structure (superstructure) is separated from the base (foundation or substructure) by introducing a suspension system between the base and the main structure

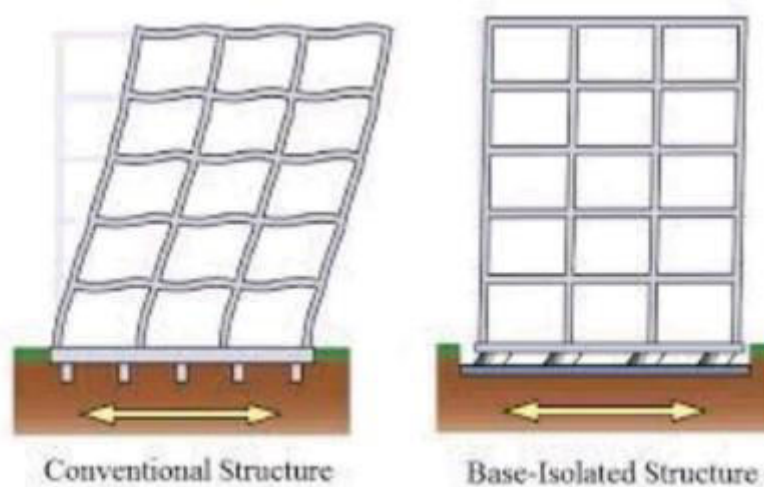


Fig no 1: Base Isolation

In context of seismic design of structures, base isolation can be replaced with seismic isolation i.e., the structure above the ground, which is most affected during earthquake is separated from the effects of earthquake forces by introducing a mechanism that will help the structure to hover. The concept of base isolation is quite easy to grasp.

1.2.3 Lead Rubber Bearing: This type of elastomeric bearings is lead-rubber bearings (LRB). This base isolation system provides the combined features of vertical load support, horizontal flexibility, restoring force, and damping in a single unit. A lead-rubber bearing is formed of a lead plug force-fitted into a pre-formed hole in an elastomeric bearing.

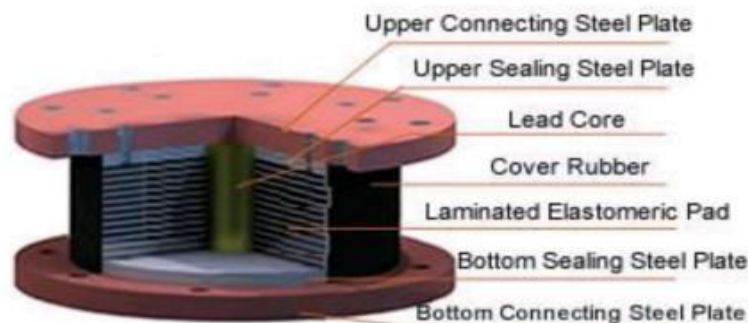


Fig no 2: Lead Rubber Bearing

The lead core provides rigidity under service loads and energy dissipation under high lateral loads. When subjected to low lateral loads such as minor earthquake the lead-rubber bearing is stiff both laterally and vertically. The lateral stiffness results from the high elastic stiffness of the lead plug and the vertical rigidity. A major advantage of the lead-

rubber bearing is that it combines the functions of rigidity at service load levels flexibility at earthquake load levels and damping into a single compact unit

1.2.4 Concentrically braced frame: Concentrically braced frame (CBF) is an effective and prevalent seismic force resisting system which is commonly used in low-rise buildings. This type of structural system utilizes steel braces to provide the stiffness and strength needed to dissipate earthquake energy

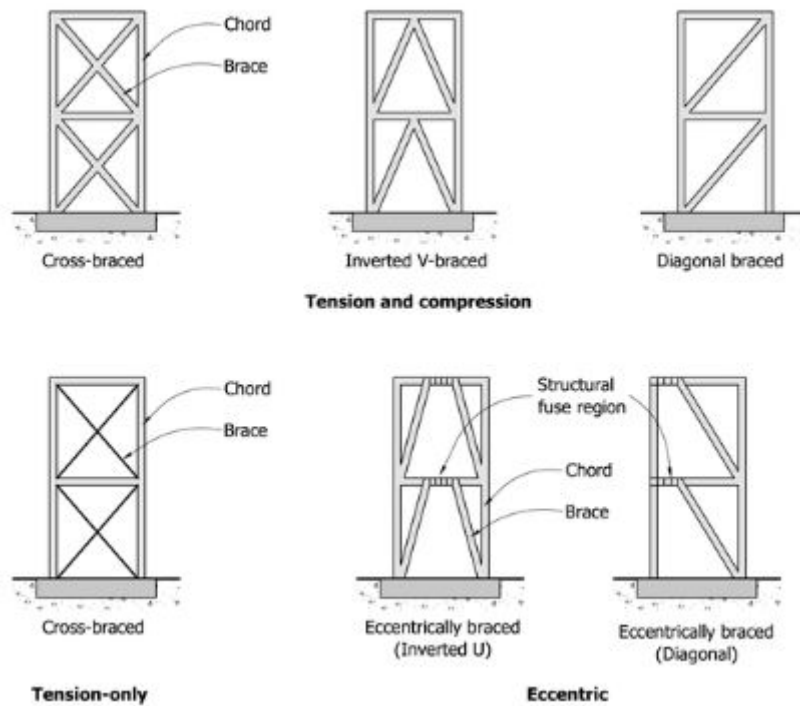


Fig no 3: Concentrically braced frame

1.2.5 Use of L shape column: The L-shaped column in building has better seismic behaviour when loaded along various loading angles. Earthquake resistance of building with L shaped columns is better as compared to the building with normal columns. Therefore, it is suitable for the construction of buildings in high seismic areas



Fig No 4: L Shape Column

1.3 Conclusion

1.3.1 From all the above analysis, it is observed that in high rise building, constructing with shear wall along short span at middle is effective in resisting seismic forces as to building without shear wall. It is also observed that the shear wall is economical and effective in high rise building.

1.3.2 L-shaped columns have the advantages of avoiding column protrusion, saving room space and good mechanical behavior. L-Shaped column has the advantages such as high bearing capacity, good ductility and high utilization rate of internal space of the building, thus avoiding the occurrence of column shearing in the indoor use space

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