REVIEW STUDY ON THE EARTHQUAKE RESISTANT CONSTRUCTION TECHNIQUES

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ABSTRACT

There are many natural phenomena and one of them is earthquake which produces waves on surface which ultimately causes the vibration of the ground and structures standing on it. These vibrations results in cracks, fissures and settlements in the ground which sometimes proves violent and damages of structures at a very large scale, though it itself is not a disaster. So the protection of buildings due to earthquake is a challenge. There are various techniques used to prevent buildings and other civil engineering structures from the effect of earthquake and from them base isolation is widely adopted all over the world. In this horizontal flexible isolation devices are placed at the base of the structure to physically decouple it from the ground to shift the natural period of the structure to the long period range. The base isolation decreases the acceleration and produces drift in structure makes it one of the effective strategies. There are many types used as isolated devices but three are major that is elastomeric bearings (rubber), rollers and ball bearings, slider bearing and includes four types of dampers that is Steel, oil, lead and friction dampers with disc springs are important and essential component of base isolation system. This report summarizes the base isolation techniques, reviews of the current practices. Our aim is also to reduce cost and weight of base-isolation. Now-a-days material of base isolation is very costly and difficult to implement. The design of structures depends on ductility, deformation capacity, strength and amount of deflection.

Keyword : - *Earthquake Structure[1] , Base Isolation[2], Scrap Rubber Seismic Force[3], Seismic Resistant Techniques[4] etc…*

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1. INTRODUCTION

Use of base isolation techniques goes back to hundreds of years ago. Pieces of wood are installed between the foundation and the walls of buildings are among the earthquake resistant construction techniques which were applied in the past. In India one of the earthquake prone areas is eastern Uttar Pradesh which is located in an active seismic area which frequently observed heavy casualties and damages done by earthquake. Therefore there are many different past techniques applied in earthquake resistant construction such as filling the stone ballast, sand filling in foundation and sides of the walls, and using pieces of woods under the load bearing walls. There were two main concepts which were applied in the past. first is base isolation devices making the civil engineering structure flexible and second is to consider the whole building as a single unit. The rolling of the building is done in the form of timber layers. Each Timber layer is capable of rolling to each other which dissipates the excess energy produced by the earthquake and in the second technique rigid structures are braced at the corners with horizontal and vertical wooden members and wooden columns provided are done at the root and at the foundation.

2. BASE ISOLATION SYSTEM

This system aims to reduce the transmission of forces done by earthquake and reduces its energy produced. This can be satisfied by putting any structure on isolated material by giving horizontal flexibility. Flexibility is sufficient to defeat the major portion of earthquake so any in elastic action does not occur.

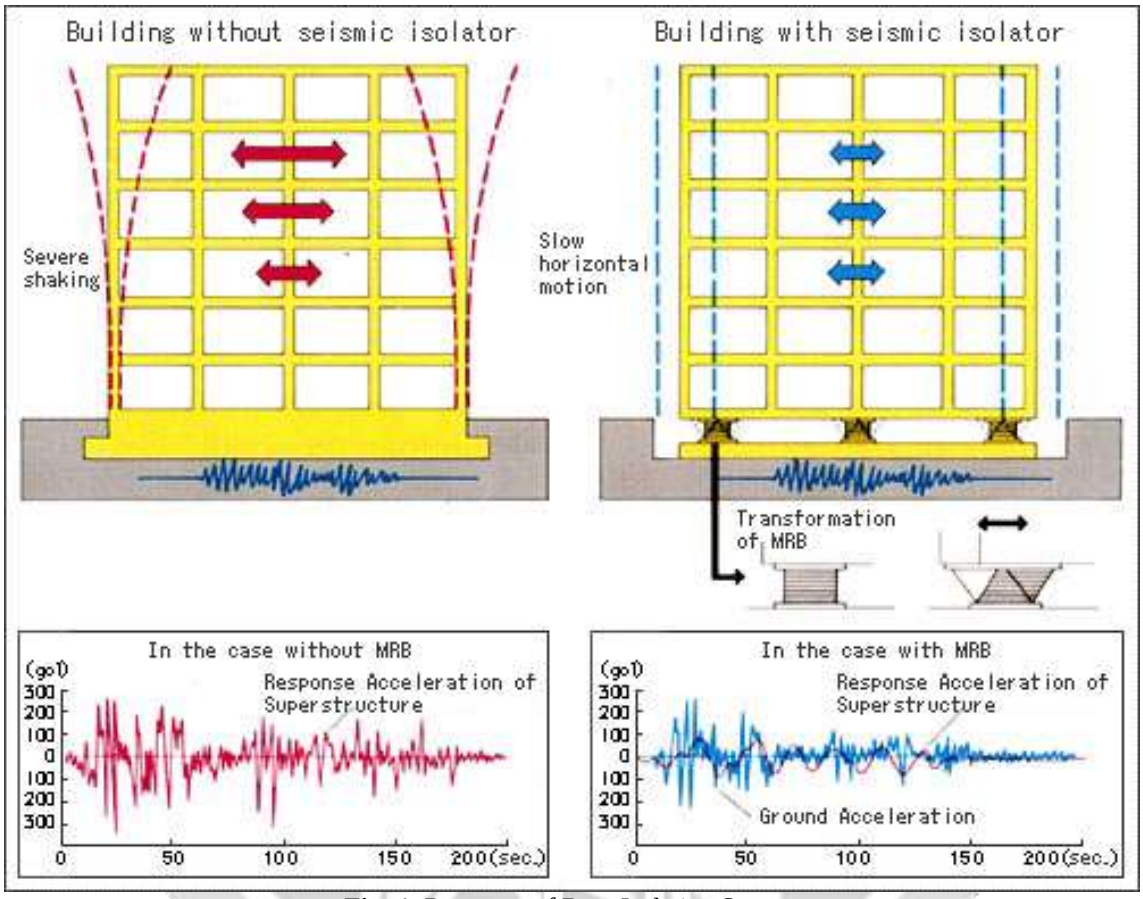

Fig -1: Response of Base Isolation System

2.1 NEED FOR BASE ISOLATION

Many fatalities and damages were caused in buildings by the earthquake. The first earthquake which produced severe damage to building and many structures occurred in Japan in 1995. All these events causes structure damage as well as death counts in lacs. The necessity is to protect non structural components and sensitive equipments to decrease the damage cost. Due to these reasons we use these anti-seismic techniques which aims to ensure fully integrity and ability to existing and new buildings.[3]

2.2 PRINCIPAL

The principal of base isolation system is to absorb the vibration occurred by the earthquake to make the building safe. This system makes the relative displacement between the ground and structures zero.

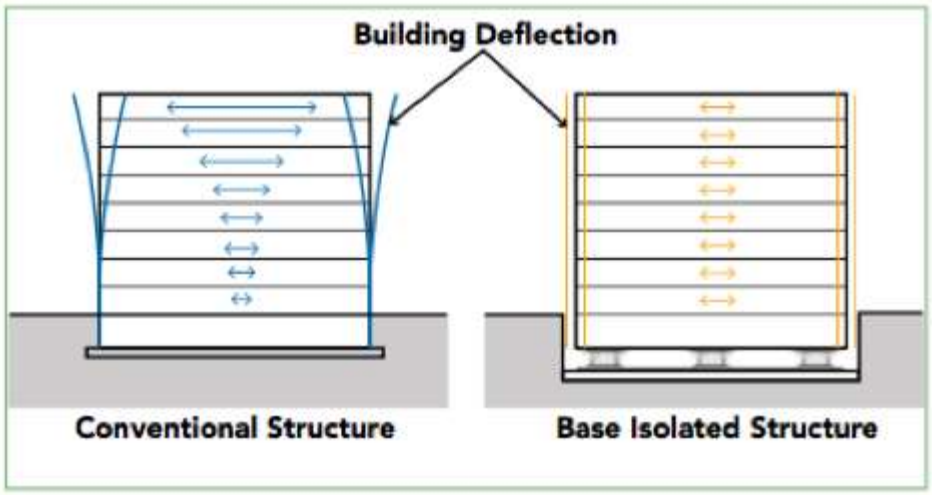

Fig -2: Comparative Building Deflection

During the occurrence of earthquake the relative displacement between the ground and building will be equal to the ground displacement and so the structure will not move but the ground will move.

DESIGN OBJECTIVES OF BASE ISOLATION PROVISIONS

- Minor and Moderate Earthquakes
- No damage to structural elements
- No damage to non-structural components
- No damage to building contents
- Major Earthquakes
- No failure of isolation system
- No significant damage to structural elements
- No extensive damage to structural components
- No major disruption to facility function
- Life safety[1]

3. ISOLATION TECHNIQUES

There are various isolation techniques, and here we are discussing base isolation technique with its various methods.

3.1 ELASTOMERIC RUBBER BEARING

Lead rubber bearing is the most important rubber bearings used in isolation techniques which is formed of horizontal layers of low damping synthetic or natural rubber with lead core which are bound in thin layers between steel and plates.

They are flexible under lateral loads and supports high vertical loads with very small deformations. The lead cores increases damping capacity by generating hysterical damping. They are hard in vertical direction and soft in horizontal direction. They have bearing pads which provides a connection to control the interactions of loading and movements between parts of structure usually between substructure and superstructure.

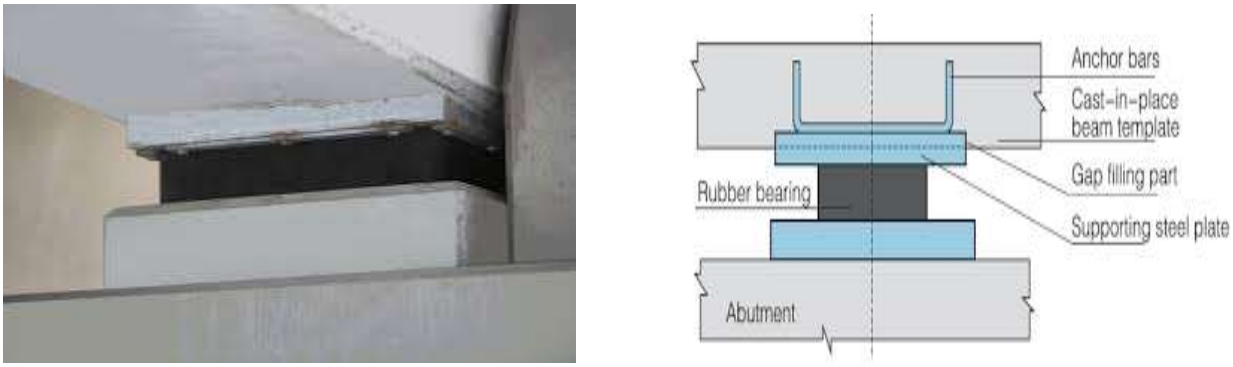

Fig -3 Elastomeric Rubber Pads Isolator

The deformation of rubber under compressive load depends upon structure's shape bearing pads reinforced with plates, which are chemically bonded to elastomer provides stable size for loads and motion of axis.

3.2 ROLLER AND BALL ISOLATING SYSTEM

They are used in bridges and machinery isolation. It consists of cylindrical rollers and balls which resist horizontal movements and damping depending on the material used. It can be applied without any changes in design, shape or technology.

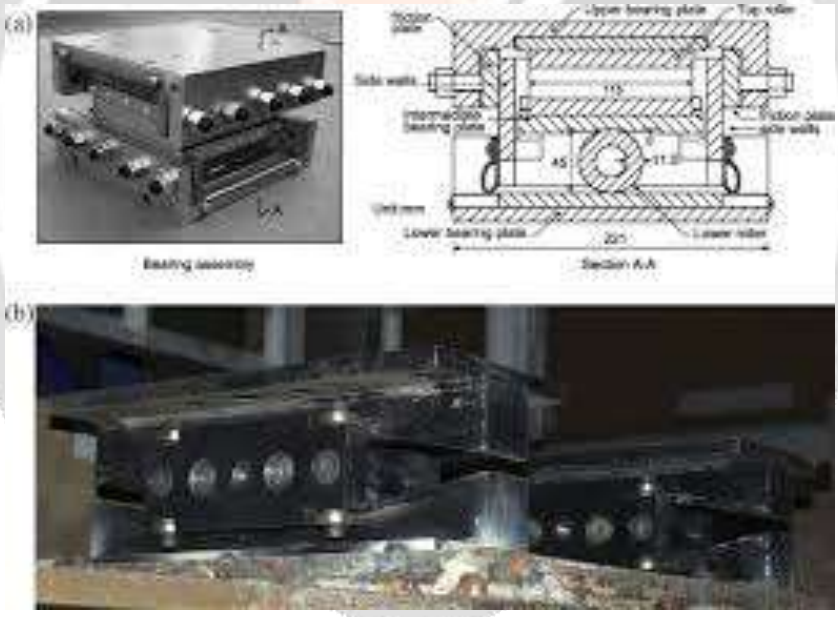

Fig -4 Roller and Ball Isolator

3.3 SLIDER ISOLATION SYSTEM

It causes large residual transitions in the structure because of the absence of mechanical forces return. It takes slider sliding surface which form concave and thus secures a waste of energy, mechanical and return to the centre. This system limits the acceleration and forces and provides flexibility and force displacement by sliding under varying load.

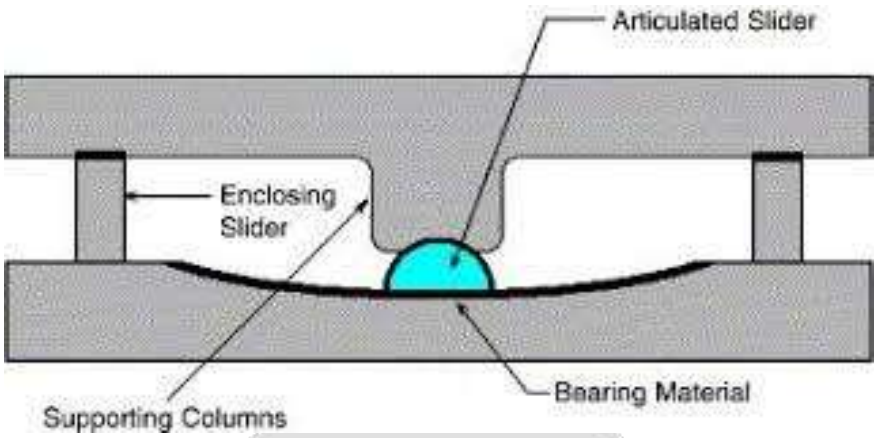

Fig -5 Slider Isolation System

3.4 STEEL SPRINGS

They are heavy duty isolators used for building systems and industry. They are mounted on a concrete block. Because these are flexible in both directions so both the horizontal and vertical vibrations are controlled.

Fig -6 Spring Isolation System

3.5 RECENT INNOVATIVE BASE ISOLATION TECHNIQUES

Cultural importance and seismic retrofitting of buildings are challenge for designer and engineers due to economic aspects and lack of technical informations.

A novel base-isolation technique for the upgradation of existing buildings which does not involve any alteration in existing building with the help of micro tunnels, trenches and retaining walls. The micro tunnels will lay under the foundation of building. The base isolation devices will be fitted in these microtunnel lines. These will isolate the structure from seismic actions. They will be able to filter seismic forces in both directions. The making of these microtunnels is critical because it can have a detrimental effect on building.

4. CONCLUSIONS

There are various techniques used in isolation but they are very costly as compared to base isolation. Base isolation is comparatively cheaper then all those techniques. This technique is becoming essential in earthquake prone areas
But further improvement are in process to make this technique more cheaper. Hence we can say that base isolation is necessary to do to make buildings and other structure to reduce the effect of earthquake disaster. This process takes the vibrations produced by the earthquake and balances it.
To imply this technique civil engineer plays a vital role, with their help we can make our building and other structure isolated. They are even applying this technique in bridges also to make high rise infrastructure buildings a better one.

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