STUDY OF SCRAP TIRE USED AS BASE ISOLATION MATERIAL

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Abstract

The Objective of this study is the development of low-cost seismic base isolation pads. Base isolation is a well-defined building Protection system against earthquakes, on which numerous studies have been performed. Our aim is to reduce cost and weight of base isolation. Aim of this project is to protect the building from earthquake and save the life of human being. Now a days Material of base isolation is very costly and difficult to implement. Steel or fiber reinforcement inside the elastomer isolators provides high vertical stiffness, where rubber segments between reinforcement layers provide low horizontal stiffness for the seismic base isolation.

Key words: Base Isolation, Earthquake, Scrap Rubber Seismic Force

I. INTRODUCTION

Now a days, so many techniques are used for minimizing effect of earthquake but most commonly used technique is base isolation technique for minimizing seismic effect to building. Presently technique which are used for high-rise buildings are very costly. Materials used in base isolation are lead rubber bearing, laminated rubber bearing etc, are very costly and it is very complex to execute. Due to the high cost this type of base isolation material can't be used in normal type of building.

Our main aim is to find out such material that is low in cost and commercially affordable for building in earthquake prone severe zone and it is easy to apply on building which can resist earthquake.

Base isolation is most widely used as seismic protection system. It eliminates effect of a seismic action by essentially isolating structure from potentially harmful ground motions, especially in between frequency range where building is most affected.

Seismic isolation is a strategy which protects the structure from damaging by adsorbing shock and effect of ground motion eliminates. Isolation is defined as a reduction if interaction between structure and ground and when seismic isolation system is situated under structure, it is referred as base isolation.

II. LITERATURE REVIEW

One of the most widely used techniques for executing seismic protection system in earthquake prone area is base isolation techniques. In which the term "Base" is used to refer foundation of structure & "Isolation" is referred to reduced iteration between ground and structure which is resting on it. It is approach to very simple design to reduce earthquake potential. It is execution of flexible or sliding interface between structure and its foundation for the purpose of decoupling. Horizontal motion of structure there by reducing damage to structure and its contents.

Although the first patents for base isolation were in the 1800's, and examples of base isolation were claimed during the early 1900's (e.g. Tokyo Imperial Hotel) it was the 1970's

before base isolation moved into the mainstream of structural engineering. Isolation was used on bridges from the early 1970's and buildings from the late 1970's. Bridges are a more natural candidate for isolation than buildings because they are often built with bearings separating the superstructure from the substructure.

The first bridge applications added energy dissipation to the flexibility already there. The lead rubber bearing (LRB) was invented in the 1970's and this allowed the flexibility and damping to be included in a single unit. About the same time the first applications using rubber bearings for isolation were constructed. However, these had the drawback of little inherent damping and were not rigid enough to resist service loads such as wind.

In the early 1980's developments in rubber technology lead to new rubber compounds which were termed "high damping rubber" (HDR).These compounds produced bearings that had a high stiffness at low shear strains but a reduced stiffness at higher strain levels. On unloading, these bearings formed a hysteresis loop that had a significant amount of damping. The first building and bridge applications in the U.S. in the early 1980's used either LRBs or HDR bearings. Some early projects used sliding bearings in parallel with LRBs or HDR bearings, typically to support light components such as stairs. Sliding bearings were not used alone as the isolation system because, although they have high levels of damping, they do not have a restoring force.

Need for Base Isolation

In the past due to earthquake there were many damages occurred in buildings and many fatalities. For instance Kobe earthquake of 1995 in Japan was first case in history of seismic event that occurred in highly industrialized urban area by producing severe damage to the building, Highways and many structures.

Such type of damage might take place in many parts of the world too. All events have damage to structure as well as death counts in lakhs. So that for post earthquake emergency facilities such as ambulance, fire brigade is clear and expected performance level for such building should be fully occupational or recreational.

It is most necessary thing to protect non structural components and high sensitive equipment to decrease damage cost. Due to this reasons there is wide extension of use of anti-seismic techniques. Its aim is to ensure fully integrity and operation ability of structure is necessary for both new as well as retrofit existing building. Earthquake prone seismic isolation technique have fully mature for such case.

III. CONCEPT

Base isolation may be defined as state of being separated and base as a part that supports as support from bottom or it is served as foundation for a structure. As a general sense the structure that is separated from its foundation. The original terminology of base isolation is more commonly replaced with earthquake seismic isolation in recent reflecting that separation of structure is somewhat above the base, for e.g. in bridges sub structure and superstructure is separated from columns. In general sense base isolation or seismic isolation is more accurate because in general sense seismic isolation is isolation that is used to separate structure from seism or earthquake.

Generally one can say that the concept of any structure to separate from the ground is simple to understand. In general sense due to earthquake ground movement occurs and due to this damage of structure occurs. If any flying object is flying above ground it does not affected. So principal of this base isolation is simple "To separate structure from ground." Due to this ground moves but structure does not move. Due to gravity structure is supported or rest on ground. Isolation occurs using proper structure engineering equipment. Civil (Structural, Earthquake) engineering is mainly concern with "How one can separate any structure from ground such that it can resist earthquake but still stand under gravity?" We cannot separate building partially but we can separate it as a whole. It can be any air gap, friction less roller, well oiled sliding surface, sky hooks, magnetic levitation etc. These materials all have practical restraints. All these materials have some drawbacks such as air gap cannot provide any vertical support; sky hooks must be hang from something etc. so far no one has solved this problem of base isolation until it can be solved in nearby future. Till it will find earthquake will damage all structure even well designed building too!!! So, this do not deal with deals but rather with practical isolation systems, systems which

are able to provide a compromise between attachment to the ground to resist gravity and separation from ground to resist earthquakes.

Passive energy dissipation is generally used in base isolation, which also includes in-structure damping. In in-structure damping there are damping devices installed in structure to damp energy but it does not permit base movement. Another form is active control, in which energy devices are used for damping of energy and to provide optimum performance. This topic is of active research but there are no widely available practical systems and we have no plan to implement this energy in the short term.

Base Isolated System

Base isolation systems are quite different from conventional used structural systems in this methods lengthening of fundamental period and hysteric energy damping mechanisms are provided and reduces effect of earthquake forces in the structure.

Base isolation system aims to reduce the transmission of forces induced to earthquake and reduction of energy produced from it. This phenomenon produces system which eliminates structure from damage due to seismic activity. The reduction in transmission offers and hysteric action originate from the isolation system that do not depend on structural damage. This aim can be satisfied by putting any structure on any isolating material by giving horizontal flexibility. Such type of isolators is designed to bear large horizontal movements while earthquake occurs and carry structural loads. Thus by imposing structural elements with low horizontal stiffness, the fundamental frequency of structure is much lower than predominant frequencies of ground motion.

Seismic isolation is characterized by flexibility and energy damping capability. Only flexibility is not sufficient to defeat major portion of any earthquake so any inelastic action does not occur, i.e., En is minimized energy dissipation in the isolation system Ed is then useful in limiting displacement response and avoiding resonance.

Design consideration

A number of factors need to be considered by an engineer, architect or owner to decide on seismic isolation for a project. Among the foremost is the evaluation of seismic hazard, which includes local geology, proximity to faults, soil conditions, characteristics of possible earthquakes such as period and severity. Subsequently, performance levels for different intensities of earthquakes need to be evaluated.

Since the isolators carry large vertical loads and deform to significant lateral displacement, the components of the structure above and below the isolator need to be designed appropriately. Plane of isolation may be chosen based on the practical aspects of installation and relative strengths of super and sub structure components. Specifically, for the isolation system to work properly, the structure should be free to move in any direction up the maximum specified displacement. Typically a seismic moat is provided around the structure to allow this movement. It is imperative that owners and occupiers of seismically isolated structures are aware of the functional importance of seismic gap and the need for this space to be left clear.

To maintain the functional purpose of the structure after a seismic event, all the utilities, electrical connections and waste pipelines should be designed to accommodate the maximum seismic displacement. The main connections between the building and the ground, such as stairs, entryways and elevators need to be unconnected across the isolation plane. In general, all the interaction between the structure and the ground need to be designed and detailed.

Seismic isolation provides immediate occupancy performance level following strong events. Costs and benefits of different approaches may be evaluated in determining the incorporation of seismic isolation.

In summary, the requirements for practical isolation system are defined by the performance objectives discussed above.

1. Flexibility
2. Damping
3. Resistance to Loads.

Additional requirements such as durability, cost, ease of installation and specific project requirements will influence device selection but all practical systems must contain these three essential elements.

Many types of isolation system have been proposed and have been developed to varying stages, with some remaining no more than concepts and others having a long list of installed projects.

IV. PRINCIPAL

Our principle of the base isolation system is to modify the response of the building so that the vibration occur due to the earthquake are not adsorb by the building and building become safe. For the completely rigid structure the relative displacement between the ground and structure will be zero.

The flexible building having infinite period. When the earthquake occur the relative displacement between the ground and building will be equal to the ground displacement. in this type the structure will not move, the ground will move.

V. SCRAP TYRE PADS AS BASE ISOLATION

Seismic base isolation is a method of putting a flexible system between the footing and superstructure. The natural vibration periods of the suspended building or structure shift towards larger values in the response spectrum causing reduction in the forces and accelerations in the suspended building. The acceleration that correspond to the natural period of the structural decrease therefore the damage of the earthquake on the structures reduces. Inter storey drifts decrease considerably and the super-structure on isolation system behaves similarly to a rigid body during earthquake motion.

Base isolation system studied in two ways

(1) Elastomer based System

(2) Slinding based system

Elastomeric bearing are the commonly used isolators in the design of seismically isolated structure. The dumping ratio is nearly 2% to 3% for the low damping rubber and 10% to 20% for the high damping rubber. Along with the low damping rubber and the high damping rubber lead-plug, and fiber-reinforced elastomeric bearing are used as common types of the elastomeric isolators. For the high vertical stiffness of the elastomeric steel reinforced is provided and for the low horizontal stiffness rubber layers are provided. Elastomeric based isolators may be mimicked using pads made out of scrap tire which are called scrap tire pads. Automobile tires are produced by vulcanizing steel mesh and cords with the rubber when the part that touches the ground is removed from the sidewalls of the tire and piled on the top of each other as rectangular rubber sheets, they form a scrap tire pads. The steel layers inside an elastomeric isolator have same effect as the steel cords inside tire layers. The terminology used for scrap tire pad includes: disposed scrap tires, a tire ring is the tread part of a tire that touches the ground and is obtained after cutting off the sidewalls of the tire. The tire bend is prepared by cutting the ring in transverse direction. Generally the length of scrap tire piece is about 0.20m long. The scrap tire pad is formed when a set of scrap tire layers are placed on the top of each other.

The layers forming a scrap tire pad can be sticked together using epoxy. The friction between tire layers must be large enough to keep scrap tire pad layers intact and working together. Different method such as axial compression, Static shear, dynamic and shaking table used for the study of the scrap tire used for base isolation.

CASE STUDY

All the structural engineer throughout the world know very well the base isolation method is very well effective to protect the building or structure against vibration. But the major disadvantage of base isolation method is installation of base isolation is very tedious. And also the cost of the base isolation is very high so that it can't be used in the normal residential building. Generally it can be adopted in the some special building such as government building, hospital, school, colleges.

If the earthquake occurs, the vibration starts. If the base isolation is provided beneath the structure or building that will absorb the shock of the earthquake and due to this building will become safe from earthquake. In India the technical and research Institute in nearly all the

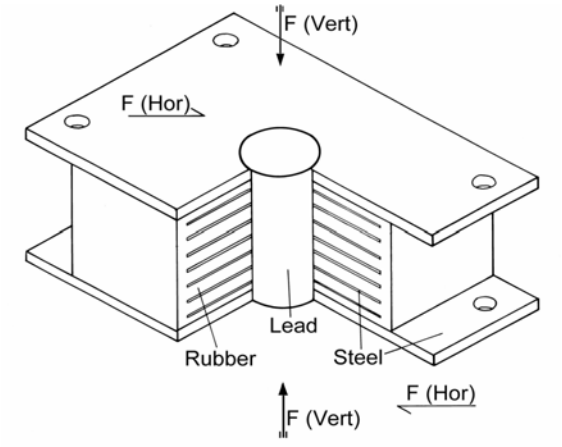
part of country but research of this base isolation is limited to only few IITs.

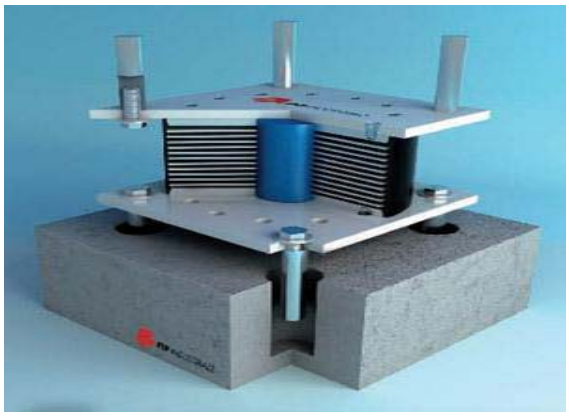
In Bhuj after 26-Jan-2001 earthquake, all the structure is made with base isolation system. Because Bhuj Come in Earthquake prone zone –IV, So earthquake comes frequently with high magnitude and intensity. So some necessary precaution must be taken to prevent the damage from severe Earthquake. We can't provide earthquake proof building because of high cost, but we able to made earthquake resist building with using base isolation method.

The lead rubber Bearing is used as base isolation material in Bhuj after 2001 Earthquake. A lead-rubber bearing is formed of a lead plug force-fitted into a pre-formed hole in an elastomeric 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, wind or traffic loads) 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 (which remains at all load levels) results from the steel-rubber construction of the bearing.

At higher load levels the lead yields and the lateral stiffness of the bearing is significantly reduced. This produces the period shift effect characteristic of base isolation. As the bearing is cycled at large displacements, such as during moderate and large earthquakes, the plastic deformation of the lead absorbs energy as hysteretic damping. The equivalent viscous damping produced by this hysteresis is a function of displacement and usually ranges from 15% to 35%.





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. These properties make the lead-rubber bearing the most common type of isolator used where high levels of damping are required (in high seismic zones) or for structures where rigidity under services loads is important (for example, bridges). As for HDR bearings, the elastomeric bearing formulas are also applicable for the design of LRBs.

A structure on sliding bearings would likely end up in a different location after an earthquake and continue to dislocate under aftershocks. The development of the friction pendulum system (FPS) shaped the sliding bearing into a spherical surface, overcoming this major disadvantage of sliding bearings. As the bearing moved laterally it was lifted vertically. This provided a restoring force. The development of the friction pendulum system (FPS) shaped the sliding bearing into a spherical surface, overcoming this major disadvantage of sliding bearings. As the bearing moved laterally it was lifted vertically.

Scrap rubber tire can also used for the base isolation. There are very large amount of friction between the two tire pads so it can be stick two tire together. Although there may be some slip between he tire, that would also helpful in the dissipation of energy. Rectangular shaped layers

cut from tread sections of used tires and then piled on the top of each other to form scrap tire pad can function as an elastomeric pad.

VI. SCOPE OF THE STUDY

The main objective of this study focuses on the experimental studies conducted on the development of low-cost seismic base isolation. Numerous studies have been conducted on seismic base isolation systems for almost a quarter decade. Although majority of the studies focus on the performance improvement of the base isolation systems, this study aims at cost and weight reduction in seismic base isolation pads

The Base Isolation is mostly used in very highly seismic area. Base isolation techniques is very high costly and literature indicates that base isolation techniques is economically not applicable in every building. base isolation is generally used in zone-4 and zone-5. In elastomer isolators, steel or fiber reinforcement vulcanized with rubber provides High vertical stiffness, whereas rubber segments between reinforcement layers provide low horizontal stiffness for the seismic base isolation

VII. CONCLUSION

Base isolation techniques used to make earthquake resistant building. This techniques which are used are more suitable for high rise building due to large over turning moment The techniques which is used is very high costly such as lead rubber bearing, laminated rubber bearing ,etc The techniques are technically complex to implement.

We are trying to find such material which is low in cost and economically affordable for new building in earthquake prone severe zone, and easy to apply on building and we can resist earthquake.

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