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## **Earthquake Resisting Brick (Sis Brick)**

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**Abstract**—*Sisbrick is a new class of earthquake-resistant building material that seismically isolates partition walls from the main building structure, significantly reducing the tension between these two elements and, therefore, the damage incurred. This paper is mainly dealing with developing a technique to isolate/insulate the masonry infill from the main structural frame of the building so as to make the theoretical and practical considerations to be somewhat identical. This can be done by providing such type of brick which will able to resist and absorb the movement at that point only, from where it transfers to the whole infill so as prevent the formation of compression struts and consequently prevents the damage/failure to column or other structural element with which it is connected.*

**Index Terms**— *Polyurethane, Sis Brick*

### **I. INTRODUCTION**

Earthquakes constitute one of the greatest hazards of life and property on earth. Due to the suddenness of this event it is considered as the most dreaded event which can't be predicted. India, being a developing country is most affected due to this life threatening event. Last decade (1991-2001) had been very severe for India, which was subjected to 5 damaging earthquakes. Out of all the five, recent damaging earthquakes, Kutch earthquake literally shook the nation, especially the professional community, who were involved in the building industry. At least 20,085 people killed, 166,836 injured, approximately 339,000 were destroyed and 783,000 damaged in the Bhuj-Ahmedabad-Rajkot area and other parts of Gujarat. Hence from the given statistical data, it was proved that there is a very major need of economical earthquake resistant structure for the developing country like India, to eradicate such a huge amount of loss of lives and property.

The usual structural system followed in construction of any structure is moment-resisting frame system. This type of structural system building comprises of two types of components or say elements namely structural elements and non-structural elements. The name only suggests that, the structural elements are those which carries the load and transfers it to other structural element and at last transfers the load to the ground below like slab, beam, column and foundation. Whereas the non-structural elements are those which do not carry any load but are provided only for architectural purpose and for compartmentalising like partition wall, contents of buildings, appendages to building, services and utilities. Thus, both structural and non-structural elements constitute the whole structural system.

### **II. MATERIAL AND METHODOLOGY**

As stated earlier in the introduction part, the proposed project consist of preventing the damage of the column and failure of masonry by providing a seismic insulated element i.e a brick which when used in a masonry infill at a particular location, will helps to absorb the forces and moments coming over the masonry infill and prevent its further transmission to the whole masonry resulting into preventing the formation of compression struts in the masonry infill and consequently prevent the failure of masonry and damages caused to the column due to formation of compression struts. This small step of preventing the failure of masonry will helps to avoid the huge loss of lives occurs even in the moderate earthquake.

The seismic insulated brick which is required to be provide in masonry infill should be made in such a way that it will able to absorb the moments to which the masonry is subjected. For this, the brick should be of such a material which will able to absorb the moment rather than resisting it. One of the method to fulfill such requirement is by making the brick of usual material (clay) with a flexible mesh like structure in between to absorb the moments coming over it. But this may arises some serious issue of bonding between the flexible mesh and clay.

Besides this, how the brick will able to absorb the in plane forces and moments coming over it due to the rigidity of the brick.

#### *A. Material Selection*

After doing some study, three different materials for matrix was selected. These materials were polyurethane, neoprene and rubber. These materials have their own different properties. A comparative study between these three shows that polyurethane is the best suited material among the alternatives. Therefore polyurethane is used as a matrix for the brick.

*B. Other Recommendations*

Polyurethane is a polymer composed of a chain of organic unit joined by carbamate links. While most Polyurethane are thermosetting polymer that do not melt when heated. Polyurethane polymers are formed by reacting an isocyanates and polyols( refer fig no. 1) . Both isocyanates and polyols used to make polyurethanes contain on average two or more functional group per molecule. Polyurethane products often are simply called “urethanes”. The rigid material for the mesh like structure in between the matrix can be taken as steel rods

( refer Fig 2) This is because, steel is a widely used material in construction work and its suitability to bear the loads. Thus a seismic insulated element will able to fulfill the requirement due to its special matrix. A flexible material is used as a matrix of the brick so that it will able to absorb the moments.

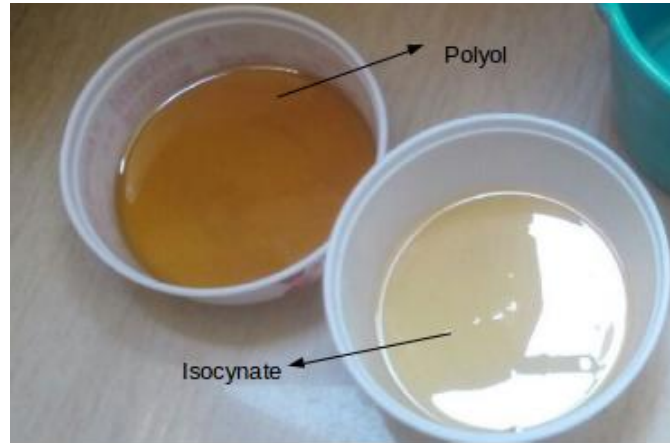


Figure 1



Figure 2

**III. EXPERIMENTAL WORK**

The main tests carried out on a conventional brick consist of compression strength test and water absorption test, shape and size test, colour test and soundness test. But the proposed brick is of polyurethane and therefore two main parameters for which the brick is tested are for its water absorption capacity and compression strength. The proposed brick consist of polyurethane material. Polyurethane are of two types i.e closed cell and open cell polyurethane. A closed cell is the one having no pores on its surface making it impermeable material whereas, an open cell is the one with the pores on the surface and are highly permeable. The polyurethane used in a proposed brick is of closed cell and therefore impermeable. Thus from this we can say that the water absorption capacity of the brick is nil and is a best suitable as a construction material in terms of water resistant capacity. Therefore the brick was tested for its compressive strength only. The compressive strength test will give the strength of the specimen in compression forces. The compression strength of a brick is determined by using a compression testing machine. Refer Figure 3 for experimental setup for testing.



Figure 3

#### **IV. RESULTS AND DISCUSSION**

The results show that the average compressive strength of the brick is 24.063 kg/cm<sup>2</sup>. From this we can say that the compressive strength of the sis brick is almost similar to that of conventional brick, as the compression strength of a conventional brick ranges from 20-35 kg/cm<sup>2</sup>

A sisbrick is very light in weight. At one side the weight of one standard size brick (19cm x 9cm x 9cm) is approximately 3.5 kg and on other side thesis brick (of density 40kg/cm<sup>3</sup>) of same size weighs merely 65gm. This means a sis brick is about 55 times lighter than a conventional brick. This will reduce various handling charges during its transportation.

#### **V. CONCLUSION**

- Polyurethane is a best suited material for a construction industry. Its use as a brick for Masonry purpose helps in achieving a seismic insulation sought.
- A sisbrick posses almost the same compression strength as of conventional brick.
- Beside this, the compression strength of the brick can be increased by doing some variations in the density of brick.
- Polyurethane also possess flexibility which when used as a matrix for a sisbrick will helps in absorbing the forces and moments to which it is subjected just like a damper in the large structures do.
- The economic impact of its use on the overall cost of an average building is very small also in return it provides the safety against the invaluable life of human.
- Thus, a sisbrick provides an innumerable advantages as compared to the conventional one.
- The future study of this product consist of, providing a solution about the bonding of the brick when used in a masonry work.

#### **VI. REFERENCES**

1. Zhang Cuiqiang,Zhou Ying,Zhou Deyuan and Lu Xilin,“Study on the effect of the infill walls on the seismic performance of a reinforced concrete frame”, Earthq Eng & Eng Vib (2011) 10: 507-517.
2. Niruba S, “Analysis of Masonry Infill in a Multi-Storied Building” , Civil Engineering Department, Erode Sengunthar Engineering College, Thudupathi, Erode, India.
3. H.J Shah, “Design of Reinforced Concrete Structures”, Book.
4. Matija Gams, A. Kwiecie., “Modeling of deformable polymer to be used for joints between infill masonry walls and R.C. frames” 2012.
5. K.E.KASAPOĞLU, “Earthquake Resistant Brick Design”, Better Housing Through Innovative Technology and Financing 1989, Pages 147-152