

# Study on Earthquake Resistant Building - (Base Isolation)

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**Abstract** — the purpose of this project is to provide a safe and a proper design of an earthquake resistant building. As earthquake has been and become one of the major disasters in human world, which has caused many deaths and chaos to human lives, due to which the economy of a particular country also goes down. And it also affects the natural balance of the world. So, it is essential that proper measures of prevention must be taken to cope up with such situations. So, adoption of base isolation using lead rubber bearing at foundation is done in our project for the protection of buildings and lives from the fatal earthquake vibration. It also preserves the economic and social state of a country.

**Keywords**— Earthquake, base isolation, shear wall, foundation, lead rubber, seismic force.

## Introduction

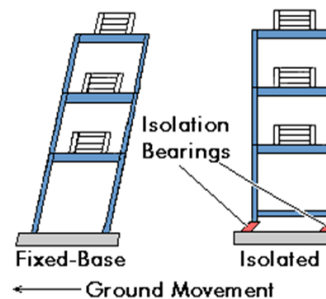
An earthquake has been a major threat to human kind and the world, in the unrecorded and recorded human history. It causes an active shaking due to volcanic eruption, which causes the failure of weak and badly designed structures, leading to the innumerable fatalities.

Base isolation technique is commonly adopted as safety precaution in earthquake prone areas all over the world. It is implemented in the foundation section of the structure to reduce the effects and damages caused by an earthquake. This system is designed to take the weight of the building and let the foundations move sideways during the earthquake. It provides flexibility at the supports of a structure in the horizontal plane. Seismic isolation can increase the performance expectation of structure in life and also minimizes damage. [1]

## I. OUR WORK:

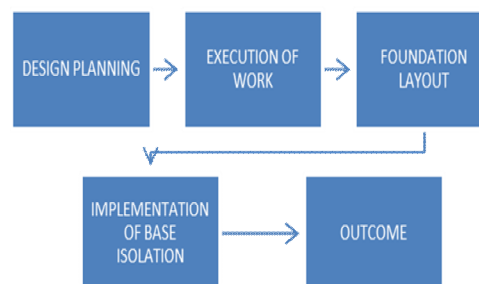
The type of base isolation implemented in our project for design of earthquake resistant building is lead rubber bearing. An isolation rubber bearing consist of alternating rubber layers bonded between thin steel plates to provide lateral flexibility. During the movement of earthquake the rubber provides flexibility that allows it to move along the movement of the earthquake and slowly comes back to its original shape or position when the shaking is off

and in that case steel that is provided between the rubber holds the rubber in a vertical direction by providing stiffness. As earthquake is unpredictable and can come up anytime, the people won't be mentally prepare for that particular situation and it can be more troublesome if the collapse of structure takes place, which may cause many accidents including the deaths of people. The occurrence of earthquake will deeply affect an individual's life. So, we have designed an earthquake resistant building with base isolation, in order to tackle these kinds of situations and as well as to provide people a safer home or place to live in.[2]



(Fig:1) fixed base and isolated base of a building.

## II. BLOCK DIAGRAM



(Fig: 2) block diagram

**A. DESIGN PLANNING:**

The area selected is located at CCCT, Chisopani, South Sikkim of area 16128\* 12075mm. The design of our structure is mainly based upon base isolation with lead rubber bearing. The total area of the plan is (14 x 8.025)m<sup>2</sup>, which consist of G+2 storey, 2BHK building. It is designed for 3 families with 5 members in each. We have designed a building for hilly areas. Shear wall is also provided along the stair wall and it is provided to resist the shear force and bending moment by proper design of reinforcement.[2]

**B. EXECUTION OF WORK:**

The design calculation of slab, beams, columns and footings` is done as per IS- 875 1987, IS- 456 2000 and IS- 13920 1993.We have also provided shear wall on the stair hall of about 24000\* 250mm.[3]

**C. FOUNDATION LAYOUT:**

The foundation trench is dug 12 feet below the ground level where the foundation is laid provided with the lead rubber bearing, the foundation we have provided `is deep foundation as the soil available at our site is soft in nature. The footing adopted is isolated footing.[4]

**III.BASE ISOLATION**

Base isolation is the most commonly adopted method for earthquake resistant building. It is the method of providing a support to the foundation for the buildings in seismic zones as it enables the reduction in earthquake induced forces by increasing the period of vibration of the structure. It effectively protects the structure against extreme earthquake without sacrificing performance during the move frequent, moderate seismic events. With the conventional method of building earthquake structure, the structure may survive of the earthquake but then it may not remain operational after any major seismic event. This technique of base isolation not only prevents the earthquake from any serious damages but also maintains functionality i.e. building remains operational after earthquake.

The base isolator adopted in our project is lead rubber bearing which consist of the layers of rubbers sand witched within the steel layers with lead plug in the middle and the plate in its base.[5]

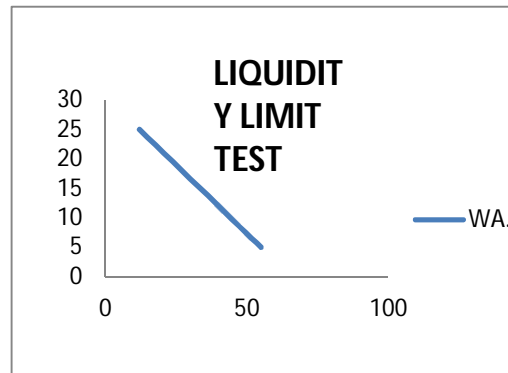


(Fig:3) actual picture of base isolation in a building.

**IMPLEMENTATION OF BASE ISOLATION:**

Lead rubber bearing is used as a base isolation in which the bearings are stiff in vertical direction and very flexible in horizontal direction. The vertical stiffness is achieved through the steel plate layers of 5mm, which is laid between each alternative layers, it does not let the rubber to dispatch from their position by holding them tight.[5]

**EXPERIMENT CONDUCTED:**

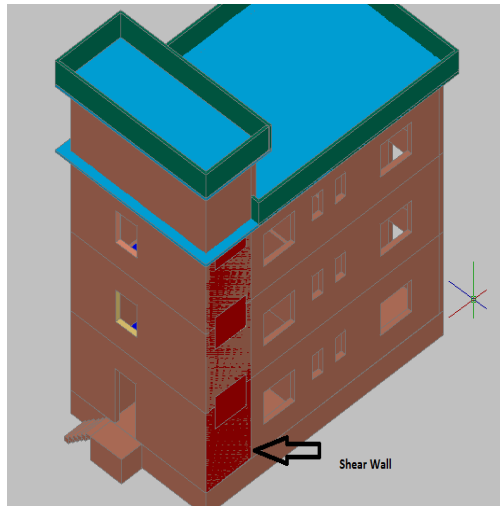


(Fig:4) graph of liquid limit.

**IV.SHEAR WALL:**

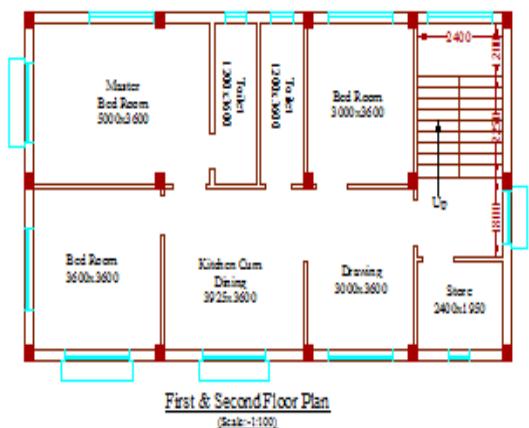
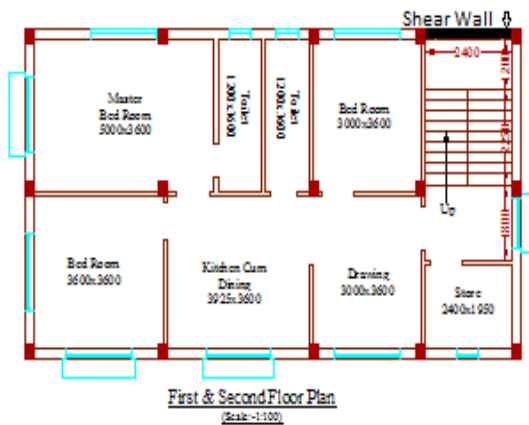
It is a structural system composed of braced panels also known as shear panel to counter effect of lateral loads acting on a structure. As per IS – 13920 we have provided shear wall in the stair hall of about 24000\* 250mm. The common loads that a shear wall resist is wind and seismic loads. It resists the large shear force and bending moment. This starts at the foundation level and are continuous throughout the building height, it is usually provided along both length and width of building. The prime function of shear wall in this building design is to resist horizontal earthquake forces and to provide lateral

stiffness for the prevention of excessive side sways of the roof and floors. The relative lateral deflection in any of the storey of building should not exceed the storey height divided by 500.[6]



(fig:5) building with shear wall.

### III. BUILDING PLAN LAYOUT: 6



(Fig:6) building plan.

Following are the main components required to build this structure –

#### EAD PLUG:

Lead was chosen because of its plastic property as it has the capability of deforming many times without losing its strength during the movement of the earthquake and thus, will return back to its earlier state.[7]

#### RUBBER:

The rubber that we considered in our project is vulcanized rubber as it has an excellent elasticity, low water absorption tendency and is more durable as compared to natural rubber.[7]

#### STEEL:

T.M.T steel has been considered in this design due to its multi properties i.e. high ductility, super bond strength, bendability, weldability and is economical as compared to other steel in market.[7]

#### CONCRETE:

M20 grade of concrete is adopted i.e., 1:1.5:3.[8]

#### V. ADVANTAGES:

- Maintenance cost is low.
- Provide sense of security to the people.
- It is durable and strong.
- Longer life span as compared to the normal structure.

#### VI. RESULTS/ OUTCOME:

- The building was designed successfully as per IS 875 -1987, IS 456- 2000 & IS 13920- 1993.
- It is certain that the base isolation provided will resist the earthquake.
- The maximum earthquake forces that our design can withstand are upto the magnitude of 9.

#### VII. CONCLUSION:

The building was successfully designed. It is evidence that the use of base isolation and shear wall in the structure can be used to bear the maximum load of an earthquake and the maximum magnitude that it can withstand is up to 9M as the location for which this building has been designed lies in zone IV, where the maximum magnitude recorded till date is up to 8M. The seismic base isolation method has proved to be a reliable method of earthquake resistance design unlike a building without base isolation, As base isolation method is usually adopted only for commercial buildings i.e. hospitals, malls, office buildings, the residential building is neglected highly. But, if this method is

adopted in the constructions of residential buildings also, it would ensure much safety to the lives of the people and leads to less destruction of the world.

#### **FUTURE SCOPE:**

- We can add some more techniques and develop a new and better building design through.
- Strong and durable buildings can be constructed.

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