What is a Base Isolation System?

A base isolation system is a method of seismic protection where the structure (superstructure) is separated from the base (foundation or substructure). By separating the structure from its base the amount of energy that is transferred to the superstructure during an earthquake is reduced significantly.

These base isolation systems often tend to include one or more type of bearing to support the weight of the structure. Some examples of these components are; elastomeric pads, sliding plates or inverted pendulums. All of these components can provide some level of energy dissipation, but typically only in the form of hysteretic damping. Hysteretic damping has certain limitations in terms of energy absorption and can excite higher modes in some cases.

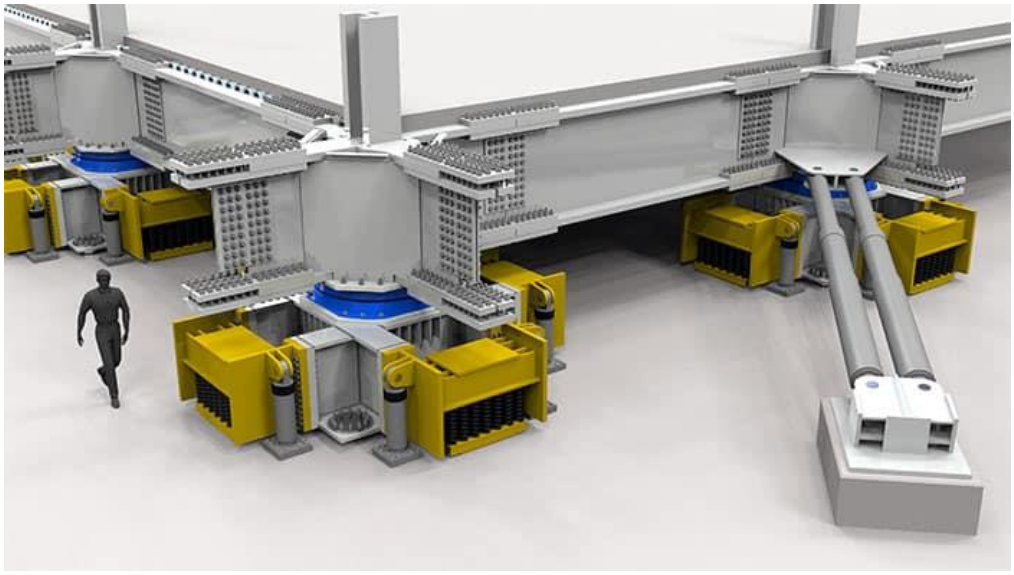

Fig: 1 Base Isolation System

How Base Isolation System Works

Base isolation is widely used in the earthquake-resistant design. This passive control technique basically decouples the structure from the ground motion by introducing a flexible or sliding type interface. During the earthquake, when the frequency of the ground motion is close to the natural frequency of the building, the structure can sway significantly. Base isolation deflects and dissipates the seismic energy, lowering the natural

frequency of the structure. That way, the base isolation minimizes the displacement of the structure and protects its structural integrity

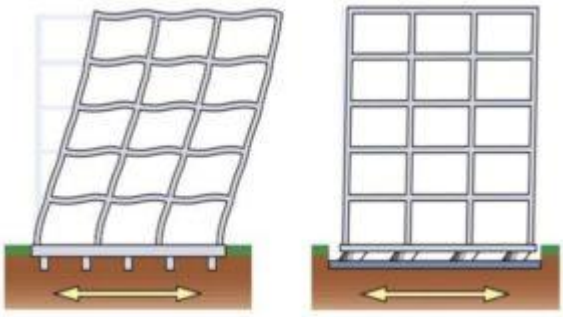

Fig: 2 Base isolation mitigates motion of the structure due to seismic activity.

Base Isolation Systems

Structural engineers use two types of base isolation systems – or their combination – to enhance the earthquake resistance of the structure: elastomeric bearings and sliding isolation bearings.

Elastomeric bearings consist of layers of natural or synthetic rubber that act in the isolator as a spring. This method is well-known in isolating vibrating machines. Civil engineers used it for the first time in 1969 to protect an elementary school in Skopje, Republic of Macedonia

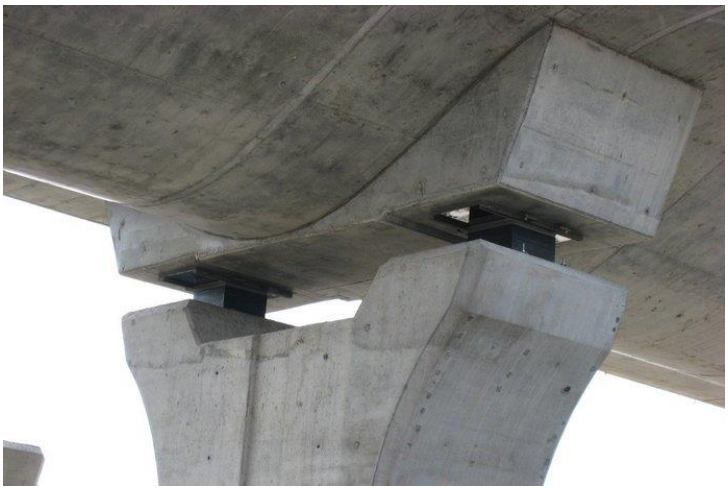

Fig: 2 Elastomeric bearings

Sliding isolators work on a principle of friction, limiting the transfer of shear across the isolation interface. Imagine two plates that can slide over each other: the sliding starts only when the exciting force of the earthquake is greater than the frictional force between the plates. As a result, the displacement motion of the isolator is of a stick-slip nature.

Fig: 3 Sliding Isolator

Friction Pendulum Bearings

Sliding isolators can be implemented in different ways. Pure friction systems use flat stainless-steel plates to introduce the sliding motion. However, this technique has some limitations. Their main disadvantage is due to the geometry of the sliding surface – it can produce large and residual sliding displacements. Friction pendulum systems, based on pendulum motion principles, overcome these issues. As the picture below illustrates, in an earthquake the slider moves along the spherical concave surface of the bearing, helping minimize the motions of the mass caused by seismic activity. At the end of the earthquake,

the gravitational force returns the slider to its original position, minimizing the residual displacement

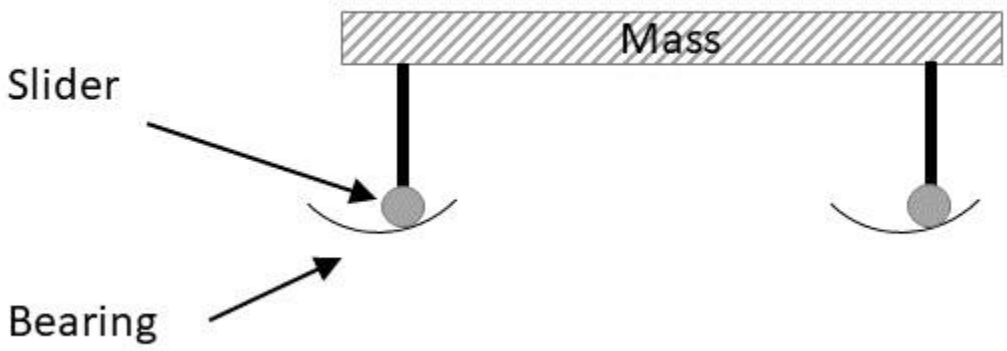

Fig: 4 Friction Pendulum Bearings

Base isolation system consists of isolation units with or without isolation components

1. **Isolation units** are the basic elements of a *base isolation system* which are intended to provide the aforementioned decoupling effect to a building or non-building structure.

2. **Isolation components** are the connections between *isolation units* and their parts having no decoupling effect of their own.