EARTHQUAKE RESISTANT STRUCTURE

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ABSTRACT

Earthquakes are serious problem as they affect life in hazardous manners. The Earthquake are mainly prevented by two methods namely Base Isolation Methods and Seismic Dampers. This report deals with Base Isolation and Seismic Dampers Methods in brief manner. Inertia is the reason for any building's displacement in the direction opposite to that of ground's motion. Baseisolated buildings undergo four times less acceleration as compared to fixed-base buildings. Reducing the vibrations in the structure is another way of resisting damage. This is where dampers come into play.

Keywords: *Advanced Earthquake Resistant Techniques, Base Isolation, Seismic Dampers, Seismic Response*

I. WHAT IS AN EARTHQUAKE?

- An earthquake is the vibration of Earth produced by the rapid release of accumulated energy in elastically strained rocks
- Energy released radiates in all directions from its source, the focus
- Energy propagates in the form of seismic waves
- Sensitive instruments around the world record the event

WHAT CAUSES AN EARTHQUAKE?

Movement of Tectonic Plates

Earth is divided into sections called Tectonic plates that float on the fluid-like interior of the Earth. Earthquakes are usually caused by sudden movement of earth plates

Rupture of rocks along a fault

Faults are localized areas of weakness in the surface of the Earth,sometimes the plate boundary itself

HOW EARTHQUAKE CAUSES DAMAGE

- The severe shaking produced by seismic waves can damage or destroy building & bridges , topple utility poles & fracture gas and water mains.
- S wave can put stress on building to tear them apart. Also trigger landslide or avalanches.

II. EARTHQUAKE RESISTANT DESIGN TECHNIQUES

The conventional approach to earthquake resistant design of buildings depends upon providing the building with strength, stiffness and inelastic deformation capacity which are great enough to withstand a given level of earthquakegenerated force. This is generally a ccomplished through the selection of an appropriate structural configuration and the careful detailing of structural members, such as beams and columns, and the connections between them.

But more advanced techniques for earthquake resistance is not to strengthen the building, but to reduce the earthquake-generated forces acting upon it.

Among the most important advanced techniques of earthquake resistant design and construction are:

Base Isolation Energy Dissipation Devices

Base Isolation

A base isolated structure is supported by a series of bearing pads which are placed between the building and the building's foundation. (See Figure 1.) A variety of different types of base isolation bearing pads have now been developed.
The bearing is very stiff and strong in the vertical direction, but flexible in the horizontal direction.

Earthquake Generated Forces

To get a basic idea of how base isolation works, examine Figure 2. This shows an earthquake acting on both a base isolated building and a conventional, fixedbase, building. As a result of a e arthquake, the ground beneath each building begins to move. In Figure 2, it is shown moving to the left. Each building responds with movement which tends toward the right. The building undergoes displacement towards the right. The building's displacement in the direction opposite the ground motion is actually due to inertia. The inertial forces acting on a building are the most important of all those generated during an earthquake.

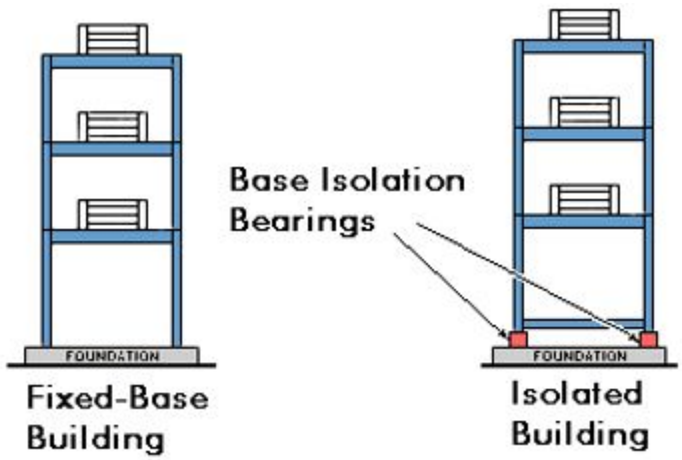

Figure 1: Base-Isolated and Fixed-Base Buildings

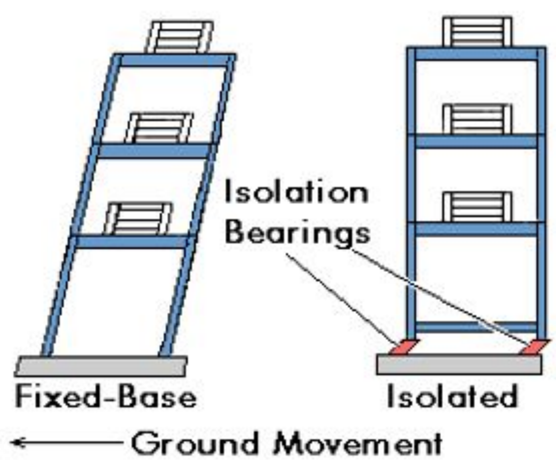

Figure 2: Base-Isolated, Fixed-Base Buildings

It is important to know that the inertial forces which the building undergoes are proportional to the building's acceleration during ground motion. It is also important to realize that buildings don't actually shift in only one direction. Because of the complex nature of earthquake ground motion, the building actually tends to vibrate back and forth in varying directions.

Deformation and Damages

In addition to displacing toward the right, the un-isolated building is also shown to be changing its shape-from a rectangle to a parallelogram. It is deforming. The primary cause of earthquake damage to buildings is the deformation which the building undergoes as a result of the inertial forces acting upon it.

Response of Base Isolated Building

By contrast, even though it too is displacing, the base-isolated building retains its original, rectangular shape. It is the lead-rubber bearings supporting the building that are deformed. The base-isolated building itself escapes the deformation and damage–which implies that the inertial forces acting on the base-isolated building have been reduced. Experiments and observations of base-isolated buildings in earthquakes have been shown to reduce building accelerations to as little as 1/4 of the acceleration of comparable fixed-base buildings, which each building undergoes as a percentage of gravity. As we noted above, inertial forces increase, and decrease, proportionally as acceleration increases or decreases.

Acceleration is decreased because the base isolation system lengthens a building's period of vibration, the time it takes for the building to rock back and forth and then back again. And in general, structures with longer periods of vibration tend to reduce acceleration, while those with shorter periods tend to increase or amplify acceleration.Finally, since they are highly elastic, the rubber isolation bearings don't suffer any damage. But the lead plug in the middle of our example bearing experiences the same deformation as the rubber. However, it generates heat. In other words, the lead plug reduces, or dissipates, the energy of motion–i.e., kinetic energy–by converting that energy into heat. And by reducing the energy entering the building, it helps to slow and eventually stop the building's vibrations sooner than would otherwise be the case–in other words, it damps the building's vibrations.

Energy Dissipation Devices

The second of the major new techniques for improving the earthquake resistance of buildings also relies upon damping and energy dissipation, but it greatly extends the damping and energy dissipation provided by lead-rubber bearings.

As we've said, a certain amount of vibration energy is transferred to the building by earthquake ground motion. Buildings themselves do possess an inherent ability to dissipate, or damp, this energy. However, the capacity of buildings to dissipate energy before they begin to suffer deformation and damage is quite limited. The building will dissipate energy either by undergoing large scale movement or sustaining increased internal strains in elements such as the building's columns and beams. Both of these eventually result in varying degrees of damage.

So, by equipping a building with additional devices which have high damping capacity, we can greatly decrease the seismic energy entering the building, and thus decrease building damage.

Accordingly, a wide range of energy dissipation devices have been developed and are now being installed in real buildings. Energy dissipation devices are also often called damping devices. The large number of damping devices that have been developed can be grouped into three broad categories:

Friction Dampers: these utilize frictional forces to dissipate energy
Metallic Dampers : utilize the deformation of metal elements within the damper
Viscoelastic Dampers : utilize the controlled shearing of solids
Viscous Dampers: utilized the forced movement (orificing) of fluids within the damper

Fluid Viscous Dampers

General principles of damping devices are illustrated through Fluid Viscous damper. Following section, describes the basic characteristics of fluid viscous dampers, the process of developing and testing them, and the installation of fluid viscous dampers in an actual building to make it more earthquake resistant.

Damping Devices and Bracing Systems

Damping devices are usually installed as part of bracing systems. Figure 3 shows one type of damper-brace arrangement, with one end attached to a column and one end attached to a floor beam. Primarily, this arrangement provides the column with additional support. Most earthquake ground motion is in a horizontal direction; so, it is a building's columns which normally undergo the most displacement relative to the motion of the ground. Figure 3 also shows the damping device installed as part of the bracing system and gives some idea of its action.

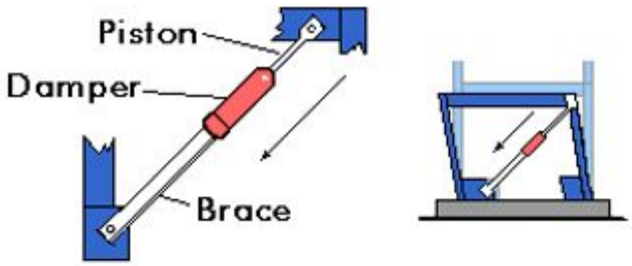

Figure 3: Damping Device Installed with Brace

III. CONCLUSION

Technology is available to drastically mitigate the earthquake related disasters. This is confirmed by minimal damage generally without any loss of life when moderate to severe earthquake strikes developed countries, where as even a moderate earthquake cause's huge devastation in developing countries as has been observed in recent earthquakes. The reason being that earthquake resistant measures are strictly followed in these countries where as such guidelines are miserably violated in developing countries. The administration system is efficient and effective in developed countries, and its not the same in developing countries – so the government should ensure the implementation of earthquake resistant design guidelines. So it is here that civil engineers in general and structural engineers in particular have a great role to play in mitigating the sufferings caused by earthquake related disasters.

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