

# LECTURE # 4



**In this lecture you will learn about:**

Various Mechanisms To Dissipate Energy Imparted To a Structure By Earthquake

1. Base Isolation
2. Seismic Dampers

**Course Name**

“Introduction To Earthquake Engineering”

**Course Code: CT-634**

**Credit Hours: 3**

**Semester: 6<sup>TH</sup>**

**Prepared By: Engr. Khurshid Alam**



# MECHANISMS TO DISSIPATE ENERGY IMPARTED TO A STRUCTURE BY EARTHQUAKE

In this lecture we will study about two mechanism which dissipate energy imparted to a structure by earthquake. They are:

1. Base Isolation
2. Seismic Dampers



# BASE ISOLATION

Base isolation, also known as seismic base isolation or base isolation system, is one of the most popular means of protecting a structure against earthquake forces. It is a collection of structural elements which should substantially decouple a superstructure from its substructure resting on a shaking ground thus protecting a building or non-building structure's integrity.

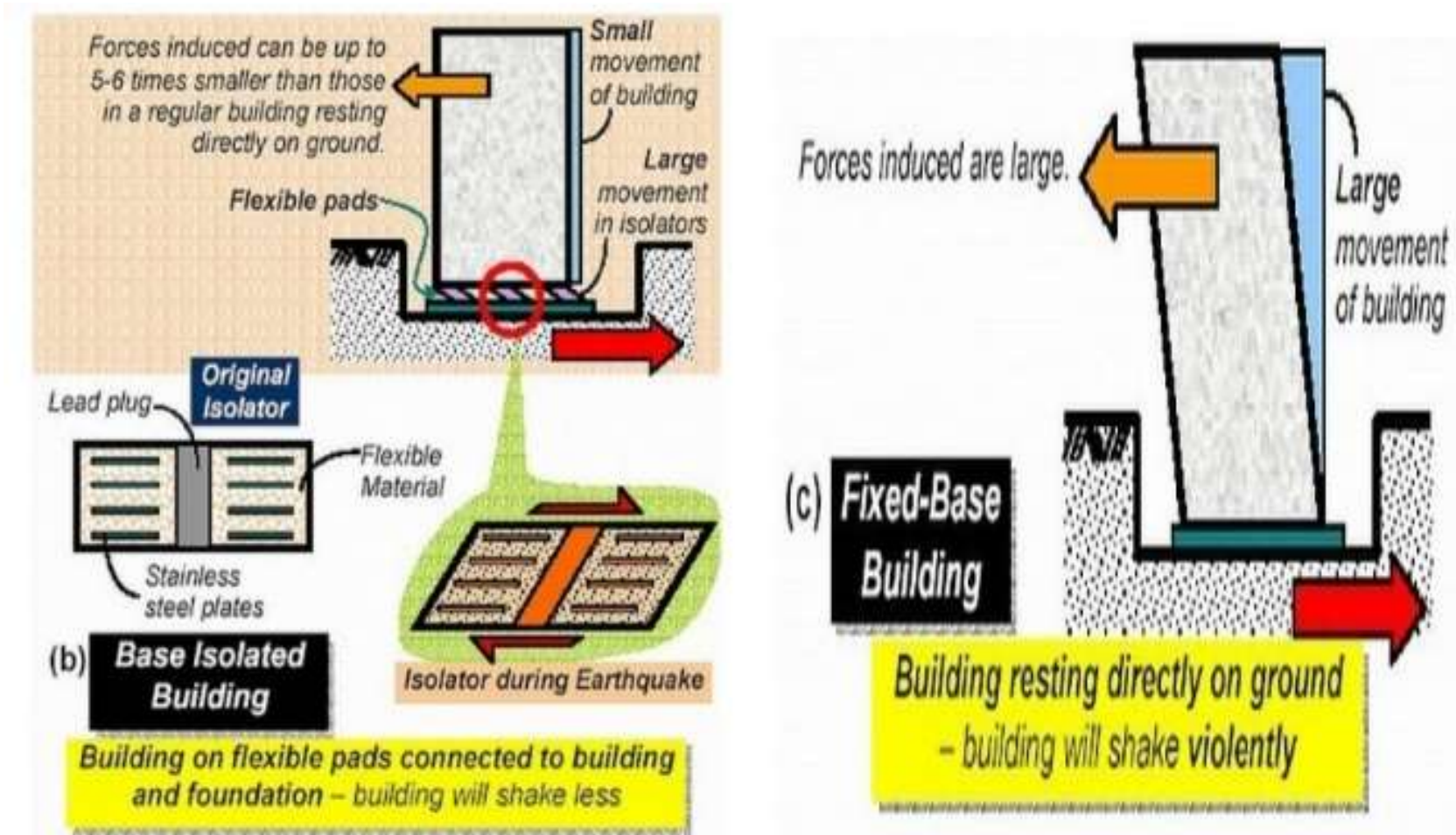


# BASE ISOLATION

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

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

# EFFECT OF BASE ISOLATION



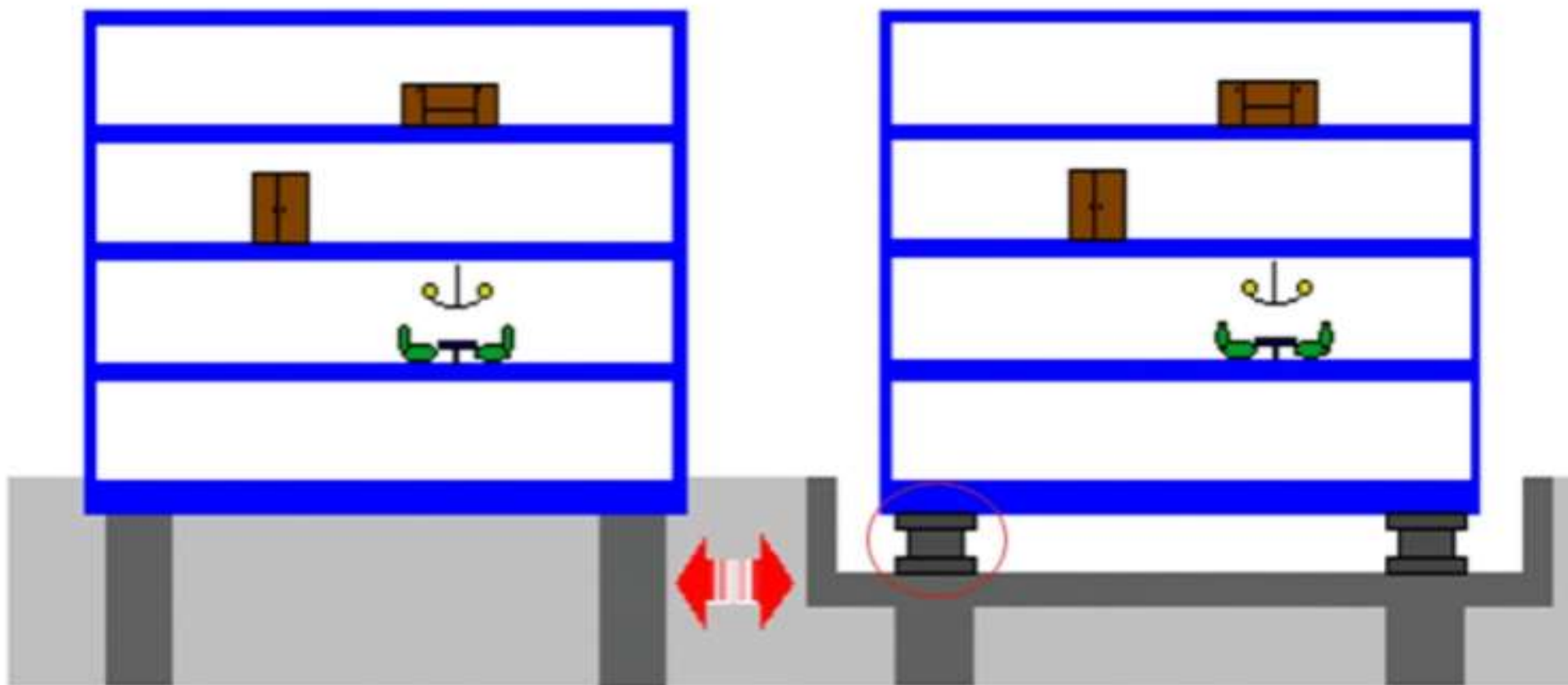


# PRINCIPLE OF BASE ISOLATION

The main principal of base isolation is to try and isolate the structure from the ground movement so you could just about put it on ball bearings if you like and the ground could move underneath it and the building stays still.

# PRINCIPLE OF BASE ISOLATION

Principle Diagram of Anti – Earthquake Rubber Bearing



Prepared By: Engr. Khurshid Alam



# TYPES OF BASE ISOLATION

Base isolation is carried out mostly by using:

1. Laminated Rubber Bearing (LRB)
2. Spherical Isolation Sliding Bearing

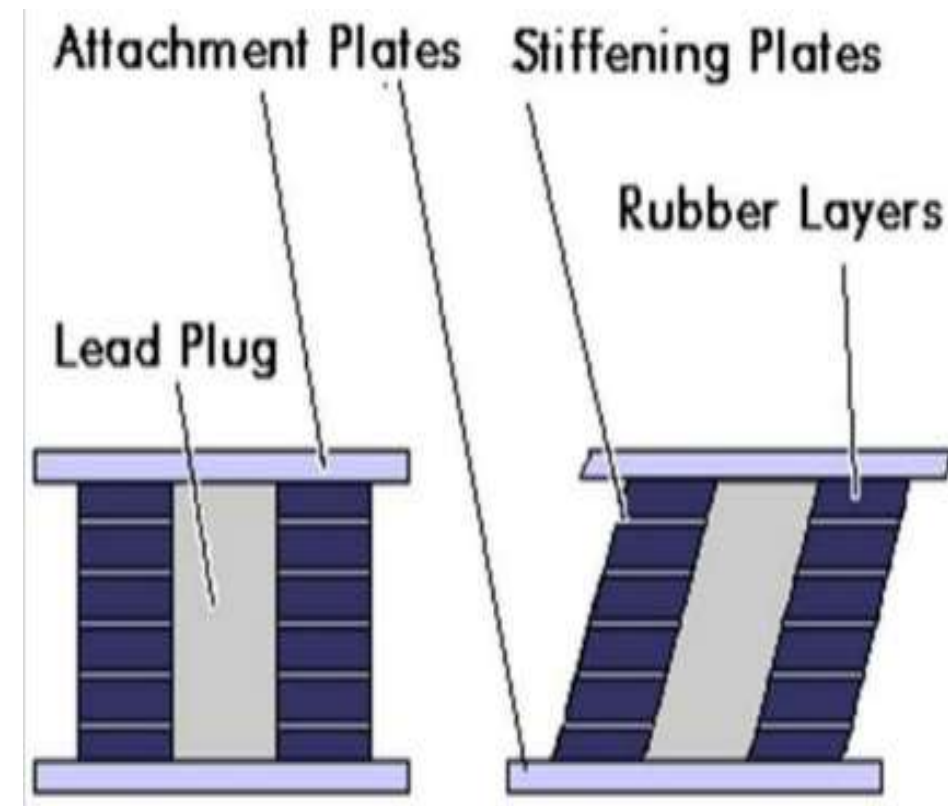


# LAMINATED RUBBER BEARING

The bearing is very stiff and strong in the vertical direction, but flexible in the horizontal direction.

Laminated rubber bearing (LRB). Lead-Rubber Bearing Lead plug in the middle of bearing experiences the same deformation as the rubber. However, it also generates heat as it does so. In other words, the lead plug reduces, or dissipates, the energy of motion-- i.e., kinetic energy--by converting that energy into heat

Base Isolation



**Laminated Rubber Bearing**

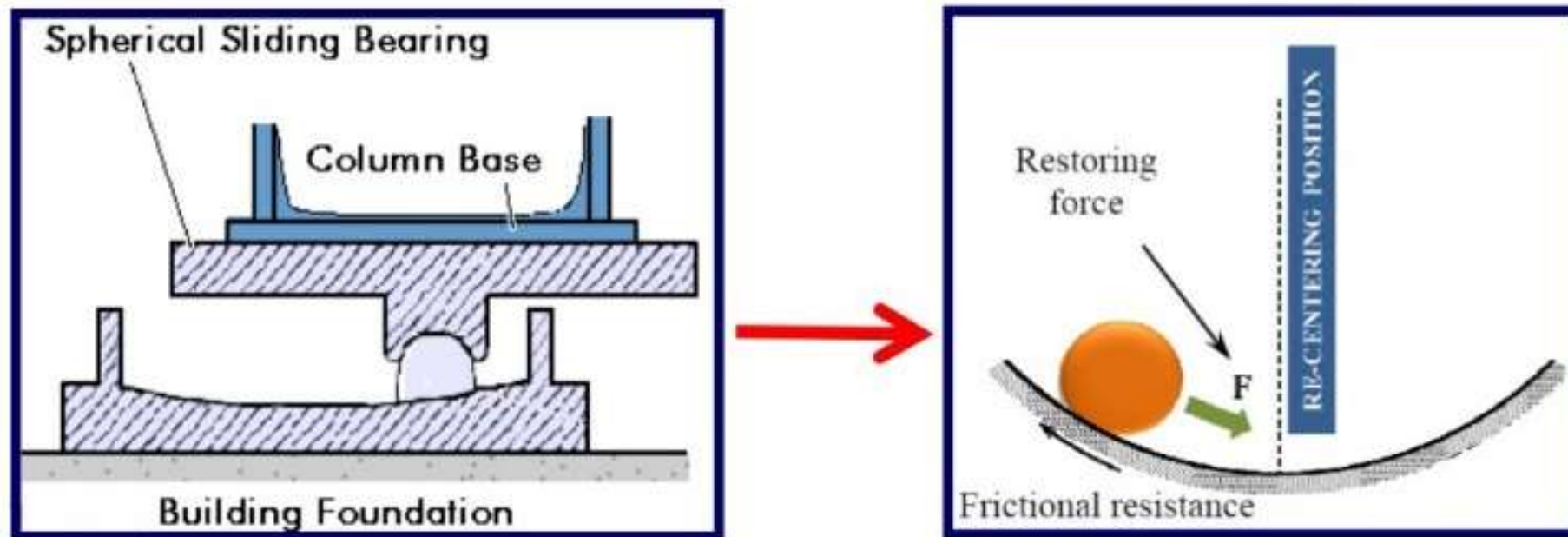
# LAMINATED RUBBER BEARING



**Prepared By: Engr. Khurshid Alam**

# SPHERICAL ISOLATION SLIDING BEARING

Spherical Sliding Isolation Systems are another type of base isolation. The building is supported by bearing pads that have a curved surface and low friction.



**Spherical Isolation Sliding Bearing**

**Prepared By: Engr. Khurshid Alam**



# SPHERICAL ISOLATION SLIDING BEARING

- The force needed to move the building upwards limits the horizontal or lateral forces (Transformation of K.E into P.E & vice versa) which would otherwise cause building deformations.
- It should be noted that base isolation is not suitable for tall high rise buildings or buildings located on soft soil.
- Base isolation is most effective for short to medium rise buildings located on hard soil.



# SEISMIC DAMPERS

Another method for controlling seismic damage in buildings is the installation of seismic dampers. In this case, the dampening is provided by a lead-based device

Ground movement forces the lead to pass through a narrow gap. When the direction of movement changes, the flow of lead is reversed. The principle is still the same as the lead rubber bearing, with kinetic energy being converted into heat energy, thereby preventing the building absorbing the kinetic energy.



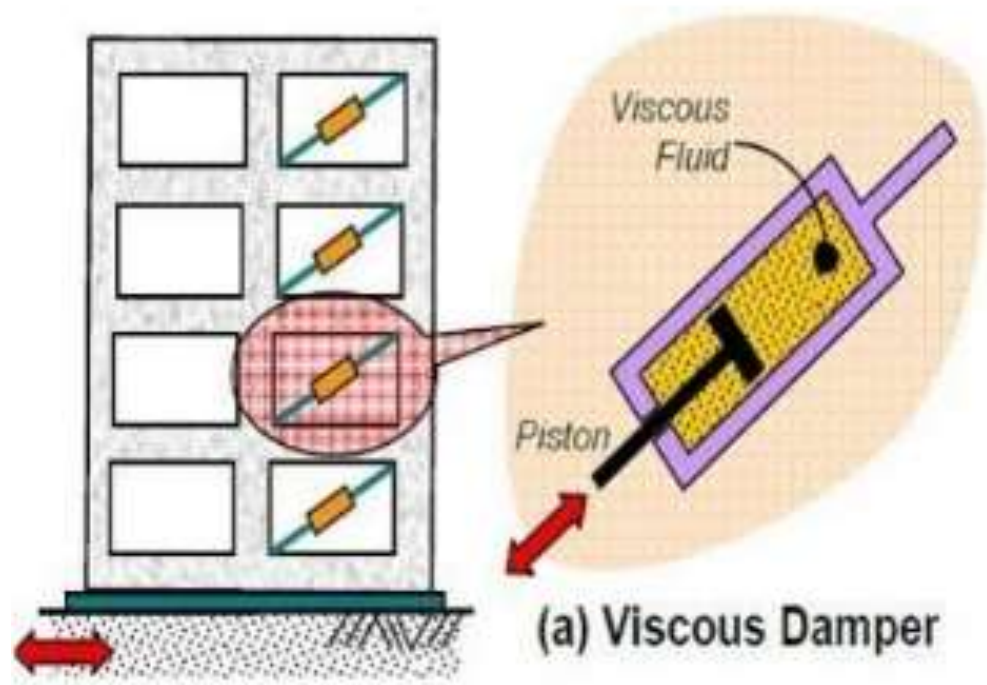
# TYPES OF SEISMIC DAMPERS

There are three types of seismic dampers

1. Viscous Dampers
2. Friction Dampers
3. Yielding Dampers

# VISCOUS DAMPERS

Energy is absorbed by silicone-based fluid passing between piston-cylinder arrangement





# FRICITION DAMPERS & YIELDING DAMPERS

## **FRICITION DAMPERS**

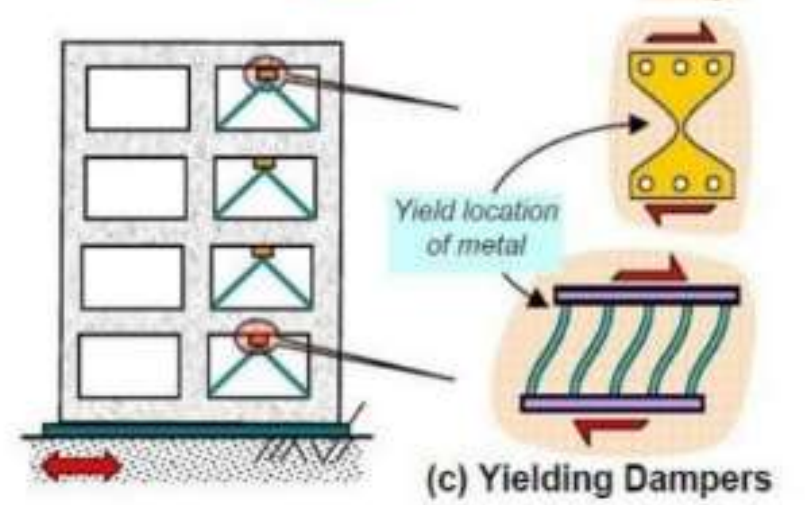
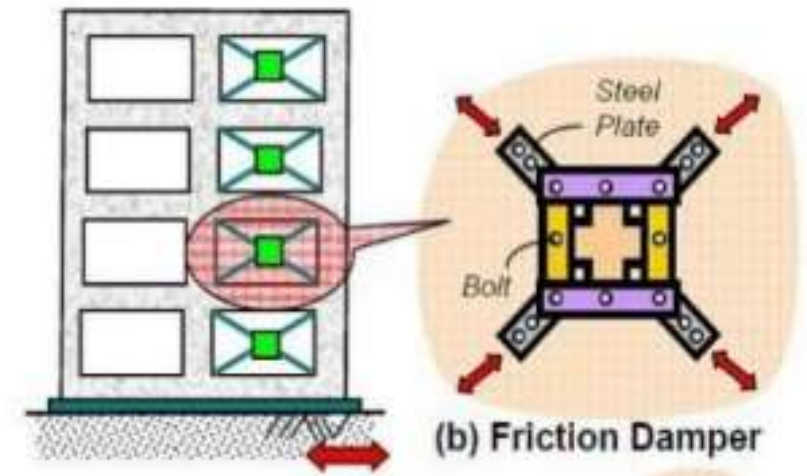
Energy is absorbed by surfaces with friction between them rubbing against each other

## **YIELDING DAMPERS**

Energy is absorbed by metallic components that yield



# FRICITION DAMPERS & YIELDING DAMPERS



Prepared By: Engr. Khurshid Alam

# FRICTION DAMPERS & YIELDING DAMPERS



**Prepared By: Engr. Khurshid Alam**

# ASSIGNMENT - 2

Write a detail note on the following

- Tuned Mass Damper (TMP).
- Advantages & Disadvantages of Base Isolation

## **NOTE**

Assignments are also included in paper.

Thank You