Isolation of Base

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Abstract - After much research and development for anti-seismic structures haven't yielded satisfactory results. Studies were being conducted on fixed base structures, but it could be performed on isolated structures. It showed that isolators minimize the lateral load imposed on the structure and reduces size of building components. Base isolation has turned out to be a fruitful design.

INTRODUCTION –

The naturally occurring ground movement leading to destruction is known to be EARTHQUAKE. The energy released forms waves. These waves are primary and secondary waves. These waves transmit ground movement to structure through foundation. Depending on intensity of vibrations, cracks and settlement is caused. Inertia force is induced because of earthquake movement resulting in damage. Engineers use ductility to attain more deformation on structure than permitted elastic limit by increasing small sum of forces. The highest point at which the structure can deform and regain shape is called as Elastic limit. If deformation exceeds elastic limit, cracks are formed. However, ductility induces acceptable damage to structure. By introduction of more elasticity, total cost increases and damage decreases, that will be harmful to components of building with less strength.

Base isolation is usually adopted earthquake resistance system. It diminishes effect of ground motion thus nullifying effect of earthquake. Bifurcating structure from ground by introducing flexible isolation system between foundation and structure prevents damage to structure above. The system will take shock effects of earthquake with its flexibility. In this manner structure will remain stable for a relative period. It increases natural period of structure and reduces displacement.

BASE= a part beneath a foundation

ISOLATION= decoupling a structure from foundation

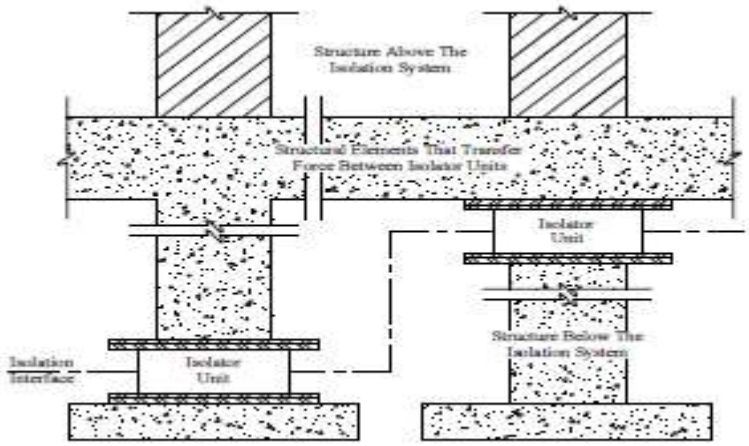

Figure Isolation system terminology

PRINCIPLE- To differentiate building from foundation , so during seismicity, building stays unharmed. Flexible structure will have longer survival. When ground moves, no acceleration is found. Displacement between structure and ground is same to amount of ground displacement.

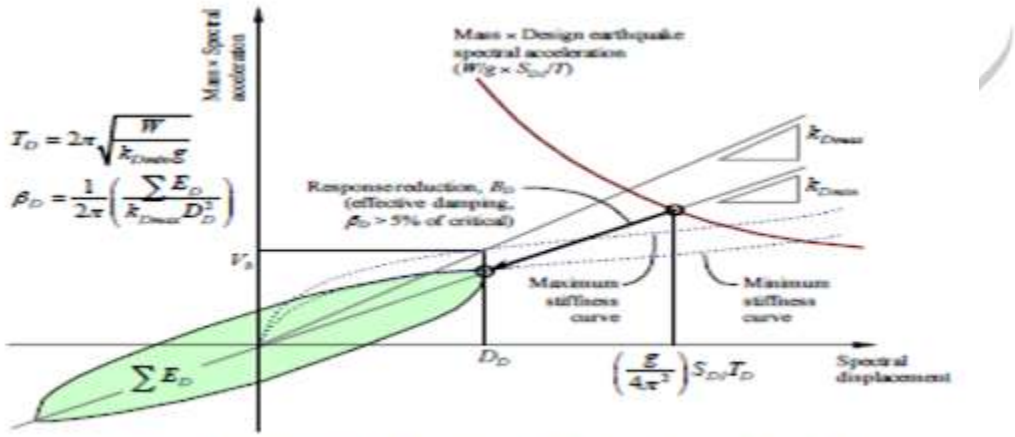

Figure Isolation system capacity and earthquake demand

PRINCIPLE IN BASE ISOLATION –

- To provide horizontal flexibility and vertical stiffness to building.
- To increase natural period of building.
- Damping in isolation system reduces displacement.
- It reduces acceleration of storey.

Base isolation system consists of:

- An elastic mount to add enough vibration periods to lower down forces in structure over
- An energy dissipater or damper to ease deflection
- Introduction of stiffness against seismic actions and wind loads

Base Isolation Consideration-

- Need to increase safety of structure.
- Low lateral seismic forces needed
- Any existing building is unable to withstand any earthquake
- Withstand minor earthquakes without any damage
- Structure will not collapse in major earthquake but some structural and non-structural damage occurs.

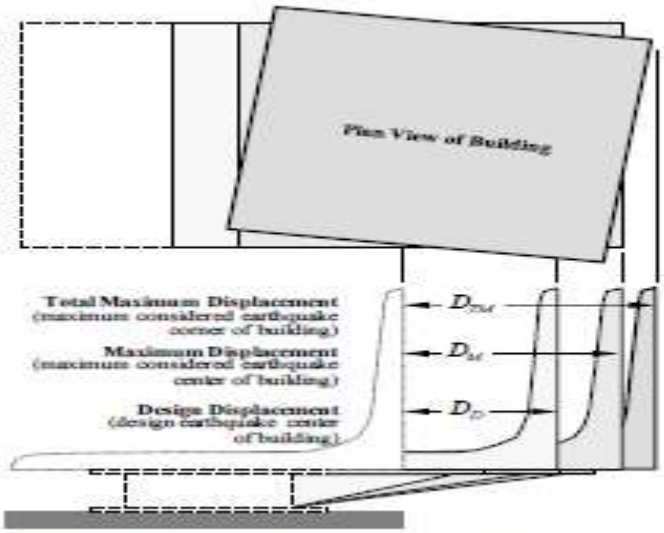

Figure Design, maximum and total maximum displacement

Different Types of Seismic Isolator-

1. Laminated Rubber (Elastomeric) Bearing
    - Natural and synthetic rubber bearing (low damping)
    - Natural rubber bearing (high damping)
2. Lead Rubber Bearing (LRB)
3. Friction Pendulum System (FPS) Bearing

1. Laminated Rubber (Elastomeric) Bearing-
    - Low Damping Rubber Bearing-

It is made of alternate layers of natural rubber providing flexibility and steel reinforcing plates leading to vertical load-carrying capacity. At top and bottom of layers are steel laminated plates distributing vertical loads and transfer of shear force to internal layers of rubber. Used in residential buildings, hospitals and halls constructed on subway or railroads.

- High Damping Rubber Bearing-

Damping in the bearing is increased by adding extra-fine carbon block, oils or resins and other proprietary fillers.

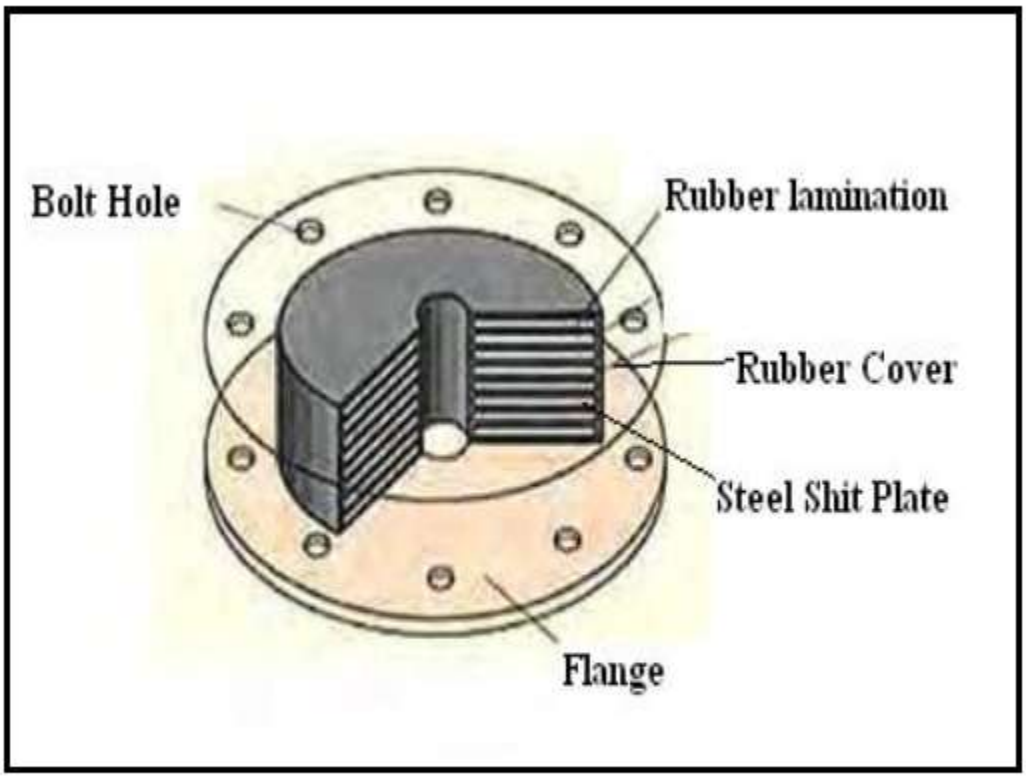

Fig. Laminated Rubber (Elastomeric) Bearing

2. Lead Rubber Bearing (LRB)-

One or more than one lead plugs are installed in bearings providing ground flexibility to structure. Used in New Zealand (1975), Japan and USA.

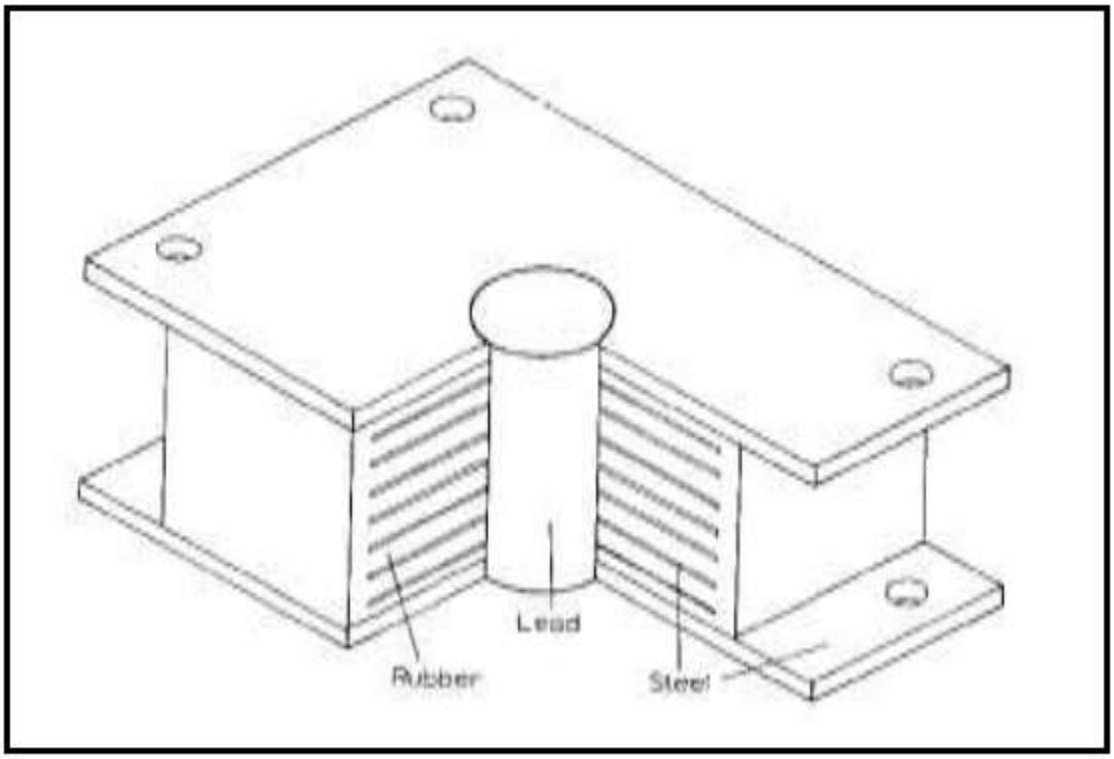

Fig. Lead Rubber Bearing (LRB)

3. Friction Pendulum Bearings-

   Types: Single Pendulum Bearing

   Triple Pendulum Bearing

   Two horizontal steel plates slide over each other during earthquake. Those bearings are strong enough to carry weight of building .

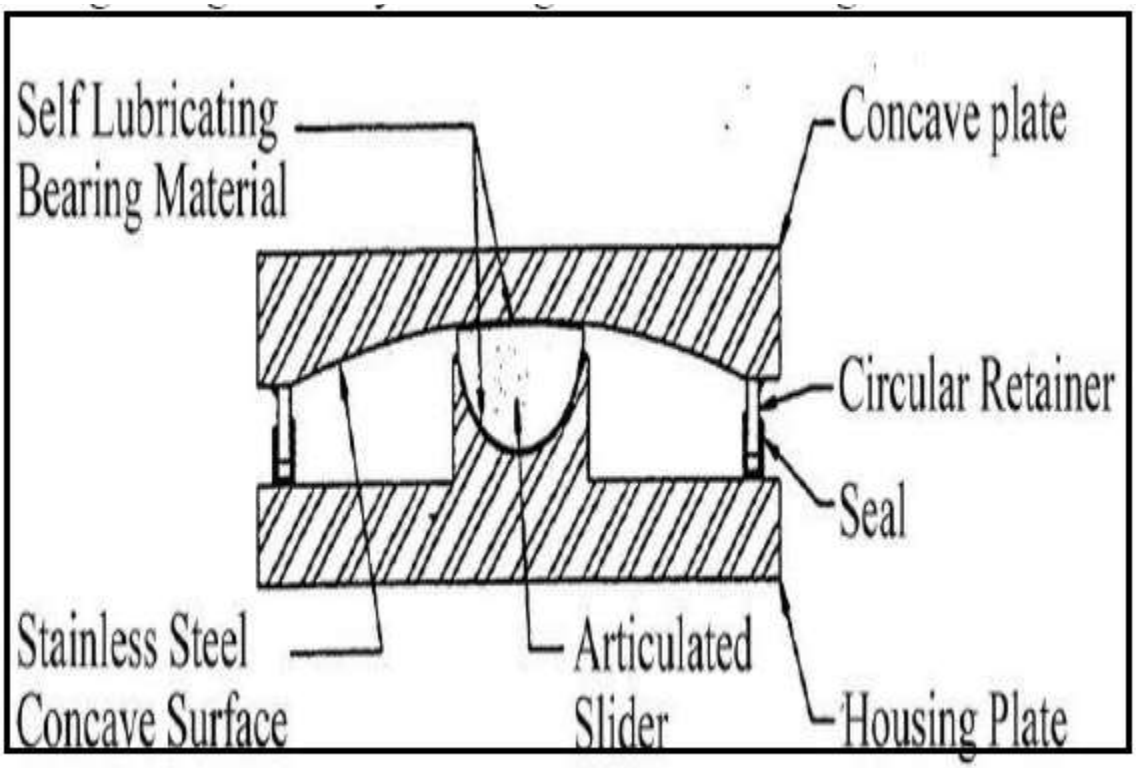

Fig Friction Pendulum bearings

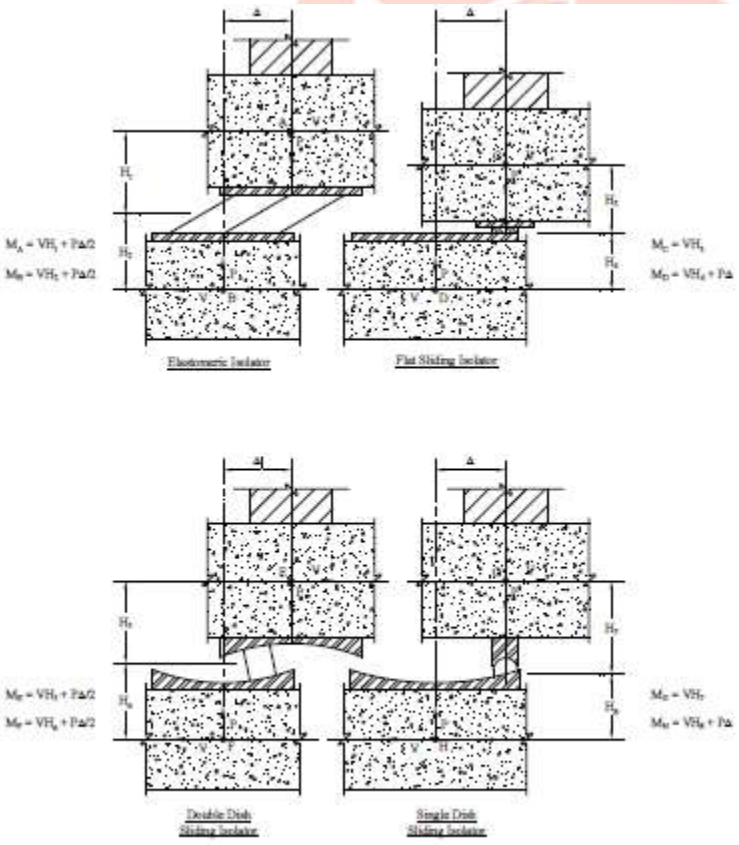

Figure Moments due to horizontal shear and P-delta effects

Conclusion -

- Effectiveness can be perceived by comparing results of non-isolated buildings.
- Used for saving lives and money spend in destruction made by earthquakes.

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