SEISMIC RETROFITTING

Seismic Retrofitting Techniques for Concrete Structures:
Seismic Retrofitting Techniques are required for concrete constructions which are vulnerable to damage and failures by seismic forces. In the past thirty years, moderate to severe earthquakes occurs around the world every year. Such events lead to damage to the concrete structures as well as failures. Thus the aim is to Focus on a few specific procedures which may improve the practice for the evaluation of seismic vulnerability of existing reinforced concrete buildings of more importance and for their seismic retrofitting by means of various innovative techniques such as base isolation and mass reduction. So Seismic Retrofitting is a collection of mitigation technique for Earthquake engineering. It is of utmost importance for historic monuments, areas prone to severe earthquakes and tall or expensive structures. **Keywords:** Retrofitting, Base Isolation, Retrofitting Techniques, Jacketing, Earthquake Resistance

1. Introduction to Seismic Retrofitting Techniques:

- Earthquake creates great devastation in terms of life, money and failures of structures.
- Upgrading of certain building systems (existing structures) to make them more resistant to seismic activity (earthquake resistance) is really of more importance.
- Structures can be (a) Earthquake damaged, (b) Earthquake vulnerable
- Retrofitting proves to be a better economic consideration and immediate shelter to problems rather than replacement of building

1.1 Seismic Retrofitting of Concrete Structures:
Definition: It is the modification of existing structures to make them more resistant to seismic activity, ground motion, or soil failure due to earthquakes. The retrofit techniques are also applicable for other natural hazards such as tropical cyclones, tornadoes, and severe winds from thunderstorms.

1.2 Need for Seismic Retrofitting:

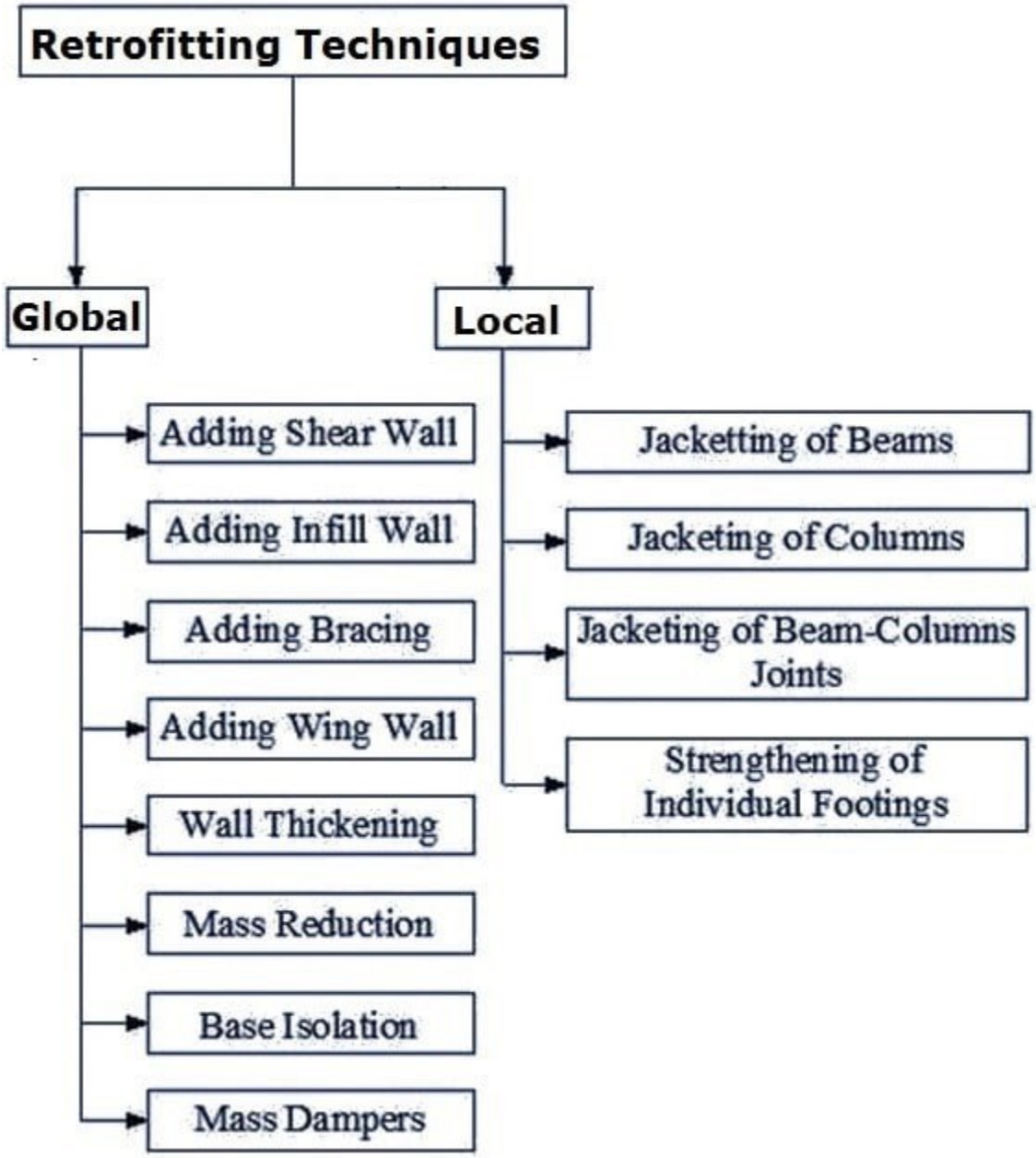
- To ensure the safety and security of a building, employees, structure functionality, machinery and inventory
- Essential to reduce hazard and losses from non-structural elements.
- predominantly concerned with structural improvement to reduce seismic hazard.
- Important buildings must be strengthened whose services are assumed to be essential just after an earthquake like hospitals.

1.3 Problems faced by Structural Engineers are:
Lack of standards for retrofitting methods – Effectiveness of each methods varies a lot depending upon parameters like type of structures, material condition, amount of damage etc.,

1.4 Basic Concept of Retrofitting:
The aim is at:

- Upgradation of lateral strength of the structure
- Increase in the ductility of the structure
- Increase in strength and ductility

2. Classification of Retrofitting Techniques



2.1 Adding New Shear Walls:

- Frequently used for retrofitting of non ductile reinforced concrete frame buildings.
- The added elements can be either cast?in?place or precast concrete elements.
- New elements preferably be placed at the exterior of the building.
- Not preferred in the interior of the structure to avoid interior mouldings.

Fig 2: Additional Shear Wall

2.2 Adding Steel Bracings

- An effective solution when large openings are required.
- Potential advantages due to higher strength and stiffness, opening for natural light can be provided, amount of work is less since foundation cost may be minimized and adds much less weight to the existing structure.

Adding STEEL Bracings:

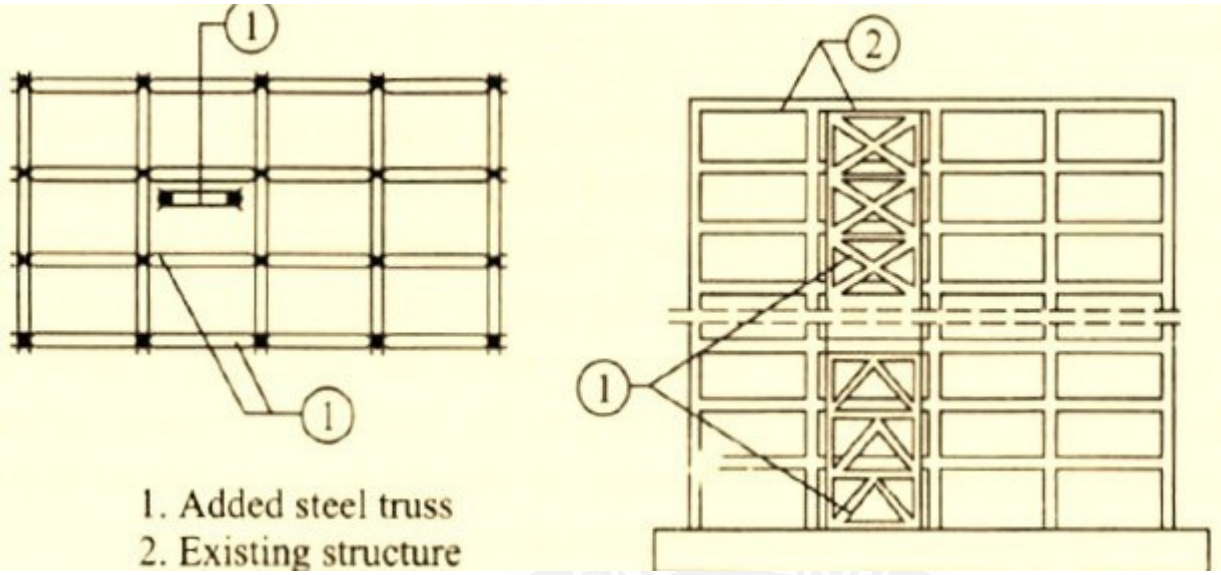


Fig 3: RC Building retrofitted by steel bracing

2.3 Jacketing (Local Retrofitting Technique):
This is the most popular method for strengthening of building columns.

Types of Jacketing:

1. 1.Steel jacket,
2. Reinforced Concrete jacket,
3. Fibre Reinforced Polymer Composite (FRPC) jacket

Purpose for jacketing:

- To increase concrete confinement
- To increase shear strength
- To increase flexural strength

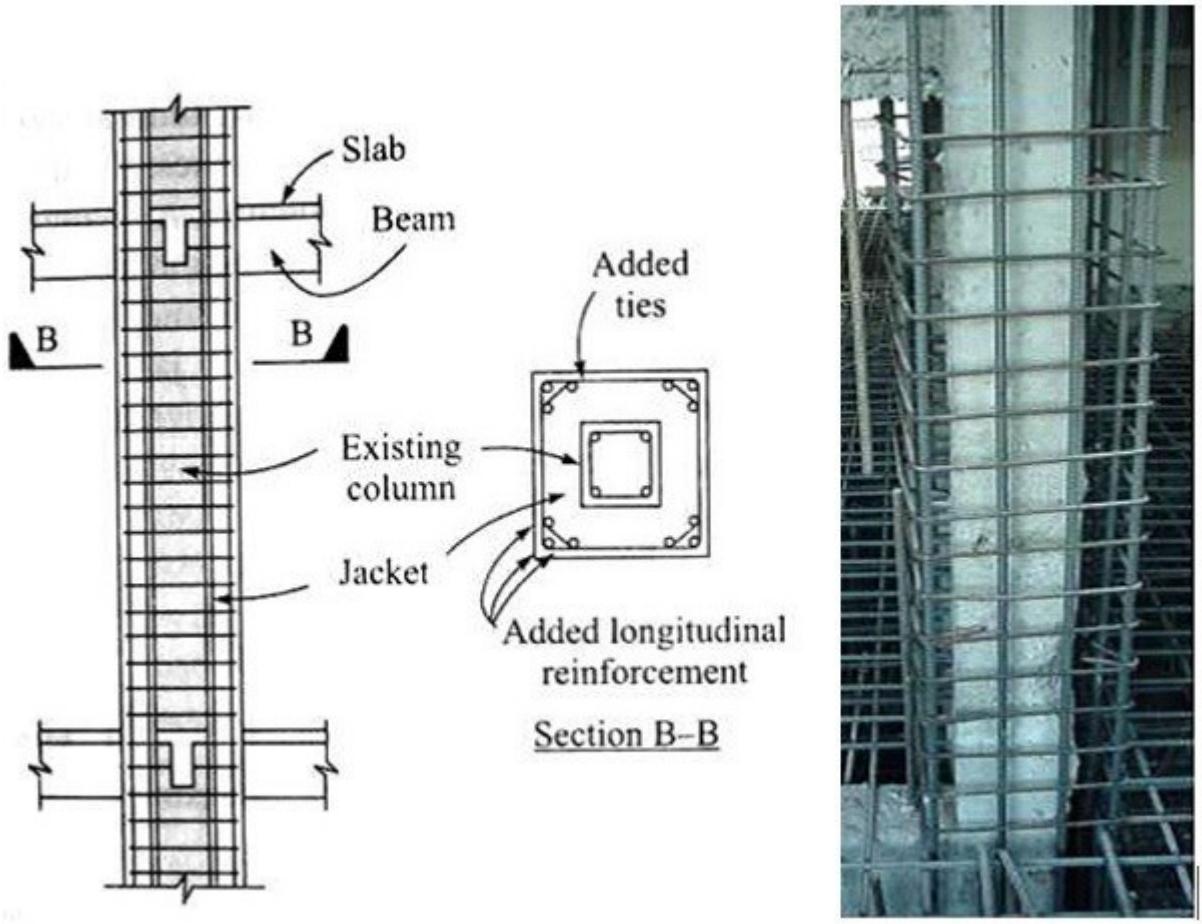


Fig 4: Column Jacketing

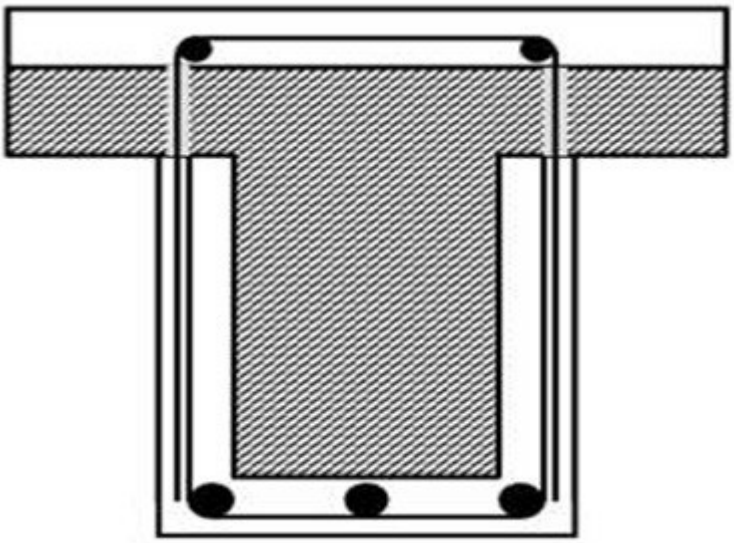


Fig 5: Beam Jacketing

2.4 Base Isolation (or Seismic Isolation):

Isolation of superstructure from the foundation is known as base isolation. It is the most powerful tool for passive structural vibration control techniques.

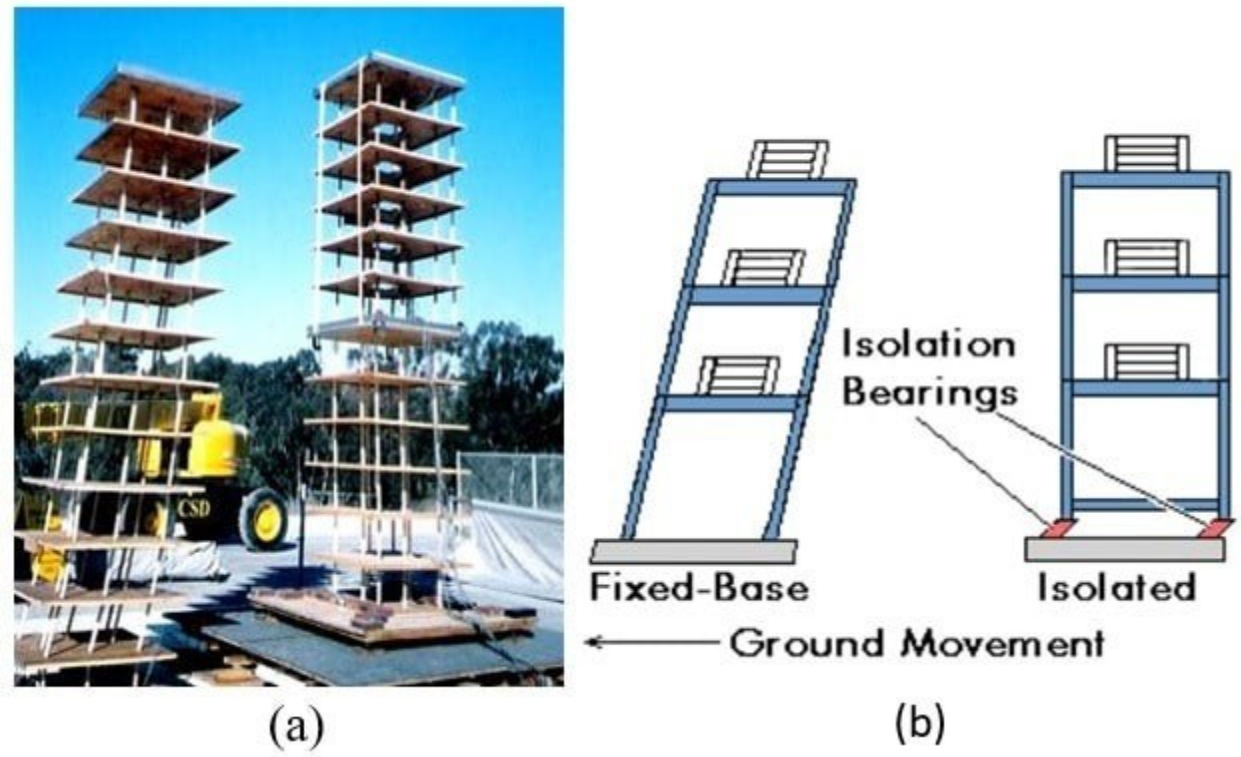


Fig 6: Base Isolated Structures (a)Model Under Test, (b) Diagrammatical Representation

2.4.1 Advantages of Base Isolation

- Isolates Building from ground motion – Lesser seismic loads, hence lesser damage to the structure, -Minimal repair of superstructure.
- Building can remain serviceable throughout construction.
- Does not involve major intrusion upon existing superstructure

2.4.2 Disadvantages of Base Isolation

- Expensive
- Cannot be applied partially to structures unlike other retrofitting
- Challenging to implement in an efficient manner

2.5 Mass Reduction Technique of Retrofitting:

This may be achieved, for instance, by removal of one or more storey's as shown in Figure. In this case it is evident that the removal of the mass will lead to a decrease in the period, which will lead to an increase in the required strength.

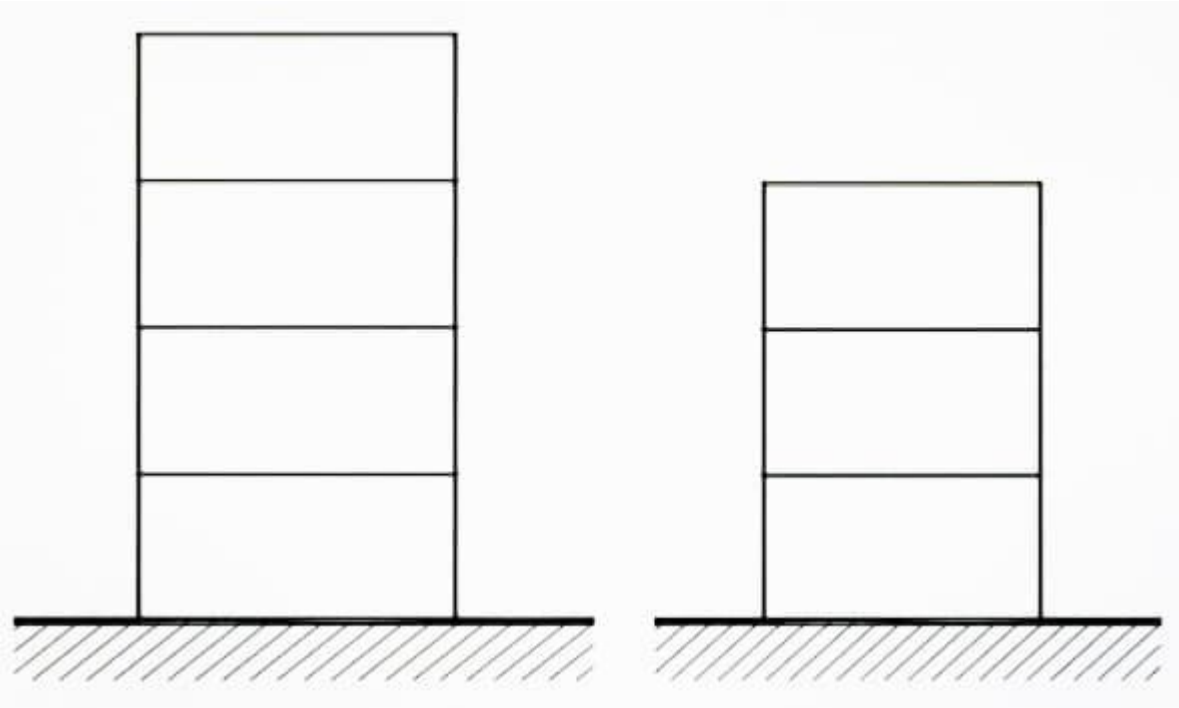


Fig 7: Seismic Retrofitting by Mass reduction (removal of Storey)

2.6 Wall Thickening Technique of Retrofitting:

The existing walls of a building are added to certain thickness by adding bricks, concrete and steel aligned at certain places as reinforcement, such that the weight of wall increases and it can bear more vertical and horizontal loads, and also it's designed under special conditions that the transverse loads does not cause sudden failure of the wall