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RETROFITTING OF BUILDING

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ABSTRACT: Recent earthquakes in the Indian subcontinent have led to an increase in the seismic zoning factor over many parts of the country. Also, ductility has become an issue for all those buildings that were designed and detailed using earlier versions of the codes. Under such circumstances, seismic qualification of existing buildings has become extremely important. Seismic qualification eventually leads to retrofitting of the deficient structures. Pushover analysis and evaluation of performance of building using Capacity Spectrum Approach or Displacement Coefficient Method are increasingly used for this purpose. There is a need to look at certain important issues for incorporation in the Indian codes before uniformity of approach can be achieved. This, in turn, needs an in-depth understanding on what has gone into ATC-40 (ATC, 1996) or FEMA -356 (FEMA, 2000), and making appropriate modifications to suit the India conditions. It is necessary that the debate on this is started and completed early to achieve the desired results. Pre-disaster preparedness strategies lead to repair/retrofitting of the reinforced concrete structures for ensuring satisfactory performance during earthquakes. Repairs can lead to increased stiffness, strength, and failure-deformation.

I. INTRODUCTION

The aftermath of an earthquake manifests great devastation due to unpredicted Seismic motion striking extensive damage to innumerable buildings varying degree i.e., either full or partial or slight. This damage to structures in its turn causes irreparable loss of life with many casualties. As a result, frightened occupants may refuse to enter the building unless assured of the safety of the building from future earthquakes. It has been observed that majority of such earthquake damaged buildings may be safely reused if they converted into seismically resistance structures by employing a few retrofitting measures.

Various terms are associated to retrofitting with a marginal difference like Repair, strengthening, retrofitting, rehabilitation, reconstruction etc. but there is no consensus on them.

The need of seismic retrofitting of building arises under no circumstance.

- 1) Earthquake damaged buildings.
- 2) Earthquake vulnerable buildings that have not yet experienced severe Earthquakes.

II. PRINCIPLES OF RETROFITTING DESIGNS

The principles of retrofitting design for buildings are:

- Strengthening of members versus strengthening of structural system. The members that do not meet safety requirements must be strengthened; however, there is often an underlying mistake that the strengthening of whole structural system is neglected. Strengthening of connection between members is quite influential to structural integrity.
- Local strengthening versus global strengthening. Local strengthening of an individual member can be carried out only if the strengthening does not affect the structural performance of the whole system.
- Temporary strengthening versus permanent strengthening. The standards and requirements for temporary strengthening may be lower than those for permanent strengthening.
- Special considerations for earthquake resistant strengthening.
- ↳ To use new seismic technologies.

III. TYPES OF RETROFITTING OF CONCRETE MEMEBRS

Various retrofitting techniques namely global and local retrofitting techniques are adopted to achieve desired solution for an existing structure. Parametric analysis has been carried out to obtain most feasible solution by considering various parameters such as nodal displacement, storey drift and base shear. Classification of Retrofitting Techniques:

- └ Adding New Shear Walls
- └ Adding Steel Bracings
- └ Jacketing (Local Retrofitting Technique)
- └ Base Isolation (or Seismic Isolation)
- └ Mass Reduction Technique of Retrofitting
- └ Wall Thickening Technique of Retrofitting

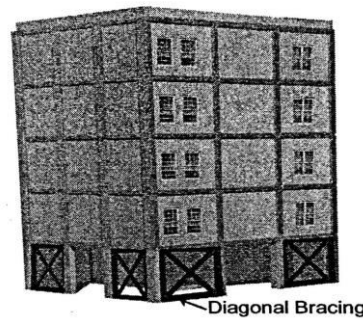
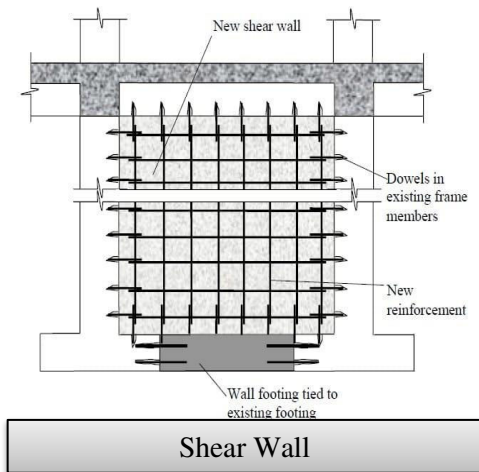


Fig. 5 Adding steel braces at ground storey

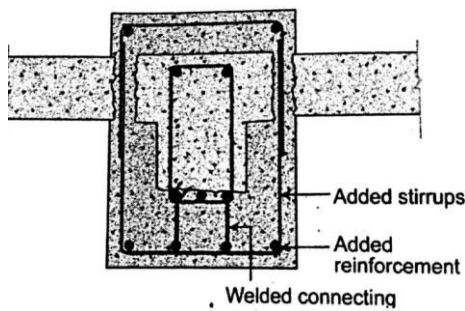


Fig. 5.21 Beam jacketing on four sides

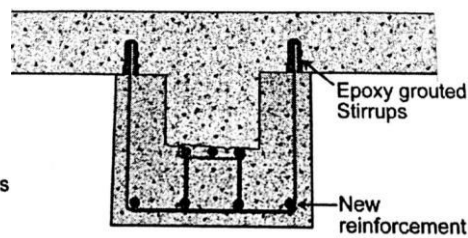
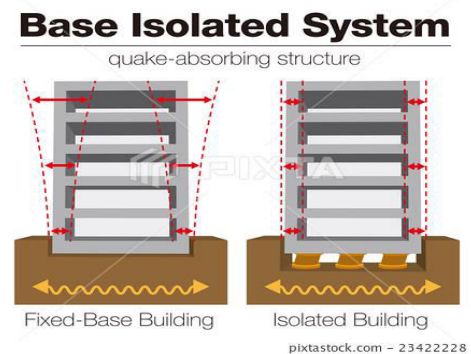


Fig. 5.20 Beam jacketing on three sides



IV. RETROFITTING OF CONCRETE MEMEBRS

- Continuous Fiber Continuous Fiber reinforced plate bonding construction method: Bonding continuous Fiber reinforced plates to the surface of the existing structure to restore or improve load-carrying capacity.
- reinforced plate jacketing construction method: Jacketing with continuous Fiber reinforced plates around the periphery of the existing structure to restore or improve load-carrying capacity and deformation characteristics
- Pre-stressed concrete jacketing construction method: Placing pre-stressing wires and pre-stressing stranded steel wires in place of lateral ties around the periphery of existing member sections and using mortar and concrete to bond them to reinforce the structure.
- Pre-stressing introduction construction method: Using internal cables for the existing concrete members to provide pre-stressing and restore or improve the load carrying capacity of the members.

- Repaving method: Replacing some or all of the existing concrete members with new members through the use of precast members or concreting on site to restore or improve load-carrying capacity.



Retrofitting of Beams & Columns

V. CONCEPT-RETROFIT OF STRUCTURES USING MODERN MATERIALS

Current research on advanced materials in civil engineering is mainly concentrated on high performance concrete and steel, and fibre reinforced plastic (FRP) composites. FRP composite materials have experienced a continuous increase of use in structural strengthening and repair applications around the world in the last fifteen years. High specific stiffness and specific weight combined with superior environmental durability of these materials have made them a competing alternative to the conventional strengthening methods. It was shown through experimental and analytical studies that externally bonded FRP composites can be applied to various structural members including columns, beams, slabs, and walls to improve their structural performance such as stiffness, load carrying capacity, and ductility. FRP composites have enjoyed varying degrees of success in different types of applications.

In general, applications that allow complete wrapping of the member with FRP have proven to be effective. Wrapping of columns to increase their load and deformation capacity is the most effective and most used method of retrofitting with composites. However, certain performance and failure mode issues regarding different wrapping configuration and fibre orientations, still need to be well understood. When wrapping is difficult or not allowed, such as when strengthening beams, slabs, or walls, success of the method is sometimes hindered by premature de-bonding failures. The performance of beams strengthened using pultruded FRP plates in various configurations.

Limited research and applications regarding seismic retrofitting of building systems with FRP composites have shown that a composite retrofitting does not significantly alter the stiffness and dynamic properties of the building. The main benefit of retrofitting with composites is the increase in deformation capacity of the building, and in its load capacity to an extent. This may achieve the retrofit objectives for buildings with lightly insufficient seismic resistance. For buildings with large seismic deficiencies, a combination of conventional and FRP strengthening techniques may prove to be an effective retrofitting solution.

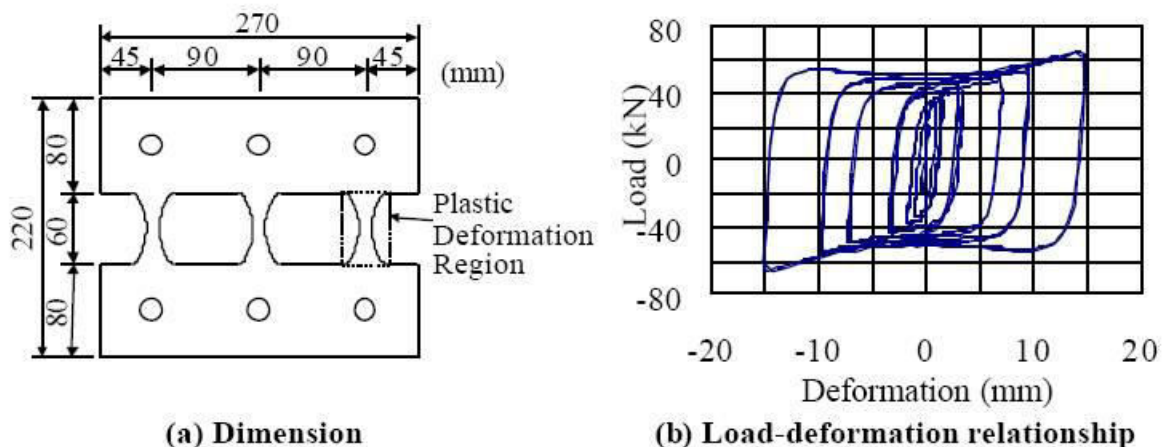
As a practical and economical solution, the retrofit design involved replacement of the existing window frames with structural steel frames constructed from steel C-sections. A verification analysis of the retrofitted building showed that installation of steel window frames largely decreased the stress concentrations, but did not suffice to reduce all stresses to acceptable levels. For this reason, additional retrofitting was designed using externally bonded FRP composites around the openings in the walls to prevent or delay concrete crack propagation by bridging the stresses at crack

locations. Thus, by combining conventional and innovative materials, an effective and economical retrofit design was achieved that did not significantly interfere with the function or historical and architectural character of the building. FRP composites are widely recognized for their potential use in seismic retrofitting applications. To achieve wide range use of these materials, however, there is need for further research into several issues related to mechanics, design, and durability of FRP retrofitted concrete and steel systems. Despite considerable progress in these areas since early last decade further improvements are necessary to meet the needs of the retrofit industry. Failure mechanisms, with emphasis on brittle shear and de bonding failures, must be thoroughly understood and associated design procedures must be incorporated in design codes.

VI. METHODOLOGY

A. OUTLINE OF RETROFITTING METHOD USING ELASTO-PLASTIC DAMPERS-

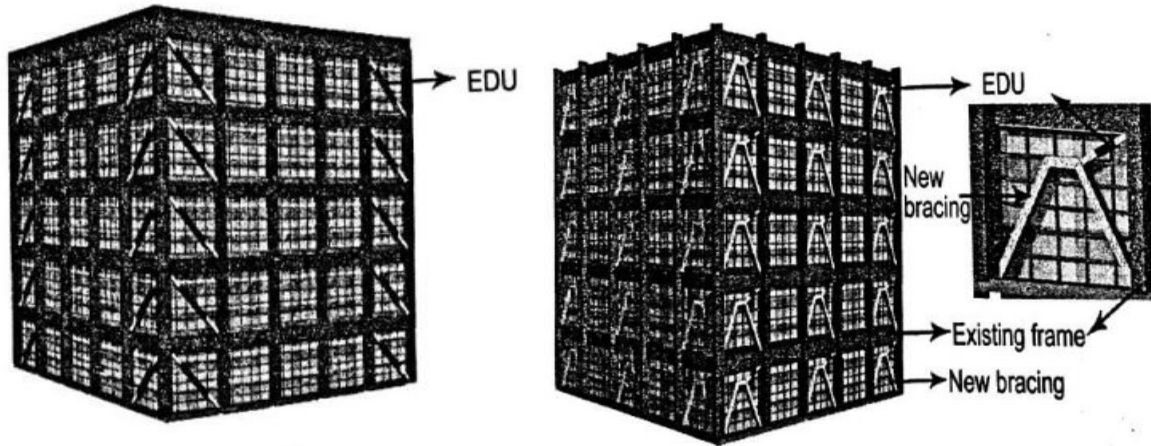
The proposed retrofitting method achieves a high level of structural safety through dampers installed in an existing seismically vulnerable building more efficiently than conventional retrofitting methods. There are many ways of installing dampers in an existing building, including (1) installing steel-framed braces that incorporate dampers into an existing open frame and (2) installing damper-embedded studs into existing frame so that existing openings are maintained. The latter method can be used in cases where the building is to be strengthened internally. Dampers used in this retrofitting method are elasto-plastic steel dampers that have honeycomb openings. The damper used in the experimental study reported in this paper is shown in Figure 1(a). The damper is designed to concentrate story drifts in its plastic deformation region and efficiently absorb earthquake energy by cyclic plastic deformations. The load deformation relationship, as shown in Figure 1(b), plot as spindle-shaped hysteresis loops and indicate a high energy absorbing capacity.



V. FUTURE SCOPE

Retrofitting buildings is an essential aspect of sustainable urban development and the effort to combat climate change. As we move towards a more environmentally conscious and energy-efficient future, the retrofitting of buildings will play a crucial role.

Retrofitting existing buildings can help reduce greenhouse gas emissions, lower operating costs, and improve the overall quality of life for occupants. As the world continues to grapple with environmental and sustainability challenges, the future scope for building retrofitting is promising, with a growing emphasis on sustainable, energy-efficient, and resilient solutions.



Earthquake demand reduction by Dampers

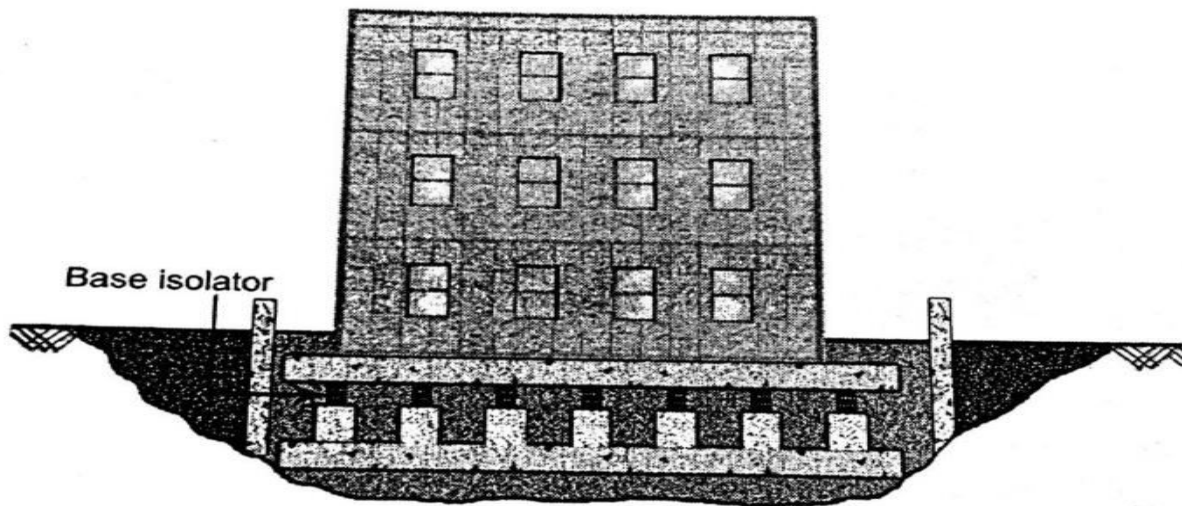


Fig. 46 Schematic representation of a base isolated building

VI.CONCLUSION

In this paper the study attempt is made on weakening points of structure, when the residential building is converted into commercial building. According earthquake code book IS 1893(PART-I) 2002, the analysis is made on existing building on ZONE II and soil Type-II. Due to increase of load in the existing four storey structure, the beams and columns of the building got weakened. So, beams and columns retrofitting technique is adopted to regain its strength. Apart from increase in the capacity and deformability, the shear deformation of the joint panel will be reduced significantly after retrofitting. Since slabs are parallel to earthquake forces, they need not to be strengthened. RC retrofitting technique enhances the axial load and moment carrying capacity in beams and column. Hence, it is concluded that retrofitting technique enhances the axial load and moment carrying capacity in beams and column.

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