International Journal of Research in Advent Technology, Special Issue, Convergence 2019
E-ISSN: 2321-9637
Available online at www.ijrat.org

Seismic Performance of RC Building Retrofiting With Various Techniques

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Abstract-A higher degree of damage in a building is expected during an earthquake if the seismic resistance of the building is inadequate. The decision to strengthen it before an earthquake occurs depends on the building's seismic resistance. The structural system of deficient building should be adequately strengthened in order to attain the desired level of seismic resistance. Though considerable research was carried out on performance of existing- and retrofitted- 'GLD' and 'Ductile' structures, studies on the behaviour of 'Nonductile' one, which falls between these two prominent levels of design concept, are inadequate. Indian Standard is well accepted in the larger part of South-East Asia which is a prominent seismic zone. Since most of the structures in this region are commonly built without adhering to ductile provisions, usability of the damaged structure after any earthquake is of great importance.

1. INTRODUCTION

Occurrences of recent earthquakes in India and in different parts of the world and the resulting losses, especially human; highlighted the structural inadequacy of building to carry seismic loads. There is an urgent need for assessment of existing building in terms of seismic resistance. In view of this various organizations have come up with documents, which serve as guidelines for the assessment of the strength, expected performance and safety of existing building as well as for carrying out the necessary rehabilitation, if required. The objective of this study is to review various document on seismic evaluation of existing building.

A higher degree of damage in a building is expected during an earthquake if the seismic resistance of the building is inadequate. The decision to strengthen it before an earthquake occurs depends on the building's seismic resistance. The structural system of deficient building should be adequately strengthened in order to attain the desired level of seismic resistance. The term strengthening comprises technical interventions in the structural system of a building; that improves its seismic resistance by increasing the strength, stiffness and / or ductility.

2. SYSTEM DEVELOPMENT

- **Capacity / Demand Method:-** The method has been initially presented by ATC (1983) [2]. The forces and displacements resulting from an elastic analysis for design earthquake are called demand (D). These are compared with the capacity (C) of different members to resist these forces and displacements. A (capacity/Demand) C/D ratio less than one indicate member failure and thus need retrofitting. When the ductility is considered in the section the demand capacity ratio can be equated to section ductility demand of 2 or 3.
- **Response Spectrum Method**:- The building model incorporating the material non-linearity is subjected to monotonically increasing lateral load, till the structure collapses. The displacement on the structure (at roof) is recorded for the corresponding base shear. The curve base shear versus roof displacement represents capacity of the structure known as pushover capacity curve. Then the capacity curve is converted to capacity spectrum (ADRS)
- **Inelastic Time-History Analysis**:- A seismically deficient building will be subjected to inelastic action during design earthquake motion. The inelastic time history analysis of the building under strong ground motion brings out the regions of weakness and ductility demand in the structure. This is the most rational method available for assessing building performance.
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3. RETROFITING SCHEMES

- Strengthening of RC members
- RC Column Jacketing
- Strengthening by MI panel**.**
- Application of Lateral Buttresses
- Inclusion of Shear Wall
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4. OBJECTIVES OF RETROFITTED

A detailed seismic evaluation of seismically deficient existing building needs to be performed to determine the nature and extent of deficiencies, which can cause poor performance in future earthquake. This evaluation also helps to decide whether structural modifications are required at few locations in the structure level so that its global behavior is improved and thus seismic **of** various components are reduced. The success of strengthening techniques, which are very specific to structural type, choice of strengthening techniques and materials of construction. Further, the design and analysis of such schemes/ techniques are quite complex and require a great level of sophistication than ordinary required for new components/elements. All documents of structural strengthening such as IS 1893[27], NZDC, Euro code, etc. provide a general framework of rehabilitation process and do not provide much specific design/ detailing procedure. However, a few of them provide code like provisions for commonly used techniques such as column jacketing, addition of shear wall, braced frame, etc.

5. METHODS OF RETROFITTING

- ***Column Jacketing:-***
  In this method the additional reinforcement bar is added

to outer periphery of column and the lateral ties is provided to increase shear capacity of column, which also serve the purpose of holding longitudinal reinforcement. The geometrical shape and spacing of lateral ties depends upon the actual orientation of column and existing load carrying capacity. Providing suitable grade of concrete as shown in covers the skeleton of the reinforcement.

- ***Conventional Retrofitting Techniques:-***

Building of various types such as those of clay, stone or brick in general and of reinforced concrete to a lesser extent receive distress to various degrees in earthquake intensities VI and more on MMI or MSK scale. The level of distress may vary from minor crack to partial to total destruction. A very large stock of such damageable buildings exists in seismic zones III, IV and V of India.

- ***Seismic Retrofitting Options and Strategies:-***

While planning seismic retrofit, basic policy on how to meet the seismic demand performance by improving strength and/or ductility of building concerned shall be clearly defined. In addition, optimum retrofit methods for meeting demand performance shall be selected. An overall study shall be conducted at the planning stage considering building function after retrofit and workability of retrofit construction as well as performance upgrading by seismic retrofit. Reliable techniques whose upgrading effects are confirmed by structural tests or other investigations shall be adopted for seismic retrofit

6. EARTQUAKE BUILDING DAMAGE IN DEVELOPING COUNTRIES

For the purposes of the study, a developing country is defined as one that is essentially non-industrialized; where building codes are not implemented non-engineered and building codes are not implemented effectively. A group of such countries exhibits wide variation in geographic location, climate, topography and culture, including construction practices.

Many types or descriptions of damage. For example, unreinforced masonry infills and load bearing walls are vulnerable to both in- plane (shear cracking) And out of plane action. This is hardly surprising given that these two systems represent the most common form of lateral resistance in developing countries. There are virtually no reports of damage to beams, in stark contrast to frequent mention of column damage. Unfortunately, columns are not only more vulnerable to damage, but of all structural. This observation reinforces the importance of the strong column- weak beam concept.

6. CONCLUSION

Seismic retrofitting of existing structures is a difficult task as compared to the construction of a new building as each building poses a unique set of constraints and problems requiring due care in design and detailing.

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