International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Role of Retrofitting of Non-Engineered Construction for Improving Seismic Performance in Developing Countries

Asrar Ul Haq

Abstract: ***Large number of building structure have been designed and constructing in India prior to the existence of seismic codes of practice. Experience in the recent past earthquake in India in the last decade, especially Kashmir earthquake of 2005 have clearly exposed the seismic vulnerability of existing structures. Majority of houses fallen under the category of non engineered construction. Such structure, which are severely deficient against earthquake forces require seismic evaluation and retrofitting measures to reduce the earthquake hazard damage in the future. This paper deals with various important issues related to identification and assessment of seismic efficiency of masonary buildings which do not satisfy the requirements of current seismic codes and design practices. The objective of this study is to discuss the nature and extent of problem and suggest various retrofitting measures that can be adopted by the builders and engineers for structurally deficient buildings to transform the killing homes into safety rooms.***

Keywords: Repair, Restoration, Strengthening, Retrofitting, Local Retrofitting, Tensile Strength, Jacketing, Global Retrofitting, Prestressing, Cracking, Ductility

1. Introduction

More than 90% of population of our country prefers to live in masonary buildings and thus they are termed as common man house. Earthquake occurred at 08: 50: 39 Pakistan standard time on 8 October in Pakistani administered Azad Kashmir. Its epicentre in Muzaffarabad city, and also affected Jammu & Kashmir and some areas of Indian administered J & K. Its magnitude is 7.6. The severity of the damage caused by the earthquake is attributing to severe upthurst. It is considered the deadliest earthquake to hit South Asia, surpassing the 1935 QUETTA earthquake. These buildings are constructed with the help of local masons without the supervision of any technical expert. So these building are constructed as non engineering. Too many buildings which collapsed were the part of non engineered construction system. Due to this natural hazard, thousands of people died. On the other side their construction cannot be stopped, as these houses build to the housing need of the economically weaker section of the society. However, their structure performance can be improved by adopting various retrofitting techniques. Retrofitting is a concept which owned at change made to an existing structure to reduce as eliminate the possibility of damage to that structure from flooding, erosion, high winds, earthquakes or other hazards. The focus of this mannal is on retrofitting buildings that are subject to flooding &earthquake, It reduce the vulnerability of damage of an existing structure during a near future seismic activity. Thus it is very essential to increase the strength, resistivity and overall life span of the structure .

Causes of Failure of Masonary Building (Non Engineering Construction)

Various cause of failure are given below:

1) Moisture Penetration: Water penetration poses a danger not only to masonary material but the adjacent assemblage including wood metal, doors and windows.
2) Cracking: Poor preparation of mortar can also cause cracking in the joints.
3) Bond facture: Brick and stones in masonary have to stay intact to guarantees the strength of a masonary structure. However the loss of adhesion b/w these materials is a comman problems in construction. It leads to bulging or peeling, hollow patches & flaking top layers.
4) Irregularities in plane and vertical direction: Overall unsymmetry in plan and elevation of building is another weakness of masonary building that cause failure during earthquakes. Load bearing walls of masonary building must be arranged in plan regularly and symmetical in respect of the two main axes.
5) Ductility: First storey collapse is accured in the masonary structure as a result of limited ductility capacity and poor strength of masonary unit materials.
6) Numerous large size windows and door opening in walls.

Retrofitting and its Need

Retrofitting may be defined as to apply new technologies to an older system. It refers to the re-strengthing of existing structure to make them seismic resistant.

Retrofitting is an economic approach to increase life span of an existing structure rather than redeveloping it.

Their advantages:

- Energy efficient
- Increase life span
- Allow change in future as per the need
- Material from structure can be used in some cases.
- Reduce maintenanous lost.
- Upgrades existing elements of a building activities.
- Adaptation of new technologies.

Retrofitting is making change to an existing building to protect it from flooding or other hazards such as high winds and earthquake—As a result, retrofitting has become necessary and important tool in hazard mitigation.

General Principle of Design

A structural engineer should be experienced and should be able to carry out seismic evaluation and conditional assessment of existing seismically weak structure. Other factors include importance of building availability of funds, technology and skilled workmanship etc.

A structural engineer' should observe the seismic behaviour of masonary building in the lights of following facts-

- Masonary building weight and rigidness should be uniformly & symmetrically distributed.
- Length and height should be compatible i.e; too long or too tall buildings are unsafe to seismic forces.
- Too much opening in walls should be avoided.
- Plan should be symmetrical and structure should be as light as possible.
- Foundation should be firm & stable.

Seismic Evaluation Methods

Retrofitting is one of the most challenging task for engineers, builders and contractors. If the structure is not properly evaluated to assess it seismic response for further earthquakes, it cannot be retrofitted. Method based on qualitative and analytical results are–

a) Consideration on the basic of past performance of building during earthquake, available records, information, case studies, documentation etc
b) Visual testing (VT) at site by structural engineer.
c) Non destructive testing.
d) Models of building are constructed and tested for failure under permanent vertical and gradually increasing lateral loads. It is the most definitive of seismic evaluation method along with visual testing.

Retrofitting Techniques

Classification of Retrofitting techniques

Global Local

• Adding shear wall	• Jacketing of beams
• Adding infill wall	• Jacketing of columns
• Adding bracing	• Jacketing of beams- columns joints
• Adding wing wall	• Strengthing of individual footings
• Mass reduction	
• Base isolation	
• Mass dampers	

2. Limitation

Main limitation of retrofitting is that the engineer are unexperienced. They did not know much about the non-engineer structure and as a result they only recommend the disassemble of these structure . India faced major earthquake in a decade due to following reasons.

a) Lack of confidence of engineer and builders.
b) Unawareness of general public
c) Brought to light the brittleness of welded steel frames.
d) High cost of epoxies.
e) Inability to attach on wet surfaces.
f) Non availability of proper material to be used for repair, restortation and fortifying measure.
g) Aesthetic value and original importance of building is likely to be lost.

3. Conclusion

1) In future earthquake; seismic behaviour can improve to upgrading the strength of masonary buildings.
2) Visual testing at site including non-destructing testing and modeling techniques are the effective methods of seismic evaluation of building.
3) Seismic performance is downgrade so that non-engineer structure needs retrofitting.
4) To make seismically efficient building, seismic retrofitting involves modification and strengthening of masonary walls.
5) Providing strong and ductile connection b/w walls and horizontal diaphragm is providing seismic lands at lintel, roof and plinth level is the most common method.

References

[1] IAEE,Gidelines for Earthquake Resistant Non-engineered construction, ACC Limited, Thane,2001.
[2] Agarwal, P. and Thakkar, S.K. " An experimental study of effectiveness of seismic strengthening and retrofitting masonry buildings, journal of European Earthquake engineering, pp 48 – 64, 2002
[3] Recent Earthquakes of chamoli and bhuj (2001). Proceeding of the workshop held during May 24- 26, 2001, Roorkee – 247667.
[4] IS 13935, Repair and seismic Strengthing of building – Guidelines, Bureau of Indian Standards, New Delhi,1993.
[5] IS 13828:1993 Indian Standard, Improving Eathquake Resistance of low strength of Masonry Buildings – Guidelines, Bureau of Indian Standards, Manak Bhavan, New Delhi .
[6] Kahan, K.W., 'Shortcrete Retrofit for Unreinforced Brick Masonry'. Eight Would Conference on Earthquake Engineering, Vol-l, San Francisco, 1984.
[7] Proceedings of workshop on ' retrofitting of structures' held during October 10- 11, 2003, IIT, Roorkee.
[8] Arya, A.S. et. al (1986) : Guidelines for Earthquake Resistan Non – engineered construction, IAEE committee, The International Association for Earthquake Engineering, Tokyo.
[9] Basu, Prabir C, 'Seismic Upgradation of Building ; An Overview' The Indian Concrete Journal, Vol 76, August 2002, No .8 pp 461 -475.
[10] IAEE,'Basic concept of seismic codes – vol- l', The International Association for Earthquake Engineering, Tokyo, Japan, 1980.
[11] Hu YuXian. Engineering of earthquake [M], Earthquake Press. 1988.
[12] National standard (Post- earthquake field works .Part two :Safely assessment of building)) [GB18208.2-2001].