INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 4)
Available online at: www.ijariit.com

Seismic retrofitting of existing reinforced concrete building

Asif Naim
asifnaimbe@gmail.com
Al-Falah University, Dhouj, Haryana

Dr B. K Singh
binodkrs@yahoo.com
Al-Falah University, Dhouj, Haryana

ABSTRACT

It is commonly observed that many RC Building collapses during an earthquake are those building which is non –engineered or those RC Buildings which are not constructed as per codal provisions. Some of such buildings have deficiencies in whole structure or individual structural members which don't have the adequate lateral capacity to counter the seismic demand. Before retrofitting of structure it is required to perform necessary assessments and evaluations of structural member or location deficiencies are found. In this case study, a G+3 storey RC Building is considered for seismic analysis which is located in the zone –IV to calculate the additional seismic strength of structural members like beams and columns. Based on this analysis retrofitting measures are suggested. This analysis is performed by using Stad pro-V8i software. The recommendations are based on IS – 15988, IS – 1893, IS – 13920 and FEMA codes provisions. The method adopted for seismic retrofitting of structures is RC Jacketing.

Keywords— *Non-engineered RC Building, Seismic Demand, Seismic Retrofitting, Seismic Strength, RC Jacketing and Lateral Capacity*

1. INTRODUCTION

An earthquake is the sudden vibration of the ground surface because of the movement of tectonic plates under the ground surface, which releases sudden energy in the crust. Earthquake makes the ground surface moves in all direction. During an earthquake the lateral movements of ground surface major failures in structure or structural members like beams and columns generally. In India Earthquake resistance designs are not so popular, very rear buildings are designed earthquake resistant. In India, buildings are designed only to resist gravity loads. Such buildings are unable to resist to resist seismic loading or horizontal loading. Due to successive earthquake like Latur earthquake in 1993 and Katch earthquake in 2001 underlines the need for earthquake resistant design. Earthquake resistant designs are done by seismic retrofitting of the existing structure.

Fig. 1: Latur Earthquake

Fig. 2: Katch Earthquake

Seismic retrofitting is a technique for the modification of the existing structure to make them resistant against the motion of the ground or soil failure during an earthquake.

The objectives of the retrofitting of the structures are mentioned below"

- To increase the lateral strength of the structure by increasing stiffness of the structure or structural members.
- To increase the ductility of the structure.
- To give unity to the structure.
- To eliminate sources of the weakness of structural components.
- The retrofitting technique should be economical.

The various retrofitting techniques are used to strengthen the existing RC Building. The techniques used for the strengthening of buildings are given below.

- RC Jacketing.
- Steel Profile Jacketing.
- Retrofitting using FRPs.

The retrofitting technique used in this analysis is RC Jacketing. RC Jacketing is popularly used retrofitting technique to strengthen the columns and beams. The main objective of Jacketing is to increase to increase the size of columns and beams. Increasing size of columns and beams increases the stiffness of the members. RC Jacketing improves the buckling capacity of the members.

Fig. 3: RC Jacketing of Column

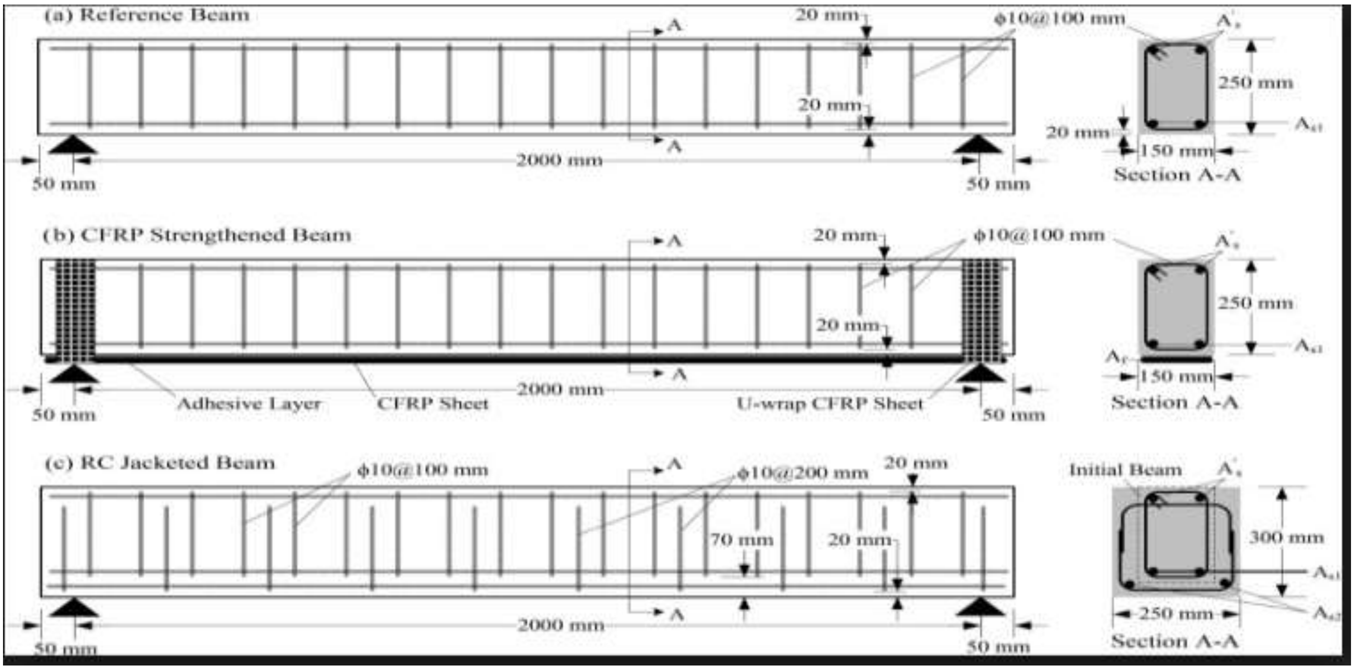


Fig. 4: RC Jacketing of Beam

2. METHODOLOGY

In this analysis the detailed design of existing G+3 RC Building is being collected which is analyzed by using Stad pro V8i software the structure was safe but when the same structure is analyzed for G+5 storey building few of the columns fail. After retrofitting columns which were failed by increasing its size and area steel required by using Stad pro-V8i software. After retrofitting of G+5 storey building it was further checked for its safety the structure was found safe. The plan and elevation of G+3 and G+5 storey building are given in **figure 5, 6** and **7** below.

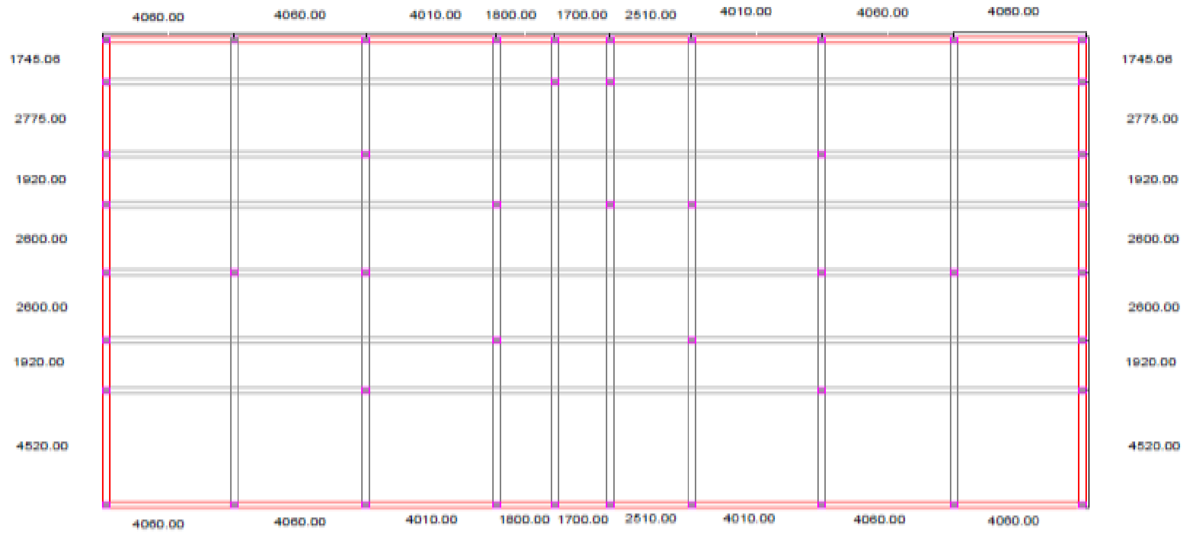


Fig. 5: Plan of Existing Building

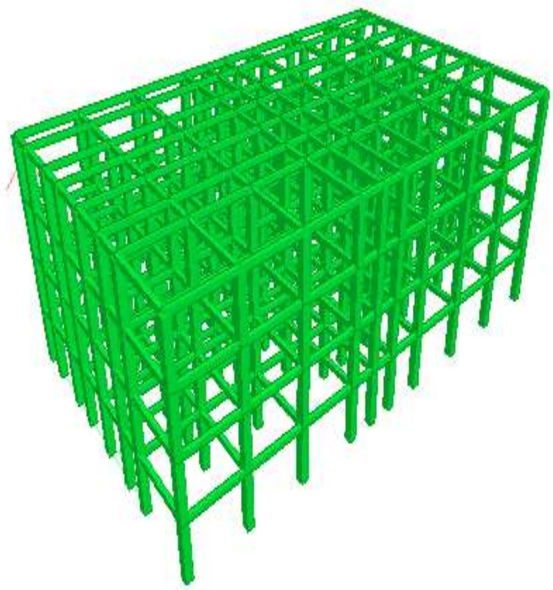


Fig. 6: Elevation of G + 3 storey

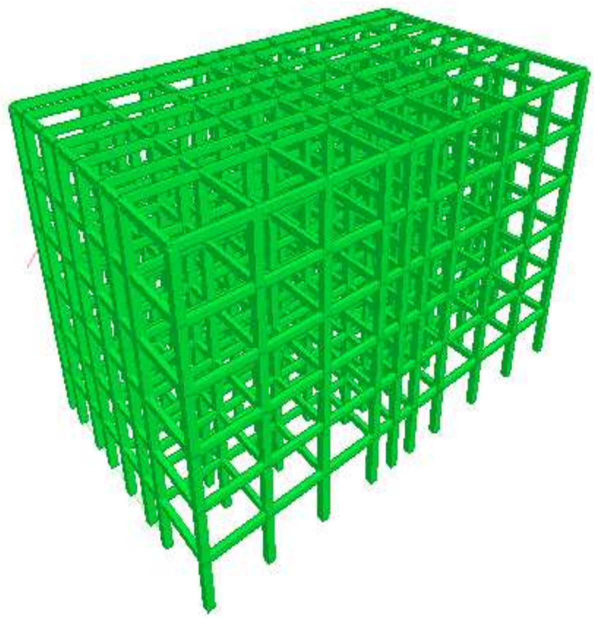


Fig. 7: Elevation of G + 5 storey

3. RESULT AND DISCUSSION

3.1 Beam

After performing analysis for existing G+3 storey building the beams were capable to take a load for G+3 storey building but when the same beams were analyzed for G+ 5 storeys building few beams were not capable to take the load (i.e fails), so it was required to increase the size of beams to retrofit them. The sizes and area of reinforcement required for the primary and secondary beams are given in **Table 1 and 2** below.

Table 1: Details of Primary beam

Details	Primary Beam	
	Ground + 3 Storey	Ground + 5 Storey
Size (mm x mm)	250 x 350	320 x 400
Area of Steel Required (mm^2)	4217.71	5141.69

Table 2: Details of secondary beam

Details	Secondary Beam	
	Ground + 3 Storey	Ground + 5 Storey
Size (mm x mm)	230 x 320	250 x 400
Area of Steel Required (mm^2)	2018.43	3596.67

3.2 Column

After performing analysis it is observed the columns of G+3 storey building were capable to take a load of G+3 storey building, but when the same columns were analyzed for G+5 storey building some of the columns fails, to retrofit those columns it was required to increase the size of columns. The details of sizes before and after retrofitting and area of steel required for them are given in **Table 3** below.

Table 3: Details of Column

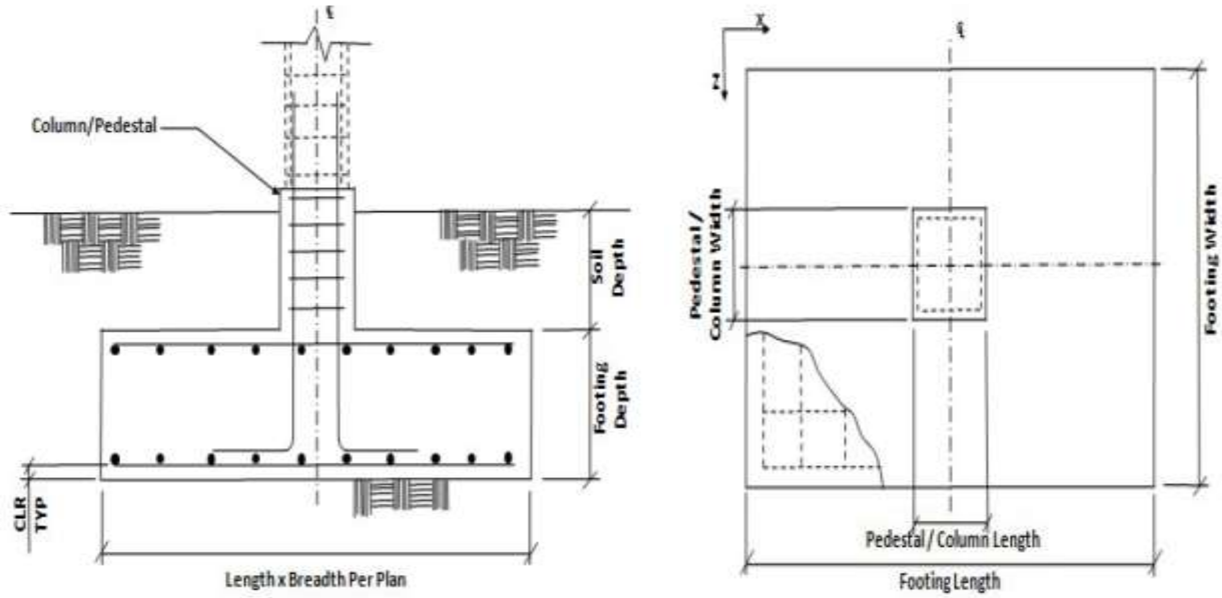
Details	Column		
	Ground + 3 Storey	Ground + 5 Storey	
Size (mm x mm)	450 x 450	450 x 450	480 x 480
Area of Steel Required (mm^2)	3726.00	5523.80	7719.92

3.3 Foundation

After performing a analysis it is observed that the footing of G+3 storey existing building was not capable to take a load of G+5 storey building (i.e fails), to retrofit the existing footing it was required to increase the area of reinforcement. The details of footing for G+3 storey building and G+5 storey building is given in **Table 4** below. The elevation and plan of the footing are also shown in **Figure 8** below.

Table 4: Details of Isolated Footing

Details	Foundation		
	Ground + 3 Storey	Ground + 5 Storey	
Size of Column (mm x mm)	450 x 450	450 x 450	480 x 480
Size of Footing (mm x mm x mm)	1000 x 1000 x 305	1000 x 1000 x 305	1000 x 1000 x 305
Area of Steel Required (mm^2)	805.200	1166.400	1836.583



Elevation **Plan**

Fig. 8: Elevation and plan of isolated footing

4. CONCLUSION

Based on analysis of G+ 3 storeys and G+5 storey building we conclude the following results.

- The present columns and footings are only capable to load of G+3 storey existing building.
- The present columns and footings are not capable to load of G+5 storey building.
- The retrofitted G+5 storey building is capable to take all kinds of the lad.

5. REFERENCES

[1] IS 13920:1993, "Ductile detailing of reinforced concrete structures subjected to seismic forces –code of practice".
[2] IS 1893(part 1):2002, "Criteria for earthquake resistant design of structures".
[3] IS 15988:2013, "Seismic evaluation and strengthening of existing reinforced concrete buildings-guidelines".
[4] IS 456:2000, "Design of reinforced and plain structures-code of practice".
[5] FEMA 356, "prestandard and commentary for the seismic rehabilitation of buildings".
[6] ATC 40, "Seismic evaluation and retrofit of concrete buildings".
[7] BS 1881: Part 202: 1986
[8] Earthquake Engineering 10th World Conference 1992.
[9] IS 13311 – 1992 (Part I).
[10] IS 13311 - 1992 – 2008 (Part II).
[11] IS 13828 - 1993 (Part I).
[12] Repair and Rehabilitation – Indian Concrete Journal, Sept. 1992.
[13] Repair and Rehabilitation – Indian Concrete Journal, Nov. 1995.
[14] Guidelines for Retrofitting of Concrete Structures - Draft published by JSCE, Sept. – 1999.
[15] Seismic Retrofitting of Existing Building – The master builder, Vol. 3 Dr. H. S. Rao. Aug.-Sept. 2001.
[16] ISIS Educational Module 4, Feb. - 2004.
[17] 13th World Conference on Earthquake Engineering, AUG.- 2004.

[18] STTP on Advancements in Concrete Technology, At – Bhimavaram (A.P.) Dec. – 2004
[19] Alpha Sheth – Seismic Retrofitting by Conventional Method, Indian Concrete Journal, Vol. 76.
[20] Project report on NDT by MERI, Nashik.
[21] Structural Audit of Existing Buildings – I. H. Shah.
[22] New and Emerging Technologies for Retrofitting and Repairs – Dr. Gopal Rai.
[23] Manual for Retrofitting of Existing Vulnerable Buildings.
[24] STTP on Earthquake Resistant Analysis, Design, and Retrofitting of Structures, at Badnera (Maharashtra) June 2008.

