

## Review on understanding different ways to Safe Guard Existing Buildings

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### **ABSTRACT –**

*Although we are going on building structures we should not forget that the old structures should also be taken care of and the solution is repair, restoration & retrofitting of existing buildings.*

### **I. INTRODUCTION**

Its been many years since mankind has started developing land to erect buildings, But today comes a time when land resources have come to the limit of depletion. Due to global changes frequency of earthquakes and other calamities have increase. Thus there is a need for repair, restoration & retrofitting of buildings.

### **II. UNDERSTANDING OF TERMINOLOGIES**

Repair – Is to hide the superficial defects by patching & finishing works.

Restoration – Recovering the lost strength of structural elements.

Retrofitting – It means to make the building fit enough so that it can survive future calamities. [1]

### **III. NEED FOR REPAIR, RESTORATION & RETROFITTING**

1. Due to Inferior quality of materials used
2. There is a lack of fine and skilled craftsmen
3. Lack of structural strength of building due to many years from construction.

4. Buildings which were built decades before and did not have the proper techniques then, but instruments and techniques are available now.

### **IV. CONCEPTS & TECHNIQUES OF BUILDING REPAIR**

Repair – To shape the buildings according to what it was before or better so that all the services get resumed easily.

1. Patching of cracks and plastering
2. To check & repair electric wiring
3. Repairing of service pipes
4. Repairing doors and replaceable elements[4]

#### **Types of Repair for Historic Buildings**

1. Masonry Repair – In this method repointing is preferred, removing inappropriate mortar and replacing it with mortar of better quality.
2. Iron Repair – Removing rust by hand scrapping, and then proper priming and painting of the iron elements
3. Organic Growth removal – Algae growth on foundations and exterior walls show that there is moisture leakage from some specific areas which lower the strength of the building.
  - a. Treatments are cleansing with the help of bristle brush along with water.
  - b. Chemicals could also be used for more rigid type of unwanted matter.[8]

These Repairs operations can also be done:

- **Walls-** Replacing, Injecting, Nailing along with Coating with Reinforced Concrete.
- **Columns and Lintels-** Reconstructing, Increasing size of section, removing and changing structural organization
- **Arches and Domes-** Addition of braces and hoops.
- **Roofs and Floors** - Addition of beams and braces [6]

Repair materials that can be used are:

1. Shot concrete  
This method involves application of a combination of sand and portland cement which is mixed pneumatically conveying it in dry state to the nozzle of the pressure gun, where hydration occurs just before expulsion.
2. Epoxy resins  
Epoxy resins have excellent binding properties with good tensile strength. The higher viscosity epoxy resin can be used for surface coating or filling larger cracks or holes.
3. Quick setting cement Mortar  
This material was developed for the use as a repair material for reinforced concrete floors. [4]

## V. CONCEPTS & TECHNIQUES OF BUILDING RESTORATION

This is done if we understand that the structure has already gone through problems and has possibilities of facing it again. Restoration is to perform structural repairs to load bearing elements. It also involves:

1. Removing portions of cracked masonry walls and building it again with richer mortar.
2. Injection of epoxy material into cracks.

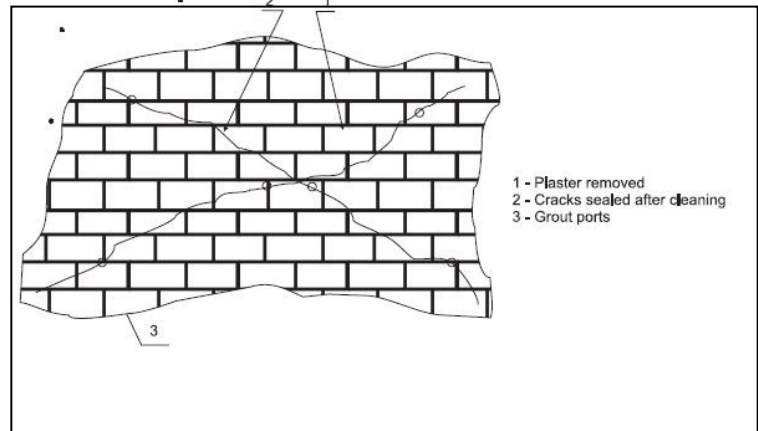


Fig. 1 Technique for Small Cracks

To get back the original tensile strength of the cracked portion pressure ejection of epoxy is done.

### Strengthening of walls through grouting

Water is injected through the holes made in the walls to clean the surface and improve bonding between the wall elements and the material to be injected.[4]

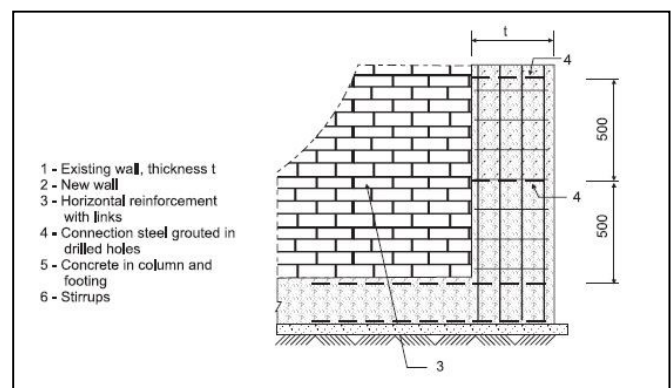


Fig. 2 Strengthening of walls with wire mesh

## VI. CONCEPTS & TECHNIQUES OF BUILDING RETROFITTING

Any kind of material quality degradation along with time due to which the strength of the

building is somewhat lost and cannot be brought back by restoration.

1. Improving lateral strength in x direction or else in both x & y axis
2. Eliminating weak sources where stress concentration is high
3. Adding resisting members & avoiding brittle failure[4]

## Retrofitting Strategies

1. URM replacement with damped bracing

Provision of K bracing in bay of span 2.5 m in the building. These help in energy dissipation due to seismic effects.

2. Column Jacketing

This will cause an increase in the lateral stiffness and lateral strength of the building.[5]

## Other Types of Retrofitting are:

1. Earthquake Damage Protection through RCC

Historical monuments or age old buildings where made of masonry structures which were non homogeneous, low in strength and non-elastic. But RCC has made things better.

2. Wall Jacketing

Providing Reinforcement steel net on both faces of wall, and then covering it with cement based mortar.

Common Mistakes made are:

- a. Proper connection missing between nets
  - b. Insufficient Cement cover provided
3. Foundation

Improvement in foundations adherence to soil.

Deep foundation should be made for absorbing vibration and strengthening the soil mass.[6]

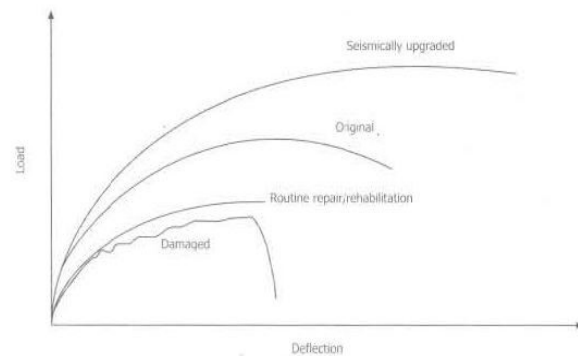


Fig. 3 Effect of retrofitting on load and deflection

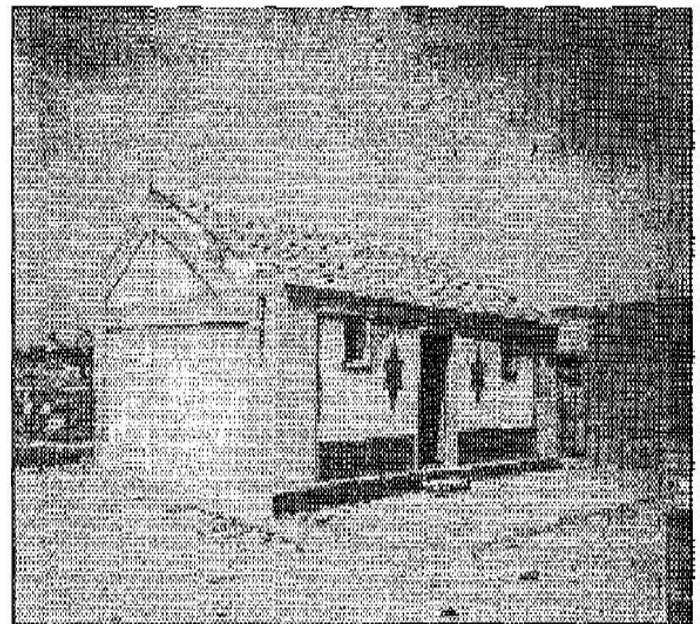


Fig. 4 An Example of Retrofitted House at kharirohar, Dist Kachhh





	Retrofitting Element	Rupees	Rs/m <sup>2</sup>
1.	Reinforced concrete bond elements (Headers), with 8 mm dia. TOR steel bar in M15 (1:2:4) C.C., 50 Nos @ 70/-	3500	41.70
2.	Corner Strengthening with 25mm x 25mm weld-mesh, anchor with 150 mm long Nails & Header, 32 mm thick plastering with (1:4) proportion (inside & outside), 52 m <sup>2</sup> @ 215.0	11180	186.30
3.	R.C.C. Band at Lintel Level with 25 mm x 25 mm weld-mesh, anchor at 1.2 m c/c & 150 mm Long Nails, plastering 32 mm thick (1:4) proportion, 12.2 m <sup>2</sup> @ 215.0	2623	43.70
4.	Diagonal Bracing for Gable wall, anchor with 4Nos. Header and 3 mm G.I. wire, 2Nos. @ 400.00	800	13.30
5.	Roof Bracing (wall plate), anchor with 75 x 25 mm size wooden Patti, 100 mm long Nails and 3 mm G.I. Wire, 85.4 m @ 16.40	1400	23.30
6.	Plastering (32 mm) thick, (1:4) proportion, with chicken mesh 6.52 m <sup>2</sup> @ 107.60	701	11.70
	<b>Total</b>	<b>20204</b>	<b>336.70</b>

Taking the cost of an earthquake resistant new similar house as Rs. 3000.00 per m<sup>2</sup>, the retrofitting cost works out to 11.2% only. In other words against rebuilding cost of the house of Rs. 1.80 lacs, the retrofitting cost is about Rs. 20,000/- only.

Tab. 1 Retrofitting elements and their costs[1]

## VII CONCLUSION

We come to know that repairing, retrofitting & restoration of buildings is very much necessary. Seeing the above researches we evaluate that it is comparatively very cheap in respect to the advantages it provides. Analysing the buildings we can come to a conclusion as to what kind of care should be provided to the building, be it repair restoration or retrofitting. These efforts can save many lives and cut economic damages at large.

## VIII REFERENCES

- [1] Repair, restoration and retrofitting of masonry buildings in kachchh earthquake affected areas of Gujarat, Gujarat state disaster management authority government of Gujarat, March – 2002.
- [2] Maintenance and Repair of Older Buildings in South Australia, Department for Environment and Heritage
- [3] Condition Assessment of buildings

For Repair and upgrading, Prepared under:-

Goi-undp disaster, risk management programme. National disaster management division Ministry of home affairs, government of India, New delhi, June 2007

[4] IAEE MANUAL, Chapter 9, Repair, Restoration and Strengthening of Buildings.

[5] Seismic Retrofit Of Reinforced Concrete Buildings - A Review And Case Study. By M C Griffith1 And A V Pinto2.

[6] Research on the restoration of heritage structures: Portland cement and concrete repair applications and repercussions. By Logan Strenchock.

[7] Repair And Strengthening Interventions On

Vertical And Horizontal Elements.

Speaker: Prof. Claudio Modena

[8] Guide to Common Repairs for Historic Buildings.

[9] I:S:4326-1993, Earthquake Resistant Design and Construction of Buildings - Code of Practice, Bureau of Indian Standards, New Delhi.

[10] Reconstruction and New Construction of Houses in Kachchh Earthquake Affected Area of Gujarat, (II printing), (GSDMA) Gujarat State Disaster Management Authority, Govt, of Gujarat, January, 2002.

[11] Decanini,, Luis, Adriano De Sortis,Agostino Goretti, Randolph Langenbach, Fabrizio Mollaioli, Alessandro Rasulo . "Masonry Building Performance in the 2002 Molise Earthquake." (2003): 1-25. Print

[12] Choudhuri, D., Mander, J.B. and Reihnorn, A.M., 1992. "Evaluation of seismic retrofit of reinforced concrete frame structures: Part 1 – experimental performance of retrofitted sub-assemblages," National Center for Earthquake Engineering Research, Report No. NCEER-92-0030, State University of New York at Buffalo, 136p.