IJARESM
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING, SCIENCE & MANAGEMENT

REPAIR & REHABILITATION OF EARTHQUAKE DAMAGED STRUCTURE

Mihir Lakdawala[1], Rushbha shah[2]
M.E. Student, Civil Eng. Dept., SNPIT &RC, Umrakh (GTU), Bardoli, Gujarat, India[1]
Asst. Professor, Civil Eng. Dept., SNPIT &RC, Umrakh (GTU), Bardoli, Gujarat, India[2]

Abstract: ***This paper describes the basic concept of the post-earthquake damage evaluation repair and rehabilitation of RC building. Earthquakes is shaking or trembling caused by the sudden release of energy. Usually associated with faulting or breaking of rocks. A damage assessment should be more precisely and quantitatively performed, and then technically and economically sound solutions should be applied to damaged buildings. Assessment procedure for evaluate damages in a structure & repair techniques. to apply Concrete repair system process damaged structure. Material used for rehabilitation. Repair and strengthening guide for earthquake damaged lowrise domestic buildings in Gujarat, India. As discussed herein, available data related to residual seismic capacity and their evaluation method are still few, and researchers are encouraged to direct their efforts for further understanding and clarifying structural performances after earthquakes***

Keywords: **Earthquake Damaged Structure, Evaulation, Repair Techanique, Rehabilitation**

INTRODUCTION

To restore an earthquake-damaged community as quickly as possible, a well-prepared reconstruction strategy is most essential. When an earthquake strikes a community and destructive damage to buildings occurs, immediate damage inspections are needed to identify which buildings are safe and which are not to aftershocks following the main event. However, since such quick inspections are performed within a restricted short period of time, the results may be inevitably coarse. Furthermore, it is not generally easy to identify the residual seismic capacities quantitatively from quick inspections.

In the next stage following the quick inspections, a damage assessment should be more precisely and quantitatively performed, and then technically and economically sound solutions should be applied to damaged buildings, if rehabilitation is needed. To this end, a technical guide that may help engineers find appropriate actions required for a damaged building is most essential.

Earthquakes IS shaking or trembling caused by the sudden release of energy. Usually associated with faulting or breaking of rocks. Continuing adjustment of position results in aftershocks. Maintenance: Actions taken to ensure that a structure conforms to its

original functional performance above a given level of acceptance. It is the process of checking the quality of the structure.

Physical damage can also arise from fire, explosion – as well as from restraints, both internal and external, against structural movement. Except in extreme cases, most of the structures require restoration to meet its functional requirements by appropriate repair techniques.

Reinforced cement concrete (RCC) as a construction material has come into use for the last one century. In India, RCC has been used extensively in the last 50-60 years. During this period, we have created large number of infrastructural assets in terms of buildings, bridges, sports stadium etc., which are lifeline for the civilized society. It has been observed that the deterioration phenomenon of RCC is not realized by majority of practising civil engineers. As a result, the factors considered necessary for durability of RCC buildings are many times not given due importance during construction and/or during maintenance

Procedures, mandatory or otherwise, for periodic inspection of buildings and structures and documenting defects, like cracks, excessive deflections, corrosion of reinforcement etc., in logical manner, and recording of structural repairs already carried out, are generally not followed or maintained. In some buildings, only visual inspection is carried out for preparing maintenance budget estimates and this exercise is often left to the engineers who have no experience in such problems

2. OBJECTIVE OF THE STUDY

(1) Damage rating of foundation and superstructure

The damage to each structural member is inspected and classified into one of damage classes I through V. Then the residual seismic capacity ratio index R is calculated and the overall damage rating of the building is performed based on R-index.

(2) Determination of rehabilitation actions Based on the damage rate made in (1) above and the intensity of shaking experienced at the building site, necessary rehabilitation actions such as repair and strengthening are determined.

(3) Visual instructions for repair and strengthening

In the Guideline, approximately 50 techniques are illustrated with recommended redesign details as well as rehabilitation procedures.

(4) Application examples

Finally two example buildings, which were damaged during earthquake 2001 KUTCH, are presented to help engineers understand the concept of the Guideline and its application procedure.

3. METHODOLOGY

3.1 ASSESSMENT PROCEDURE FOR EVALUATE DAMAGES IN A STRUCTURE

- Physical Inspection of damaged structure.
- Preparation and documenting the damages.
- Collection of samples and carrying out tests both in situ and in laboratory.
- Studying the documents including structural aspects.
- Estimation of loads acting on the structure.
- Estimation of environmental effects including soil structure interaction.

- Taking preventive steps not to cause further damage.
- Remedial measures necessary to strength and repairing the structure.
- Load test to study the behavior.
- Choice of course of action for the restoration of structure

3.2 CONCRETE REPAIR SYSTEM PROCESS

- Determine the causes of damage
- Evaluate the extent of damage
- Evaluate the need to repair
- Prepare the old concrete for repair
- Apply the repair method
- Cure the repair properly

3.3 MATERIAL USED FOR REHABILITATION

- Grout
- Epoxy resin
- Epoxy mortar
- Shortcrete
- Fibre reinforced concrete
- Fibre reinforced polymers

Grouting: With grouting, the density of the underlying material increases. Though the grout is of a different density than concrete, used with appropriate calibration charts, core results and analysis, a fair co relation can be established between the UPV and the strength of the structural member.

Selectively, cores can be taken on site to assess the true nature of underlying material and provide a calibration base for other readings.

Epoxy resin: Epoxy resins cure to form relatively brittle materials with bond strengths exceeding the shear or tensile strength of the concrete. If these materials are used to rebond cracked concrete that is subsequently exposed to loads exceeding the tensile or shear strength of the concrete, it should be expected that the cracks will recur adjacent to the epoxy bond line. In other words, epoxy resin should not be used to rebond "working" cracks.

Epoxy mortar: The application of epoxy mortar to repair areas of concrete deterioration caused by corroding reinforcing steel is also not recommended. The epoxy bond coat and epoxy mortar create zones of electrical potential that are different from the electrical potential in the surrounding concrete. This difference in potential can result in the formation of a galvanic corrosion cell with accelerated corrosion at the repair perimeters

Shortcrete: Dry mixing involves premixing of binders and aggregates which are fed into special mechanical feeder metering the premixed materials into a hose.

The mix is jetted out along with compressed air from a nozzle connected to the hose having a water ring outfitted to it. This mix is injected to the repair spot.

The resultant hardened properties include increased flexural, compressive strengths and more durability.

Wet mix shotcrete is a method that involves premixing of all ingredients including binder, water, aggregates and admixtures.

The premixed repair materials are deposited into a pump which transports the materials to an exit nozzle where compressed air is introduced. The repair material is propelled onto the substrate with compressed air.

Fibre reinforced polymers: Efforts on upgrading existing beam column joints have focused on the use of FRP composites in the form of epoxy-bonded flexible sheets, shop-manufactured strips, or near-surface-mounted rods.

The relatively higher initial cost of FRPs is purportedly outweighed by their advantages such as high strength-weight ratios, corrosion resistance, ease of application, low labor costs, and no significant increase in member sizes.

4. CASE STUDY

Repair and strengthening guide for earthquake damaged lowrise domestic buildings in Gujarat, India

An example of a recently completed reinforced concrete frame building with block work masonry infill walls which was severely damage, caused by a catalogue of poor design practices is described below The owner of this property had retained the service of a local engineer to design his building.

- Poor building configuration
- Discontinuous columns
- Large window openings
- Short column failures

Example of a 3-Storey reinforced concrete frame structure, which is severely damaged in Kundanpur (near Kera) Kutch

Large windows openings close to corners and short column failures

Diagonal cracking at corner column caused by twisting of frame and short column failure

Repairs and strengthening works should be carried out is given in various:

1) Repairs to random (rubble) masonry buildings
2) Repairs to masonry cut stone buildings
3) Repairs to reinforced concrete framed buildings

- ❑ Choice of repair method will depend on ease of repair, physical constraints and degree of damage.
- ❑ The owner-builder can identify a particular repair type and use the figure to suit his repair.

Conclusion:

Guide concentrates on providing good repairs and strengthening works to no engineered structures, it was considered that some guidance may be useful on new buildings.

However, all new buildings must be designed by a structural engineer, with knowledge of earthquake resistance design to the relevant Indian and/or American UBC: 1988 codes

5. CONCLUSION

Seismic evaluation and rehabilitation before damaging earthquake is definitely most essential to mitigate damage. It is also true, however, that such efforts need a certain period of time, manpower and budget to complete enormous buildings throughout the country. A well prepared post-earthquake strategy including damage evaluation and rehabilitation schemes as well as pre-event preparedness is therefore an urgent task to be developed in the researchers and engineers community, and should be ready for the immediate application after an event.

In this paper, the basic concept and procedure for post-earthquake damage evaluation of RC buildings in are presented, together with background and several supporting data. As discussed herein, available data related to residual seismic capacity and their evaluation method are still few, and researchers are encouraged to direct their efforts for further understanding and clarifying structural performances after earthquakes

ACKNOWLEDGMENT

The author thankfully acknowledge to Mr. J.N.Patel, Chairman Vidyabharti Trust, Mr. K.N.Patel, Hon. Secretary, Vidyabharti Trust, Dr. H.R.Patel, Director, Dr.J.A.Shah, Principal, Dr. Neeraj Sharma, Head of Civil Engineering Department, Asst. Prof Rushbha shah , Our Guide,S.N.P.I.T.&R.C.,Umrakh, Bardoli, Gujarat, India for their motivational & infrastructural supports to carry out this research.

REFERENCES

[01] Director General Works CPWD "CPWD Handbook on Repairs and Rehabilitation of RCC Buildings",Government of India, New Delhi Government of India, New Delhi Publication 2005

[02] Murat Engindeniz, Lawrence F. Kahn, and Abdul-Hamid Zureick "Repair and Strengthening of Reinforced Concrete Beam-Column Joints: State of the Art" Publication 2002

[03] http://www.niuniv.com/NIUWeb/qbank/EVEN%20SEM/BE%20Civil/CE1305.pdf

[04] Guide to concrete repair united state department of interior bureau of reclamation technical service center Gujarat relief engineering advice team (great) "repair and

strengthening guide for earthquake damaged low-rise domestic buildings in gujarat, India" Publication 2002

[05] Gujarat state disaster management authority government of gujarat "guidelines for repair, restoration and retrofitting of masonry buildings in kachchh earthquake affected areas of gujarat" publication march - 2002

[06] Robert D HANSON And Craig D COMARTIN "THE REPAIR OF EARTHQUAKE DAMAGED BUILDINGS"

[07] Yoshiaki NAKAN, Masaki MAEDA, Hiroshi KURAMOTO, and Masaya MURAKAMI "GUIDELINE FOR POST-EARTHQUAKE DAMAGE EVALUATION AND REHABILITATION OF RC BUILDINGS IN JAPAN" published August 1-6, 2004.

