REPAIRING & REHABILITATION OF RCC STRUCTURES

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ABSTRACT: RCC as a construction materials has come into utilization for the last one century. In India, Reinforced cement concrete has been utilized widely in the last 50-60 years. During this period, we have created enormous number of infrastructural resources in terms of bridges, buildings, sports stadium etc., which are lifeline for the civilized society. These have been made with gigantic speculation of resources. We can't even think of recreating such resources out of limited national assets. It is, therefore, essential to maintain them in functional condition.

The purpose of this project is to realize elementary and sensible understanding on concrete repairing and rehabilitation of the structures. The rapid urbanization has led to spreading of small RCC Buildings and has severely strained the resources in our country. Most recent constructions in the urban areas consist of poorly designed and constructed buildings. The more seasoned structures, regardless of whether built in consistence with pertinent guidelines at that time, may not consent to the more tough particulars of the most recent principles. There is a critical need to evaluate the seismic weakness of structures in India, as a basic part of a comprehensive earthquake (seismic) disaster risk / harm management policy.

The main reason of repairs is to bring back the architectural state of the structure so that all administrations begin working & the functioning of structure is resumed quickly. Repair doesn't profess to improve the structural strength of the building & can be very deceptive for meeting the strength necessities of the next seismic tremor.

Rehabilitation is the compensation of the strength the structure had before the harm occurred. This kind of action must be attempted when there is proof that the structural harm can be ascribed to remarkable wonders that are not prone to happen again & that the original strength provides a satisfactory degree of wellbeing.

KEY WORDS: ***Cement, concrete, Construction, civil engineering, demolished, design, development, jacketing, Rehabilitation, reduction, seismic strength.***

I.INTRODUCTION:

RCC construction is commonly expected to give inconvenience free assistance all through its proposed plan / design life. However, these desires are not understood in numerous constructions because of structural deficiency, material deterioration, unexpected over loadings or physical harm. Premature material decay can emerge from various causes, the most common points when the construction particulars are abused or when the facility is presented to harsher service environment than those expected during the planning & design stages.

The existing structure approaching its functionality life & showing indication of breakdown does calls for specialized intercession for improving their life & to maintain a strategic distance from any unintentional disappointment because of seismic occasion or other structural reason. Physical harm can likewise emerge from fire, explosion – as well as from restraints, both internal & external, against structural movement. Except in extraordinary cases, most of the structures expect Rehabilitation to meet its utilitarian prerequisites by appropriate repair techniques.

Post the specialized assessment / evaluation of such structures, the choice to repair or supplant a structure or its segment must be taken. This must be in consistence with economy, construction feasibility & according to most recent patterns and strategies.

The methodology towards Rehabilitation of any structure can be categorized in following steps & activities.

- Performing Structural Audit of the structure.
- Evaluating different retrofitting alternatives, materials, possibility & economy.
- Performing structural computations & capacity demand proportion for structural members.
- Suggesting retrofitting/construction system & getting the restoration of the structure done.
- Post retrofitting tests on the structure.

II. RESEARCH BACKGROUND ON REPAIRS & REHABILITATION OF RCC BUILDING:

- CPWD, New Delhi concluded in his studies that Buildings & other structures have a certain useful life, which depends on the specifications adopted. The huge number of monuments, which are loved legacy (cherished heritage) structures have stood well throughout some undefined time frame. However, a portion of these have given indications of misery because old enough, aggressive natural environment/ industrial pollution, modern contamination and so on.

- S.S. Chandar Str. Er., Structural Department, MWH Global, Bajaj Brand View, Wakdewadi, Pune, Maharashtra, India. In 2014 expressed that the engineering which involves in modifying the existing buildings for structural behaviour without hampering its basic intent of use is termed as retrofitting.

- Dr.Anand S. Arya, FNA, FNAE, FIE (Professor Emeritus, Dept. of Eq. Engineering, IIT Roorkee) Chairman, BIS Committee CED 39 National Seismic Advisor (EVR) Ministry of Home Affairs. In June 2006 stated that Introducing new load bearing members including foundations to relieve the already loaded members. Jacking operations may be needed in this process. He also said that one of the strengthening methods includes adding new structural elements to an existing structure to increase the lateral force capacity. Shear walls & steel bracing can be added as new elements to increase the strength and stiffness of the structure.

- Shamim A. Sheikh, David DeRose, & Jamil Mardukhi concluded in his studies that because the damage to the building was partly caused by excessive differential foundation settlement, improvement in flexibility was one of the principle centres in planning the retrofitting plans, especially on account of beams showing indications of failure in shear. Another factor in the choice of the repair method was the proceeded with utilization of the structure for typical activities.

- Hemchandra Chaulagain in his paper Assessment of seismic strengthening solutions for existing low-rise RC structure in Nepal concluded that RC jacketing of columns increases significant deformation capacity. It confirms that RC jacketing is a very effective strengthening technique, leading to uniformly distributed values of strength & stiffness of the strengthened column that are considerably higher than those of the original column. The measured hysteretic loops for the jacketed columns indicated good energy dissipation.

III. NEED OF STRUCTURAL REPAIRS & REHABILITATION:

During design & development of any structures numerous precautions & steps are taken to avoids any harms during serviceability life. But if any how damage caused then we need structural repairs & Rehabilitation.

The need of structural repairs can emerge because of any of the accompanying reasons:-

- Faulty design of the structure.
- Low quality materials utilized.
- Improper execution and awful workmanship.
- Due to any side by construction or any adding & modifications in existing structures.
- Extreme enduring or due to changes in ecological conditions.
- Changes in seismic zones, inciting seismic retrofitting for critical structures like healthcare facilities, defence establishments etc.
- Improper utilization of structure. E.g. Increased loads etc.
- Changes in design codes. E.g. changes in the minimum grade of concrete to be utilized.
- Due to any explosion or because of serious degree of chemical attack.
- Ageing of the structure.

IV. ADVANTAGES OF STRUCTURAL REPAIRS & REHABILITATION:

- Strength: - In case of lost strength, repairs should restore the strength.
- Economic: - There are no detrimental effects on concrete & on other structural & non-structural elements.
- Save environment: - There is no uncovering of natural assets and less transportation. Also less land is utilised.
- Save time: - There is no hanging tight for material accessibility.

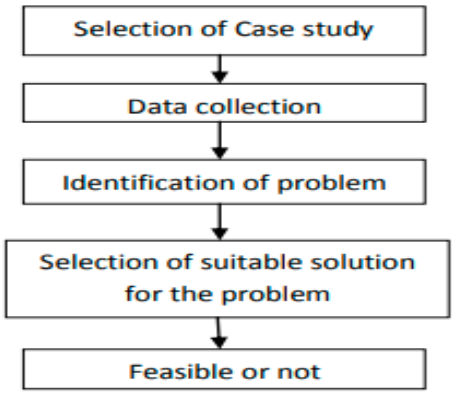
- Sustainable: - Less outflow of carbon because of less smashing.
- Less Noise, Dust and Debris.
- Ideal for short term jobs.
- Reduce the impact of squander materials on environment in terms of dust particles, disposed etc.

V. DISADVANTAGES OF STRUCTURAL REPAIRS & REHABILITATION:

- Structural Repairs & Rehabilitation activities cannot be done during heavy rain or freezing conditions, since mortar will be severely affected.
- Repairs & Rehabilitation activities construction requires a good amount of time and adequate project planning. Depending on the type or Repairs & Rehabilitation activities, specialized manpower may be necessary.
- The stability of Repairs & Rehabilitation exercises relies totally upon their foundation. If any settling of the foundation happens, cracks are likely & they should be repaired to prevent dampness infiltration & harm.
- Sometimes Structural Repairs & Rehabilitation exercises includes substantial materials such as bricks, stone and concrete blocks. These can't be transported in conventional vehicles, & in some cases they must be ordered from uncommon indexes, especially stones.
- Sometimes Structural Repairs & Rehabilitation activities involves of steel bars that may cause loss of historical material.
- Sometime because of dust respiratory problems arise in the workers involves in Repairs & Rehabilitation activities.

VI. TYPICAL STRUCTURAL REHABILITATION OR STRENGTHENING TECHNIQUES

It is a general practice to have structural retrofitting to primarily restore or enhance either concrete or steel in the structure



Flowchart-1: Process of Repair and Rehabilitation

The methodology towards rehabilitation of any structure can be categorized in following steps & activities.

- Performing a Structural Audit of the structure.
- Evaluating different retrofitting choices, materials, possibility and economy.
- Performing structural calculations and capacity demand ratio for structural members,
- Re-design an existing structure using ETABS according to demand and analyzing the result with existing reports for ascertaining the seismic load carrying capacity of that structure.
- Suggesting retrofitting/construction system and getting the rehabilitation of the building done.
- Post retrofitting tests on the building.

There are primarily the following method used for the above said purpose.

❖ **Concrete**

- Jacketing of columns, beams & increasing slab thickness.
- Rehabilitation of cover and loose concrete.

❖ **Steel plates to improve the strength of the structure**.

❖ **Footings**

- Extension of footings.

❖ **Steel**

- Replacement of steel
- Fibre wrapping

VII. SEISMIC REPAIRS & REHABILITATION TECHNIQUES

System strengthening and stiffening are the most common seismic performance improvement strategies adopted concurrently for buildings with inadequate lateral force resisting systems. Typical systems employed by the authors during strengthening of earthquake-damaged buildings in India include the additional of new vertical elements, shear wall, braced frames & jacketing. Amidst all the retrofitting option, appropriate option can be selected on case-to-case basis after proper seismic evaluation and considering its merits & demerits, which are briefly discussed hereunder:

7.1 Shear Walls

The introduction of shear walls into an existing concrete structure is extremely effective method of increasing both building strength and stiffness. A shear wall system is often economical and tends to be readily compatible with most existing concrete structures. However, the addition of shear walls to an existing structure can have some adverse impacts, like addition of

large number of shear walls to a building can result in a significant increase in building mass and therefore increase seismic forces and strength requirements. Shear walls may often result in significant architectural impact through the loss of windows and the introduction of barriers within areas of floor space and also tend to produce large overturning forces at their bases that may require supplemental foundation work, which is often expensive.

7.2 Braced Frames

Braced steel frames are another common method of enhancing lateral stiffness and strength of an existing building. However, it is not as popular in India as it is difficult to effectively attach braced frames to an existing RC frames. Typically, braced frames provide lower levels of stiffness and strength as that of shear walls, but they add far less mass to the structure and can be constructed with less disruption of services, less loss of light, and have a smaller effect on traffic patterns within the building.

7.3 Eliminating or Reducing Structural Irregularities

Inconsistencies identified with dispersion of strength, stiffness and mass outcome in poor seismic Performance. Often these anomalies exist due to discontinuity of structural members. Straightforward expulsion of such discontinuities may diminish seismic interest on other structural Components to worthy levels. A viable measure to address vertical inconsistencies such as weak as well as soft storey is the expansion of shear walls and braced frames within the weak or soft storey. Braced frames and shear walls can also be adequately used to adjust stiffness and mass distribution within a storey to diminish torsional inconsistencies.

7.4 Supplemental Damping and Isolation

Seismic isolation & supplemental damping are quickly advancing flighty systems for improving seismic execution of structures. A general reaction of base isolation is decrease in demands on the components of the structure. This procedure is best for moderately stiff structure with low profiles & enormous mass contrasted with light, flexible structures. However, base isolation is technically complex & costly to implement. Energy scattering helps in generally decrease in displacements of the structure. This strategy is best in structures that are generally adaptable and have some inelastic deformation limit. Once more this strategy is technically complex, yet less expensive contrasted with base isolation.

VIII. NEW APPROACHES FOR SEISMIC REPAIRS & REHABILITATION.

Immediately after the earthquake, the focus is drawn to repair the most vulnerable locations in the buildings by conventional repair cum strengthening schemes such as jacketing of ground storey columns, addition of shear walls etc. mainly governed by socio-economic considerations. However, these seismic retrofit schemes cannot be applied since one or more of the following conditions may often have higher priority in determining available repair scheme.

- Limit of construction space, period, & time
- Noise, vibration, dust during work
- Preservation of architectural & structural design

- Functional performance as well as structural performance
- Serviceability during construction

Among many new technological options viz. seismic isolation, supplemental energy dissipation, active control, high performance materials available for retrofitting, cost constraint restrict the use of these techniques in Indian context. However, recently developed seismic retrofit technique, 'carbon fiber wrapping of structural members' has been implemented successfully at number of multistoried buildings during post rehabilitation work after Bhuj-earthquake despite of cost considerations. This enjoys edge over the conventional repairing techniques due to its speed of execution and durability. It is experimentally as well as analytically verified that the Carbon Fiber Wrapping around deficient columns and beams adds to confinement and thereby improve strength against flexure, shear and ductility.

8.1 Carbon Fiber Jacketing of RC Columns

The fiber wrapping system is a high strength hybrid woven fabric/epoxy composite made of E - glass & Kevlar / Aramid fibers embedded in an epoxy resin. This scheme basically aims at improving ductility of existing RC columns, which may fail in shear during seismic hazordus. The advantage of using carbon fiber jacketing is relatively easy for application; rapid execution; high strength to weight ratio; good resistance to corrosion and environmental degradation; tailor ability to adapt to any shape of the substrate concrete. However, the general methodology, design principles, & some test results for application of fiber wrap have been discussed elsewhere.

8.2 Base Isolation

This approach requires the insertion of compliant bearings within a single level of the building's vertical load carrying system, typically near its base. The bearings are designed to have relatively low stiffness, extensive lateral deformation capacity & may also have superior energy dissipation characteristics. Installation of an isolation system results in a substantial increase in the building's fundamental response period &, potentially, its effective damping. Since the isolation bearings have much greater lateral compliance than does the structure itself, lateral deformation demands produced by the earthquake tends to concentrate in the bearings themselves. Together these effects result in greatly reduced lateral demands on the portion of the building located above the isolation bearings. However, this is not being practiced in India for post-earthquake rehabilitation.

IX. CONCLUSIONS

- ❖ Rehabilitation decrease the vulnerability of harms of an existing structure during a future seismic tremor. It means to fortify a structure to fulfil the necessities of the current codes for seismic plan.
- ❖ In this regard, seismic repairs is beyond traditional repairs or even rehabilitation. The standards of seismic repairs allude to the goals, objectives & steps.

- The steps include condition appraisal of the structure, assessment for seismic powers, choice of retrofit systems & construction.
- The applications incorporate various kinds of structures, modern structures & so on.

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