A Case Study of Non-Destructive Techniques in Retrofitting of MP Govt. Water Tank & Buildings Structures

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Abstract— This report of Deterioration of Strength of RCC overhead water tanks and Residential Buildings using Rebound Hammer as dissertation is done for the purpose that how the deterioration in strength varies with age of construction and varies with respect to other factors affecting them. Retrofitting of RCC overhead water tanks and the public building is to be done on priority basis for public welfare and to minimize loss of life and property. In Retrofitting of the structure the NDT is to be carried out during the initial investigations, as these tests provide the various properties of the existing concrete easily without damage the existing structure and based on these test results the retrofitting measures are to be suggested. This study is related to RCC Columns. Hence, the results are concluded with the percentage Retrofitting affected by the age and some other factors. The NDT was led again after the finishing of retrofitting of the structure. This case study analysis displays the utilization of standard and inventive repair materials, proper innovation, workmanship, and quality control for effective repair, reinforcing and reclamation of harmed structures.

Key words: RCC Overhead Water Tanks, Non-Destructive Techniques in Retrofitting

I. INTRODUCTION

Any man-made structure used or intended for supporting or sheltering any use or continuous occupancy. Buildings are in different shapes and have different functions. In vast contrast we see that the building play very vital role in the lives of human being and in the development and progress of nation. Hazardous are the events, which make the adverse impact over the life and property. They are artificial or natural the time of occurrence is not decidable. Some of common hazardous are Earthquake (seismic force), Fire, Cyclones.

The impact of the adverse factor on the building are weakening of the foundation, buckling/eccentricity of the columns, development of the cracks, palling of the concrete, deflection and sinking of the beams and columns, which induce the moment which tend the building to maintain its equilibrium and cause the fall, expose of the steel structural frame, reinforced section to the atmospheric corrosion.

Some Causes of Failure of Buildings and structures are:

1) Buildings with sporadic setups, for example, those with unexpected changes in Stiffness, huge floor openings, substantial floor statures and so on.
2) Buildings or structures on locales inclined to liquefaction.
3) Buildings with dividers of un-fortified workmanship, which tend to break and disintegrate under serious ground movements.
4) Building with absence of ties amongst dividers and floors or rooftops.
5) Buildings with non-flexible solid casings, where shear disappointment at shaft segment joints and segment disappointments are regular.
6) Concrete structures in which inadequate lengths of bar harbor are utilized.
7) Concrete structures with level chunk encircling, which can be seriously influenced by vast story floats.

A. Rehabilitation

These pre measures are taken to improve the seismic resistance of a structure beyond its original capacity.

B. Retrofitting

It will involve actions for upgrading strength of an existing building that are affected by the seismic effects, so that it becomes safer for the future seismic forces.

II. LITERATURE REVIEW

Elyson A.P. Liberati, Edson D. Leonel (2015) were concluded that among such processes, the diffusion of chlorides is recognized as one of major responsible of corrosion phenomenon start. In this context, this study presents a nonlinear formulation based on the finite element method applied to mechanical analysis of RC structures subjected to chloride penetration and reinforcement's corrosion. The physical nonlinearity of concrete is described by Mazars damage model whereas for reinforcements elastoplastic criteria are adopted. The steel loss along time due to corrosion is modeled using an empirical approach and the chloride concentration growth along structural cover is represented by Fick's law. The proposed model is applied to analysis of bended structures. The results obtained by the proposed nonlinear approach are compared to responses available in literature in order to illustrate the evolution of structural resistant load after corrosion starts.

Taraka Ravi Shankar Mullapudi and Ashraf Ayoub (2013) reported the Investigative studies are directed to build up a compelling systematic model to recreate the non-straight reaction of strengthened cement (RC) dividers subjected to three-dimensional (3D) loads. The communication between the solid and steel is brought into record with thought of the spread conduct of steel and strain solidifying of cement. The proposed model is figured to address the collaboration between the pivotal power, shear, bowing and torsion loads. The shear instrument along the shaft is demonstrated by receiving a Timoshenko pillar approach for 3D outline components with self-assertive cross-segment geometry. The non-direct conduct of the composite component is gotten totally from the constitutive laws of cement and steel. The solid constitutive model takes after the mellowed layer model that predicts the elastic splitting, pressure pulverizing, strain softening, steel yielding and material harm under joined loadings. The legitimacy of the model is set up through a

connection investigation of tentatively tried RC shear dividers subjected to monotonic stacking conditions.

J Hola, K Schabowicz (2010) suggested best in class non-damaging symptomatic methods of testing building structures and illustrations of their applications. Much consideration is given to acoustic systems since they have been significantly created as of late and there is a reasonable pattern towards procuring data on a tried component or structure from acoustic signs handled by legitimate programming utilizing complex information investigation calculations. Another pattern in the improvement of non damaging strategies is towards evaluating qualities other than quality in components or structures, especially the ones made of concrete or strengthened cement. The paper concentrates on methods suitable for: recognizing imperfections imperceptible at first glance, evaluating the profundity of splits, deciding the measurements of components available from one side just and 2D and 3D imaging of fortification dissemination in such components. At long last, headings of further advancement in this field are demonstrated.

MKD Khan and M. Wamiq (2008) observed the impact of solid breaking on the lateral reaction of building structures has been explored and talked about. The examination business related to the investigation of impact of solid splitting on its firmness has been overviewed. The debates in the declarations of the prime parameter identified with the breaking of the fortified cement are likewise talked about. The alteration elements and comparisons prescribed in writing and additionally in distinctive nation principles to present the non-linearity of cement are likewise given. The surrounded building plan samples are exhibited for quantitative impact of horizontal reaction fusing the solid splitting under seismic stacking in light of Indian seismic code.

Oral Buyukozturk (2004) discusses the enthusiasm for the movement of non-ruinous testing (NDT) frameworks for solid structures has stretched out with the making stress over the isolating state of the World's base. Competent and exact imaging systems are required for a solid examination of thriving and serviceability of solid structures. Be that as it may, quickly, imaging is routinely utilized as a bit of different fields, usage of these advances in NDT of helper arranging frameworks, particularly of solid structures, offers different difficulties and requires extra change by virtue of the composite strategy for the solid material and the complexities of sustained or prestressed solid structures. This paper demonstrates the key models of different imaging systems connected with a couple NDT plans material to solid structures. The methods considered are radiography, radioactive mechanized tomography, infrared thermography, radar imaging and acoustic imaging. Incredible contemplations regarding the congruity and exactness of these strategies for the condition evaluation of solid structures are talked about, and cases of imaging applications are given.

III. From the Case Studies Investigations, we Conclude the Following

- Retrofitting of the public building is to be done on priority basis for public welfare and to minimize loss of life and property.
- In Retrofitting of the structure the NDT is to be carried out during the initial investigations, as these tests provide the various properties of the existing concrete easily without damage the existing structure and based on these test results the retrofitting measures are to be suggested.
- Remedial measures :

A. Case Study No.1: Berasia Road Water Tank, Bhopal

- Cracks in the columns are to be filled by injecting neat cement slurry or epoxy material (which is strong in tension)
- Wrapping the cracked column with steel ties and cover, those with cement mortar called jacketing.

B. Case Study No.2: Bal Vihar (Social Building), Bhopal

- Deflection of the slab is prevented by providing the jack at the deflected portion the Channel or I section beams diagonally or laterally or longitudinally are used
- Parapet RCC wall by placing steel rods at certain intermediate distances and re-plastering it with cement mortar.
- Deflection in Beams corrected by providing the tension member steel as the U shaped bracket at the bottom of the beam and fasten it by bolts

Spelling of concrete in beam would be prevented by providing the wire mesh with grouting of concrete Cracks in Beams can be prevented by stitching of the cracks using the dowels

C. Case Study No.3: Water Tank near Hanuman Ganj Thana, Nadra Bus Stand, Bhopal

Deflection of the Slab is prevented by providing the jack at the deflected portion by providing the Channel or I-section beams diagonally, laterally, or longitudinally
Deflection in Beams prevented by provides the steel plate and fastens it with bolts and also by providing bottom bars

D. Case Study No.4 Statistical Study of Three Houses

1) A-55 Compressive strength found at A-55, Ayodhya Nagar Bhopal

a) Here the collected set of strengths from MP housing board of House A-55 in Ayodhya
Nagar is (At the construction time)

- Upper surface compressive strength = 25 N/mm^2
- Medium surface compressive strength = 25 N/mm^2
- Lower Surface compressive strength=25 N/mm^2

b) Observations of compressive strength by NDT (At present time)

- Upper surface compressive strength= 18.5N/mm^2
- Medium surface compressive strength= 21.4 N/mm^2
- Lower Surface compressive strength=21.4 N/mm^2

c) Calculation of deterioration in strength

$$= ((25-20.43)/25) \times 100 = 18.28\%$$

2) A-24 Compressive strength found at A-24, Ayodhya Nagar Bhopal

a) Here the collected set of strengths from MP housing board of House A-24 in Ayodhya

- Nagar is (At the construction time)
- Upper surface compressive strength = 25 N/ mm^2
- Medium surface compressive strength = 25 N/ mm^2
- Lower Surface compressive strength=25 N/ mm^2

b) Observations of compressive strength by NDT (At present time)

- Upper surface compressive strength= 24.8N/ mm^2

– Medium surface compressive strength = 21.4 N/ mm^2
– Lower Surface compressive strength=22.9 N/ mm^2

c) Calculation of deterioration in strength
= ((25−23.03)/25) × 100 = 7.88 %

3) A-05 Compressive strength found at A-05, Ayodhya Nagar Bhopal

a) Here the collected set of strengths from MP housing board of House A-05 in Ayodhya
– Nagar is (At the construction time)
– Upper surface compressive strength = 25 N/ mm^2
– Medium surface compressive strength = 25 N/ mm^2
– Lower Surface compressive strength=25 N/ mm^2

b) Observations of compressive strength by NDT (At present time)
– Upper surface compressive strength= 19.5N/ mm^2
– Medium surface compressive strength = 20.6 N/ mm^2
– Lower Surface compressive strength=21.4 N/ mm^2

c) Calculation of deterioration in strength
= ((25−20.5)/25)× 100 = 18%

E. Case Study No.5 Statistical Study of Two Houses

1) F-12 Compressive strength found at F-12, Ayodhya Nagar Bhopal

a) Here the collected set of strengths from MP housing board of House F-12 in Ayodhya
– Nagar is (At the construction time)
– Upper surface compressive strength = 25 N/mm^2
– Medium surface compressive strength = 25 N/mm^2
– Lower Surface compressive strength=25 N/ N/mm^2

b) Observations of compressive strength by NDT (At present time)
– Upper surface compressive strength= 20.2 N/mm^2
– Medium surface compressive strength = 17.1 N/mm^2
– Lower Surface compressive strength=18.5 N/mm^2

c) Calculation of deterioration in strength
= ((25−18.6)/25) × 100 = 25.60 %

2) F-35 Compressive strength found at F 35, Ayodhya Nagar Bhopal

a) Here the collected set of strengths from MP housing board of House F 35 in Ayodhya
– Nagar is (At the construction time)
– Upper surface compressive strength = 25 N/mm^2
– Medium surface compressive strength = 25 N/mm^2
– Lower Surface compressive strength=25 N/mm^2

b) Observations of compressive strength by NDT (At present time)
– Upper surface compressive strength= 24.4N/mm^2
– Medium surface compressive strength = 24.4N/mm^2
– Lower Surface compressive strength=21.4N/mm^2

c) Calculation of deterioration in strength
= ((25−23.4)/25)× 100 = 6.4 %

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