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Rehabilitation and Retrofitting Of Concrete Structures: A Review

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Abstract-Reinforced cement concrete used extensively for construction of different type of structures like buildings, bridges, industrial structures, pavement, water tanks etc. It is essential to maintain these structures in functional condition. Rehabilitation of existing damaged structures is the main construction activity now a day.A plan, methodology for structural repair and rehabilitation should be there. It is essential to know exact reason of distress, type of distress and correct methods to repair concrete structures. The workmanship during repair needs to utmost care to maintain quality repair. The various methods of defects and repairdiscussed in this paper as per the field knowledge. Various structures had studied and causes of the defects identified. This paper had given the easy and economical solutions for the maintenance of the structures.

Index Terms-Rehabilitation, Reinforced cement concrete, Retrofitting, Structural repair, Workmanship.

1. INTRODUCTION

1.1 Selection of Material

Selection of material plays an important role in repair of the concrete structures. Correct specification, its correct chemicals were selected for repair of concrete structures. Detailed inspection of structures had done to find out the root cause of deterioration of structures. Expert, Knowledgeable and experienced person to visualize the defects along with NDT test to come on the conclusion on structural assessment. Generally, concrete structures deteriorate due to below reasons:

i. Corrosion of steel,
ii. Concrete quality and poor workmanship during construction of structures,
iii. Concrete strength characteristics,
iv. Environmental conditions,
v. Design deficiency and its elements,
vi. Poor maintenance of the structures,
vii. Selection of construction materials.

1.2 Rehabilitation:

Evaluation of existing structures, strength, and durability, deficiencies, destructive and non-destructive testing, damaged structures and deterioration mechanisms, materials criteria and techniques for repairing and strengthening of concrete structures.

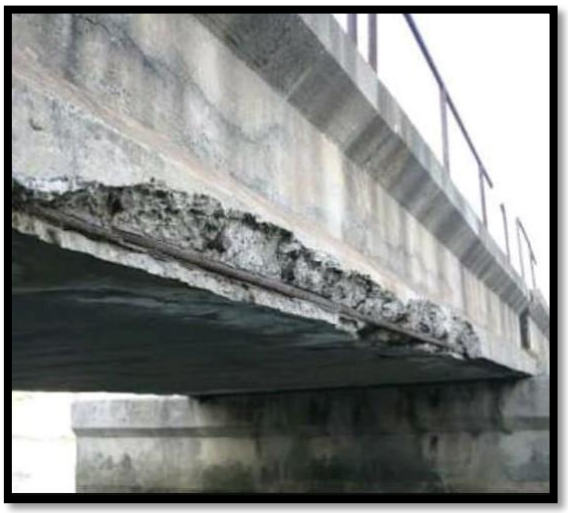

Fig 1.1: Rehabilitation engineering is the systematic application of engineering science to design, develop, adapt, test, evaluate, apply and distribute technological solutions to problems confronted by individuals with disabilities.

1.3 Retrofitting:

Seismic retrofitting is the modification of existing structures to make them more resistant to seismic activity and ground motion, soil failure due to earthquakes.

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Fig 1.2: Concrete jacketing involves placing an additional layer of concrete around the existing columns.

In general, analysis of a jacketed column, strength is determined based on an interaction diagram for the composite section or for some equivalent section. Investigation of the strength of jacketed columns and the performance of jacketed columns in beam-column joint sub-assemblages.

1.4 Grouting and Crack Repair

Cracking grout in a newly tiled floor is a real letdown after all the work you put into it. All the loose and cracked grout with a grout saw and completely vacuum out the gapshad done. Apply the caulk on the floor and smooth it with a wet finger or plastic spoon. Let the caulk cure for 48 hours before allowing anyone to the floor or anything on the floor.

1.5 Patch Repair

Surface patching hadperformed to a standard commensurate with resource availability and the objective of retaining a smooth ride as long as possible with time. A high quality patch is one of the most cost effective means of utilizing available resources.

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Fig 1.3: Flexible pavements require patching at times during their service life.

1.6 Replacement of spalled concrete

The word Spall describes the chips or fragments of a material that is broken off a bigger object. The process of spaling also known as spallation is the surface failure that occurs when a material such as concrete, brick, or limestone is subjected to excess moisture, corrosion, weathering, and much more. It was known, as (concrete cancer) is an eyesore and has the potential to be an extreme hazard.

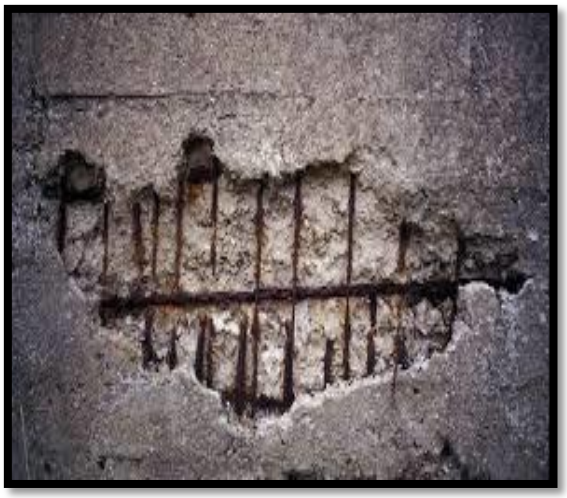

Fig 1.4: Eye shores to an external wall

1.7 Structural Jacketing

Concrete jacketing increase bearing load capacity following a modification of the structural design, to restore structural design integrity due to a failure in structural member. It used on vertical surfaces such as

walls, columns and other combinations such as beam sides and bottoms.

Fig 1.5: Structural Jacketing of a column

2. CASE STUDY

2.1 Why cracks are occurred in concrete?

Cracks in concrete are due to some problems in the foundation but it is not always connect and it should not be considered failure of structure or improper design or bad quality of work. Generally 1/16 to ¼ inch wise crack is acceptable limit even the best construction and concreting cannot prevent cracks in concrete,and 2% crack is unrealistic thing.

2.2 Causes of cracks in concrete:

i. Due to heavy load applied and due to loss of water from concrete surface shrinkage occurs
ii. Insufficient vibrations at the time of laying the concrete
iii. If the cover is not provided properly during concreting
iv. If there is high water cement ratio to make concrete workable
v. Due to the corrosion of reinforcement steel
vi. Delay of building fabric due to wood worm, rust and so on

2.3 Types of cracks in concrete structures

1. Structural cracks in concrete

Structural cracks are those cracks which result from incorrect design faulty construction or over loading these cracks are dangerous and it may endanger the safety of a building

2. Non structural cracks in concrete

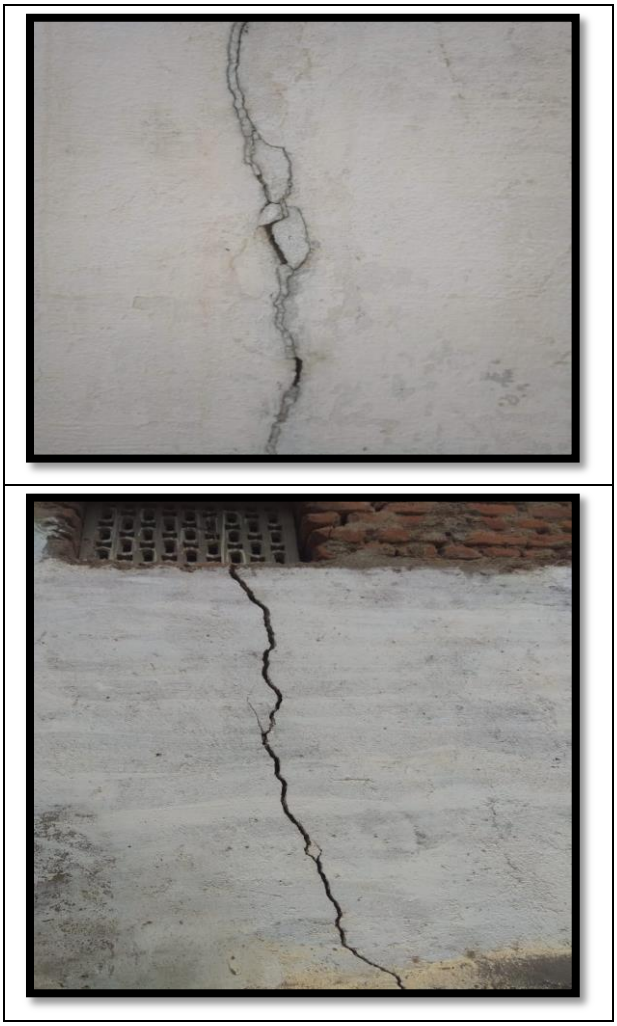

Fig 2.1: Non-structural cracks occur mostly due to internally induced stresses in building materials

This cracks are normally not dangerous for a building but it may look unsightly and if creates and impression of faulty work or improper work.

2.4 How to prevent cracks in concrete structures?

2.4.1 Reduce water content in concrete :

A low water cement ratio will often the quality of concrete. A lower water cement ratio leads to high strength in concrete and lesser cracks and the water cement ratio shall not exceed 0.5 in concreting.

2.4.2 Proper concrete mix design and use of quality materials :

The concrete is properly mixed. If we use too cement, we can almost guarantee cracks. If we use too much

water, it will make the concrete weak and should use good quality aggregates so will produce lower shrinkage concrete.

2.4.3 Finishing of concrete surface :

Proper finishing techniques should be used flat floating and flat trowelling are often recommended. Do not finish the concrete when there is bleed the water on the surface, finishing leads the water back to concrete instead of evaporating thus leading to cracks.

2.4.4 Proper wring of concrete :

Stop rapid loss of water from surface due to hydration causes drying of slab so cure the concrete for several days the concrete subjected to load during the curing, which can last up to one month.

2.4.5 Proper placement in vibration of concrete

If the concrete properly placed, vibrated, finished it reduces the chances of producing cracks. Properly vibrate the concrete to release the entrapped air, which later leads to cracks

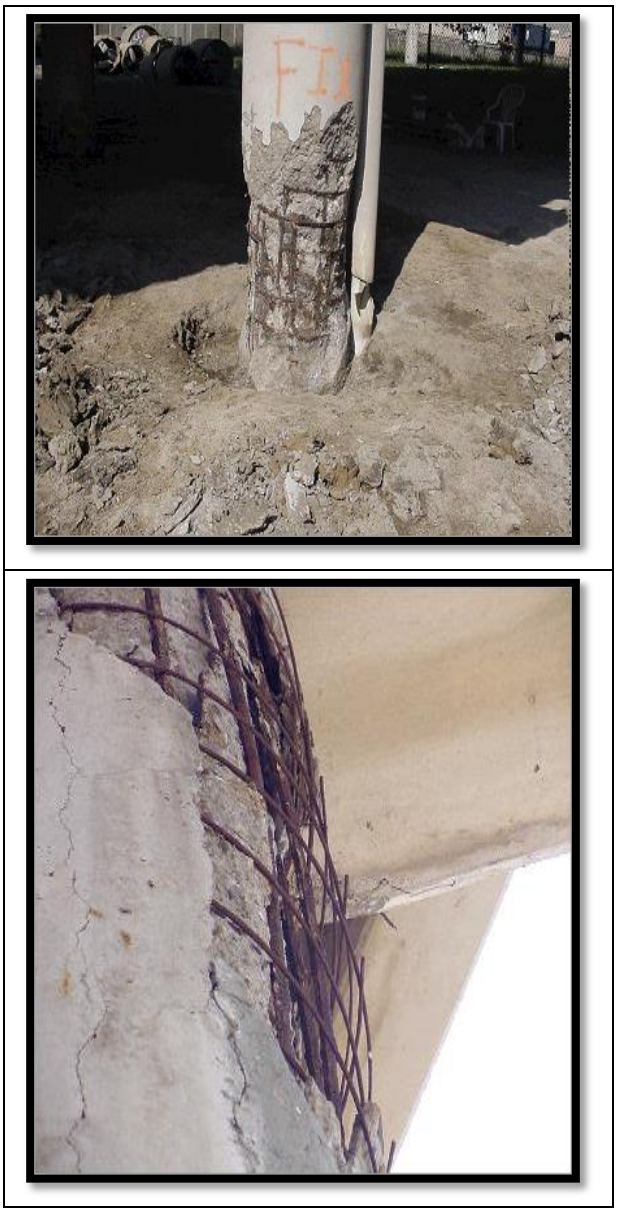

Fig 2.2:Sulphate attack on concrete is a chemical breakdown mechanism where sulphate ions attack components of the cement paste.

The compounds responsible for sulphate attack on concrete are water-soluble sulphate containing salts such as alkali earth and alkali sulphates that are capable of chemically reacting with components of concrete.

2.5 Repairing methods of cracks in concrete

2.5.1 Epoxy injections:

Epoxy injections used to fill the cracks that are as narrow as 0.05MM.in this method the surface are sealed injecting epoxy under the concrete. However, before injecting first fix the root cause of cracks otherwise the cracks will pop up again. This method of crack repairing requires a lot of skill full execution.

2.5.2 Routing and sealing:

Routing and sealing the crack is much more common and a much simpler method. It used in cases where only remedial crack repairing is required and not structural repairs. This method involves enlarging the crack on the surface and then filling and sealing it with a joint sealing.

2.5.3 Stitching the crack:

The stitching method is a simple and long lashing method of repairing crashed building. in this method holes are drilled to make entry and exit point across the cracked surface a number of U- shaped metallic staples are then passed through the holes and tied strongly in the holes with a grout.

2.5.4 Drilling and plugging:

This method is very useful to repair vertical cracks for its cost effectiveness and time consuming. In this method, vertical holes are drilled in the crack and a key is formed by passing down a grout. The grout key helps in preventing leakages and the consequent loss of soil from the wall.

3. CONCLUSION

Generally, concrete structures were neglected in industries. We must have inspection and maintenance at required interval for all industrial concrete structures. Reliability and Durability of structures can be ensured if all care as mentionedcan be ensured.

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