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Forensic The Damages in Building and Treatment

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***Abstract*—At present fact that every one of us needs proven standards and same pertains to building and its service too. The objectives of building construction are mainly concerned with the stability of buildings, the weather tightness, internal comfort level, the optimum use of building and its longer serviceable life. But the life of an individual elements in the building get deteriorate with age or either due to weathering action or other factors such as poor selection of materials, the human ignorance to maintenance, vandalism and biological agencies, and these cause some of common damages such as cracking, corrosion, etc. The area which get affected in a proposed site has been investigate by physical inspection and by a suitable non-destructive tests to gather more information about damaged area and how much they get affected as been studied. Based upon the investigation, the technique which method and material is more suitable for repairing these damaged area. Apart from this project what are common maintenance need to be done regularly to avoid the damages in structure and to make the structure more durable for ling life as also studied in our project.**

Keywords: Forensic, Damages, Treatment

I. INTRODUCTION

When man used to live in huts, the repair and maintenance was simple and easy to carry out. At the same time the required materials for this purpose were available abundance in nature. During ancient times, the huts were constructed activity acquired the gigantic scale and industrial status. Factors like man, material, machine and money started playing an important role in constructing industry.

Since 1950s, the construction activity in India has been increasing geometrically without matching increase in the availability of quality inputs, in terms of materials and skilled women. The gap between the quality planned and the quality achieved continues to become wider. The factors contributing to damages in building have, thus, become intrinsic right from the construction stage. Often these are concealed under external renderings and defect takes time to manifest itself.

Concrete construction is generally expected to give trouble free service throughout its intended design life. However, these expectations are not realized in many constructions because if structural deficiency, material deterioration, unanticipated over loadings or physical damage. Premature material deterioration can arise from a number of causes, the most common being when the construction specifications are violated or when the facility is exposed to harsher service environment than those expected during the planning and designing stages.

The excellent condition of such a structure indicates the appropriate design, quality of construction, workmanship and good maintenance practices. Thus it can be said that repair and maintenance of building structures was one of the vital aspect right from the beginning till the life of structure.

Damages mean that the condition of a structures or a building or its components has degenerated or has become unstable. Damages of building or its components, if allowed to occur may result in complete decomposition where replacement becomes the only solution. Damages is nothing but gradual disintegration on account of any destructive action from aggressive waters and soils, exposure conditions to weathering agents and relative movements of components. The rate of damages of building varies with resistance of the materials used. Permeability is one of the critical characteristics influencing the durability. there are several ways in which mechanism of damages sets up.

One is the external environment to which structure is exposed and second is internal cause within the material. Thus, there can be external and internal cause damages.

The process of damages can also be classified as under. Mechanical-wear and tear, Fatigue, Impact or over loading. Physical- cracking, Volume change, Deformation of shape, freezing and thawing. Chemical-reaction of harmful chemicals present within the material. Electro-chemical process like corrosion. Biological-bacteriological growth.

The process of damages is very complex and may set in due to one or combination of above mechanisms.

The various factors responsible for initiation of the process of damages are:

- Chemical factors
- Environmental Furring
- Human aspects
- Inappropriate cleaning
- Misuse of building
- Fire hazards
- Faulty hazards
- Faulty design
- Faulty construction
- Faulty materials
- Faulty system of maintenance

II. MATERIALS

A. Materials and Techniques for Repair

A variety of repair materials have been formulated to provide a wide range of properties. Since these properties will affect the performance of repair, selecting the correct material for specific application requires careful study. Concrete repair materials have been formulated to provide a wide range of properties. It is likely that more than one type of material will satisfy the design criteria for durable repair of specific structure. In these cases other factors must be taken into consideration which includes:

Ease of application
Cost
Available labor skills and equipment
Pot life of the materials

B. Types of Repair Material

Following materials are generally used for repairing of cracks and rehabilitation of RCC structures.

Ordinary or rapid hardening port land cement
Polymer modified concrete
Epoxy resins
Polyester resins
Ferro cement concrete
Polyvinyl acetate
Fine and coarse aggregate

i. Portland cement:

- Cement slurry injections with or without polymers to seal the gaps, pores or cracks.
- Motor with or without plasticizers for replacement of concrete cover or surface coating.
- Microcrete: guniting/shotcrete as replacement of concrete or cover concrete.
- Concrete with or without plasticizers as replacement of concrete or cover.

ii. Poly modified concrete (PMC):

Polymer modified concrete or mortars with the help of polymer latex such as acrylates and SBR (styrene butadiene rubber).

iii. Epoxy resins:

With or without addition of filler materials such as quartz sand for injection or concrete repairs. Polymer resins with or without addition of filler materials for concrete repairs.

iv. Ferro cement concrete:

Ferro cement is a composite materials of reinforcement (GI woven wire mesh) and cement sand mortar modified with polymers or other chemicals. Ferro cement concrete is used to replace cover concrete due to rusting.

C. Methods of Repair of Concrete

In case corrosion of steel has not started but carbonation of concrete has started and cracks are thin, coating of polymer or epoxy resins or polymer modified mortars prevent/ retard entry of moisture, CO_2 and O_2 etc. Such coatings prevent concrete and prevent corrosion for a period of 10 to 15.

If corrosion has started, following process is adopted:

Remove weak concrete and expose reinforcement all around.
Clean the rust of steel by wire brushes or sand blasting.
Apply rust removers and rust preventers.
Provide reinforcement to supplement rusted steel if required with anchorage shear connectors.
Apply tack coat of polymer or epoxy based bonding material.
Use one of the patching technique to restore concrete to the original surface level. Polymer modified mortars are very good. This can be used with or without guniting.
Injection of cement slurry or polymer modified slurry or epoxy to fill up pores or internal cracks or honey combing.
Apply suitable protective coating.
In case the condition of original concrete is very bad and injection grouting is not able to rehabilitate the section to take the required loading, RCC jacketing of concrete section is to be provided.
Provide the required supporting system to the structure.
Remove weak concrete
Clean the surface and clean the rust of steel
Apply steel removers and rust preventers
Provide additional steel all around the section
Provide required formwork
Provide polymer based bonding coat between old and new concrete
Place the concrete of required thickness and grade and workability admixed with plasticizers

III. METHODS

A.Stitching:

Shaped and twisted stainless steel rods are bonded into the walls, stitched the masonry across the cracks at regular intervals. The brick stitched system allows the cracked wall to behave as a reinforced non fractured unit. Having a helical configuration the crack stitch rods physically interlock with the bonding agent and exhibit a unique and resilient torsion spring like quality that allows small amounts of wall movement and recovery to occur without brittle failures.

B. Installation of stitched bars:

Installation is straight forward. A horizontal channel is cut in the masonry, usually in the bed joint where installation can be easiest disguised. The slots are flushed with clean water immediately prior to the installation of high performance shrink compensated cementitious

grout. Brick stitched bars are simply pushed into the grout, ensuring full encapsulation of the bars along their length. The helical bars extend 500mm each side of the cracks to dissipate loads and disperse them evenly into wall structure.

C.Jacketing:
Jacketing involves fastening of a repair material to enhance the resistance to the threatening environment i.e causing deterioration. The material can be metal, rubber, plastic or high strength concrete. It can be secured to the existing element by bolts, nails, screws, bonding adhesives, straps or gravity. The materials and method of jacketing depends on the exposure conditions and locations. There are a number of proprietary mortars and grouts used for this work. Common applications of jacketing include tanks, spillways, piers, and other concrete elements that are exposed to corrosive materials or erosive force of rapidly flowing water.

D.Shotcreting:
Shotcreting process is sometimes called guniting or pneumatic application of concrete. Application of shotcrete involves shooting concrete under pressure onto the prepared surface of the deteriorated concrete. Shotcrete may require pumping of completely mixed materials through the hose pipe or blowing the dry constituents through the hose pipe and mixing them with water at the nozzle.
The later method requires an experienced and competent operator but offers the capability of customizing the shotcrete with reference water content and consistency according to the specific needs of areas of repair job. shotcrete is practicable for large jobs, both on vertical and horizontal surfaces. The surface profile should be somewhat irregular and rough textured. Curing is especially critical in shotcrete work.

E. Epoxy Injection:
Epoxy injection is a possible repair method, for crack between about 0.02mm and 6mm in width.
For epoxy injection to be effective, the crack must be free of dirt, grease or other contaminates. In relatively newyork, satisfactory cleaning can often be achieved by vacuum cleaning ahead of the sealing operation. In older cracks, flushing with water or other solvents may be needed, but any solvents used must be compatible with the concrete and the epoxy. Acids have ben used but are not recommended. Blowing with compressed air or blasting with water or air/ water mix have been suggested. If the compressed air is used, then it is important, that the equipment is fitted with efficient oil and water traps, to prevent surface contamination from the air supply.

IV. RESULT AND DISCUSSION

A. Investigation and Repair Methods for damages:
We investigated our college, Parisutham Institute of Science and Technology, thanjavur which is our proposed site for study and found out some of the common damages that the aesthetic view and damages the structure.

B.Site 1:
This damages comes under non-structural damages
Causes for damages:
1. Mainly this damages is caused due to vegetation.
2. The structure near to the tree is compacted road.
3. So the root is not able to penetrate through it and cause damage to structure.

Remedial measures:
This damage can be controlled by leaving some space from the tree surface during initial construction of structure.
Now, we can construct them by building a new wall near to replace the old wall, normally for coconut we need 2meter radius gap to avoid damages for nearby structure.

C. Site 2:
This damages comes under damages due to settlement.
Causes for damages:
1. Mainly this damage is caused due to settlement.
2. The soil below the structure is not tightly packed.
3. So as there is a drainage outlet above it, water comes out of it and makes the soil to settle.

Remedial measures:
This damage can be controlled by proper compaction of the base layer before construction above the ground level.

D. Site 3:
This damages comes under cold joint crack
Causes for damages:
1. Mainly this damages is caused due to improper joint.
2. Fresh concrete structure is not properly attached to the cold concrete structure.
3. So water leaks from the joint during the rainy seasons which needs to be repaired.

Remedial measures:
This damage can be controlled by proper location by joints
As of now shotcrete method is used to repair the joints.

E. Site 4:
This damage comes under dampness.
Causes for damages:
Mainly this damage is caused due By this we use 30% of silica fume as admixture with cement and make repair material.

F. Non Destructive Test:
to test about the strength of repair material we repaired the damaged concrete cubes and cylinders of standard sizes and tested by using the NDT test.

Rebound hammer test**:**
By this rebound hammer we test the strength of repaired materials, how much they get strengthened just analyze with their hardness.
1. to oozing of water.
2. The adjacent wall always gets water shower from the overhead tank.
3. The outer wall which is constantly getting water shower tanspirates the water to the inner wall also.

Remedial measures:
This damage can be controlled by proper disposal of the over flowing water.
As of now micro materials like limestone powder is allowed to penetrate inside the wall, so that it fills the minor pores which serves as a entry port for the water to transpire.

G. Silica Fumes As A Repair Material:
We use a silica fumes as an admixture with cement to repair the cracks in structure.
About silica fume:
Silica fume, also referred to as micro silica or condensed silica fume, is a material that is used as an artificial pozzolanic admixture. It's a product resulting from reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy.
Silica fume rises as an oxidized vapor. It cools, condenses and is collected in cloth bags. Condensed silica fume is essentially silicon dioxide (more than90%) in non crystalline form.
Silica fumes properties:
Since it is an airborne material like fly ash, it‘s spherical shape.
It‘s extremely fine particle sizes less than 1 micron and with an average diameter of about 0.1micron, about 100 times smaller than average cement particles.
Preparation method:
We add silica fume with cement in proportion of 20%, 30% to 50%.

TABLE 1: Initial Setting Time:

Percentage of silica fume	**Initial setting time**
20%	32
30%	35
40%	37
50%	40

TABLE 2: Rebound Hammers Test

Slot	**In damaged condition**	**Repaired with cement**	**Repaired with mix of silica fume &cement**
1	8.2	12.4	19
2	8.6	13.5	18.4
3	8.5	13.4	18.1
4	7.8	10.2	17.2
5	8.2	11.5	16.4

V. CONCLUSION

Thus we can conclude that every material in nature have the deterioration nature that we cannot able to control fully but we can avoid damages by proper maintenance. The material which available nowadays for repair are very costly compare to normal cement. Most of the people use cement as repair material due to cheap and easy, at the same time they are available at all place. Finding the root cause for damages and repairing may take a effective compare to normal rehabilitation process and by using silica fume as admixture with cement can give more strength and also low cost compared to liquid resin.

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