

Aum Struct Build Pvt. Ltd.



Retrofitting Expert

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Retrofitting is a Techniques for Strengthening of old structure by enhancing load bearing capacity with respect to its previous condition.

Prevailing Techniques for Strengthening

Primary aim of strengthening a structure is to increase its load bearing capacity with respect to its previous condition. Only those aspects related to flexure are discussed here. Established techniques which have been in use successfully for a number of years are recognized as follows:

1. Over Slabbing
2. Sprayed Concrete with Additional Reinforcement
3. Steel Plate bonding
4. External Pre-stressing
5. Fibre wrapping.

RETRO FITTING @ NEERI, WORLI, MUMBAI



COLUMN JACKETING



REINFORCEMENT TREATMENT



FIBER WRAPPING TO BEAM & COLUMN



PRE - TREATMENT



POST - TREATMENT



FINISHED HALL

A. Repair Methodology for Excessively damaged RCC Section

1. Enabling Works:

a) Scaffolding Erecting :

Erecting bamboo/steel scaffolding to access the damaged part of structural elements

b) Supporting the structure:

Supporting the structure by using steel props prior to breaking loose damaged concrete.

C) Removing Plaster:

Remove all plaster of elements which are having cracks & spalling of concrete is observed.

2. CHIPPING:

Chip off loose and infected concrete from surface of existing structural elements with help of chisel and hammer till sound concrete is encountered. Remove laitance, oil etc. present on concrete surface by grinding/ sand blasting. De-scale the surface of exposed reinforcement with help of brush to remove the rust scales. Carbonated concrete if left in structure shall initiate deterioration process.

3. CORROSION TREATMENT:

a) Treatment to corrosion damaged existing steel reinforcement.

i) Application of rust converting alkaline primer:

Thoroughly clean the corroded reinforcement/ steel rebar by wire brush or rotary grinder. Remove all the corrosion scales present on the bare and reach up to sound steel. Apply of rust converting alkaline primer on corrosion affected steel bars after removing all the scales. It is alkaline in nature and convert both hematite & magnetite compounds in to stable compounds. The material shall pass minimum 400 alternate immersion cycles of 2 minutes in 3.5% NaCl solution at room temperature.

ii) Application of two coats of IPNet- RB anticorrosive epoxy coating on steel rebars:

Application of primer shall be followed with application of two coats of IPNet- RB (confirming to CBRI requirement) anticorrosive epoxy coating for bar protection against future corrosion. Coating is for old as well as newly provided steel. This system (Interpenetrating polymer network system for rebars: IPNet-RB) once applied on steel shall provide extended protection against future carbonation and chloride attack. The material shall pass minimum 720 hours as per ASTM- B- 117 and shall confirm to IS 2770 PART I and ASTM 3963-86.

b) Application of Concrete penetrating corrosion inhibitor on concrete surface

Carry out application of 'Bi-polar migratory corrosion inhibitor on concrete surface by brush in two coats. This inhibitor has migratory kind of property which permits the material to migrate to a virtual extent of 60 mm, through pores of concrete, inhibiting the corrosion and de-passivating the Electro-chemical reaction. It has property to attack anode as well as cathode, which is purely alkaline in nature (pH-9.5).

Material shall have evaluated test reports indicating significant reduction in corrosion rate after minimum 90 thermal cycles at 60° Centigrade followed by 8 weeks of accelerated corrosion indicative of its suitability for tropical applications.

Grout the corrosion inhibitor in case of excessively damaged RC sections by drilling 50 to 75 mm deep holes at the spacing of 350mm c/c with the dosing of 100ml per hole in concrete body.

4. MAKING UP OF LOST STEEL AREA DUE TO CORROSION BY ADDITIONAL STEEL

Makeup lost steel area due to corrosion by providing additional steel reinforcement. The steel shall confirm to IS 1786 grade Fe 415/ Fe 500. Anchor the steel rebar in sound concrete body up to desired depth by structural GRADE adhesive. Fixing of rebars is to be with pre left binding wires with existing steel at regular grid after aligning concrete profile with new mortar up to existing steel face.

5. SECTIONAL RECONSTRUCTION IN EXCESSIVELY DAMAGED CONCRETE IN STRUCTURAL ELEMENTS

i) Bonding Coat:

Bond between new and old concrete is important aspect for effective participation of total cross sectional area of concrete. Selection of type of bond coat is based on, type of stresses bond strata is expected to go and prevailing area where application is to be carried.

After the various pre-treatment apply liberal quantity of bond coat on cleaned concrete surfaces as per the detailed manufacture's procedure. Ensure that the application of new concreting is carried out during the pot life of material.

ii) Making up lost –section with free flow micro concrete.

For replacing the carbonated part of concrete and repairing the damaged surface of concrete, fix the form work across the profile of damaged structural element. Pour the free flow concrete mix in the form work. Makeup concrete is based on type of structural element and its location.

iii) Making up lost –section with latex modified mortar

Makeup mortar is based on type of structural element and its location. Here following type of modified mortars are recommended.

Modified mortar:

For replacing the carbonated part of concrete and repairing the damaged surface of concrete usage of following formulated mortar is recommended.

Mix:

- Cement: 50KG
- Sand: 150KG
- MONOBOND: 2.5 to 5KG
- Water: 15-20 Ltrs.

6. Strengthening with non metallic Fibers Reinforced Composite-in select areas

Procedure for wrapping with glass fiber wraps

Wherever loss of shear and flexural reinforcement is more it is recommended to use various fiber wraps of glass and carbon in damaged areas.

- **Surface preparation:**

Grind repaired concrete substrate for cleaning rounding sharp edges to min 20-25 mm radius

- **Profiling:**

Apply compatible primer on prepared substrate, Fill holes and uneven surface with thixotropic putty.

- **Wrapping:**

Apply first coat of fiber compatible saturant, cut the fabric to size, wrap the fiber sheet to structural element at desired orientation using tamping roller to avoid any air voids.

- **Finishing:**

Applying second coat of saturant after min. 12 hrs, rectify air voids if any.

STEPS FOLLOWED FOR REPAIRS TO CORROSION DAMAGED RCC STRUCTURAL ELEMENTS

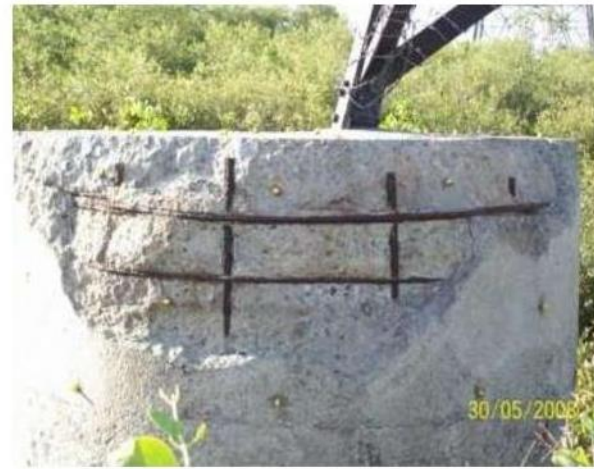


1. **Corrosion of steel reinforcement in Concrete**
2. Due to water Entry through Cracks, Pores, etc. Excessive Corrosion due to Chloride, CO₂ from Atmosphere, SO₂, HCL from Acid Rain.
Chloride removes passivity obtained from concrete Induces Acid Formation.
3. Its conversion into a porous Non-Protective scale. Excessive corrosion/Rust formation induces stresses that crack concrete making it unsafe.

TREATMENT TO STEEL REINFORCEMENT

1. Cleaning of steel reinforcement & application of alkaline rust converting primer

- Removing loose rust on steel by wire brush and cleaning surface of reinforcement.
- Application of alkaline rust converting primer on cleaned steel reinforcement by brush.
- Alkaline in nature hence safe to use does not damage parent concrete convert both hematite and magnetite types of rust





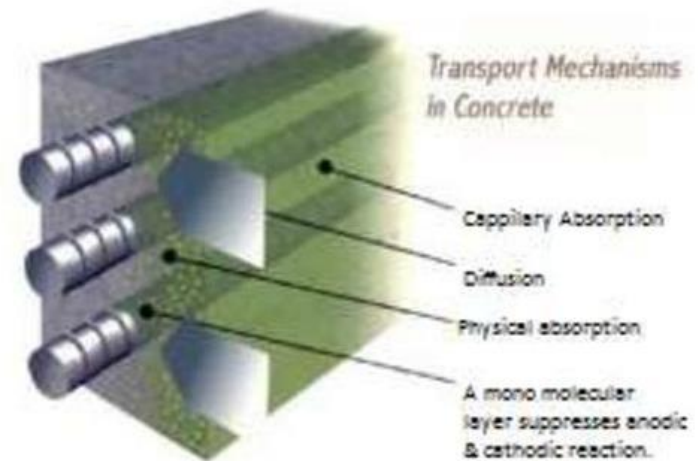
2. Application of IPN protective coating

On steel reinforcement

- For protection of steel reinforcement from future corrosion.
- Two component system applied by brush in two coats.

3. Protection of unexposed steel reinforcement inside concrete by migratory corrosion inhibitor (MCI)

- Due to high vapor pressure, the inhibitor evaporates and vapors penetrate the porous concrete to reach the steel surface.
- Due to its affinity and being an organic material the vapors form an insulating layer on steel surface.
- Applied on concrete surfaces or grouted inside concrete



TREATMENT TO CONCRETE CORE FOR STRENGTH IMPROVEMENT

- Improving core concrete strength
by pressure resin grouting
- Drilling holes & fixing nozzles in design grid.
- Pressure grouting of resin, monomer of polymer cement slurry as per requirement.
- Advantages: Penetrates even in fine cracks.,
Seals cracks, restores structural integrity.
Good mechanical and durability properties



SECTIONAL RECONSTRUCTION OF DAMAGED RCC ELEMENT



1. **Application of structural bond coat to ensure good bond between old concrete and new repair system**
 - 3 component system to be applied by brush on old concrete surface.
 - Ensures good bond between old concrete and repair mortar increased durability of repairs, Non re-emulsifiable, Compatible with cement

2. Sectional reconstruction by micro concrete

- MICROCONCRETE is supplied as a ready to use dry powder .
- Only specified amount of water is to be added to produce a free – flow non – shrink mix.
- Advantages: Super fluidity reaches to all complex areas, ensure complete filling of cavities and cracks in concrete, lesser demoulding time.

3. Sectional reconstruction by Polymer Modified Mortar

- Latex polymer is used as an additive to rich cement sand mortar to reconstruct damaged surface by hand packing or trowelling.
- Advantages: Improves mechanical resistance (Tensile & Flexure) of modified mortar which is essential in repairs
- Render the mortar impermeable, waterproof & impact resistance

1.Original Condition of pier



2. Fixing of form work and pouring of micro - concrete



3.Final Condition after removal of formwork





4. PUTTY

Adhesive, high viscosity putty is applied where necessary to the surface to fill in 'bug holes' offsets or voids.



7. APPLYING FABRIC

The pre-wetted, or dry, fabric is carefully laid onto the surface and smoothened out to remove air bubble sand ensure that the fibers are straight.



5. CUTTING FABRIC

In a clean area away from the resins, the fabric is carefully measured and cut in accordance with the specifications.



6. SATURATING FABRIC

On large, high volume projects, the fabric can be saturated using custom saturator. For lower volumes and shorter strips, the fabric can be either saturated on a table, or the surface can be coated with resin and the dry fabric applied.



8. QUALITY CONTROL

MONITORING

During the cure, 2 to 6 hours depending on ambient conditions, the fabric is checked to ensure that all air bubbles are removed and that the fabric is not sagging.



9. APPLYING SECOND COAT & SAND PASTING

After inspection of wrapped fiber apply second coat of saturant on wrap and apply subsequent FRP layer as per design. Apply coarse river sand if wrapping is followed by plastering or POP when second coat becomes tacky.



10. APPLYING BOND COAT & PLASTERING

Apply compatible bond coat on wrapped surfaces and carry out plastering with rich

11. APPLYING TOP COAT FOR EXPOSED SURFACE

Apply compatible UV resistant polyurethane top coat on wrapped surfaces in case of wrapping surfaces are exposed to direct sun light and wrapped surfaces are not plastered.