Corrosion Repair and Protection Measures – A Case Study

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1.0 Background

A corner located commercial building in South Mumbai got damaged due to corrosion of reinforcement for which repair and rehabilitation was needed. The present case study discusses the step by step approaches that were adopted for repair. The damage was to such extent that the RCC sunshade collapsed while removing the waterproofing layer on top of it. This building was very close to sea coast. The corrosion took place due to ingress of chloride ions. There was combined effect of carbonation and chloride ingress for accelerating the corrosion and damaging the structural members of columns, beams and slabs. The basic scope of the project assigned was for general repair, structural repair, and terrace waterproofing, part replacement of sanitary and plumbing, external waterproofing, re-plastering and then common area painting and external protective coating.

2.0 General Repair

2.1 Breaking of Plaster and RCC Sections

The vertical fins, which were just for elevation purpose, were suggested for their removal completely to reduce the dead load and future maintenance cost. This took considerable time to break the RCC along with its reinforcement and to level the broken area as per the elevation design.

2.2 Recasting of RCC Sunshade

It was suggested that a continuous sunshade Fig.1 be constructed for protection against rainwater, instead of the old sunshades just over the window openings. This helps prevent water running over empty spaces along the walls that results in the growing of moss and fungus, which causes the appearance of black spots and spoils the paint. All new re-bars were anchored to the beam with the help of FISCHER epoxy resin capsules and 100 mm thick reinforced concrete was cast uniformly with the help of waterproof ply shuttering.

Fig. 1: Continuous sunshade being provided after breaking damaged pardies

2.3 Plastering

Old and new plaster was joined using a bonding adhesive for proper bonding. PP (Polypropylene) Fibres were used as transverse reinforcement to join the first and second coats of plaster consecutively, in 1 : 4 and 1 : 3 cement mortar ratio. Liquid waterproofing compound was added as an admixture in the mortar. The gaps between the RCC and masonry were filled by a polymer modified mortar, embedded with metal aggregates. Fresh pointing was done in loose brickwork wherever bedding and jointing mortar had disintegrated. Dash coat plaster was provided wherever loss of brick/block work required the application of a mortar thickness of more than 25 mm.

2.4 RCC Coping

To prevent leakage on top of the parapet, RCC coping was laid over at a height of a 1.04 m parapet wall with 25 mm projecting outside, 75 mm projecting inside and a top finish of a 25 mm inward slope. Making shuttering on three sides has no complication because of the scaffolding support. The fourth side was also cast with additional safety measures.

3.0 Structural Strengthening

The external columns, beams and slabs on the ground floor and the columns and beams on the top most floors deteriorated very badly and were repaired with a polymer modified mortar and micro concrete. Fibre wrapping on few columns was done to enhance the strength of these weak columns.

All the old bars were cleaned with rust remover. 24 hours after application, the surface was cleaned with water jets so that all rust and loose concrete was cleaned thoroughly. Wherever reinforcement bars lost more than 25% of their original diameter volume, additional rebars were provided as replacement/ replenishment. Old and new bars were coated with a rust preventer, as a passivator coat. One or more coats were applied using a ready-to-use powder that was mixed with water and modified with powder polymers. The new reinforcement was connected to the original concrete by fixing Shear Connectors, using polyester resin anchor fix grouts. These connectors were fixed using a chemical based grout that has high pullout bond strength by drilling a hole into the concrete of a minimum of 100 – 150 mm in depth. It was ensured that the pullout strength of that anchor was more than the tensile strength of the bar. After 24 hours, the entire surface was coated with a long pot life epoxy bond followed by a watertight shuttering, prepared to pour micro concrete.

The beams and slabs in the basement were damaged as shown in Fig. 2 due to leakage from the common WC block on the ground floor which were jacketed with micro concrete by drilling a hole from the top floor (Fig. 3).

Fig. 2: View of roof slab before micro concreting

Fig. 3: View of roof slab after micro concreting

Fig. 4: Column before micro concreting

Fig. 5: Column after micro concreting

A portion of the slab bottom sagged and de-bonded. By providing watertight shuttering, slab casting was done using micro concrete with 6 mm down pea gravels poured from the top floor by making a few core cuttings for maximum flow up to 2 metres (Fig. 3). Similarly the damaged columns were strengthened with micro concreting. Fig. 4 and Fig. 5 show the column before micro concreting and column after micro concreting respectively.

4.0 External Protective Coating

The external surface of the building was protected again with good quality coating that had elastomeric properties. A hand roller was used for application instead of a brush. Three coats were applied with the hand roller as per manufacturer recommendations. Acrylic coating was used having crack bridging properties. This is very important for old buildings. A five year warranty against leakage was received and given to the client stating that the manufacturer will give free material during the tenure of the contract and the contractor will apply the material at no extra cost to the Society during the defect liability period. Fig. 6 and Fig. 7 show the external treatment with primer and finished coat respectively.

Fig. 6: View after primer coat

Fig. 7: View after final coating