REINSTATING AN OBLITERATED DREAM: CASE STUDY OF REPAIR AND REHABILITATION OF 62-YEAR-OLD BUILDING

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Scorching heat, tempestuous weather, and desertification are few of the common things that a Mumbaikar has to experience regularly. In addition, imagine being captivated living in a house where there are palpable movements in structural members. The oblivion occupants soon realised that their dream of living in a house in Mumbai quickly turned into a nightmare when the building started rattling and settling.

Dilapidated buildings on the verge of collapse are a grim reality in Mumbai. This case study is about reinstating an obliterated dream of habitants living in 6 decades old dilapidated G+3 building consisting of four commercial establishments.

The Problem

It was early morning of rainy November 2019, when construction work of Mumbai Metro aqua line 3 was in full flow. As part of the construction activities, piling work was going on for which 25m deep soil excavation was done. The location was a suburb and the weather was wet. An unfortunate incident took place where soil retained by the retaining wall eroded. Due to this, the soil below the east portion of building settled and differential settlement of foundation took place. The residents felt their beds shaking and doors and windows rattling. Soon, their ceilings started developing cracks too, and more and more of the residents started waking up, as the glass doors of the shops located on the ground floor, came crashing down. Immediately, the building was declared 'unfit for habitation' and sealed by the municipal authorities. Subsequently, the building was evacuated and all occupants were relocated to nearby hotel by client.

The incident was under a lot of media scrutiny. The client took it upon himself to reinstate the building's health and make it habitable again. In a detailed structural audit, few structural problems were revealed e.g isolated footings were provided for the building which rested on the soil, plinth beams were not provided, concrete grade and reinforcement had deteriorated. The foundation settlement had aided to the already existing issue. The asymmetrical soil movements caused torsional movements in the building leading to obliteration of the structure. A continuous monitoring using tiltmeter revealed active settlement and continued distress propagation in the building.


Mumbai: Cracks noticed in 60-year-old building

Richa Pinto / TNN / Updated: Nov 10, 2019, 22:24 IST


MUMBAI

[redacted] building develops cracks due to Metro work

STAFF REPORTER

MUMBAI NOVEMBER 11, 2019 01:44 IST
UPDATED: NOVEMBER 11, 2019 01:44 IST

The Hurdle

In Mumbai, thousands of houses are built in a compact parcel of land. For such buildings, a concept of free spaces does not exist. Thus, there were chances that the decrepit building may result into cascading effect and harm the nearby structures. Therefore, the decrepit building was provided with temporary supports using steel sections before the repair work could start.

Structural Intervention by Retrofitting

Typically, in a structure that has pronounced foundation settlement, it is possible to reinstate the structure by jacking up the structure. Accordingly, the entire structure was jacked up and all the column footings were combined with high strength M40 grade of concrete to create a raft. Plinth beams were also provided. All columns were sequentially jacketed to provide additional strength to the vertical elements.

Fig 1: Building image before rehabilitation

Rehabilitation and Retrofit of Superstructure

The super structure of the building consisted for brick masonry load bearing walls at exterior and beam column system in interior of building.

For retrofit of the building, ISMC channel columns were strategically introduced in place of load bearing wall along the periphery of the building to impart stiffness to the building.

For retrofitting of structural elements, in addition to traditional techniques of RC jacketing, advanced technique of strengthening using carbon fibre reinforced polymer (CFRP) were utilised.

1. Slab

East portion of the building had significant slab deflections. It was catered by introducing new RC beams and steel beams which helped in reducing span of the slab.

Fig 2: Introduction of steel beam to arrest slab deflection

There were few slabs which had collapsed in west portion of building. Light weight fibre reinforced Aerocon sandwich panels were installed instead of RCC slabs to relieve dead weight from foundation.

Fig 3: Sudden collapse of Slab panel

Fig 4: Recasting of slab with Aerocon Sandwich Panels

2. Beams

Due to settlement in the foundation, additional moments were generated in the beams resulting in developments of the crack. These beams were retrofitted with high strength-low weight R&M carbon fibre laminates and sheets. This advanced technique imparts minimal additional weight to the beam and are corrosion resistant unlike steel rebars.

Fig 5: Beam retrofitted using R&M CFRP

3. Columns

Structural analysis was carried out to arrive at the degree of distress in columns. For columns with severe deficiency, RC jacketing was done. For moderately distressed columns, confinement with high strength R&M carbon fibre was done.

For fibre wrapping work, first the concrete surface was prepared by surface grinding. Then a layer R&M primer was applied to provide adhesion bond for R&M saturant. Putty was applied to fill small surface voids on the concrete substrate and to prevent formation of bubbles during curing of saturant. Then a layer of saturant is applied, followed by a layer of carbon fibre sheet followed by another layer of saturant. Above this, sand sprinkling was done followed by plaster coating.

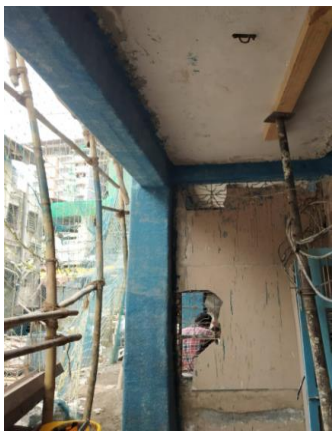

Fig 6: R&M CFRP wrapping on columns

4. Balcony

In East face of the building, there were 3 balconies facing the road which were resting on 1.5m cantilever beams. When investigated, the cantilever beam, RC pardi beam and balcony slab were severely deteriorated. Any collapse of these beams would have resulted in severe loss of lives as these balconies were just above the road facing shops. To address this problem, sufficient propping was provided to balcony slabs, cantilever beams and pardi beams were jacked and balcony slabs were recast.

5. Brick Masonry wall

During inspection, severe cracks were observed in the brick masonry walls. Cracks lower than 0.75mm width were repaired by epoxy resin injection. After cleaning the surface thoroughly, injection ports were placed on both sides of cracks. Epoxy resin was injected into ports sequentially. For walls with larger cracks, the brick wall was demolished and recast.

Fig 7: Image showing cracks in periphery brick wall

Covid Challenges and Post Retrofit Scenario

Fig 8: Building Interiors after rehabilitation

Fig 9: Building before and after rehabilitation

The onset of the COVID-19 pandemic introduced enhanced challenges to work with limited manpower. However, just like a medical-operation cannot be left midway, retrofitting operation cannot be left either. Thus, with all precautionary measures and governmental permissions, the site execution continued.

When the next monsoon arrived, it was feared that further settlement of foundation will happen and cause collapse of building. However, as the foundation was retrofitted by then and temporary structures were in place, no such mishap happened. No casualty was reported during the execution of the work. The building was inaugurated recently and is now in operation with all residents back to their houses.

Conclusion

The disaster canvassed in this paper and its reinstatement back to life is still hovering above our heads. Retrofitting of old buildings that have suffered dilapidation is a 'National Commitment' to return to the habitants. However, the onus will always be on the engineers to use correct methodology and proper engineering judgement before executing any retrofitting job.

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