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Structural Audit And Repair Recommendations For Sahil Arzoo Chs. Ltd., Mira Road, Thane

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Abstract

This paper presents a comprehensive structural audit conducted on the Sahil Arzoo Cooperative Housing Society (CHS), a 24-year-old residential building located in Mira Road (East), Thane. The audit involved visual inspections and non-destructive testing (NDT) methods to assess the current structural integrity of the building. Key observations include significant structural cracks, dampness due to leakage, and potential corrosion of reinforcement bars. Recommendations are provided for immediate repairs to enhance the building's safety and longevity.

1. Introduction

Structural audits are crucial for ensuring the safety and durability of buildings, especially aging structures in urban areas like Mumbai. The Sahil Arzoo Chs. Ltd., constructed around 1999, has exhibited signs of structural distress common in buildings over two decades old. This study aims to:

- Evaluate the current structural condition of Sahil Arzoo Chs. Ltd.
- Identify critical areas requiring repair.
- Provide recommendations to restore and enhance the building's structural integrity.

2. Building Description

2.1 General Details

- Location: Off Naya Nagar Road, Mira Road (East), Mumbai - 401 107.
- Age: Approximately 22+ years.
- Structure Type: Ground plus three upper floors (G+3), RCC framed structure.
- Usage: Residential.

2.2 Construction Features

- Structural System: Reinforced Cement Concrete (RCC) frame with slabs, beams, and columns.
- Walls: 9-inch thick external brick walls and 6-inch thick internal partitions.
- Floors: Five residential units per floor.
- Terrace: Brickbat with china mosaic finish, including headroom and Overhead Water Tank (OHWT).
- Mobility: Staircase access to all floors.
- Plumbing: Internal and external ducts for plumbing pipes.

3. Methodology

The structural audit comprised:

- Visual Inspection: Comprehensive walkthroughs to identify visible signs of distress.
- Non-Destructive Testing (NDT):
 - Rebound Hammer Test: Assess surface hardness and estimate compressive strength.
 - Ultrasonic Pulse Velocity (UPV) Test: Evaluate concrete homogeneity and detect internal flaws.
 - Half-Cell Corrosion Potential Test: Determine the likelihood of corrosion in reinforcement bars.
 - Core Test: Assess in-depth structural integrity by analyzing concrete cores.

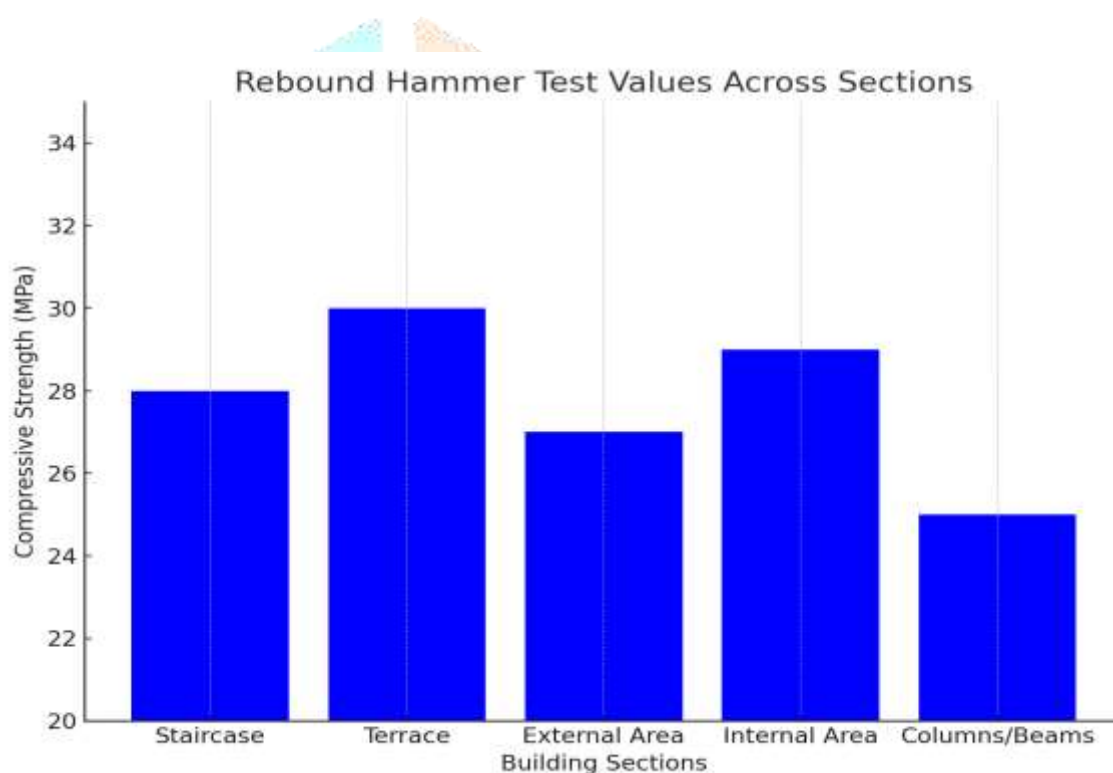
4. Observations and Results

4.1 Visual Observations

Table 1: Summary of Observations in All Flats

Flat No.	Living Room	Bedroom	Kitchen	Toilet
301	Beam cracks due to steel and concrete deterioration.	Column cracks. Dampness from external wall.	Undulations in floor slab.	Floor undulations. Column and beam cracks.
302	Bulging and cracks indicating slab deterioration.	Bulging and cracks in slab. Separation cracks.	Beam cracks due to steel deterioration.	Open tile joints causing seepage.
303	Bulging and cracks in slab. Hollow sound in column.	Bulging and cracks in slab. Column cracks.	Column cracks. Floor undulations.	Beam and column cracks.
304	Hollow sound in column.	No major issues.	Minor cracks.	Minor undulations.
305	Undulations and cracks.	Hollow sound.	Cracks in slab.	Minor seepage in tiles.
201	Hollow sound indicating concrete debonding.	No visible damages.	No visible damages.	No visible damages.
202	Bulging and cracks in slab.	Undulations in floor slab.	Column cracks.	Tile joints allowing seepage.
203	No structural damages observed.	Hollow sound in column.	Minor cracks in slab.	Minor seepage.
204	Flat locked.	Flat locked.	Flat locked.	Flat locked.

205	Ceiling covered with false ceiling.	Cracks in beams and columns.	Bulging and cracks in slab.	Minor damages.
101	Flat locked.	Flat locked.	Flat locked.	Flat locked.
102	Column cracks due to steel deterioration (3 Nos.).	Bulging and cracks in slab.	Cracks in slab and beams.	Core test: Concrete strength lower than expected.
103	No structural damages.	No structural damages.	No structural damages.	Beam cracks due to steel and concrete deterioration.
104 & 105	Column cracks due to steel and concrete deterioration (3 Nos.).	Bulging and undulations in slab.	Damp patches in slab.	Beam and column cracks.



4.2 Non-Destructive Testing Results

4.2.1 Rebound Hammer Test

- Purpose: Assess surface compressive strength of concrete.
- **Results:** Rebound numbers varied between 18 to 25, indicating fair surface concrete quality.
- **Interpretation:** Concrete is in a doubtful state; surface hardness is below acceptable limit & shows signs of aging.

4.2.2 Ultrasonic Pulse Velocity (UPV) Test

- Purpose: Evaluate concrete homogeneity and detect internal flaws.
- **Results:** Pulse velocities ranged from 1.2 km/s to 2.5 km/s.

- **Interpretation:**
 - **3.5 - 4.0 km/s:** Good quality concrete.
 - **3.0 - 3.5 km/s:** Medium quality concrete.
 - Lower velocities in certain areas indicate potential internal cracks or voids.

4.2.3 Half-Cell Corrosion Potential Test

- **Purpose:** Determine the likelihood of corrosion in reinforcement bars.
- **Results:** Potential readings ranged from -300 mV to -310 mV.
- **Interpretation:**
 - **>-200 mV:** 90% probability of no corrosion.
 - **-200 mV to -350 mV:** Uncertainty zone.
 - **<-350 mV:** 90% probability of active corrosion.
- **Conclusion:** High likelihood of active corrosion in reinforcement bars in several areas.

4.2.4 Carbonation Test

- **Purpose:** Measure depth of carbonation affecting reinforcement protection.
- **Results:** Carbonation depth was found to extend up to the reinforcement level in certain samples.
- **Interpretation:** Loss of protective alkalinity around reinforcement bars, increasing corrosion risk.

5. Recommendations

Based on the audit findings, the following actions are recommended:

- **Structural Repairs:** Address cracks in columns, beams, and slabs using epoxy injections and jacketing where necessary.
- concrete strength, suggesting immediate strengthening of concrete in this flat through jacketing or replacing damaged sections.
- **External Repairs:** Re-plaster cracked areas and apply waterproof coatings to mitigate leakage and dampness issues.
 - **Terrace Repairs:** Ensure waterproofing measures on the terrace and headroom to prevent future water damage.
 - **Maintenance Plan:** Conduct structural audits every five years, with routine checks for plumbing and waterproofing to ensure long-term stability.

6. Conclusion

The structural audit of Sahil Arzoo Chs. Ltd. revealed significant issues that require immediate attention to ensure the safety and longevity of the building. Structural cracks, corrosion of reinforcement bars, and water ingress are the primary concerns. Core test results in Flat 102 indicate lower-than-expected concrete strength, necessitating immediate repairs. Implementing the recommended repairs will restore the structural integrity and extend the building's service life. It is crucial to undertake these repairs promptly and adhere to a regular maintenance schedule.

7. References

- IS 456:2000 - Plain and Reinforced Concrete - Code of Practice.
- IS 13311 (Part 1): 1992 - Non-Destructive Testing of Concrete - Methods of Test.
- ASTM C876-91 - Standard Test Method for Corrosion Potentials of Uncoated Reinforcing Steel in Concrete.