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A Review of Structural Audit of Building

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Abstract: Structural audit is a key step in checking the condition and strength of buildings, especially older ones. This report is meant to look closely at a chosen residential or commercial building to understand its current state. The main purpose is to find any signs of structural problems, check how safe the building is, and suggest needed repairs or improvements. The audit uses methods like visual checks, non-invasive testing, detailed structural analysis, and making sure the building follows all the required standards. The results show parts of the building that need urgent care and steps for ongoing maintenance to keep people safe and the structure strong over time. This study highlights how regular audits are important for managing buildings in a sustainable way.

Keywords: structural audit, non- destructive test, repairs and controls, audit standards.

I. INTRODUCTION

In India there are many old buildings which have reduced strength in due course of time. If further use of such deteriorated structure is continued it may endanger the lives of the occupants and surrounding habitation. Appropriate actions should then be implemented to improve the performance of structures and restore the desired function of structures. Thus, it is utmost important to perform structural audit of existing buildings and to implement maintenance/ repair work timely which will lead to prolonged life of the building and safety of the occupant. To act more responsible and preemptive towards the dilapidated buildings, the municipal corporation must issue notices to the buildings and co operative societies which are more than 30 years old to carry out mandatory structural audit and submit the audit report. Structural audit should highlight and investigate all critical areas and recommend immediate remedial and preventive measures. It should cover the structural analysis of existing frame and find critical elements for all types of loadings. It also helps in delivering a strong building structure with cost effective solutions and appropriate maintenance program. This paper deals with study of different parameter of structural audit including visual inspection, non-destructive testing, core sampling and testing. It also emphasizes on different repairs and retrofitting measures to be used for buildings after structural audit.

II. LITERATURE REVIEW

1.Structural Auditing : It is detailed process of checking existing buildings to ensure they are safe and determine how much longer they can last. It involves looking at the building visually, assessing its structural strength through tests, and using analysis to compare what the building is expected to handle (like loads and wear) with what it actually can support. This helps figure out if any fixes are needed. These audits are now being shaped by national standards and local rules to make sure people are safe and potential dangers are minimized.

2. Codes, Guidelines And Regulatory Context :There are national and local rules that set the standard for how structural audits should be done, what they should check for, and how the results should be reported. In India, the Bureau of Indian Standards (BIS), like the IS 16700 code and related BIS/NBC guidelines, serve as the main references. Recent actions by city authorities suggest that audits are becoming mandatory for older and taller buildings, showing a stronger focus on checking safety regularly.

3. **Inspection Methods And Visual Instrumental:** The literature says that a detailed visual check is the first and most affordable step in finding issues like cracks, spalling, leaks, and corrosion. These visual checks are often followed by more detailed tests using instruments when a deeper look is needed. Some of these instruments include non-destructive testing techniques like ultrasonic pulse velocity, Schmidt hammer tests, half-cell potential tests for mapping corrosion, ground penetrating radar, and drill/core tests to determine the material's properties. Recent studies show that using multiple non destructive methods together (multi-modal testing) increases accuracy and reduces uncertainty in determining the building's strength and durability.

4. Structural Health Monitoring (SHM) And Sensor-Based Approaches : In addition to one-time audits, there's growing interest in continuous Structural Health Monitoring (SHM) to catch damage develops and support long-term

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management of the building's condition. SHM ranges from simple tools like vibration sensors and displacement meters to advanced systems using networks of sensors and data-driven algorithms to find irregularities and predict wear. While there are challenges such as cost, data handling, and interpreting results, SHM is seen as valuable for high-risk structures and for checking the effectiveness of building improvements.

5. Assessment Approaches And Analytical Evaluation Audit : Assessments usually compare what the building is being asked to do (like current loads, potential seismic or wind risks, and changes in use) with what it can actually handle (like reduced strength due to wear or corrosion). Methods include structural analysis using as-built data and material properties, checking if the building meets current regulations, and using simpler assessments when full analysis isn't possible. Indian guidelines suggest using the latest building codes for checks, but also accept using older standards for historical buildings, with expert judgment used for deciding on repairs.

6. Repair, Retrofit And Life-Cycle Considerations : The literature often mentions common ways to fix issues like repairing concrete, protecting against corrosion, and strengthening with materials like FRP or steel plates. It stresses the importance of creating a plan that's both cost-effective and prioritized based on risk level and how long the building is expected to last. Many studies suggest combining maintenance plans with audit findings to make sure repairs are done on time and support long-term management of the building's life.

III. METHODOLOGIES

1. Data Collection & Preliminary Study- We collect all the building documents that are available, including architectural and structural drawings, the building's age, past repair records, and details about its current use. We also determine the building type, like whether it's made of reinforced concrete (RCC), load-bearing walls, or a combination, the year it was built, the materials used, and any previous renovations that have been done. A site visit is conducted to get a general idea of the building's condition and to identify areas that might be at risk.

2.Visual Inspection- We carry out a thorough visual check to spot various issues such as: Cracks in the structure or non-structural parts, Spalling of concrete surfaces, Corrosion on steel reinforcements, Water leaks, dampness, and white deposits (efflorescence), Settlement or tilting of the structure, and signs of foundation problems, The condition of slabs, beams, columns, staircases, balconies, and parapets, The state of the building’s exterior, waterproofing systems, drainage, and plumbing. All observations are recorded using photos, notes on the severity of problems, and a map showing where issues are located.

3.Non-Destructive Testing (NDT) - To check the health of the materials and estimate their strength without damaging the structure, we perform certain non destructive tests: Rebound Hammer Test – to estimate surface hardness and get an idea of the compressive strength. Ultrasonic Pulse Velocity (UPV) – to find out if there are internal cracks, voids, or poor quality concrete. Half-Cell Potential Test – to assess the likelihood of steel reinforcement corrosion. Cover Meter Test – to measure the distance between the reinforcement and the concrete surface, and how the bars are spaced. Rebar Locator or Ground Penetrating Radar (GPR) Scan – to locate the reinforcement layout, identify areas with corrosion, and spot any internal issues. Core Cutting (if needed) – to get precise values for the compressive strength and density of the concrete. The results of these tests are analyzed as per Indian Standards (IS 13311, IS 516, IS 456).

4.Structural Assessment & Analytical Evaluation -We create as-built models based on either site measurements or existing drawings. We determine the current load conditions such as dead load, live load, and seismic load as per IS 875 and IS 1893. We compare the existing capacity of beams, slabs, and columns with the required load capacity based on code provisions. We identify structural elements that have a reduced cross-sectional size due to corrosion or deterioration. We perform a structural analysis, either manually or using software like ETABS or STAAD, to check: The safety of the structure, Limits on deflection, Load paths, Performance during earthquakes. We also find out which parts of the structure need to be strengthened.

5.Condition Rating & Risk Categorization- Each structural element is evaluated based on the visual and NDT findings and is assigned a condition rating such as: Good, Fair, Poor, Critical or Unsafe. We prepare a risk matrix to decide which repairs need to be done urgently and which can be done in the long term.

6.Identification of Causes of Distress- We analyze the main reasons for damage such as: Low quality of concrete used, Water leakage or poor waterproofing, Corrosion of steel due to carbonation or chloride attack, Overloading or changes in how the building is used, Construction errors, Environmental factors like temperature changes and pollution. Understanding the causes helps in choosing the right repair methods.

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7.Recommendation Of Rehabilitation Measures Repair & Based On The Structural Assessment - we suggest different repair options depending on the severity: Minor repairs: filling cracks, plastering, and waterproofing, Moderate repairs: using concrete jacketing or polymer-modified mortar, Major repairs: applying FRP wrapping, bonding steel plates, or reinforcing beams and columns, Safety actions: setting up temporary supports or evacuating high-risk areas. We provide cost-effective and prioritized strategies for repairs.

8.Preparation of Structural Audit Report- We compile a detailed audit report that includes: Basic information about the building, All the findings from the visual inspection, Results of the NDT tests along with their interpretation, Summary of structural analysis, A table showing the condition rating of each element, Repair recommendations with their urgency levels, Estimated costs and timelines.

III. CONCLUSION

The paper states that for any structure, a structural audit is needed after a certain amount of time. There are rules that set the time period after which an audit becomes mandatory. Usually, audits are done in two main ways: visual inspection and non-destructive testing. There's also a third method called destructive testing, but it damages the structure's parts, making them unusable. Because of this, destructive testing is not used very often. This explains how structural audits are typically carried out for different types of structures.

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