

Structural Audit of Old Structures

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Abstract — Structural audit is an overall health and performance check-up of buildings. It is important to the building to check their safety and they have no risk. It is process of analyses of building And this process suggest a appropriate repairs and retrofitting measures required for the buildings to perform better in its service life structural audit is an important tool for knowing the real health status of the old buildings.

Keywords — Structural Audit, Non-Destructive Test, repairs and controls, audit standards

I. INTRODUCTION

A structure is a system of inter connected elements such as frames to carry loads safely to underground earth. The health examination of concrete building called as "Structural audit" or structural audit is an overall health and performance check-up of building like a doctor examines a patient.

India is a heritage of old building and Structures. These buildings have age more than 30 years. These buildings have reduced Strength due to Material Deterioration. If, further use of such damage structure is continued it may cause severe loss of life and Property. Structural Audit is the overall Health Check-up of a building to ensure that the building is Safe and has no risk. It also suggests some Repair to increase the Serviceability of the building. It is necessary for maintenance and Repair of Existing Structure having age more than 30 years.

II. LITERATURE REVIEW

1. A.B. Mahadik and M. H. Jaiswal concluded that to create awareness amongst the civil engineers, residents and owners of building towards the health examination of existing concrete buildings called as Structural Audit which help to implement maintenance and repair work timely which leads to prolonged life of the building and safety. The need of structural audit is for maintenance and repairs of existing structures whose life has exceeded the age of 30 years to avoid any mishap.

2. B.H Chafekar, O.S Kadam K.B Kale, S.R Mohite, P.A Shinde, V.P Koyle studied that before going in detail about the structural audit is necessary to know about the structure. A structure is a system of inter connected elements to carry loads safely to underground earth. The health examination of

concrete building called as structural audit. The author shows different methods in paper:

E.g. Visual inspection, non-destructive test.

3. M.M.Sonawane, D.H.Markad, V.G.Maindad, M.B.Patil, K.D.Manwar, P.D.Mote. Concluded that appropriate actions should then be implemented to improve the performance of structures and restore the desired function of structures. Thus, it is almost 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.

4. K.R.Sonawane ,Dr.A.W.Dhawale concluded that The life cycle of building can be broadly divided into four phases i.e. architectural planning, structural design, and construction maintenance. In most of building at most care is taken in first three cases but maintenance is forgotten. Ignorance to maintenance causes severe structural distress in building over period of time. Regarding the structural health of building and repair required can be carried out. Such an investigation can be carried out using the following methods:

- a) Visual examination
- b) Non Destructive Testing
- c) Partial Destructive Testing.

WHAT IS STRUCTURAL AUDIT?

Structural Audit is an overall health and performance check-up of a building like a doctor examines a patient. Structural Audit is an important tool for knowing the real status of the old building. It ensures that the building and its premises are safe and have no risk. It analyses and suggests appropriate repairs and retrofitting measures required for the buildings to perform better in its service life. Structural audit is done by an experienced and licensed structural consultant.

A. Purpose of Structural Audit

- 1) To save human life and building.
- 2) To understand the condition of building.
- 3) To find critical areas to repair immediately.
- 4) To comply with Municipal or any statutory requirements.
- 5) To enhance life cycle of building by suggesting preventive and corrective measure like repairs.
- 6) To know the health of your building and to project the expected future life.

7) Highlight the critical areas that need to be attended with immediate effect.

B. How Structural Audit is carried out?

Steps to be followed in Structural Auditing

STEP 1: It is imperative that we must have Architectural and Structural plans of the buildings. It will be helpful if we have detailed structural calculations including assumptions for the structural design.

STEP 2: If the Architectural plans and Structural plans are not available, the same can be prepared by any Engineer.

STEP 3: Inspection of the Building - A detailed inspection of the building can reveal the

Following:

1. Any settlements in the foundations.
2. Cracks in columns, beams and slabs.
3. Concrete disintegration and exposed steel reinforcements photographs can be helpful.
4. Slight tapping using hammer can reveal deterioration in concrete.
5. Corrosion in reinforcement.
6. Status of Balconies – sagging, deflection, cracks.
7. Status of Architectural features viz. Chhajjas.
8. Cracks in walls indicating swelling in R.C.C. members or deflection or corrosion.
9. Leakages from terrace & Toilet blocks.
10. Leakages & dampness in walls resulting into cracks and corrosion.
11. Status of repairs & last repaired.
12. What was repaired?
13. Who was the Agency?
14. How much was spent for repairs?
15. Building plans are available? When approved?

STEP: 4 Preparation of Audit Report:

On the basis of inspection of building an Audit Report is prepared.

STEP 5: Tests Recommended:

It is important that various tests are carried out in the old buildings. This will give an idea about the

extent of corrosion, distress and loss of strength in concrete & steel.

STEP 6: Highlight the critical areas and how to go for repairs.

III. METHODOLOGY

1. Destructive testing

To verify the integrity of a component, it is always possible to cut or section through the components and examine the exposed surfaces. Components can be pulled or stressed and pressurized until failure to determine their properties of strength and toughness. Materials can be chemically treated to determine their composition. These are some forms of destructive testing. Unfortunately this approach of destructive testing renders the component useless for its intended use as against non-destructive testing which can be performed on the components and machines without affecting their service performance.

2. Non Destructive testing

Non-destructive testing (NDT) is a wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage. The terms **Non-destructive examination**, **Non-destructive inspection** and **Non-destructive evaluation** are also commonly used to describe this technology, because NDT does not permanently alter the component being inspected, it is a highly valuable technique that can save both money and time in product evaluation, troubleshooting, and research. Common NDT methods include ultrasonic, magnetic particle, liquid penetrate, radiography, remote visual inspection (RVI), eddy current testing.

2 Non destructive Tests:

1. Rebound Hammer Test

2. Pulse Echo Method

3. Impact Echo Method

4. Ultra Sonic Pulse Velocity Method

5. Probe Penetration Test or Windsor Probe Test

6. Ground Penetration Radar Method

7. Carbonation Test

8. Half Cell Potential Meter Test

1Rebound Hammer Test

1. Schmidt Rebound Hammer Test is a most common non destructive test (NDT) performed on hardened concrete.
2. Schmidt Rebound Hammer Test method is most useful in checking the uniformity of concrete in laboratory as well as in the field.
3. It works on the principle that the rebound of an elastic mass depends on the hardness of the surface against which the mass impinges.

4. Theoretical relationship between the strength of concrete and the rebound number of the hammer.
5. The rebound value indicated by the hammer is related empirically to the compressive strength of concrete.
6. It is able to provide a quick estimate of the quality of concrete.
7. The Plunger is held perpendicular to the concrete surface and the body pushed towards the concrete.
8. This movement extends the spring holding the mass to the body. When the maximum extension of the spring is reached, the latch releases and the mass are pulled towards the surface by the spring.
9. The mass hits the shoulder of the plunger rod and rebounds because the rod is pushed hard against the concrete,
10. During rebound the slide indicator travels with the hammer mass and stops at the maximum distance the mass reaches after rebounding. The distance travelled by the mass. Expressed as a percentage of the extension of the spring is called rebound number.
11. The button on the side of the body is pushed to lock the plunger into the retracted position and the rebound number is read from a graduated scale is fitted on the body.

IV. GENERAL FORMAT OF AUDIT REPORT

STRUCTURAL AUDIT REPORT FORMAT

Name of Building:

Name of owner:

Address:

Contact no:

Year of Construction:

Name of Structural Engineer for Audit:

V. VISUAL INSPECTION

General Observations:

SR. NO	DESCRIPTION	REMARK
1	Type of building	
2	Age of building	
3	No of wings	
4	Mode of use	
5	No of stories	
6	No of flats	
7	Architectural plan available	
8	Structural plan available	

9	Building plan approval date	
10	Occupation certificate date	
11	Last repair date	
12	Cost of repair	
13	Details of repair	

Structural observations :

S R. N O.	DESCRIPTIO N	LOCAT ION OF COMPO NENT	GRAD E
A	SETTLEMENT		
1)	Column		
2)	Walls		
3)	Cracks in column, walls joint at plinth		
B	CRACKS		
1)	Column		
2)	Beams		
3)	Slab		
4)	Plaster		
5)	External wall		
6)	Internal wall		
C	CORROSION OF STEEL		
1)	Column		
2)	Beam		
3)	Slab		
D	LEAKAGES AND DAMPNES AND WATER PROOFING		
1)	External wall		
2)	Toilet		
3)	Terrace		
4)	Top floor slab		
5)	Inspection of over head water tank		
6)	Inspection of underground water tank		
7)	Leakages & damages plumbing lines/ waterlines, drainage lines		

E	DEFLECTION		
1)	Beam		
2)	Slab		
3)	Overloading on slab		
4)	Cantilever deflection		
F	CONDITION OF OTHER COMPONENT		
1)	Staircase		
2)	Balcony		
3)	Flooring		
4)	Ducts		
5)	Terrace		
6)	Plumbing System		
7)	Electric Supply Line		
8)	Water Supply Line		

VI.RESULT:

The remarks of Structural Audit Report should be given in grades and colour coding instead of description so as to simplify it for Non Technical person.

VII.GRADES:

SR. NO.	GRADE	DESCRIPTION	COLOUR CODE
1	0 to 3	Major Distress	Red
2	3 to 5	Considerable Distress and Repairable	Yellow
3	5 to 7	Moderate Distress and Repairable	Blue
4	7 to 10	Sound Structure	Green

S R. N O.	DESCRIPTION	REMARK
1)	Non Destructive Test Recommended	
2)	Test Result	
3)	Repair and Retrofitting	
4)	Conclusion	

VIII.CONCLUSION

As per the preliminary inspections & general discussion, it is recommended to carry out further test. Relationship between pulse velocity, rebound number and compressive strength of concrete are obtained by conducting test in next phases.

IX.REFERENCE

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