

Structural Health Assessment of a RCC Building

Shirish Lal

M.Tech. Research Scholar, Shri Ram Group of Institutions, Jabalpur, (M.P.) [INDIA]

Abstract- This review paper covers the study of Structural Health Assessment of RCC Buildings. Structural health assessment is the structural audit/ technical survey of the building in order to check its strength, stability and life of the structure. Structural audit is the preliminary step in restoration and maintenance of the building. Structures can be any kind it can be Historical, Heritage Structure, Residential building, Commercial building or an Industrial building. Every structure has its own serviceability period, and within this period it should stand sturdily on its position. A collapsed mechanism has increased and today's structures are getting collapsed before their service period is completed. Hence, it is suggested to monitor it periodically by taking a structural expert opinion. In this Project a Root Cause of a faulty mechanism of structure and a preventive measures to overcome a failure of this structures. 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 catastrophe and disruption. Now a days buildings have reduced strength because of structural deficiency, material deterioration, unexpected over loadings or physical damage. There is demand of appropriate actions and measures for all such building structures to improve its performance and restore the desired functions of structures which may leads to increase its functional life. The structural audit must be carried out following auditing norms, methods of non-destructive testing and code provisions. The structural auditing will help to implement maintenance and repair work timely which leads to prolonged life of the building and safety of the occupants.

Key Words- Structural audit, Structural Engineering, Non destructive method, Structural Evaluation Program, Structural health assessment, Rehabilitation, Retrofitting.

1. 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 health assessment and submit the audit report. Structural health assessment should highlight and investigate all critical areas and recommend immediate remedial and preventive measures.

1.1 About Structural Health Assessment

Structural Audit is nothing but health check-up of the building to know building. After knowing the real condition of the building we give remedial measures to increase service life of the building.

1.2 Need of Structural Assessment

1. To increase life of the building.
2. To know the health of the structure and its expected life.
3. To check the actual reliability of the structure
4. To recommend rehabilitation techniques
5. To highlight the critical areas and repairs them immediately
6. To save life of lives in the building.
7. To know the real condition of the building whether it is safe for dwelling or not.

2. METHODOLOGY FOR CARRYING OUT STRUCTURAL HEALTH ASSESSMENT

2.1 Study of architectural and structural drawings, design criteria, design calculations, structural stability certificate of existing structures.

2.2 If architectural and structural drawings are not available, as built drawings can be prepared by an engineer

2.3 Visual Inspection

2.3.1 General Information of the building.

2.3.2 Structural system of the building.

2.3.3 Addition and alteration in the building.

2.3.4 Critical areas of the building.

2.3.5 Dampness and leakages.

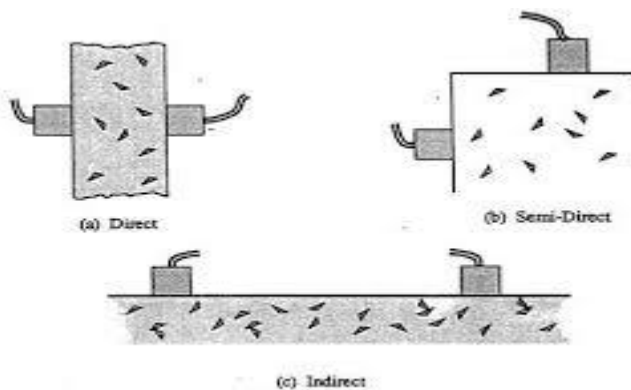
2.4 Non Destructive and Destructive testing

2.4.1 Concrete Strength

- Rebound Hammer Test: These tests are primarily done to assess the likely compressive strength of concrete & the uniformity of concrete.



- Ultrasonic Pulse Velocity Test: To assess homogeneity of concrete, to assess strength of concrete qualitatively, to determine structural integrity



3.5 – 4.0 km/s	Good to very good, slight porosity may exist
3.0 – 3.5 km/s	Satisfactory but loss of integrity is suspected
<3.0 km/s	Poor & loss of integrity exist

- Core Sampling and Testing: To measure strength, permeability, density of concrete.



2.4.2 Chemical Attack

- Carbonation Test: To assess depth of carbonation and pH of concrete
- Chloride Test: To assess total water/acid soluble chloride contents
- Sulphate Test: To assess total water/water soluble sulphate contents of concrete



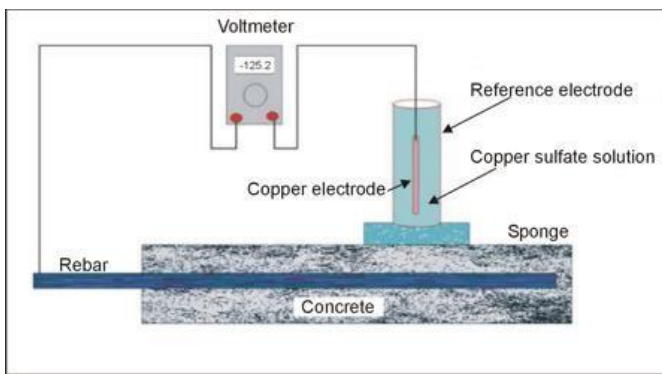
PULSE VELOCITY	CONCRETE QUALITY
>4.0 km/s	Very good to excellent

pH	Not less than 8
Cl (kg/m ³)	For PCC, maximum 3.0 kg of Chloride per m ³ of concrete.
	For RCC, maximum 0.6 kg of Chloride per

	m3 of concrete.
SO3 (%)	Less than 4% by mass of cement in the concrete mix.

2.4.3 Corrosion Potential Assessment

- Cover Meter: To measure cover of reinforcement, diameter of reinforcement and spacing of reinforcement.
- Half Cell Method: To assess probability of corrosion in the embedded steel.



- Permeability Test: To assess permeability of concrete due to water and air.

2.5 Reinforcement Mapping

Rebar mapping is a mechanism to obtain information related to reinforcement in existing concrete buildings where drawings are missing or reinforcing data needs to be verified.

These tests are carried out to:

- check the size and numbers of reinforcing bars present in concrete members
- determine the concrete cover provided to reinforcement
- Prepare structural drawings for RCC structures where original drawings are not available.

2.6 Pushover Analysis

Generally Push over analysis is used to understand the existing capacity of structure for seismic and gravity loading which will show different occupancy levels like immediate occupancy, life safety and collapse prevention.

The seismic evaluation of existing buildings compares their capacity against earthquake demand at specific site and concerns the potential earthquake-caused risk to building systems and elements that are closely related to human life safety.

3. STRUCTURAL AUDIT DETAILS

3.1 Building: Educational & Research Institute in South Mumbai.

3.2 Type of Structure: RCC Frame Structure (Basement + Ground + 3 floors).

3.3 Age of Construction : 50 years old

3.4 Mode of Inspection:

- Visual and Binoculars.
- Instrument used - Hammers and Measurement tapes.
- Non Destructive & Destructive testing.

3.5 Areas Inspected: External faces of the building, Terrace areas, Lift machine room, Basement areas, insides of the premises, Common Staircase and passage areas, etc.

3.6 Additions & Alterations carried out in the premises: All such Additions/ Alterations done which are at variance with the original approved building plans should be made good in accordance with the general guide lines suggested by I S S E to ensure the structural stability.

3.7 Probable Causes of Distress

Age related	Usual wear & tear and structural deteriorations related with the age of the structures.
Severe Corrosion	Inadequate cover, honeycombing resulting to severe spalling off concrete thereby exposing the inherent reinforcement resulting to reduction in the load carrying capacity of structural elements.
Leakages & Seepages	Both through External walls and leaking toilets.
Chajjas	Leakages through cracked/damaged chajjas.
Scant Maintenance	Structural defects, Plaster, Paint, Waterproofing.

Drainage Pipes and water pipes	Leaking, corroded, damaged vertical drain pipes and the resultant Leakages at many places.
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4. STRENGTHENING AND RETROFITTING (BUT NOT LIMITED TO FOLLOWING REMEDIES)

- Scaffolding and Platform
- Plastering
- Concreting
- Jacketing
- Micro Concreting
- Crack sealing
- Nozzle Grouting
- Waterproofing in toilets and terraces
- Temporary support system
- Polymer modified mortar
- Additional reinforcement
- Painting (Plastic emulsion, synthetic enamel)

5. OBJECTIVES

- To study the types of structural defects.
- To identify any signs of material deterioration.
- To identify any signs of structural distress and deformation.
- To identify any alteration and addition in the structure.
- Remedies for the restoration of the structure.
- To assess the life of the building.
- To know the quality of construction.

6. CONCLUSION

We can assess the tentative life span of the RCC buildings after remedial measures and restoration works as per the best repairs work practice and standards to increase the life span of the RCC buildings. Thus their suitability will be checked whether the structure is repairable or the life span of the building is over and need to be demolished. The

structural diagnosis is vast, important and highly responsible job which is connected with lives of human beings. It is mandatory and advisable to carry out the periodical structural audit of the buildings by professional experts and act immediately through recommendations provided in audit report. The success of repairs and restoration is always based on thorough knowledge, correct diagnosis and in-depth studies of problems in building, proper repair practices and finally socio-economic considerations. The effective implementation of auditing enhances the life span of structure, prevents deterioration of building leading to sustainability.

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