

# A BRIEF REVIEW ON HEALTH MONITORING OF STRUCTURES

<sup>1</sup>Asst. Prof.Khan Junaid, <sup>2</sup>Shaikh Md. Shakib, <sup>3</sup>Shaikh Mohd. Kasheef,  
<sup>4</sup>Adeel Ahmed, <sup>5</sup>Humera Anjum

<sup>1</sup>H.O.D Civil Engineering, Everest College of Engineering, Ohar, Aurangabad

<sup>2-5</sup> B.E Student, Civil Engineering, Everest College of Engineering, Ohar, Aurangabad

**Abstract:-** This paper deals to create awareness amongst the civil engineer related to residents, owner, bridge, building towards the health examination of concrete building are nothing but the structural audit. It is overall health performance checkup of building like a doctor examines a patient. It is important to the building to check their safety and they have no risk. Structural audit is important tool for knowing the real status of the old buildings, but the structural audit is for maintenance and repairs of existing structure whose life has exceeded the age of 30 years to avoid damages and save valuable human life. It should also cover the structural analysis of the existing frame and pinpoint the weak structural areas for static wind, & earthquake loads. Civil Engineering Industry is one of the oldest industries which provide a basic infrastructure to all the human beings. Structure can be any kind it can be Historical, Heritage Structure, Residential building, Commercial building or and Industrial building. Every structure has its own service life, and within this service life it should stand firmly on its position. EX –A Taj Mahal in Agra in India which is one of the oldest structure and a Wonder of the World, and still stand on its position very effectively, but this not a condition about the today's structures. A Collapse mechanism has increased and today's structures are getting collapsed before there service life is completed. Therefore, it is advisable to monitor it periodically by taking a professional opinion.

**Keywords-** Structural Audit, Non-Destructive Method, Rebound Hammer Test, Non Destructive Test

## 1.INTRODUCTION

The general health and performance of a building depends on its quality of maintenance as a building grows old, ageing, use (or misuse) and exposure to the environment can affect the health of the building significantly. Therefore, it is advisable to monitor it periodically by taking a professional opinion. Structural Audit is a preliminary technical survey of a building to assess its general health as a civil engineering structure. It is usually initiated as the first step for repair. This is similar to the periodic health checkup recommended for older people. A methodology for Structural Audit was first presented by the Indian Society of Structural Engineers.

“Structural audit is the inspection or examination of the building, to evaluate the strength so as to improve its appropriateness, safety, efficiency” The Audit should highlight & investigate all the risk areas, critical areas and whether the bldg. needs immediate attention. It should also cover the structural analysis of the existing frame and pinpoint the weak structural areas for static, wind & earthquake loads. If the bldg. has changed the user, from residential to commercial or industrial, this should bring out the impact of such a change.

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.

### What is Structural Audit?

Structural Audit is an overall health and performance checkup of a building like a doctor examines a patient. 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.

### Purpose of Structural Audit

- To save human life and buildings
- To understand the condition of building
- To find critical areas to repair immediately
- To comply with statutory requirements
- To enhance life cycle of building by suggesting preventive and corrective measures like repairs and retrofitting

### Need of Structural Audit of Building

A Norm According to the model bye-law no. 77 for co-operative housing societies, it is mandatory that if the age of a building is 15 to 30 years, a structural audit must be carried out once in five years and for buildings older than 30 years it should be carried out once in three years.

### Destructive testing

In destructive testing, tests are carried out to the specimen's failure, in order to understand a Specimen's structural performance or material behaviour under different loads. These tests are generally much easier to carry out, yield more information, and are easier to interpret than non-destructive testing. Destructive testing is most suitable, and economic, for objects which will be mass produced, as the cost of destroying a small number of specimens is negligible. It is usually not economic to do destructive testing where only one or very few items are to be produced (for example, in the case of a building). Some types of destructive testing.

**A) Stress Testing:** It is a form of testing that is used to determine the stability of a given system or entity. It involves testing beyond normal operational capacity, often to a breaking point, in order to observe the results. Stress testing may have a more specific meaning in certain industries, such as fatigue testing for materials.

**b) Crash Testing:** It is a form of destructive testing usually performed in order to ensure safe design standards in crashworthiness and crash compatibility for automobiles or related components. Some of the examples are Frontal-Impact Tests, Offset Tests.

**c) Side-Impact Tests:** Roll over Tests, Roadside hardware crash tests etc. The tests are not discussed here as it is beyond the scope of this presentation.

**d) Hardness Testing:** Hardness refers to various properties of matter in the solid phase that gives it high resistance to various kinds of shape change when force is applied. Macroscopic hardness is generally characterized by strong intermolecular bonds. However, the behaviour of solid materials under force is complex, resulting in several different scientific definitions of what might be called "hardness" in everyday usage.

### 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.

### 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

#### A. Visual inspection method

By visual inspection survey findings the Health Rating Index of structure by following rating forms. For this study make visual inspection for old existing frame structure and mark ratings as per condition. At the same time taking the photographs of structure

#### B. Liquid Penetrant Testing (PT)

This is a method which can be employed for the detection of open-to-surface discontinuities in any industrial product which is made from a non-porous material. In this method a liquid penetrant is applied to the surface of the product for a certain predetermined time after which the excess penetrant is removed from the surface. The surface is then dried and a developer is applied to it. The penetrant which remains in the discontinuity is absorbed by the developer to indicate the presence as well as the location, size and nature of the discontinuity.

#### C. Schmidt's Rebound Hammer Test

Principle of test: The test is based on the principle that the rebound of an elastic mass depends on the hardness of the surface upon which it impinges. When the plunger of the rebound hammer pressed against the surface of the concrete, the spring controlled mass rebounds and the extent of such rebound depend upon the surface hardness of concrete. The surface hardness and therefore the rebound is taken to be relation to the compressive strength of concrete. The rebound is read off along a graduated scale and is designated as the rebound number or rebound index.

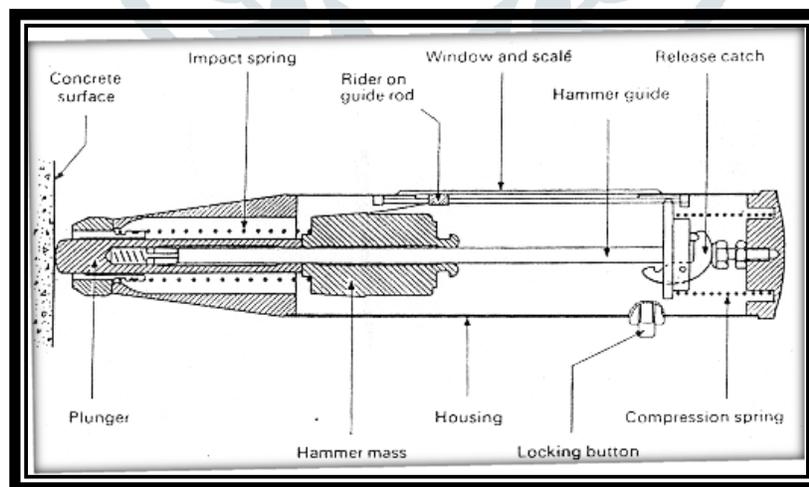


Fig. 1: Basic Features of Rebound Hammer

Working of rebound hammer: A schematic cut way view of schmidt rebound hammer is shown in fig. 1. The hammer weight about 1.8 kg., is suitable for use both in a laboratory and in the field. When the plunger of rebound hammer is pressed against the surface of concrete, a spring controlled mass rebounds and the extent of such rebound depends upon the surface hardness of concrete.

The rebound distance is measured on a graduated scale and is designated as rebound number. Basically, the rebound distance depends on the value of kinetic energy in the hammer, prior to impact with the shoulder of the plunger and how much of that energy is absorbed during impact.

The energy absorbed by the concrete depends on the stress-strain relationship of concrete. Thus, a low strength low stiffness concrete will absorb more energy than high strength concrete and will give a lower rebound number.

#### **D. Ultrasonic Pulse Velocity Method**

The ultrasonic pulse velocity method is used for non-destructive testing of plain, reinforced and prestressed concrete whether it is precast or cast in-situ.



Fig 2: Ultrasonic Pulse Velocity Metho

## **II. LITRATURE SURVEY**

**Patil S.R., Prof. Sayyed G.A[1]** Civil Engineering Industry is one of the oldest industries which provide a basic infrastructure to all the human beings. Structures can be any kind it can be Historical, Heritage Structure, Residential building, Commercial building or an Industrial building. Every structure has its own service life, and within this service life it should stand firmly on its position. Ex- A Taj Mahal in Agra in India which is one of the oldest structure and a Wonders of the World, and still stand on its position very efficiently. But this is not a condition about the today's Structures. A collapsed mechanism has Increased and today's Structures are getting collapsed before there service life is completed. Therefore, it is advisable to monitor it periodically by taking a professional opinion. Structural Audit is a preliminary technical survey of a building to assess its general health as a civil engineering structure. It is usually initiated as the first step for repair. In this Project a Root Cause of a faulty mechanism of structure and a preventive measure to overcome a failure of this structures.

**Ajay V Joseph [2]** Structural Audit is a technical survey of an engineering structure to assess its health. Evaluation of current vague practices of Structural Audit paved way to understand the drawbacks of those processes and modify the same for methodical implementation of Structural Audit. This research aims at understanding the drawbacks if any in the current procedure, recast the structural auditing process and propose some improvement measures to the governing body. This paper also deals with the repair rehabilitation measures that are to be enacted after the Audit and prepare an advanced operating procedure for Structural Audits.

**A.B. Mahadik and M.H. Jaiswal [3]** This paper deals to create awareness amongst the civil engineers, residents and owners of building towards the health examination of existing concrete buildings called as Structural Audit. 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 mishaps and save valuable human life. The concrete is widely used as construction material being inexpensive, easy for construction, applications and because of it high strength-cost ratio. More than ever, the construction industry is concerned with improving the social, economic and environmental parameters of sustainability. In India, from 1980 onwards the infrastructure industry witnessed stepping up of public investment and growth in infrastructure industry which results in construction of new multistory concrete apartments which are now in the age of thirty plus years. There are many buildings during this period and earlier have reduced strength in due course of time because of structural deficiency, material deterioration, unexpected over loadings or physical damage. If, further use of such deteriorated structure is continued it may endanger the lives of occupants and surrounding habitation. 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 periodical structural auditing and diagnosis for health of existing buildings is thus utmost important for finding the present serviceability and structural viability of structures. 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.

**Saiesh.L.Naik , Basavraj Saunshi [4]** Structural audit is the technical survey of the building in order to check its strength and stability. Structural audit is the first step in repairing procedure of the building. Structural audit is generally recommended for older buildings. Structural audit was first introduced by Indian society of structural engineers. structural audit helps in improving the safety, efficiency and gives idea about the strength of the structure by detailed technical inspection. In present study attempt have been made to carry out structural audit of the old RCC building by carrying out site inspection, performing NDT on the structure. Building is modeled and analyzed using ETABS and Demand to capacity ratio is determined. After checking strength and stability of the structural members suitable recommendations are given in order to retrofit unsafe structural component. Finally structural audit report is prepared for the building.

**B.H Chafekar, O.S Kadam, K.B Kale, S.R Mohite, P.A Shinde, V.P Koyle [5]** In a framed structure building, frame which is the heart of building. This frame is design by structural engineer taking in to consideration of factors and various codes which necessary. Different techniques used to assess of frames of old structure. Visual inspection non destructive test are used to access frame of structure is made.

**Abhinandan Kale, Mahesh Gond, Pallavi Kharat [6]** The life cycle of a building can be broadly divided into four phases i.e. architectural planning, structural design, construction and maintenance in most of the building almost care is taken in first three cases but the maintenance is forgotten. Ignoring to maintenance causes severe structural distress in building over period of time. This paper deals to create awareness amongst the resident, owner of building, civil engineers towards the health examination of existing concrete building and current status of the building. Every structure has its own service life and it should stand firmly on its position during its complete service life. But now a days due to lack in the quality in construction process and the low quality material used in the construction has decreases the life of the structure and it also has increased the rate of failure of structure which leads to lose the life of the people. There are the various demand from the society and from the government for appropriate action and measure to be taken to prevent it from the collapse of structure, to save the life of the occupant and to improve the life of the structure. The reinforced cement concrete is used as a construction material all over the world because of its high-strength and cost ratio, its application, it is easy to use. As the time passes the strength of the rcc members get decreased. This decrease in strength increases the risk of the structural to collapse. So as to prevent this type of the collapse necessary precaution should be carried out and this type of the procedure is known as Structural Audit.

### III. CONCLUSION

- For any load bring or framed structure structural audit is necessary. From structural audit overall inspection of structure carried out and it beneficial to decide remedial measures to any type of structural defects and damages.
- For every structure once in five years structural audit is necessary.
- If building older than 15 years, once in a 3 years structural audit should be done. However it is advisable to carry out
- Structural auditing every 3 years regularly as many harmful modifications self-inflicted damages get also checked during auditing.
- Government also make compulsory for structural audit for buildings which are more than 30 years old in Maharashtra.

### REMARKS

The present work is aimed at explaining the methods of NDT and their techniques. Engineering is not always complete and further research works

Is needed. Different methods can be applied to the same problem, but the best method is chosen based on the features of the problem.

To set up a good system for monitoring stability of existing structures, auditing must be carried out periodically and suggested outcomes must be implemented

### SCOPE OF WORK

- The main object of the NDT analysis is to determine the strength of existing structures and to provide a solution to defects found after conducting NDT.
- We studied the Analysis of NDT and the study is aimed at performing Non-Destructive test over different structures using Schmidt Rebound Hammer.
- By the help of readings by NDT test calculations for the strength of elemental members is proposed to be carried out, which will assist in determining elemental members efficiency and the strength capability of a structure on the whole and suggest viable solutions to turn the structure stable & safe.

### REFERENCES

- [1] Patil S.R., Prof. Sayyed G.A "STRUCTURAL AUDIT" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN : 2278-1684, p-ISSN : 2320-334X PP 60-64
- [2] Ajay V Joseph "ADVANCED STRUCTURAL AUDIT SCHEME" International Journal of Engineering Trends and Technology (IJETT) – Volume 38 Number 2- August 2016
- [3] A.B. Mahadik and M.H. Jaiswal "STRUCTURAL AUDIT OF BUILDINGS" IJCER, ISSN : 2278-3652 Vol :5, Number 4 (2014), pp. 411-416.
- [4] BasavrajSaunshi "STRUCTURAL AUDIT OF RCC BUILDING" assistant prof. dept. of civil engg. , KLS Gote institute of technology, Belagavi, India. IRJET Vol. 4, issue: 5th may 2017, e-ISSN : 2395-0056
- [5] B.H Chafekar, O.F.Kadam "STRUCTURAL AUDIT" International Journal Of Civil And Structural Engineering Research (IJCER), Vol. 1, Issue 1, Published 2013
- [6] Abhinandan Kale, student of civil engineering, D.Y. Patil Pune, Maharashtra, India "STRUCTURAL AUDIT FOR AN EDUCATIONAL BUILDING" (IJARIE) Vol.3 Issue-3 2017, ISSN(O)-2395-4396
- [7] Krish R. Villaitranami "PREFABRICATED CONSTRUCTION FOR MASS HOUSING IN MUMBAI" International Journal of Innovative Research in advance Engineering (IJIRAE) ISSN: 2349
- [8] Anjali N Satbhai, Pournima K Vispute "STRUCTURAL AUDIT OF OLD STRUCTURES" B.E student, dept. of civil engg. , R.H. Sapatcollege of engineering management studies and research Nashik, Maharashtra, India (IJETT)-Volume-43 Number-3 January 2017, ISSN: 2231-5381
- [9] Pranjali V Kulkarni, Sachin V Admane "RECOMMENDATION FOR SYSTEMATIC AND PRECISE FORMWORK OF STRUCTURAL AUDIT OF RESIDENTIAL BUILDING" from International Journal of Emerging Trends in Engineering and Development (IJETED) Issue 5, Vol.3 (April-May 2015), ISSN: 2249-6149
- [10] P.A. Shinde student of civil engineering, (AISSMS) , India "STRUCTURAL AUDIT" International Journal Civil and Structural Engineering Research (IJCER) Vol.1, Issue 1, pp: (42-46), Month: October-2013-March-2014