

# Experimental Assessment & Performance Evaluation of an Old Bridges by NDT Method

Aniket Gurav<sup>1</sup>, Janil Mali<sup>2</sup>, Bhupesh Patil<sup>3</sup>, Ankit Raut<sup>4</sup>, Swati Dhurve<sup>5</sup>

<sup>12345</sup>(Department of Civil Engineering, University of Mumbai, Palghar)

Received Date: 28 February 2020

Revised Date: 08 May 2020

Accepted Date: 12 May 2020

**Abstract** – India is a highly populated country & ranks 2<sup>nd</sup> in the whole world, increasing with 1.2% yearly. Hence safe transportation is a challenge for the government. Migration is also one of the important aspects of many problems, and after that, the facilities should also be enhanced. This paper deals to create awareness amongst the civil engineers and for the users of public bridges towards the health examination of existing bridges in Palghar. Therefore nowadays it is important & need of present generation to do the regular check-up of old bridges for that purpose this paper gives some knowledge about the strength test & factors affecting the health of Bridge. A structural audit is an important tool for knowing the real health status of the old bridges.

**Keywords** – Strength Test, Structural Audit, Health of Bridge, Regular Check-up

## I. INTRODUCTION

Before going into detail about the structural audit, it is necessary to about the structure. A structure is a system of interconnected elements to carry loads safely to underground earth. The health examination of concrete Building or Bridges called “Structural Audit” or structural audit is an overall health and performance check of building like a doctor examines a patient. Structural audit is an important tool for knowing the real status of the bridges.

The audit should highlight and investigate all the risk areas, critical areas, and the bridges need immediate attention. It should also cover the structural analysis of the existing frame and pinpoint all structural areas for static, wind and earthquake loads. Society Bye-Law no. 77 specifies Structural Audit as a mandatory (necessary and binding to society) requirement. It stipulates that if the age of building or bridges is 15 to 30 years, once in 5 years and older than 30 years, it should be carried out once in 3 years.

## II. PURPOSE OF STRUCTURAL AUDIT

- A. To save human life & prosperities.
- B. To understand the condition of building or bridges.

- C. To find the critical areas to repair immediately.
- D. To comply with statutory requirements.
- E. To enhance the life cycle of bridges by suggesting preventive and corrective measures like repairs and retrofitting.

## III. LITERATURE REVIEW

This paper deals with the Structural Audit report of bridges located at Mahim, Palghar. As the structural audit is done on visual observation & partially based on NDT method. Hence the recommended repair measures should be followed as soon as possible before any major mishap takes place. [1]

This paper is reviewed to understand the concept structural audit, repair measure & estimate of the old bridges in Palghar area, which have more than 35 years old. They have studied the audit of several bridges and identify the cracks & strength of concrete Bridge & give the suggestion to fill the crack & estimate the crack to fill. [2]

## IV. METHODOLOGY

### A. Visual Inspection:

The Bridge was investigated pier by pier for observation. Some of the pier, abutments & deck of Bridge within the section were observed for a range of defects such as cracks, spell, crazing, seepage etc. All the defects were marked on the observation sheets were approximate repair which formed the total data the structure.

### General information of the Bridge:

- Address of the Bridge
- Number of spans
- Loading on Bridge
- Maintenance history of the Bridge
- Identify the cracks in Bridge & settlement of the foundation

### B. Non-Destructive Testing

Non-destructive testing is:

1. Rebound Hammer test
2. The ultrasonic pulse velocity test



3. Carbonation test
4. Half Cell potential test

changes its grey colour to pink, it means that the concrete is in good condition.

**a) Rebound Hammer Test:**

- Rebound hammer is used to find out the compressive strength of concrete as per **IS 13311(part 2) – 1992**. The underlying principle of the **rebound hammer test** is: The Rebound of an elastic mass depends on the hardness of the surface against which its mass strikes.
- A **Schmidt Hammer**, is also known as **Swiss Hammer**, is a device to measure elastic properties or strength of concrete or rock, mainly surface hardness & penetration resistance.

**b) Ultrasonic Pulse Velocity Test:**

- An ultrasonic pulse velocity test is in-situ, non-destructive test to check the quality of concrete or natural rocks as per **IS 13311(part 1) – 1992**. In this test, the strength and quality of concrete is assessed by measuring the velocity of an ultrasonic pulse passing through a concrete
- This test is conducted by passing a pulse of ultrasonic through to concrete to be tested & measuring the time taken by the pulse to get through the structure. Higher velocities indicate good quality & continuity of the material, while lower velocities may indicate concrete with many cracks or voids.
- A simple formula measures pulse velocity: **PULSE VELOCITY = (Width of structure/Time taken by pulse)**.

**c) Carbonation Test:**

- **Carbonation test** is most commonly carried out by spraying the **Phenolphthalein indicator** on freshly exposed surfaces of concrete broken from the structure. Carbonation of Concrete is a process by which carbon dioxide from the air penetrates concrete through pores & reacts with calcium hydroxide to form calcium carbonate.
- Carbonation of concrete is associated with the corrosion of steel reinforcement & with Shrinkage. However, it also increases both the compressive & Tensile strength of concrete, so not all of its effects on concrete are bad.
- A spray of 0.2% solution of phenolphthalein chemical is done on the surface of the concrete to find area affected by the carbonation. Phenolphthalein indicator indicates the change of pH level in the concrete. If the concrete

## V. RESULT

**Table.1. Rebound Hammer Test**

Sr.No.	Structural Member	Direction of Hammer	Average Rebound no.	Average compressive strength (N/mm <sup>2</sup> )
1	Deck	-90	29	29
2	Deck	-90	36	40
3	Deck	-90	38	44
4	Deck	-90	28	27
7	Pier	0	34	32
8	Pier	0	33	30
9	Pier	0	36	35
10	Pier	0	38	38
11	Abutment	0	36	35
12	Abutment	0	34	32

**Table.2. Ultrasonic Pulse Velocity Test:**

Sr.No.	Structural Member	Transmission Time	Path Length (m)	Velocity (Km/sec)
1	Deck	76	0.25	3.29
2	Deck	81	0.25	3.09
3	Deck	86	0.32	3.72
4	Deck	79	0.36	4.56
5	Pier	108.6	0.25	2.30
6	Pier	106.2	0.25	2.35
7	Pier	91	0.28	3.08
8	Pier	88	0.34	3.86
9	Abutment	71	0.25	3.52
10	Abutment	74	0.25	3.38

**Table.3. Carbonation Test Result:**

Sr.No.	Structural Member	Depth Of Carbonation (mm)
1	Deck	13
2	Deck	15
3	Pier	16
4	Pier	14
5	Abutment	19
6	Abutment	17

## VI. CONCLUSION

Regarding all condition & usage of Bridge, we collected all information about the effect on the bridges we conclude that it is necessary that to do a

structural audit of bridges after every 10-15 years to maintain the performance of the bridges & also conclude that take repairs measure on it. Also, resistance to the accident occurred. It is obvious to do the structural audit.

### VII. Reference

- [1] Ms P. S. Jadhav, Ms R.S.Chavan, Mr G. K. Mohite R. D. Gosavi, Prof. P.S.Shinde, Structural Audit Of Bridges, International Inventive Multidisciplinary Journal, 5(9) (2017).
- [2] Chaitanya Kuchekar, Prof. Umesh Deshpande, Visual Inspection Of Concrete Bridge, International Journal Of Innovations In Engineering Research And Technology [Ijiert], 4(3)(2017).
- [3] Sumit Bhardwaj, Qazi Naveed Mehraj, A Review on Foundation of Buildings& Structures, SSRG International Journal of Civil Engineering 2(3) (2015) 1-6.
- [4] Yash Agarwal, Prem Upadhyay, Rohan Majgankar, Shubham Gaikwad, Vijay Wairagade, Literature Review On Structural Audit Of Various Structures, International Journal Of Management, Technology And Engineering, 8(9)(2018).
- [5] A.B Mahadik and M.h Jaiswal, Structural Audit of Buildings, International Journal of Civil Engineering Research (IJCER), 5(4)(2014) 411-416.
- [6] Kazem Reza Kashyzadeh, Neda Aghili Kesheh. Study type of Cracks in construction and its controlling. 2(8)(2012) 528-531.
- [7] Advanced Structural Audit Scheme- Ajay V Joseph.
- [8] www.IRJCE.com