

# Health Assessment of RCC Residential Buildings using Rebound Hammer - A Case Study of MP Housing Board Colony, Bhopal

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**Abstract**— In this study, deterioration of strength of RCC residential buildings of MP Housing Board Colony, Ayodhya nagar Bhopal has been assessed using Rebound hammer. The age of the buildings vary between 1995 to 2013. The analyzed results are obtained on the basis of comparative study of strengths at the time of construction and at present time. From the results, it is concluded that the percentage deterioration is affected by the age and some other factors.

**Key words:** RCC Residential Buildings, Rebound Hammer, Rebar Locator, Compressive Strengths, Non Destructive Test

## I. INTRODUCTION

Health assessment of old RCC residential buildings is of paramount importance for their safety. Many old buildings are showing the sign of distress and deterioration which put a question mark about their durability. As the occurrence of natural disasters like earthquakes and winds are on rise, their safety need to be established through estimation of present strength. Nondestructive testing tools such as rebound hammer offer an economical solution for determination of the current strength of different structural members. Some of the prominent work on this topic is as below:

Oral Buyukozturk (2004) discussed that the demand for the advancement of non-destructive testing (NDT) procedures for concrete structures has expanded with the developing worry about the breaking down state of the World's base. Proficient and exact imaging systems are required for a solid assessment of wellbeing and serviceability of solid structures. Albeit, shortly, imaging is routinely utilized as a part of different fields, usage of these advances in NDT of structural designing frameworks, particularly of solid structures, offers numerous difficulties and requires extra improvement because of the composite way of the solid material and the complexities of strengthened or prestressed solid frameworks.

Hisram Y. Qushrawi (2010) carried out estimation of concrete quality by consolidated techniques for nondestructive testing is outlined in this paper. Both the customary surely understood rebound hammer and ultrasonic pulse velocity tests were utilized as a part of the study. Different outlines demonstrating the outcomes are introduced. All graphs demonstrate the 95% expectation interims, along these lines empowering experts to anticipate concrete quality just and dependably. Not at all like other work, had the examination finished with one basic graph that requires no past learning of the constituents of the tried cement. The technique exhibited is basic, speedy, solid, and covers wide scopes of concrete qualities. The system can be effectively connected to solid examples and also existing concrete structures. The last results were contrasted and past ones from writing furthermore with real results got from tests separated from existing structures.

D.G. Aggelis, D.V. Soulioti, M. Strantza (2011) estimated the nondestructive testing methods is connected in this paper for the discovery and subsurface harm in cement.. Also, chilling off bends improve the portrayal by the diverse rate of warmth trade in the middle of broke and sound zones. Thusly ultrasound spread is utilized to appraise the profundity, by the firm relationship between's wave transmission and harm qualities. The corresponding utilization of the two procedures is examined as a potential powerful strategy for assessment of troublesome harm in cement before it is unmistakable.

Manish A. Kewalramani, Rajiv Gupta (2006) researched on the various methods to utilize ultrasonic pulse velocity (UPV) as a measure of compressive quality of cement has been made because of clear points of interest of non-damaging testing techniques. The present study is led for expectation of compressive quality of cement in light of weight and UPV for two distinctive solid blends (in particular M20 and M30) including examples of two unique sizes and shapes as an aftereffect of requirement for quick test system for foreseeing long haul compressive quality of cement. The expectation is done utilizing numerous investigations. An examination between two techniques can be utilized to anticipate the compressive quality of cement successfully. The outcomes are plotted as tentatively assessed compressive quality versus anticipated quality through both routines for investigation.

Objective of this research work includes, mainly, the work done to find the deterioration in compressive strengths.

Hence these are as follows:

- 1) Selection and surveying of site for further analysis of compressive strength of the residential buildings can give a wider range of observations to draw the conclusion.
- 2) Obtaining the Strengths of Houses Constructed in the period from 1995-2013 from the office record of MP Housing Board, Ayodhya Nagar, Bhopal.
- 3) Testing the compressive strengths of locations selected.
- 4) To find out an analytical result of deterioration in compressive strength

## II. METHODOLOGY

Methodology deals with the theoretical and practical investigation of the various methods related with the study. This deals with the investigation about the techniques used and the standards. Basically, it gives idea, i.e. location, area, test performed etc. A methodology does not gives a solution but it helps us to give all the theoretical and practical knowledge about the set of methods by which we can get the best results and with the help of these results we can connect

to get a particular solution by plotting graph or by inter relating the readings or results.

The following steps are adopted during the experimental work

- 1) First of all the Location /Area is selected where the experimental work is to be carried out or is to be done.
- 2) The information is collected about the MP HOUSING BOARD, Bhopal.
- 3) Information collected about all the projects previously and presently running under MP HOUSING BOARD.
- 4) Many of the projects are running under MP HOUSING BOARD, Bhopal which are at Katara Hills, Ayodhya Nagar etc.
- 5) I selected the location of Ayodhya Nagar, Bhopal for testing or find out the deterioration by Age on Residential Buildings.
- 6) After that I took the Permission from the Higher Authorities of MP HOUSING BOARD Office Situated on the First Floor of Satellite Plaza at Ayodhya Nagar for testing.
- 7) All the Designed values are collected from the Office of various houses constructed.
- 8) After that, I gathered the information about various sectors constructed in AyodhyaNagar under MP HOUSING BOARD, Bhopal.
- 9) I collected the information about the period of construction of different sectors i.e. year of construction of houses.
- 10) Marked the houses in different sectors where the testing of strength is to be carried out.
- 11) Marked the exterior columns and interior columns for testing.
- 12) With the help of the instrument, i.e. Rebar Locator locates the steel bar.
- 13) Now the Strength Testing is performed on these columns by Schmidt Rebound Hammer test.
- 14) Now, the percentage (%) of deterioration is calculated with Age.
- 15) Lastly, the Graph is plotted and the result is determined.

S. No	Name of Sectors	Year of Construction
1.	A Sector	1995
2.	F Sector	1999
3.	C Sector	1999-2000
4.	D Sector	2001
5.	E Sector	2003-04
6.	G Sector	2004

S. No.	House No.	Owner Name	Area (Sq. m)	Year of Construction	Grade of Concrete Used
1	A-55	Dr. R.K JAIN	9*15	1995	M20
2	A-24	S.K CHAUHAN	9*15	1995	M20
3	A-05	VIJAY KUMAR	9*15	1995	M20

Table 2: Data of A sector

S. No.	House No.	Owner Name	Area (Sq. m)	Year of Construction	Grade of Concrete Used
1	C-42	Rohit Mishra	7*13.5	1999-2000	M20
2	C-48	Pramod Goswami	7*13.5	1999-2000	M20

Table 3: Data of C sector

7.	H Sector	2006
8.	J Sector	2010
9.	K Sector	2007-2008
10.	L Sector	2005-06
11.	M Sector	2013

Table 1: Period of construction of Houses

#### A. Testing on various houses

Testing is done in Sectors A, F, C...M. After the survey of sectors, the results are analyzed. Then Houses Are Selected for the Further Testing.

##### 1) A Sector

- Survey of 3 Houses
- Selection of Exterior and Interior column in each House.
- Testing is applied on Respective Selected columns



Fig. 1: Testing in houses

Observations taken of various houses

House No.	Min. Rebound Value	Max. Rebound Value	Mean rebound Value(X)	Standard Deviation	Compressive Strengt F(N/mm <sup>2</sup> )
A 55	17	23	19.0	2.1	18.5
	18	28	24.0	3.7	21.4
	18	25	21.0	2.4	21.4
A 24	15	29	24.0	4.8	24.8
	17	26	21.0	3.8	21.4
	14	25	22.0	3.6	22.9
A 05	18	27	19.0	3.8	19.5
	18.5	25	21.0	4.2	20.6
	17	25	22.0	8.6	21.4
F 12	15	24	20.0	3	20.2
	14	23	18.0	3.3	17.1
	17	22	19.0	1.8	18.5
F 35	15	24	23.0	3	24.4
	19	28	23.0	2.9	24.4
	18	23	21.0	1.8	21.4
C 42	16	29	22.0	3.6	22.9
	17	26	21.0	2.6	21.4
	18	30	23.0	3.7	24.4
C 48	17	22	22.0	2.8	21.6
	19	24	23.0	3.4	23.4
	18	27	24.0	3.6	22.5
D 29	18	29	21.0	3.9	21.4
	18	31	25.0	3.8	24.4
	16	24	19.0	2.9	18.5
D 64	21	30	23.0	3.2	24.4
	18	27	22.0	3.1	22.9
	16	26	22.0	3.6	22.9
D 55	22	35	27.0	4.4	29.2
	20	29	24.0	1.9	25.4
	19	34	22.0	3.2	25.4

Table 4: Observation Table

III. RESULT AND DISCUSSION

The result obtained is shown in the form of graph, observations of collected compressive strength of houses at the time of construction and it shows its comparative relativity with observed strengths came at the time of research work.

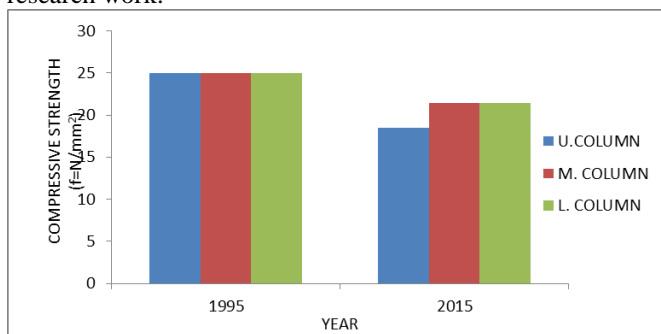


Fig. 2: Compressive strength found at A-55, Ayodhya Nagar Bhopal

$$\text{Calculation of deterioration in strength} = \frac{25 - 20.43}{25} \times 100 = 18.28\%$$

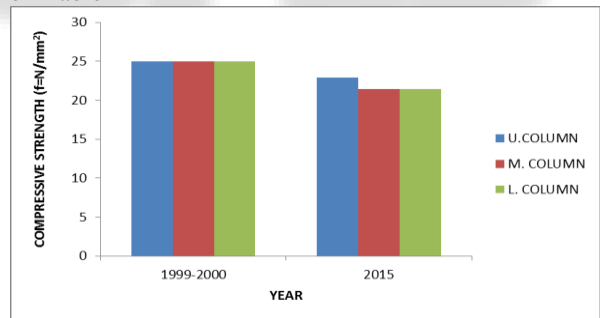


Fig. 3: Compressive strength found at C-42, Ayodhya Nagar Bhopal

$$\text{Calculation of deterioration in strength} = \frac{25 - 21.9}{25} \times 100 = 12.4\%$$

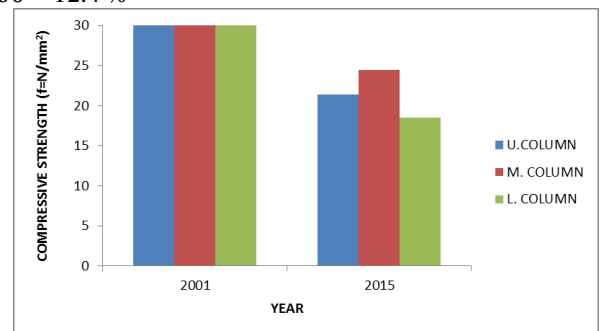


Fig. 4: Compressive strength found at D-29, Ayodhya Nagar Bhopal

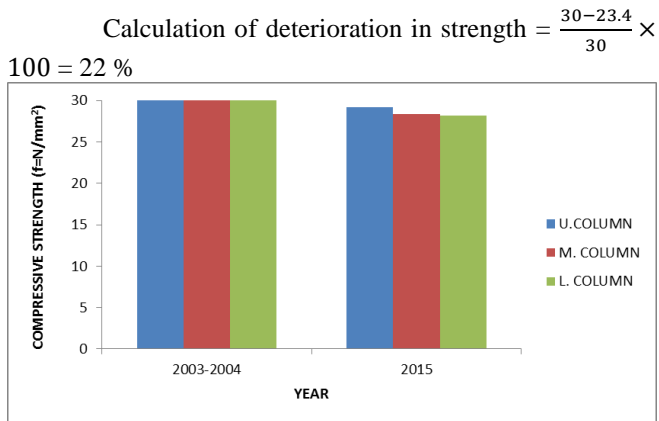


Fig. 5: Compressive strength found at E-27, Ayodhya Nagar Bhopal

Calculation of deterioration in strength =  $\frac{30-26.93}{30} \times 100 = 10.23\%$

#### IV. CONCLUSION

Collection of data of compressive strengths of houses of various sectors located in Ayodhya Nagar Bhopal is done from the housing board society. We have observed in the research period that the designing of houses at that time (1995-2013) is done by M 20 and M 25 grade and respective compressive strengths are found as 25 N/mm<sup>2</sup> and 30 N/mm<sup>2</sup>. The observations are done by the Schmidt rebound hammer which is a type of non-destructive testing and is found that Nondestructive manner of testing was done for the calculation of strengths of houses, where results are drawn in the form of Deterioration of strength by age. I concluded that the Deterioration of strength in RCC Residential buildings takes place and the percentage of Deterioration is in the range of 2.5 to 25% based on their construction time and it is also depends on moisture conditions and damages. The study is based on dissertation titled "Deterioration of Strength of RCC Residential Buildings using Rebound Hammer". After observations, conclusion derived that the deterioration of strengths is majorly dependent on age of construction.

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