Study of Non Destructive Test on Concrete

Prof. K. G. Bhagat[1], Mr. Noor Mohd. Taslim pinjari[2], Mr.Tushar Malvekar[3], Mr.Sagar Chavan[4]
[1, 2, 3, 4] Dept of Civil Engineering
[1, 2, 3, 4] Padm. Dr. V. B. Kolte college of Engg. Malkapur, Maharashtra, India

Abstract- *In the recent past, Non Destructive Techniques to evaluate defects and strength of concrete have developed great importance. These techniques have their own advantages as well as limitations, when compared to conventional strength estimation and damage detection tests. In this project various concrete specimens (Beams and Square Slab) were cast and discontinuities were created in these using thick paper sheet and wooden pieces at varying depths and position within the specimens. The objective of this project was to detect these defects by using three techniques: (1) Rebound Hammer Test (2) Ultra Sonic Pulse Velocity Test (3) Thermal Imaging Technique And finding the most suitable and economical technique to serve the purpose. Use of Thermal Imaging Technique in this area is a very new concept and its relevance in this area has been explored in this project and it has been found that this technique is of great use in detecting defects in concrete. Please note that this project does not deal with determining the strength of specimens.*

Keywords- concrete, compressive strength and Building materials rebound hammer

I. INTRODUCTION

Non Destructive techniques are the methods predominant these days. These methods in civil engineering are used to detect defects and determine the strength of a structure. As the name suggest, in these techniques strength and discontinuities are determined without causing any harm to the structure. These techniques have their own advantages as well as limitations, when compared to conventional strength estimation and damage detection tests.

Methodology and technique employed

In this project 3 techniques have been used, namely

Rebound Hammer Test.
Ultra Sonic Pulse Velocity Test.
Thermal Imaging Technique.

1.1Analysis and Results

In the first test graphical results were obtained and at the location of defect the value (R number) goes out of range of equipment and no value is obtained thus indicating the presence of defect.

In the second experiment also graphical results were obtained and the formation of peak in the graphs clearly indicated the presence of a defect at that point.

In the third test, a thermal image was obtained in which a clear picture of the defect could be seen.

II. EXPERIMENTAL INVESTIGATION

2.1. Rebound Hammer Test

2.1.1Experimental Set Up

FIG 2.1Rebound Hammer (Schmidt Hammer)

Rebound Hammer Test was performed on the Rectangular Beams having thick paper sheet discontinuities and the results were as shown.

TABLE 2.1

Point Number	Rebound Number (R)	Point Number	Rebound Number (R)
1	20	17	23
2	21	18	24
3	23	19	23
4	23	20	23
5	23	21	22
6	21	22	22
7	22	23	22
8	22	24	20
9	24	25	24
10	21	26	23
11	20	27	22
12	22	28	24
13	23	29	24
14	23	30	27
15	22	31	22
16	22	32	35

R number vs Number of points along the specimen for the above values.

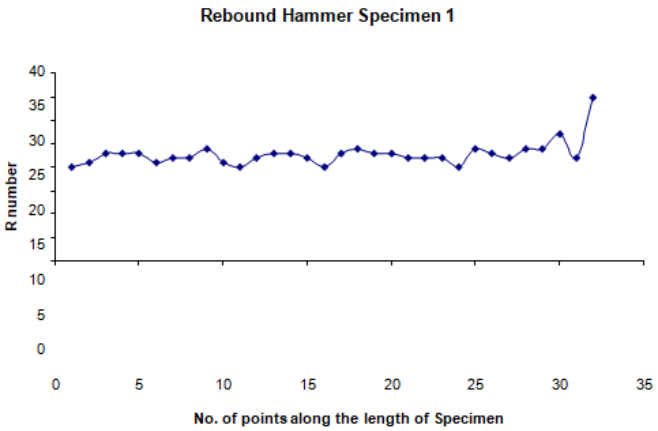

FIG 3.2 Rebound Hammer test result on Beam with no discontinuity (FIG.4.1).

Ultra Sonic Pulse Velocity Test

Experimental Set Up

FIG 3.2 USPV Test Apparatus (PUNDIT)

USPV Test was conducted on the rectangular beams having thick paper sheet discontinuities at different locations and the results obtained are as under:

TABLE 3.

Point Number	Time taken by pulse to travel from one end to other (microseconds)	Point Number	Time taken by pulse to travel from one end to other (microseconds)
1	19.8	6	20.3
2	20.5	7	21.8
3	20.2	8	21.5
4	20.2	9	20.8
5	21.2	10	21.0

Average value plot of Point Number vs Time is:

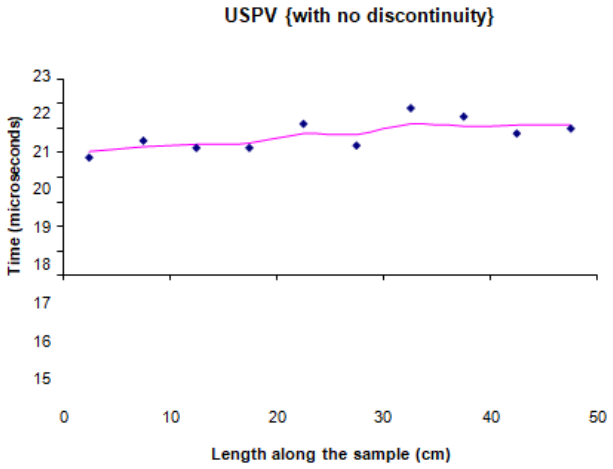

FIG USPV test result on beam with no discontinuity

As expected the Time taken by pulse to travel from one face of beam to other (10cm) do not vary much along the length of the beam(50cm).

III. CONCLUSIONS

Rebound Hammer Test

According to my Experiments we can clearly see that for Non Destructive Evaluation of Defects in Concrete Rebound Hammer test is not the one that can be relied upon. Though from data obtained (R number) andwe can clearly see that it gives some indication of the presence of some defect but strong conclusion can't be drawn from these results.

Also if the concrete specimen is such that it's R value is low (that is R<18) than by Schmidt Hammer we can't get the R value at all (at any point) and the little bit indication that we were able to draw from this test about the presence of discontinuities could not be drawn and in that case this test will be a complete failure.

So the only conclusion that can be drawn here is that Rebound Hammer test is of negligible importance in detecting defects in concrete.

Ultra Sonic Pulse Velocity Test

From my experiments it can be seen that the USPV Test is the one on which we can completely rely to serve our purpose. From Time taken by pulse vs Points along the length of specimen] we can easily see that at the points of discontinuities the time taken by the pulse to travel across the beam increases considerably and this point is seen as a peak in the graph.

Thermal Imaging Technique

The use of this technique in Non Destructive Evaluation of Defects in Concrete is entirely a new concept. Not much work has been done so far in this field. By the work I have carried out during my project in this field, it has been found that this experiment is of great relevance to us.

In this experiment whole specimen can be scanned in a single shot unlike Rebound Hammer Test and USPV test where each and every point is to be scanned.

The results I got, by this experiment clearly show the picture (blurred image) of the defect. The result could be improved further and a sharp image of the defect can be seen by the use of high peak energy heat sources. In IIT the heat source available are of 1KW power and to obtain the sharp image the heat sources required should have energy of 4KW.

Despite this limitation the results show the clear image of the defect, its location and size. By further analysis of the cooling curves obtained, we can get the depth of the defect but this part is beyond the scope of this project.

REFERENCES

[1] Sinha S.N. (2002), Reinforced Concrete Design, 2nd ed. Tata Mc Graw Hill Publishing Company, New Delhi
[2] IS 456 (2000), Plain and Reinforced Concrete- Code of Practice, Bureau of Indian Standards, New Delhi.
[3] Ch. Maierhofer *et al* (2006), "Application of impulse-thermography for non-destructive assessment of concrete structures" Cement & Concrete Composites Vol 28 Page 393-401
[4] A. Brink *et al* (2005) "Quantitative impulse-thermography as non-destructive testing method in civil engineering – Experimental results and numerical simulations" Construction and Building Materials Vol 19 Page 731–737.
[5] Takahide Sakagami *, Shiro Kubo (2002) "Development of a new non-destructive testing technique for quantitative evaluations of delamination defects in concrete structures based on phase delay measurement using lock-in thermography" Infrared Physics & Technology Vol43 Pag