

## Non Destructive Test On Concrete Structure

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**Abstract**— In this paper the non destructive test results are carried out with practical presentation. The non destructive test is reliable when the data of structure is not known. This test is cost efficient. The practical work of this paper was carried out in the Govt. College of Engineering, Amravati. Each NDT test having certain capabilities and limitations.

Key words: NDT, structure.

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### I. INTRODUCTION

Non destructive test is the test in which the strength of concrete, number of bars provided in concrete structure, durability of concrete is found out without destruction of concrete member or structure. This test is carried out when the structural data is not available. For old buildings, in case the information about the building like the age of building, material used, etc. is not available then to find the strength of building structure the non destructive test is useful. If the data of the most important structures like old historical buildings, monuments, forts, bridges, dams, etc. is not available then the non-destructive test is reliable. NDT test is carried out for the inspection of the samples formed for fabrication or the manufacturer of the structural members. There are three methods of NDT used in this paper first rebound hammer test then second ultrasonic pulse velocity test then rebar locator test. Rebound hammer test procedure is given in IS 13311(Part 2): 1992. Schmidt hammer is used for rebound hammer test which weighs 1.8kg which is suitable for laboratory as well as field work. Test surface can be horizontal, vertical or inclined at any angle. For calibration cylinders can be adopted having size 15cm × 30cm of same material. Ultrasonic pulse velocity test procedure is given in IS13311 (Part1): 1992. The instrument used for this test is a set of Portable Ultrasonic Non-destructive Digital Indicating Tester. Rebar locator test is carried out with the help of a set of Rebar Locator (Phonoscope), Ruler and Marker.

### II. METHODS OF NDT

1. Rebound hammer test.
2. Ultrasonic pulse velocity test.
3. Rebar locator test.

### III. REBOUND HAMMER TEST

1. Rebound hammer test: the rebound hammer is a surface hardness tester for which an empirical correlation has been established between strength and rebound number. Schmidt hammer is only known instrument to make a use of rebound principle for concrete testing. Schmidt hammer weighs 1.8 kg and it is suitable for laboratory as well as field work.

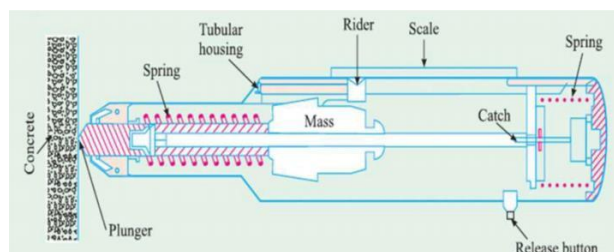


Fig 1: Rebound Hammer

It made up of a spring controlled hammer mass that slides on a plunger within a tubular housing. The rebound hammer is forced against the surface of the concrete by the spring and the distance of rebound on a scale. The test surface can be horizontal, vertical or inclined at any angle but the instrument must be calibrated in this position. 15cm X 30cm cylinders can be used for calibration of the same cement and aggregate used on the job.

#### INTERPRETATION OF RESULT:

Average rebound number	Quality of concrete
More than 40	Very good hard layer
30 to 40	Good layer
20 to 30	Fair
Less than 20	Poor concrete

Advantages of rebound hammer test are as follows:

1. Without destruction of concrete structure the strength of concrete structure is found out with the help of rebound hammer test.
2. Rebound hammer test is the simple and quick method of obtaining the strength of concrete.
3. This method is an inexpensive method for finding out strength of concrete.

Limitations of rebound hammer test are as follows:

1. The accuracy of  $\pm 15$  to  $\pm 20$  percent is possible only for specimens casted and tested under conditions for which the calibration curve is formed.

OBSERVATION TABLE:

Sample NO.	Rebound Number		Compressive Strength
	Horizontal	Vertical	
1.	20		12.00
2.	36		36.00
3.		27	26.00

Result and conclusion:

The compressive strength of the concrete cubes tested by rebound hammer is found to be 25MPa. When compared with the compressive strength obtained after destructive testing (35MPa) shows very less strength. Thus, it can be concluded that the values or result obtained by rebound hammer test (ie .,NDT) are not to be completely relied on.

#### IV. ULTRASONIC PULSE VELOCITY TEST

2. Ultrasonic pulse velocity test: Ultrasonic pulse velocity test is the non destructive test carried out for knowing the gaps or cracks present in concrete. In short UPV test is carried out for finding the strength of concrete. The uniformity of concrete is checked by this method. This method can be adopted for existing structures as well as under construction structures. It measures the time required for the ultrasonic pulse passing through concrete.

UPV test carried out by three types:

1. direct transmission.
2. semidirect transmission.
3. surface transmission.

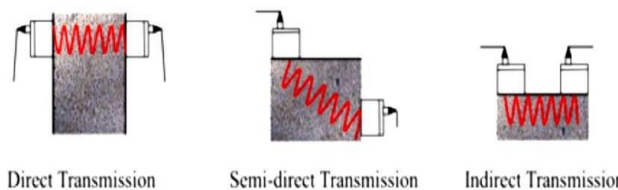


Fig2 : UPV Test Transmission.

Pulse velocity of concrete is calculated with the help of UPV test.

Velocity Criteria for Grading of concrete quality (As per IS : 13311-Part1) :

Sr. No.	Pulse velocity by cross probing in km/sec.	Concrete quality grading
1	Above 4.5	Excellent
2	3.5 to 4.5	Good
3	3.0 to 3.5	Medium
4	Below 3.0	Doubtful

Pulse velocity through the concrete can be calculated as follows:

$$V=L/T$$

Advantages of ultrasonic pulse velocity test are as follows:

1. Without destruction of concrete structure the quality of concrete is determined with the help of ultrasonic pulse velocity test.
2. The uniformity of concrete is found out with the help of ultrasonic pulse velocity test.
3. The ultrasonic pulse velocity test is useful for existing structure as well as under construction structure.
4. The porosity of concrete structure is determined with the help of ultrasonic pulse velocity test.

Observation Table:

Sample	Length (cm)	Travel time(sec)	Velocity(km/sec)	Concrete velocity grading
1	15.00	$32 \times 10^{-6}$	4.68	Excellent
2	15.00	$38 \times 10^{-6}$	3.95	Good
3	15.00	$31.5 \times 10^{-6}$	4.76	Excellent
Average velocity (km/sec)				4.46(good)

Result and conclusion:

The average velocity of pulse induced through concrete cube is found to be 4.46 km/sec.

This value indicate good concrete quality grading.

#### V. REBAR LOCATOR TEST

3.Rebar locator test: Rebar locator test is the non destructive test used for determination of rebars, measuring the concrete cover and the diameter of bars. The set of rebar locator

(Profoscope), ruler and marker is used to carry out the rebar locator test.

For the R.C.C. structures rebar locator test is most useful when the data or the structural design is not available. For find out the strength of structure without destruction of structure the rebar locator test is useful this saves the cost required to reconstruct the structures for some interval of time.

Advantages of rebar locator test are as follows:

1. Without destruction of concrete structures it is possible to found out the number of bars present in concrete structures, the spacing provided, diameter of bar, cover provided, etc. with the help of rebar locator test.
2. This is the easiest and fastest way for detecting the reinforcement details.
3. When the data of structure is not available or the inspection of structure is required then this method is more efficient.

Limitations of rebar locator test are as follows:

1. This method is helpful but is not much accurate.
2. The method gives qualitative analysis but not quantitative.

Observation table:

Structures. Presented in 2nd International Conference on rehabilitation and maintenance in civil engineering.

S. Shetty and A. K. Jain.

Location	Concrete cover (mm)	Diameter of bar (mm)
L1	30	32.5
L2	27	30.5
L3	23	25.4
L4	31	24.6
L5	28	35.5
L6	24	32.6

1. Actual cover provided = 25mm.
2. Actual bar diameter = 6mm.

Result and conclusion:

The average cover recorded in the profometer or rebar locator is 27.16mm. which is near to the actual cover provided.

However, the average bar diameter is found to be 30mm, which is more grater than actual diameter.

Thus, it can be concluded from above observations that though these NDT methods are helpful but are not accurate. Thus they can only give qualitative analysis and not quantitative.

## VI. CONCLUSION

Under the realistic conditions, NDT provides the cost effective and reliable analysis.

Each NDT technique has certain capabilities and limitations and more than one technique is used to cover various parts.

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