WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Comparative Study of Concrete Strength by Destructive and Non-Destructive Test

Sumit L. Chauhan[1], Prajwal Zilpe[2], Samiksha Badge[3], Prajwal Dange[4], Suchit Sakharkar[5], Shradha Shegamwar[6]

[1]Assistant Professor, Civil Department, PCE Nagpur
[2-6]B.E ,4th Year, Civil Department, PCE Nagpur

ABSTRACT

Testing of the concrete sampling plays and important role to know about the strength, durability and condition of the structure. The work will present a detailed comparison between the destructive tests and non-destructive methods (Rebound Hammer and Ultrasonic Pulse Velocity). This work focuses on comparing the destructive and non-destructive testing which can determine the potential durability of the concrete. This work helped us to reach a conclusion where we can further find the best testing method system that shall be applicable for various concrete structures as well as in the concrete industry. Tests were performed to compare the accuracy between there bound hammer and the ultrasonic pulse velocity method in estimating the strength of concrete. Ninesamples (cubes of 150× 150 ×150mm)werepreparedusingmixdesignof1:1.83:2.65withaconstant w/c ratio of 0.37 and were tested at 7, 14, and 28days. The slump test was between 100-130 mm. The results obtained from the non-destructive testing methods werecorrelatedwiththecompressivestrengthresultswhichshowedthatahighercorrelationexistedbetweentheRebound Hammer and the compressive strength than the Ultrasonic Pulse Velocity.

INTRODUCTION

Concrete is a composite material produced from the combination of cement, fine aggregate, coarse aggregate and water in their relative proportion. It is a ubiquitous building material because its constituents are relatively cheap, and readily available. In addition to that, concrete in its fresh state has the ability to be molds into any desired shape and size.

Concrete is the most used material in today's world, in the construction industry. It is continuously being used in the construction of countless number of public structure and building.

The most important property of concrete is its strength which can be determined by destructive and non-destructive testing. It is important to have regular schedule for testing concrete structure, in order to have a safe and efficient operation of these structures. In this study, a general series of rebound hammer tests and destructive tests will carry on in a concrete laboratory. A set of concrete cubes measuring 150 x 150 x 150 mm will cast and water curing for to obtain the cube strength and rebound number. Three grades of concrete, namely M40 will used in this experiment.

Compressive Testing**:**
The quality of concrete is important for construction. Hardened concrete attains strength as it matures. The compressive test of concrete helps to understand the behavior and quality by breaking the test specimen at certain loads.

The main intention of compressive tests is to investigate the service life and detect the weakness of design that might not show under normal working conditions.

Non-DestructiveTesting**:**
Non-Destructive testing is a method of testing existing concrete structures to assess the strength and durability of concrete structure.
In NDT without loading the specimen to failure we can measure strength of concrete.
Methods of Non-Destructive Testing of Concrete:

- Rebound hammer method
- Ultrasonic pulse velocity method
- Radioactive methods
- Penetration method

OBJECTIVE

- To study about non-destructive testing method for evaluating the compressive strength of concrete.
- Comparison of concrete quality.
- Monitoring changes in the structure of the concrete.

- Condition of reinforcement steel with respect to corrosion.
- Detection of presence of imperfection.
- Estimating the in-situ compressive strength, uniformity, quality and homogeneity.
- Measurement of Elastic Modulus.

LITERATURE REVIEW

3.1 Akash Jain, Ankit Kathuria, Adarsh Kumar, developed a method of combined use of both UPV and RH tests for assessing the strength of concrete with great accuracy. The concrete mix design for M20, M30, M40, and M50 was done using IS 456:2000 and IS 10262:1982 and a total of 288 cubes were casted. The samples were tested for ultra-pulse velocity and rebound number followed by Indian standards (IS 13311 part (2) 1992). Relationship graphs were plotted between age of OPC/PPC and rebound number and between age of OPC/PPC and UPV. A relationship curve was also plotted between ultra-pulse velocity, rebound number and compressive strength. The results derived from the experiments showed that UPV readings increased with age but the change was very small and it alone could not be used for finding out the compressive strength. The readings of rebound number also showed an increase with age and the approximate value could be directly determined by using rebound number only. Results also showed that if correlation was developed between rebound number and pulse velocity, more accurate results could be predicted and achieved.

3.2 Samson, Omoniyi, Moses, Investigated about the correlation between nondestructive and destructive testing of compressive strength of concrete. Concrete cubes of size (100x100x100mm) were cast using M20, M30, and M35 grade concrete and were cured for 7, 14 and 28 days. Preliminary tests were performed on materials. Total of 90 cubes were produced and rebound hammer test was performed. 10 readings for rebound hammer compressive strength on each specimen were taken. Various tables for rebound number and compressive strength were drawn and correlations were listed out. Regression analysis was carried out and results showed high rebound number in high compressive strength. Correlation coefficients of regression models ranged between 92.1%- 97.9% which showed an excellent relation between rebound number and compressive strength. Results also showed that if only rebound number was known, the compressive strength of concrete could be easily predicted.

3.3 Siddharth Shankar, Hikmat Raj Joshi,this paper deals with the determination of compressive strength of concrete which are destructive tests (DT) and nondestructive tests (NDT). The NDT test methods include rebound hammer, ultrasonic pulse velocity test, penetration test, radiography test, sonic integrity tests etc. The DT of concrete is not always appropriate method to find compressive strength of concrete and concrete structures because it affects the durability and lifespan of concrete.

The analysis concluded that, at present stage the NDTs are suitable only for controlling and estimating the compressive strength within the specified range of the target object.

3.4 Damodar and Gupta, experimentally investigated to develop an ideal curve equation that could predict the value of concrete's compressive strength. OPC, PPC and PSC cements were used in the experimental work.18 cubes of 1st batch of M20, M25, and M30 grade were cast and subjected to normal curing. 3 cubes from every mix were tested for compressive strength at 1 and 3 days respectively and result of average of 3 cubes was taken. Similar cubes for PSC and PPC were cast and tested. 2nd batch of M20, M25 and M30 grade were cast. 18 cubes were subjected to normal curing while as 18 cubes were subjected to accelerated curing. Results obtained from the experiment showed that OPC gained strength of 80% in the 1st day of accelerated curing while as PSC and PPC only gained 50% strength in the 1st day and these results could be used in future for prediction of early strength of concrete. Results also showed that an ideal curve equation could be obtained and used in computing the compressive strength of concrete.

MIX PROPORTION

Concrete consists of different ingredients. The ingredients have their different in dividual properties. Strength, workability and durability of the concrete depend heavily on the Concrete mix proportion of theindividualingredients.InthisstudyM40gradeofconcretewereused.

Design Requirements

1. Characteristic cube concrete strength(fck)40N/mm²
2. Max water cement ratio (w/c)0.37
3. MaxAggregateSize20mm
4. Slump40mm

The following tables illustrate them ix of concrete

Materials	M40
	Weight per one cubic meter(kg/m^3)
Cement	440
Water	163
Fine Aggregate(Sand)	748
Coarse Aggregate(10mm)	449
Coarse Aggregate(20mm)	673
Proportion	1:1.83:2.65

Table 3.1: Details of M40 Grade concrete specimens

M40Gradeconcrete				
Specimens	7 days	14days	28days	Total
Cube	3	3	3	9

Table3.2: Details of no. of cubes

RESULT AND DISCUSSIONS

5.1 Comparison of Rebound Hammer test and Compressive Strength Test

	Compressive Test			Rebound Hammer		
	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days
Cube 1	39.11	48.89	52.89	50.1	45.7	60.8
Cube 2	40.89	54.67	52.00	42.1	43.1	42.1
Cube 3	39.56	51.11	53.78	35.6	50.1	43.0
Average	39.85	51.56	52.89	42.6	44.1	48.63

Table5.1:CompressiveStrength&ReboundHammer

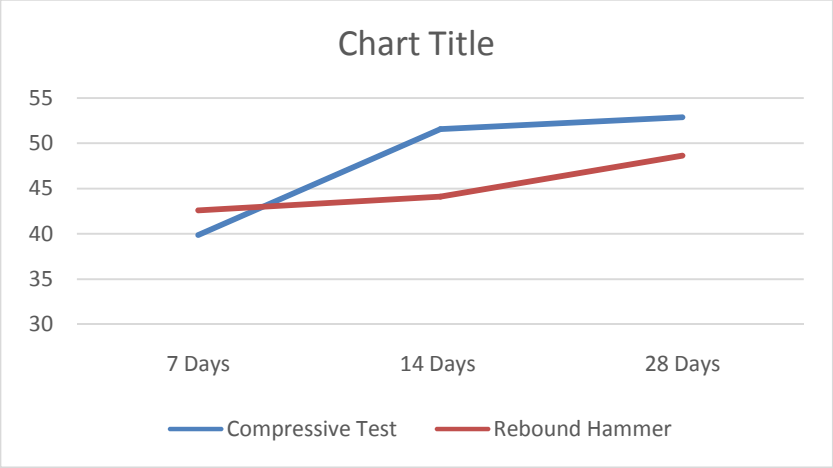

Fig 5.2: Comparison between Compressive strength and Rebound Hammer

Above graph (fig. 5.1) shows that the relation between Compressive Strength and Rebound Hammer Strength the average rebound strength is 42.6N/mm², 44.1 N/mm², 48.63 N/mm²then compressive strengthis39.85N/mm², 51.56 N/mm², 52.8 N/mm²on7, 14 and 28 Days of curing.

5.2 Result of Ultrasonic Pulse Velocity Test:

Cubes	**7 Days**	**14 Days**	**28 Days**
1	4.02	4.02	4.01
2	4.02	4.29	4.11
3	4.53	4.32	4.27
Average	4.19	4.21	4.13

Fig 5.4: Result of Ultrasonic Pulse Velocity Test

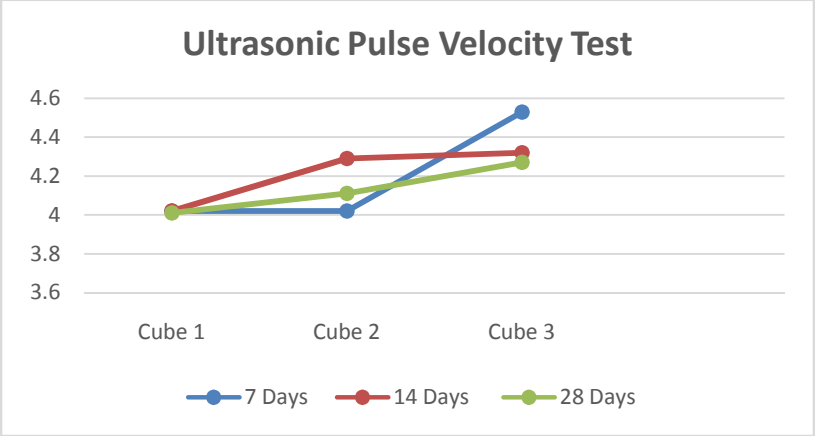

Fig 5.4: Result of Ultrasonic Pulse Velocity Test

CONCLUSION

1. The rebound hammer test method is more effective in predicting concrete cube compressive strength.
2. Rebound hammer was proved to be the simplest and quick method of obtaining the compressive strength of concrete specimens.
3. The values obtained from the multiple regression analysis equation which relates rebound hammer test results with strength of concrete cube is very close to the actual compressive strength test result.
4. It can be observed that the graph of rebound hammer readings has shape similar to the graph of compressive strength. There is rise in the values of the test results of these two test methods with increase in age. This means that rebound hammer test results, can give an idea of the compressive strength of the same structure.
5. Applying proper correction factor is a must to get the reliable results. Schmidt hammer test results should be calibrated according to specific condition of concrete. It is essential to develop a prior correlation relationship between actual compression strength of the concrete and the NDTs. As a result of these, some destructive tests seems unavoidable in order to calibrate the mode.
6. Schmidt hammer test and ultrasonic test are very convenient and can be executed anywhere but these tests have their own limitation and these limitations may result in unavoidable errors which can't be eliminated totally.

References

1. IS code -13311 (part 1) -1992 NDT of concrete – methods of test with ultra-sonic pules velocity.
2. IS code -13311 (part 2) -1992 NDT of concrete – methods of test with rebound hammer.
3. IS 456, 2000, IS Code of Practice for Plain and Reinforced Concrete, fourth revision; Bureau of Indian Standards.
4. Akash Jain, Ankit Kathuria, Adarsh Kumar, "Combined Use of Non-Destructive Tests for Assessment ofStrengthofConcreteinStructure."2013PublishedbyElsevierLtd.
5. Shankar S, Joshi H(2010) Comparison of Concrete Properties determined by Destructive and Non-destructive Tests. Journal of The Institute of Engineering
6. SamsonD, Omoniyi, MosesT(2014) Correlation between Non-Destructive Testing and Destructive Testing of Concrete. International Journal of Engineering Science Invention.
7. Shariati M, Hafizah N, Mehdi H, Shafigh P, Sinaei H (2011) Assessing the strength of reinforced concrete structures through UPV and Schmidt Rebound Hammertests. Scientific Research and Essays.