INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

A COMPARATIVE EXPERIMENTAL STUDY OF COMPRESSION TEST AND REBOUND HAMMER TEST ON CONCRETE

ANKUSH M. PACHGHARE, SHANU A. SHAH

Department of Civil Engineering D.R.G.I.T. & R. Amravati

Accepted Date: 15/03/2016; Published Date: 01/05/2016

Abstract: In this paper we have done the comparative experimental study of strength of concrete by using compression test on concrete as destructive testing method and rebound hammer test as non-destructive testing method. For that we have casted 6 cubes each of M20, M25, M30, M35 and M40 grade by doing mix design as per IS 10262:2009. For doing mix design all the materials are tested for their physical properties as per IS code provision and casting of cube is carried out as per IS 1199:1959. Three cubes are tested for 7 days strength by Non-destructive and Destructive testing and the remaining three cubes are tested for 28 day strength for the same. Compression test give 100% strength of concrete as per mix design. Though the Schmidt rebound hammer provides a concrete strength up to accuracy of ±15 to ±20 percent but from experimental work we get percentage accuracy of 10.08% for 7 days and 10.50% for 28 days. Schmidt rebound hammer is an inexpensive, simple and quick method to assess the concrete strength of structure.

Keyword– Concrete, Design mix, Compression test, NDT

Corresponding Author: MR. ANKUSH M. PACHGHARE

Access Online On:

www.ijpret.com

How to Cite This Article:

Ankush M. Pachghare, IJPRET, 2016; Volume 4 (9): 314-321

PAPER-QR CODE

INTRODUCTION

The strength of concrete is its most important property (especially when needed for structural purposes) alongside its durability [5]. Therefore, it is very important to ascertain the compressive strength of concrete before subjecting it to its anticipated loads. Compressive strength of the hardened concrete can be determined using the destructive and non-destructive testing (NDT) methods. The destructive testing (DT) method is carried out by crushing the cast specimen to failure while the non destructive is carried out without destroying the concrete specimen. The main disadvantage of the destructive testing methods is the length of time it takes for the results to be ready, the equipment and the power required.

The rebound (Schmidt) hammer is one of the most popular non destructive testing (NDT) methods used to test the strength of concrete. This is due to its relatively low cost and simplicity in use. Although the non destructive testing (NDT) results are much quicker compared to the destructive methods, they are more of an approximation than exact compressive strength values. In as much as the rebound hammer results are quicker, and do not destroy the surface of concrete tested, there is no established relationship between the compressive strength obtained using NDT and DT. The aim of this research is to compare concrete compressive strengths measured using destructive method and those measured using the non destructive method.

II) MATERIALS AND METHODS

Raw materials such as cement, sand, coarse aggregates and admixture were collected from the nearby sources. Portland pozzolona cement [8] of ACC brand is used for the experiment. Sand [4] was collected from Kanhan river. Course aggregate [4] used throughout the experiment was procured from local quarry site in Rajura village, Amravati. The admixture [12] (superplasticizer) used was supplied by BASF brand.

Sr. No.	Materials	Source
1	Cement	Portland Pozzolona Cement of ACC brand
2	Fine Aggregate	Kanhan River
3	Coarse Aggeregates	Masod Quarry
4	Water	Potable water

5	Admixture	Superplasticizer of BASF

Table 1 Material used and their sources

Physical tests were conducted as per specification. Following tests were conducted on the raw materials

1. Standard consistency of cement [11].

2. Specific gravity of sand and course aggregate [10].

3. Silt content in sand.

4. Water absorption [10].

5. Sieve analysis [4] [9].

Tests	Materials			
	Cement	Natural Sand	10 mm	20 mm
Standard Consistency	35 %	-	-	-
Specific Gravity	3.14	2.60	2.71	2.75
Silt Content	-	2.22 %	-	-
Water Absorption	-	2.96 %	1.19%	1.19 1%
Sieve Analysis	-	Zone II	OK	OK

Table 2 Test results obtained from physical test

Concrete of grade 20 N/mm^2, 25 N/mm^2, 30 N/mm^2, 35 N/mm^2 and 40 N/mm^2 were used for the study. The mix design was done in accordance with IS 10262 (2009) [13] specification for concrete mix design.

Materials (Kg/m^3)	Grade of concrete				
	M20	M25	M30	M35	M40
Cement	320	350	370	390	410
Sand	802	729	793	790	785
10mm	633	625	539	537	534
20mm	545	538	626	623	620
Water	144	144	137	133	131
Admixture	0.00	4.20	4.44	4.68	4.92

Table 3 Quantity of each material required for 1cu.m.

Batching of concrete constituents was carried out by weighing using the manual weighing machine [2]. Mixing of the constituents was done by using mechanical mixer until a uniform mix was obtained. Batch size of 0.30 m^3 was prepared for 6 specimens. Concrete cubes [5] [6] [7] of size 15cm x 15cm x 15cm were casted from the freshly prepared concrete. The procedure was carried out in accordance with IS 1199 specification [7]. The specimen were de-moulded after 24 hours and immersed into the curing tank filled with water and cured for 7 and 28days [1] [5] [6]. Six concrete specimens for each grade were casted. A total of thirty (30) cubes were casted for the study.

Figure 1 Concrete cube casting

Figure 2 Curing of concrete cubes for 7 days and 28 days

Testing of concrete cubes

For non destructive testing [14] choose the uniform face of cube and marked 9 points spaced at equal distance. Then placed that cube under CTM and apply a 100 KN load for firmly holding that cube. After that take nine rebound hammer readings at nine marked points for each cube.

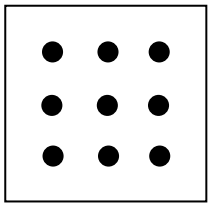

Figure 3 NDT by using Schmidt rebound hammer

Figure 4 NDT by using Schmidt rebound hammer

For compressive test [6], the testing machine may be of any reliable type, of sufficient capacity for the tests and capable of applying the load at the rate of 140 kg/sq.m/min as specified in IS 516 [6]. The permissible error shall be not greater than ± 2 percent [6] of the maximum load.

Figure 5 Compression test by using compression testing machine

RESULT AND DISCUSSION

On the basis of individual test results on the specimens, a correlation was developed between the compressive strengths by compression testing machine and the corresponding rebound hammer carried out on the specimen.

Grade of concrete	Strength of concrete in N/mm²		Difference in %
	Destructive test	Non-destructive Test	
M20	23.62	16.75	35.05
M25	27.72	22.67	21.89
M30	32.36	36.17	-14.32
M35	33.89	31	9.60
M40	36.07	36.67	-1.79
Average difference			10.08 %

Table 4 Correlation between destructive and non-destructive test after 7 days[2]

Grade of concrete	Strength of concrete in N/mm²		Difference in %
	Destructive test	Non-destructive Test	
M20	28.50	26.67	-4.18
M25	37.50	33.0	13.64
M30	39.50	38.50	2.63
M35	36.00	26.60	21.86
M40	54.00	45.1	18.54
Average difference			10.50 %

Table 5 Correlation between destructive and non-destructive test after 28 days [2]

CONCLUSIONS

Based on the current research work, the following conclusions can be drawn regarding the application of non destructive testing and destructive testing to assess the strength of existing concrete blocks with mix design. The select mix design is tested and examined a using Non Destructive Testing and Destructive Testing method which includes Rebound Hammer and Compression Testing Machine.

The conclusions made from above mentioned tests are as follows:

1) The Schmidt hammer provides an inexpensive, simple and quick method of obtaining an indication of concrete strength, but accuracy of ±15 to ±20 percent is possible.

2) From our experimental work we get accuracy of 10.08% in 7 days and 10.50% in 28 days

3) The compression testing machine gives an accurate compressive strength of concrete by applying uniform axial load on the concrete cube.

4) From the results obtained it was concluded that 100% strength of concrete was achieved as per design except M35 grade due to some casting errors.

REFERENCE

1. Correlations between non-destructive and destructive tests of low strength concrete published by Khodja Ali-Benyahia, Said Kenai and Mohamed Ghrici at World Congress on Housing October 26 – 29, 2010, Santander, Spain.
2. Correlation between Non-Destructive Testing (NDT) and Destructive Testing (DT) of Compressive Strength of Concrete published by Duna Samson, Omoniyi, and Tope Moses at *International Journal of Engineering Science Invention ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726 www.ijesi.org Volume 3 Issue 9 ‖ September 2014 ‖ PP.12-17.*
3. Concrete mix proportioning published by S.C. Maiti, Raj K. Agarwal and Rajeeb Kumar at ICJ, December 2006 Fundamentals of concrete, Canadian Portland cement association.
4. IS 383:1970 Specifications for coarse and fine aggregate from natural source for concrete.
5. IS 456:2000 Code of practice for plain and reinforced concrete Aug 2005 (fourth revision).
6. IS 516:1959 Method of test for strength of concrete Oct 2008
7. IS1199:1959 Methods of sampling and analysis of concrete Oct 2008
8. IS 1489(Part 1):1991 Specification for Portland pozzolana cement: Jul 2009 Part 1 Fly ash based (third revision)

9. IS 2386(Part 1):1963 Methods of test for aggregates for concrete: Jan 2007 Part 1 Particle size and shape.
10. IS 2386(Part 3):1963 Methods of test for aggregates for concrete: Jan 2007 Part 3 Specific gravity, density, voids, absorption.
11. IS 4031(Part 4):1988 Methods of physical tests for hydraullic cement: Jul 2009 1 Part 4 Determination of consistency of standard cement paste (first revision)
12. IS 9103:1999 Specification for admixtures for concrete.
13. IS 10262:2009 Guidelines for concrete mix proportioning (First Revision)
14. IS 13311(Part 2):1992 Methods of non-destructive testing of concrete: Oct 2008 Part 2 Rebound hammer.