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A Study on the Effects of Different Water proofer on Compressive Strength of Concrete Cubes

Rohit Jain[1], K.K. Pathak[1],Rajesh Bhargava[2]
[1]National Institute of Technical Teachers' Training and Research, Bhopal (MP) INDIA
[2]S.V Polytechnic, Bhopal (M.P) INDIA
Email: kkpathak@nitttrbpl.ac.in

Abstract : ***In this study effects of different water proofers on compressive strength of cement concrete has been made using experiments. Total 108 cubes were cast using normal, 60% of 20 mm and 40% of 10 mm size of coarse aggregates having three water proofer Dr. fixit, Roff, Aqua Roff proportion of 4ml/kg cement. NDT of the cast cubes using rebound hammer and UPV have been also carried out. All the cubes were tested for ultimate load using compression testing machine and compressive strengths of the cubes are calculated. Based on these data, comparative studies have been carried out to quantify the effect of different water proofers on the compressive strength of the concrete. From these data, salient conclusions are drawn***

Keywords—**Concrete, Normal Aggregates, Water proofer chemicals, Compressive Strength**

I. Introduction

Concrete is one of the most important material in the world, where coarse and fine aggregate are filler material and cement paste is binding material. It is made by mixing coarse and fine aggregates, water, cement, and added substances in recommended extent, Concrete has discovered use in heart all kind of development from highway, canal, lining, bridge, dam to the most lovely and masterful of building. With the addition of admixture to supply the need of compressive strength, the greatest properties of concrete and workability of concrete depend on aggregate.

This study is to evaluate the effect of different water proofer on compressive strength of concrete cubes. Some of the background studies, related to thesis work are discussed here-

Prajapati and Arora (2011) reported on a study on oxygen permeability of concrete containing different water proofing admixtures and cementious material. Concrete mix proportion 1.05:2.13:2.76 was used to cast cube specimen having seven different, water proofing chemicals, silica fume and fly ash. Oxygen permeability test was performed after 56 days of casting and their oxygen permeability were compared. The results exposed that concrete with FOSROC CONPLAST admixture gave higher workability among all the concrete mixes. Silica fume and fly ash reduce the workability of concrete. 10 % replacement of cement by fly ash or silica fume reduces oxygen permeability of concrete compared to plain concrete. Hasan Katkhuda (2012) reported on the effect of micro silica and water proofer on resistance of concrete to phosphoric acid attack. In this paper concrete mix proportion M20 grade was used to cast cube specimen having three MS replacement levels and three WP mixes were considered 10%, 15% and 20% by weight of cement for MS and mixes of 0.4, 0.6 and 0.8 L for WP. Sixteen mix proportion cubes specimen was cast to compare each mix proportion. Compressive strength and modulus of rupture after 28 days were investigated. Results indicate that use of MS only has a negative impact on the workability of concrete, especially for high replacement ratios, while the use of WP only increases the workability of concrete. The use of WP only and high MS only decrease the compressive strength and the modulus of rupture after 28 days. Leena J. Sedeeq (2013) conducted experiments to assess the effectiveness of an acrylic coatings in limiting the initial surface absorption in concrete. The acrylic coating utilized was of two mixes, hardened (cement based) and resin (acrylic based) . The blending proportions of resin to hardened were 1:1, 1:1.5, 1:2. The 1:2 blending proportion had the capacity to accomplish waterproofing of 100% for the concrete specimens. The acrylic coating brought about an increment in flexural strength of 25-48%, and an increment in the splitting strength of 15-63%. There were three specimen casted to locate the normal value of compressive quality at 28 days. The impact of the acrylic coating on the compressive strength was negligible. Coating the concrete surface with acrylic is powerful in restricting the water consumed by the cover concrete. Mukesh Kumar (2009) examined impact of water proofing admixture on hydration of Portland concrete water leakage. In this paper Portland cement and 2% KIM (Krystol Inward Film) water proofer were utilized as a part of solid blend and compressive strength got of 28 days was found. KIM water proofer have got in the way of impact on the hydration of cement. Water permeable surface decreased in the vicinity of KIM. Chandraha Sahu (2013) studied the impact of super plasticizer on fresh and hardened concrete mix. It utilized three mixes with three super plasticizer doses (0.2%, 0.4% and 0.6%). Workability and compressive strength of the cubes were obtained at 7 and 28 days. Debabrata Pradhan (2011) reported on the combinational investigation of mineral admixture and super plasticizer on concrete. This paper showed the investigation of silica fume concrete cast for 5 mixes. Annadurai (2014) reported on development of mix design for high strength of concrete with admixture. In this paper the result of the of blend outline created for high quality concrete with silica fume and high range water diminishing admixture (HRWR) is presented. Study of micro silica added 0% to 9%, increased compressive quality, supplanting of concrete with miniaturized scale silica 9%, HRWR 0.9% gave the maximum higher strength. Anuradha Varshney (2013) investigated effects of novel super plasticizer on workability

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and strength of RMC. In this paper RMC at the least conceivable water cement proportion while keeping up a high workability has been achieved. Water cement ratio was maintained between 0.38-0.47.

From the literature review, it is observed that researchers have studied on different water proofers. But it is observed that very few literature are available on the effect of water proofers on compressive strength. Hence, in this study efforts have been made to measure the effect of different water proofer on compressive strength of concrete cubes through an experimental program.

II. Material and Methodology

A comparative study has been carried out to evaluate the compression behavior of concrete cubes of M15, M20, and M25 grade of concrete with different water proofers and normal aggregates having four type mix conditions, nominal mix, and three types of special mix conditions having three water proofer (dr. fixit, Roff, Aqua Roff).

Four sample mixes were prepared, namely-
1. Nominal mix i.e. water + cement + fine aggregate + coarse aggregate (60% 20 mm, aggregate + 40% 10mm)
2. Special mix 1 i.e. water + cement + fine aggregate + coarse aggregate (60% 20 mm, aggregate + 40% 10mm) + Dr. Fixit (lw+) (4ml/kg cement)
3. Special mix 2 i.e. water + cement + fine aggregate + coarse aggregate (60% 20 mm, aggregate + 40% 10mm) + Roff (4ml/kg cement)
4. Special mix 3 i.e. water + cement + fine aggregate + coarse aggregate (60% 20 mm, aggregate + 40% 10mm) + Aqua Roff (4ml/kg cement)

First mix condition is nominal mix condition as per IS code considerations using cement, sand, aggregate and water. Second mix condition is special mix condition use (60% 20 mm, + 40% 10mm) normal aggregate with Dr. Fixit (lw+) (4ml/kg cement) with cement, sand, and water. Similarly for third mix same proportion of aggregate with cement, sand, and water having Roff water proofer (4ml/kg cement) and fourth type of mix conditions has Aqua Roff (4ml/kg cement). Results have been compared on the basis of NDT and UTM based results.

Following steps have been followed -

1. Making of concrete mix with water, cement, sand, aggregates (normal) and water proofers
2. Selection of mould and mould preparation for casting of cubes.
3. Compaction of concrete mix, compact each layer by using tampering rod.
4. DE moulding of cubes.
5. Curing of the cubes for 7, 14 and 28 days in the curing tanks.
6. Testing of the cubes with help of NDT equipment's and UTM.
7. Comparative analysis of results in terms of water proofer and normal aggregates with different mixing conditions.
8. Critical study of results.

Experimental program

In selection of material for making of concrete mixes are given below-

Cement –PPC (Portland-pozzolona cement) was used.

Following tests were conducted, on cement:

- Consistency limit test:- Average consistency of three sample is 35%
- Initial setting time and final setting time: initial setting time is 52 min and final setting time is 583 min

Sand – Sieve analysis for the sand was carried out in the lab as per the procedure mentioned in IS 2386 (part-I)-1963. The size of sand is between 2.36 mm to 4.75 micron.

Aggregates – For this study the locally available coarse aggregate was used. Grading of natural coarse aggregate considered as per IS: 456:2000. The sizes of aggregates are between 10 mm to 25 mm. Following tests were conducted on aggregates –

Aggregate Impact Test - This test has been designed to evaluate the toughness or the resistance of stones aggregate to breaking down under repeated application of impact. Aggregate impact value specifies a relative quantity of the conflict of aggregate to impact. The aggregate impact test apparatus and procedure have been standardized by the Bureau of Indian Standard (BIS).

The aggregate impact value is the ratio of fines passing 2.36 mm sieve expressed in terms of total weight of sample. The impact value of the aggregate obtained is 27.82%.

Flakiness index test - Flakiness index value of aggregate is obtained as 14.37%.

Elongation index test - Elongation index value of aggregate is obtained as 24.3%

Water Proofer - Water proofer is the one of the most important requirements of modern concrete. It may be obtained in powder, paste or liquid. Three water proofer (dr. fixit, Roff, Aquaroff) have been utilized in concrete mix with the proportion of 4ml/kg cement.

Preparation of Concrete - Nominal mix of concrete of 1:2:4, 1: 1.5:3, 1:1:2 was used for making M15, M20 and M25 grade concrete. The concrete was mixed by hand in the laboratory, in such a manner as to avoid loss of water or other materials. Each batch of concrete is of such a size as to leave about 10 per cent excess after moulding the desired number of test specimens. To determine the workability of concrete, compaction factor test was carried out. This test is suitable for mixtures having medium and low workability i.e. compaction factor in between 0.91 to 0.81, but is not appropriate for concretes with very low workability, i.e. compaction factor below 0.71. Compaction factor obtained for three samples are 0.84, 0.86 and 0.88.

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Casting of Cube Specimens - In this study three types of water proofers (Dr.fixit, Roff, Aqua Roff) and normal aggregate were used in preparing cube specimens. Three types of mixed proportion are used M15, M20 and M25 for each mix. The concrete cube prepared on normal aggregate and 60% and 40% of size 10 mm (40%) and 20 mm (60%) and water proofers are used in concrete cube in quantity of 4ml/kg of cement, various steps of cube preparation are shown in Fig.1-4. These cubes are tested on 7, 14 days and 28 days. The compressive strength of this cubes is determined with the help of destructive and non-destructive test equipment's.

Figure 1 Oil coating of moulds

Figure 2 Casting of cubes sample

Figure 3 Hand compaction of cubes sample.

Figure 4 Vibration compaction

The ultrasonic pulse velocity and rebound hammer (non-destructive) test and universal test machine (destructive) were performed on 108 specimens from different high strength concrete mixtures. In order to determine the effect of water proofer, cube specimens with standard dimensions were tested at 3 ages, i.e.7, 14 and 28 days. The determination of the strength of each mixture and specimen ages are based on the average of 3 specimens.

III. Results and Tables

Various tests were performed on the prepared specimens. Results extracted from all these experiments are illustrated below on the basis of following sub-heads:

4.1. Non- destructive Tests

NDT tests were performed on all the specimens after 7, 14 and 28 days of casting and results are given below-

4.1.1 Rebound Hammer Test

The rebound hammer test results for M15, M20 and M25 grade of concrete cubes with normal aggregate having different water proofer mix for 7, 14 and 28 days are shown in Figure 5, 6 and 7 respectively.

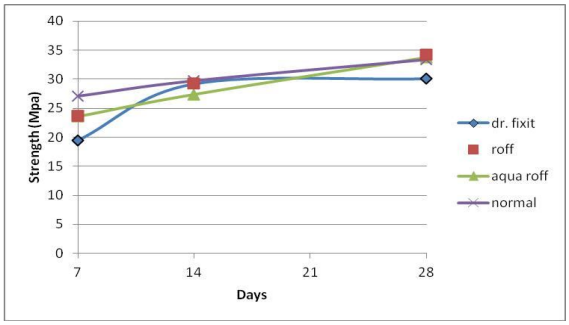

Figure 5 Rebound strength for M15 concrete

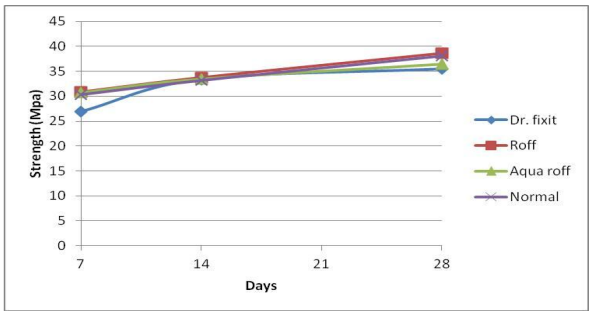

Figure 6 Rebound strength for M20 concrete

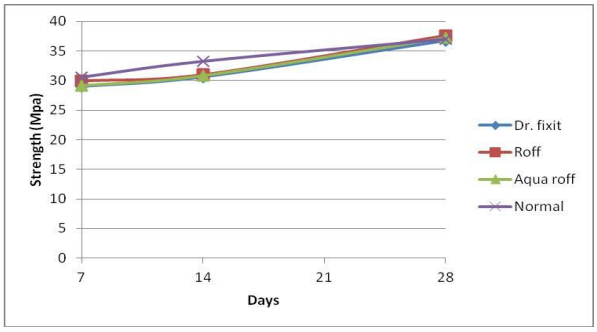

Figure 7 Rebound strength for M25 concrete

It can be observed that 28 days rebound strength increase for Roff and decrease for Dr. fixit when compared to normal mix.

4.1.2 Ultrasonic-Pulse Velocity Test

The UPV test results for M15, M20 and M25 grade of concrete cubes with normal aggregate having different water proofer mix for 7, 14 and 28 days are shown in Figure 8, 9 and 10 respectively.

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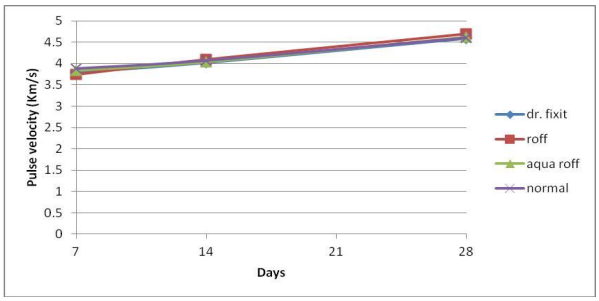

Figure 8 Ultrasonic pulse velocity for M15 concrete

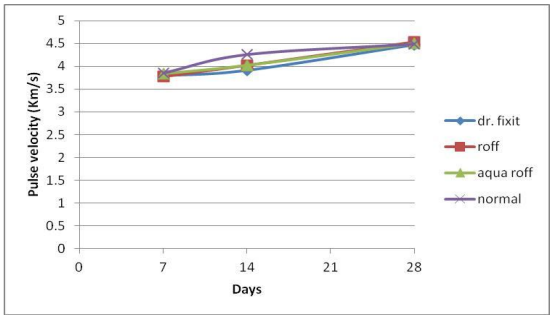

Figure 9 Ultrasonic pulse velocity for M20 concrete

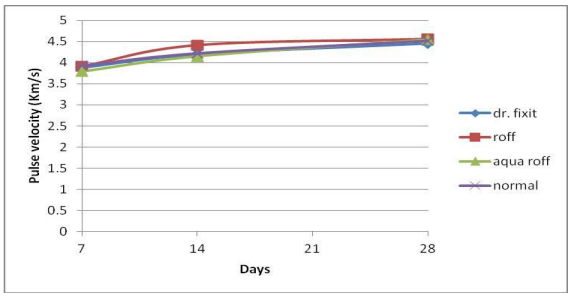

Figure 10 Ultrasonic pulse velocity for M25 concrete

It can be observed that 28 days pulse velocity increases for Roff and decreases for dr.fixit as compared to normal mix.

4.2 Compression Test

The Compressive strength test results for M15, M20 and M25 grade of concrete cubes with normal aggregate having different water proofer for 7, 14 and 28 days are shown in Figure 11, 12 and 13 respectively.

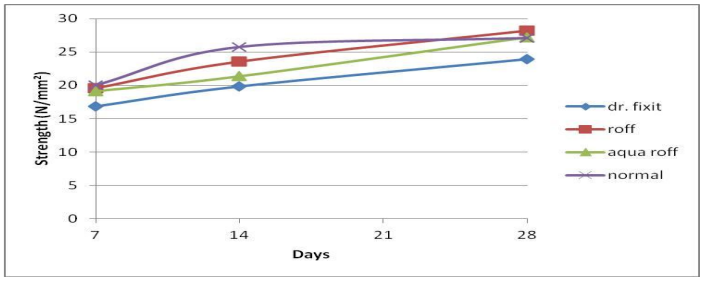

Figure 11 Compressive strength (MPa) of M15 concrete

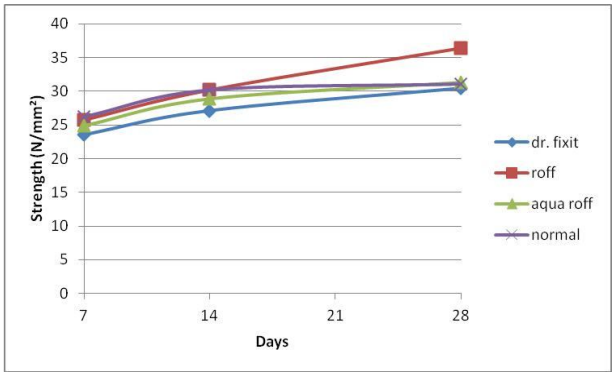

Figure 12 Compressive strength (MPa) of M20 concrete

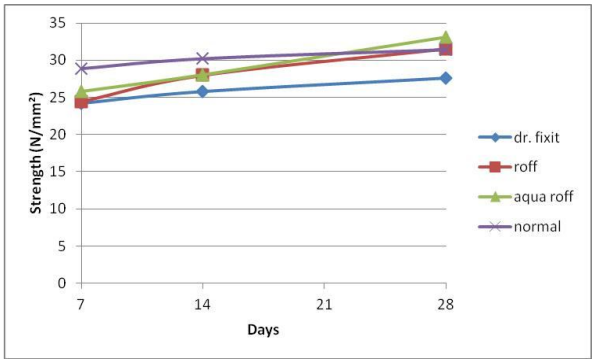

Figure 13 Compressive strength (MPa) of M25 concrete

It can be observed that for 28 days M15, M20 and M25 compressive strength increases for Roff and decrease for Dr. fixit as compared to normal mix.

IV. Conclusion

From the results of destructive and non-destructive tests, following salient conclusions can be drawn:

A) Rebound hammer test

- Rebound hammer reading for 7 days of M15 grade normal composition is highest, Roff water proofer is highest for M20 grade, normal composition is highest for M25 grade of concrete and Dr. fixit water proofer is lowest for all cases.
- Rebound hammer reading for 14 days of M15 grade normal composition is highest, Roff water proofer is highest for M20 grade, normal composition is highest for M25 grade of concrete and Dr. fixit water proofer is lowest for all cases.
- Rebound hammer reading for 28 days of M15 M20, and M25, Roff water proofer is highest and Dr. fixit water proofer is lowest.

B) UPV test

- Ultrasonic Pulse velocity for 7 days of M15 and M20 concrete is highest for normal composition and lowest for Roff water proofer. For M25 grade of concrete, normal compositions reading is highest and Aqua Roff water

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proofer is lowest.

- Ultrasonic Pulse velocity for 14 days of M15 grade Roff water proofer is highest, and Dr. fixit water proofer is lowest. Normal concrete reading is highest for M20 grade, and Dr. fixit water proofer is lowest. Roff water proofer is highest for M25 grade of concrete and Aqua Roff water proofer is lowest.
- Ultrasonic Pulse velocities for 28 days of M15 M20, and M25 Roff water proofer are highest and Dr. fixit water proofer is lowest.

C) Compressive strength test

- Compressive strength for 7 days of M15, M20 and M25 concrete for normal composition is highest and Dr. fixit water proofer is lowest in all cases.
- Compressive strength for 14 days of M15, M20 and M25 concrete for normal composition is highest and Dr. fixit water proofer is lowest in all cases.
- Compressive strength for 28 days of M15 and M20 concrete with Roff water proofer is highest and Dr. fixit water proofer is lowest. Aqua roff water proofer is highest for M25 grade and Dr. fixit water proofer is lowest.

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