Comparison of Compressive Strength of Concrete Cube after curing with different methods

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Abstract— Concrete comprise of course aggregate, fine aggregate, cement and water and it is prepared in a ratio of course aggregate: fine aggregate: cement: water with a water-cement ratio of 0.50. Then concrete cubes were prepared in size of 15 X 15 cm mould for testing the compressive strength at 7 and 28 days of curing respectively using three curing methods namely immersion, sprinkling and Plastic sheeting, curing to cure the cube specimens until the day of testing. After curing the entire prepared cube they all set for compressive testing and then the results of the entire test were compared. Test results indicates that water curing (WAC) as well as sprinkling (spraying) curing provided much better results than membrane (Plastic Sheeting) method of curing. The rate of drying was significant when the specimens were subjected to membrane (Plastic sheeting) method of curing. This thus hampered the hydration process and thus affected the compressive strength property of the hardened concrete. The overall finding of this study suggests that concrete should be cured by water curing to achieve a better compressive strength.

Keywords: concrete, aggregate, cement, curing, water curing, sprinkling curing, plastic sheeting, compressive strength test

I. INTRODUCTION

Concrete is one of the most important and massively used materials of construction worldwide which basically composed of course aggregate such as natural stone of standard size, fine aggregate such as sand and cement with water. Concrete is not only the largest used material but by this a large amount of natural resource is consumed annually which is of 12.6 billion tons (Mehta, 2002). Basically concrete comprise of course aggregate, fine aggregate, cement and water but in some case or condition other chemical or admixture was added for any special or specific purpose. The building material used for making concrete are naturally extracted except cement like course aggregate, fine aggregate and if necessary special additives with selected concrete proportions of the ingredients to produce concrete mix with specific properties. Various research works has been started by the researchers for the proper development and for more sustainability of concrete in India as well as worldwide with an aim to decrease the effect on ecology and environment and to save the raw materials. It has to be satisfactorily hard in state with a good concrete workability of freshly prepared concrete. The primary requirement from the freshly prepared concrete is the consistency of mix so that it get compacted properly without extra effort and also that the mix be cohesive enough for the method of placing used, not to produce segregation with consequent lack of the finished product .The usual primary requirements of good concrete in its hardened state are satisfactory compressive strength, density, durability, tensile strength, etc., are considered. The selection of more suitable and economical mix can be made, using mix design to give concrete with specified conditions and any defect in the mix ingredient may cause some problems in the concrete mix, such as segregation, bleeding and may cause shrinkage and creep after hardening. India is a hot country with an average temperature of 25-30o C and highest temperature is nearly 50o C and lowest temperature of nearly 10o C. In warm to hot weathers, in-site concrete quality will vary for many reasons other than selection of materials and design characteristics. So, in such high temperature zone to achieve good strength in concrete a proper curing is required. Concrete changes in volume when it loses or gains water. Surface cracking of fresh concrete occurs due to drying shrinkage caused by rapid loss of water in hot and dry climates. The rate at which concrete will dry depends on air temperature, concrete temperature, relative humidity and wind velocity. The lack of proper curing affects the quality of concrete in both fresh and hardened states. Concrete hardens and gains strength because of a chemical reaction between Portland cement and water. If concrete dries prematurely, there will be insufficient water for that reaction, i.e. .no water, no hydration, no strength gain. According to the standards, ponding is the most through method of water curing but it is seldom used in the field because it is difficult and cumbersome. Fog spring or sprinkling with nozzles provides excellent curing, but it requires constant vigilance. Burlap, wet sand and saw dust, usually provide good curing when fully saturated. Sealing materials are sheets or membranes placed on the Concrete to reduce the loss of mixing water. Use of plastic films is one way to protect the fresh concrete and can be applied as soon as free water has disappeared from the surface. Liquid membrane curing compounds are one of the practical methods of curing concrete.

II. MATERIALS AND METHODS

A. Materials

1) Cement

Portland Pozzolanic Cement (fly ash based) confirming to IS 1489 (Part 1) - 1991 was used in the present study.

2) Fine Aggregate

River sand confirming to IS 383-1970. It was passed by 4.75 mm IS sieve. Fineness modulus and specific gravity was 2.42 and 2.8 respectively.

3) Coarse Aggregate

Locally available coarse aggregate have been used of two different size 20mm and 10mm sizes and both were sieved

properly before using and then used in the present study. One fraction completely passed through 20 mm sieve and another 10 mm sieve. For mix the ratio of these aggregates was 50:50 respectively.

B. Methods

All the building material which was required for the present study such as course aggregate, fine aggregate and cement is purchased from market and then bring to the concrete technology laboratory as the all the work has to done there only. About 50 kg of cement were bought and 15 kg of course aggregate as well as fine aggregate were bought. After Bringing all the construction material to the concrete technology laboratory, sample will be prepare for making M20 grade concrete and the ratio of M20 is 1:1.5:3 so all the construction material are mixed in the specified ratio by volume and water is mixed in the mixture of building material and the paste is thoroughly mix by the help of trowel. After the preparation of concrete, about 50 cubes of concrete in the size of 15 cm X 15 cm was casted and tempting rod is used for removing air voids. The cube casting was done by the help of cube mould of standard size which is easily available in the market. These casted cubes were left in the mould for about 12 hours in order to archive the setting time of cement then it is taken out of the mould by removing nut and bolt which was used to attached the plates of mould together and then kept in water for curing. After Casting of cubes they were allow to settle down first and for achieving this the concrete was left in the mould for about 12 hours and when they get set the cubes were taken out of the mould by removing nut and bolt and then the cubes were directly subjected to different types of curing. Here three types of curing was used in the current study namely Ponding, Spreying, Covering hold water. After the curing Compressive strength test will be performed on the casted and cured cube on the 3, 7, 14, 21 & 28 days. The days that were selected for compressive testing of concrete cube were according to Indian Standard (IS 456:2000) and the test procedure that were followed were according to Indian Standard codes.

III. RESULTS

The sample preparations as well as analysis of the cured concrete cubes were done according to the IS 456:2000.

Results for the analysis on the concrete cubes are as follows

Testing days	Types of curing		
	Cover Hold Water (N/mm^2)	Ponding (N/mm^2)	Spraying (N/mm^2)
3 day	7.06	6.96	6.13
7 day	11.82	11.31	10.80
14 day	17. 76	17.35	17.01
21 day	18.69	17.71	15.73
28 day	19.82	17.93	16.58

Table. 1: Result Concrete cube test analysis

IV. CONCLUSION

The conclusion for the present investigation is as follows.

- After casting and curing of concrete cube for 3, 7, 14, 21 & 28 days. The cubes are subjected for compressive test and the result is tabulated above.
- Curing with water is very effective method. It balances the heat of hydration and helps in gaining compressive strength in concrete. This all happens due to the pore structure and low porosity cause due to heat of hydration which cause loss of moisture in concrete.
- Covering hold water method of curing provides good compressive strength than the ponding and spraying method. As we can see in the table above the ponding provide its maximum strength on 14 day and spraying provide at 21 day but covering hold water provide at 14 and 28 days.
- When spraying and ponding are considered, the ponding performance is better than spraying as it provides good compressive strength. This is because the moisture movement from the concrete specimen is higher in spraying method, which did not provide and any protection against early drying out of concrete. Hence hydration of cement reaction was abated.
- The extent of moisture movement was greatly dependent of the method of curing. Greater moisture movement occurs under spraying method, and it significantly affected the strength property of the concrete.
- Normal concrete should be cured by water curing method in order to achieve good hardened properties. Water curing produces no loss of moisture, and therefore enhances cement hydration reaction. In case of water shortage, in covering hold water immediate sprinkling can be adopted instead.

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