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Effect of Curing Methods on Strength and Elastic Properties of Concrete

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Abstract**: *This paper reports the results of a research study conducted to evaluate the effect of curing methods on the mechanical properties of ordinary Portland cement (OPC) With Fly ash as cementitious material with 30% replacement to cement. Concrete Cube specimens were prepared and cured by different curing methods. These methods included without curing, Ponding, Gunny bags, Curing Compounds. The curing membrane was applied immediately after demoulding or after an initial period of drying. The effect of the selected curing regime on the properties of OPC was evaluated by measuring compressive strength, and also checking the quality of concrete with the pulse velocity instrument. The strength and durability characteristics of both OPC concrete specimens cured by applying the selected curing compounds were similar or better than that of concrete specimens cured by other methods. There was no significant change in strength noted due to the curing methodology. Shrinkage of Concrete cylinders was also measured along with quality of concrete by Ultrasonic Pulse Velocity Test.***
Keywords: Cement, Concrete, Curing, Curing Compounds, OPC, Cementitious material, Flyash, Ponding, Gunny Bags, Compressive test.

I. INTRODUCTION

The hot weather conditions in many parts of the world create Several problems for both the fresh and hardened concrete. Reduced durability is one of the major problems in concrete prepared under hot weather conditions. Under hot weather conditions, concrete has to be cured for an extended period of time compared to normal weather conditions in order to achieve acceptable strength and durability. Rasheeduzzafar et al. indicated that the protection provided by concrete against corrosion of steel by migration of chlorides into the concrete is greatly dependent upon the duration of curing. With increasing use of supplementary cementing materials, proper curing of concrete becomes all the more important. Many problems of cracking of silica fume cement concrete have been reported from the field due to inadequate curing. Curing is also essential for the pozzolanic cement concretes as water is required for the pozzolanic reaction to take place in the later stages of hydration of cement. Concrete is cured either by water ponding, covering with wet hessian or by the application of a curing compound. The first two methods have been preferred over the third one. However, due to shortage of water there is an increasing tendency to cure concrete by applying a curing compound. This is particularly true in regions with severe water shortage.

II. LITERATURE REVIEW

Some studies have been conducted on the efficiency of curing compounds. Wang et al evaluated the performance of a membrane curing compound and the experimental results showed that the effectiveness of membrane curing was dependent markedly on the time of its application. Among the curing compounds studied, chlorinated rubber was reported to be the most effective one, followed by the solvent-based curing compound, and the least effective was the water-based type. However, concretes moist cured for only 2 days exhibited significant improvement in strength and other characteristics, compared with concrete without any curing [4]. Austin and Robins [5] indicated that wet burlap curing was the most effective and air curing was the least effective between 7 and 28 days in the hot climatic conditions. Moist cured blast furnace slag cement concrete exhibited a greater increase in the pulse velocity than similarly cured OPC concrete. Wang and Black [6] reported that the curing efficiency index (CEI) correlated well with the capability of the curing membranes in retaining moisture within concrete. Experiments conducted by Grafe and Grube [7] on the influence of curing on the gas permeability of concrete prepared with different types of cement indicated that GGBFS and PFA cement concrete had greater permeability than OPC concrete, when specimens were cured only for 1 day. However, they concluded that with prolonged sealed curing, mixes prepared with blended cements performed better than OPC with the same water–cement ratio and cement content. According to Khan and Ayers [8], the minimum period of curing should be optimized in terms of several properties, such as strength, permeability and the movement of aggressive gases and/or liquids from the environment. Their results show that the minimum period of curing required for OPC, FA and the SFC concrete mixtures were 3, 3.75, and 6.5 days, respectively. In general, it has been shown that concretes prepared with mineral admixtures are more sensitive to water curing than OPC concretes.

III. NEED

Curing is the process of controlling the rate and extent of moisture loss from concrete to ensure an uninterrupted hydration of Portland cement after concrete has been placed and finished in its final position. Curing also ensures to maintain an adequate temperature of concrete in its early ages, as this directly affects the rate of hydration of cement and eventually the strength gain of concrete or mortars. Curing of concrete must begin as soon as possible after placement and finishing and must continue for a reasonable period of time as per the relevant standards, for the concrete to achieve desired strength and durability. Uniform temperature should also be maintained throughout the concrete depth to avoid thermal shrinkage cracks. Also protective measures to control moisture loss from the concrete surface are essential to prevent the plastic shrinkage cracks. In a nutshell curing process is designed primarily to keep the concrete moist by controlling the loss of moisture from the body of concrete, during the given period in which it gains strength. Curing is basically done to increase the strength of concrete. Concrete strength increase with age as moisture under favourable temperature is present for hydration of cement. With proper curing of concrete it can be observed that concrete allowed to dry out immediately, achieves only 40% of strength of the same concrete water cured for the full period of 180 days. The durability of concrete is affected by number of factors including its permeability, porosity and absorpity. Concrete that is allowed to dry out quickly undergoes considerable early age shrinkage. Inadequate curing contributes too weak and dusty surfaces having a poor abrasion resistance. Material properties are directly related to their micro structure. Curing assists the cement hydration reaction to progress steadily and develop calcium silicate hydrate gel, which binds the aggregate leading to a rock solid mass, makes the concrete denser, decreases the porosity and enhances the physical and mechanical properties of concrete.

IV. METHODOLOGY

Concrete cube specimens, measuring 150X150X150mm, were prepared. The OPC and silica fume cement concrete specimens were prepared with IS code recommendation type. The concrete specimens intended for water curing were cured by covering with different curing methods.. The curing compounds were applied by either a brush or with a spray. The coverage rate of the curing compound corresponded to that recommended by the manufacturers,

So our total project works spans a variety of 6 curing methods as follows.

1) Without Curing
2) Curing Compound
3) Applying Paint
4) Use of Gunny Bags
5) Curing Compound
6) Ponding

The cubes and cylinders will be casted accordingly the curing methods and the tests to be carried out.
Following are the total no. of cubes to be casted in order to complete the project in all respect.
Total No. of Curing methods – 6
Mix Design – 2
Total No. of cubes required for 1 curing method of 1 mix design = 6 cubes
Total cubes required for 6 curing methods for 1 mix design = 6X6 = 36 cubes
And total cubes for 2 mix design = 36 X 2 = 72 cubes Cylinder required for 6 curing methods for 1 mix design = 6 X 2= 12 cylinder
Total Cylinder required for 2 mix design = 12 X 2 = 24 cylinder
A total of 72 cubes and 24 cylinders are to be required to complete the project successfully.

V. TESTS ON CUBES AND CYLINDERS

A. Compression Test

To know the compressive strength of the concrete cubes attained after curing of 7 days and 28 days respectively.

B. Pulse Velocity Test

To check the quality of concrete

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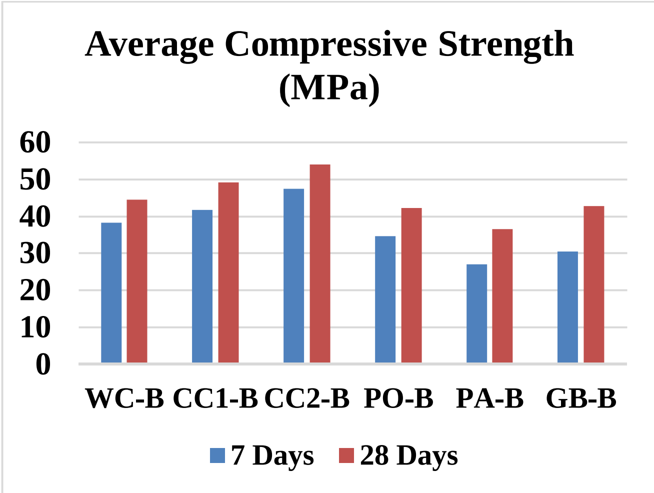
C. Dry Shrinkage test

To know the amount of shrinkage caused in the cylinders because of the variation in curing methods after 28 days of casting and proper curing.

VI. RESULT ANALYSIS

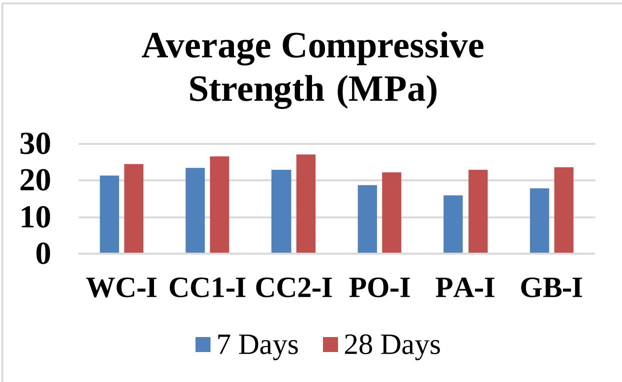
A. Average Compressive Strength for Mix 'B'



In the above graph the blue coloured bar represents the compressive strength after 7 days of curing, whereas the orange coloured bar represents the compressive strength after 28 days. We can see the variation in strength of concrete for high grade concrete of grade 40. We can see the slight increase of compressive strength between 7 days to 28 days, i.e. The rate of increase of compressive strength after 7 days of curing until 28 days is much more less than initial increase in compressive strength. We can see that the curing compound 2 has attained the maximum compressive strength amongst the curing methods. And Painting has obtained minimum strength.

We can also see that there is lot of variation in compressive strength among different curing methods in high grade concrete as compared to low grade concrete. Thus it is evident that the different methods of curing can result into lots of variation in compressive strength of concrete.

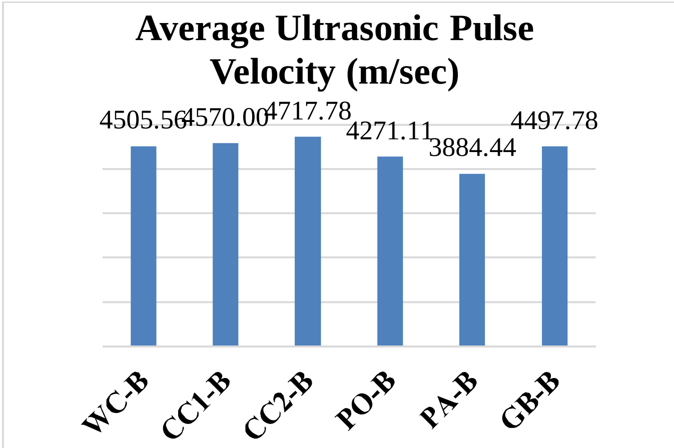
B. Average Compressive Strength for Mix 'I'



In above graph blue bar shows compressive strength for 7 days and orange bar represents compressive strength for 28 days. It shows result for compressive strength for low grade concrete (20). We can see that curing compound 1 and 2 show almost similar results as compared to other methods. Curing compound 2 shows maximum strength and paint shows minimum result also without curing shows significant strength for both 7 and 28 days. There is significant increase in strength for paint after 7 days uptil 28 days of curing.

Thus we can conclude from both graph that high grade concrete show more variation amongst different methods as compared to low grade concrete.

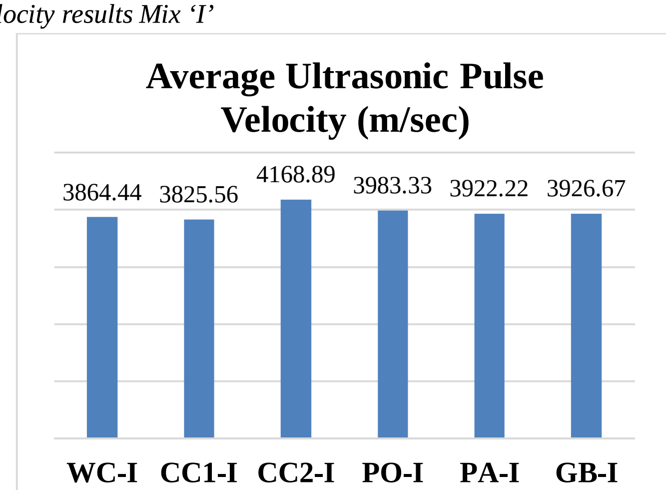
C. Average Ultrasonic Pulse Velocity results Mix 'B'



For higher grade of concrete it was observed that the ultrasonic pulse velocity was seen maximum in curing compound 2 i.e. VITCON 9021 AB which was above 4500 m/s showing excellent quality of concrete, it is followed by curing compound 1 i.e. Algaecure showing 4570m/s which is excellent quality of concrete. From which we can say that the quality of concrete is good when curing compounds are used and concrete grades are higher according to IS:13311 (Part 1) 1992. This is surprisingly followed by without curing method by which we can say that due to formation of cracks on surface and effect of moisture present in atmosphere which is 4505.56m/s showing excellent quality of concrete.

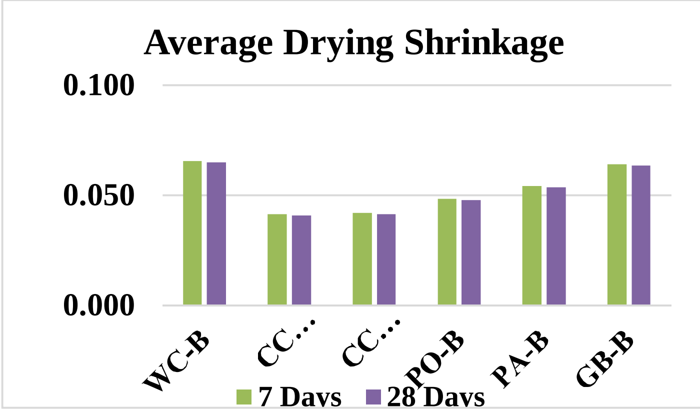
Lowest quality is seen in painting method of concrete and in ponding method of curing which are 3884.44m/s and 4271.78m/s respectively, showing good quality of concrete by which we can say that for high grades paint method and ponding and comparatively less effective than curing compounds and without curing methods. This may be due to effect that by the coating of surface restricting the moisture from acting for proper hydration.

D. Average Ultrasonic Pulse Velocity results Mix 'I'



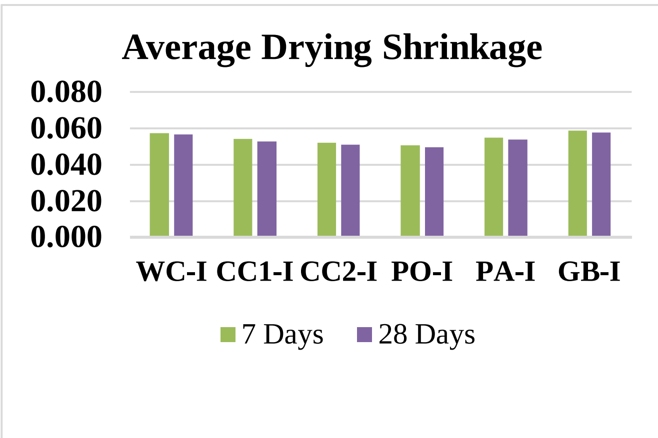
For lower grade of concrete it was observed that the ultrasonic pulse velocity was seen not much varying for different curing methods. It was noted maximum in in curing compound 2 i.e. VITCON 9021 AB similar as higher grade concrete ponding method, painting method and gunny bags method which showed results as 4168.89m/s,3983.33m/s, 3926.67m/s, 3922.22m/s indicating good quality standards according to IS:13311 (Part 1) 1992. Lowest readings were observed in without curing method and curing compound method.

E. Average Drying Shrinkage results Mix 'B'



The above chart shows the result for Dry Shrinkage Test results for Concrete Mix Design B. The Test results were carried out on cylinders casted for Curing methods as mentioned earlier. As no standard instrument was available in the college, a new instrument was assembled to carry Drying Shrinkage Test on the Cylinders Casted. The test were carried out on cylinders immediately after initial setting time of concrete and 28 days of effective curing of concrete. And then the shrinkage difference between 1st and 28th days was studied. It can be seen that without curing (WC-B) and Gunny Bags curing (GB-B) gives maximum shrinkage. The shrinkage is within range 0.060-0.070. Whereas Curing Compound 1 and Curing Compound 2 shows maximum shrinkage as compared to other. Ponding curing method and painting curing method also showed reasonable shrinkage within range of 0.040-0.050 and 0.050-0.060 respectively. It can also be seen that variation in shrinkage between all the curing methods for high grade concrete is too much as compared to low grade concrete. As the amount of cement increases the shrinkage also varies a lot.

F. Average Drying Shrinkage results Mix 'I'



The above chart shows the result for Dry Shrinkage Test results for Concrete Mix Design I. The Test results were carried out on cylinders casted for Curing methods as mentioned earlier. As no standard instrument was available in the college, a new instrument was assembled to carry Drying Shrinkage Test on the Cylinders Casted. The test were carried out on cylinders immediately after initial setting time of concrete and 28 days of effective curing of concrete. And then the shrinkage difference between 1st and 28th days was studied. The graph depicts that maximum shrinkage was seen in Gunny Bags Method, whereas minimum shrinkage was seen in Ponding Method. Without curing, curing compound 1 and paint showed reasonable shrinkage within range 0.050-0.060. Whereas curing compound 2 shows shrinkage close to 0.050. It is also seen from that the variation in shrinkage between all the curing methods for low grade concrete is not too much. There is considerable variation between all the curing methods.

VII. CONCLUSION

At the age of 28 days, compressive strength demonstrated variations according to the adopted curing method although with only minor changes. However, the variations in curing methods in Mix B was much more than in Mix I. So as the amount of cement increased in the concrete the variation increased. The effect of curing methods over the different mix design can be easily noticed. However, despite satisfactory strength achievement, concrete could not achieve satisfactory durability performance in some cases. can be seen from the results that quality of concrete is much better in High grade concrete for all the curing methods than in Low grade concrete. Average velocity for methods for Mix Design B for WC-B, CC1 and CC2 was more than 4.5km/sec and other methods little less. Whereas all the methods for Mix Design I showed less than 4.5 in between 3 to 3.5 km/sec. Drying Shrinkage test was taken immediately after the concrete was set and after 28 days of effective curing. So from the results obtained it can be seen that more shrinkage occurred in High grade concrete as compared to Low grade concrete. For high grade concrete the shrinkage is between 0.060mm to 0.070mm whereas in low grade concrete it is in between 0.050mm to 0.060mm. A conclusion can be drawn that as the cement content increases there is a lot variation in between Curing methods. As of the results the specimen with Curing Compound showed considerably less shrinkage than other methods where use of water was included.

REFRENCES

[1] M. Maslehuddin, M. Ibrahim, M. Shameem, M.R. Ali, M.H. Al-Mehthel. Effect of curing methods on shrinkage and corrosion resistance of concrete
[2] M. Ibrahim, M. Shameem, M. Al-Mehthel, M. Maslehuddin Effect of curing methods on strength and durability of concrete under hot weather conditions.
[3] Sandor Popovics. Effect of Curing Method and Final Moisture Condition on Compressive Strength of Concrete.
[4] Mohammed Seddik Meddah, Ryoichi Sato. Effect of Curing Methods on Autogenous Shrinkage and Self-Induced Stress of High-Performance Concrete
[5] Abdullah M. Zeyad, Effect of curing methods in hot weather on the properties of high-strength concretes.
[6] Wasim Khaliq. Waqas Javaid Efficiency Comparison of Conventional and Unconventional Curing Methods in Concrete.
[7] Parameshwar N. Hiremath, Subhash C. Yaragal. Effect of different curing regimes and durations on early strength development of reactive powder concrete
[8] Semion Zhutovsky, Konstantin Kovler. Influence of water to cement ratio on the efficiency of internal curing of high-performance concrete.
[9] Mateusz Radlinski, Jan Olek. Effects of Curing Conditions on Properties of Ternary (Ordinary Portland Cement/Fly Ash/Silica Fume) Concrete.