

# EFFECT OF DIFFERENT CURING ON STRENGTH OF CONCRETE

RAM PRATAP YADAV<sup>1</sup>, KUNDAN KULBUSHAN<sup>2</sup>

<sup>1</sup>M.Tech, Department of Civil Engineering, Maharishi University of Information Technology, Lucknow, U.P.

<sup>2</sup>Assistant Professor, Department of Civil Engineering, Maharishi University of Information Technology, Lucknow, U.P.

\*\*\*

**Abstract** - Normal concrete was prepared with a water-cement ratio of 0.50. cube specimens were cast 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. 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.

**Key Words:** concrete, coarse aggregate, cement, curing, compressive strength test.

## 1. INTRODUCTION

Concrete in general is the most commonly used structural material and it consists essentially from mixing water, cement, aggregate and if necessary special additives with selected concrete proportions of the ingredients to produce concrete mix with specific properties. The concrete has to be satisfactory in its hardened state and also in its fresh state while being transported from the mixer and placed in the form work. The requirements in the fresh state are that the consistence of the mix is such that it can be compacted by the means desired without excessive 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. In warm to hot weathers, in-site concrete quality will vary for many reasons other than selection of materials and design characteristics. 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 spray 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.

## 2. MATERIALS AND METHODS

### Materials:

*Cement* -

Portland Pozzolana Cement (fly ash based) brand name Birla Gold conforming to IS 1489 (Part 1) - 1991 was used in this study.

*Fine Aggregate* -

River sand available in Allahabad conforming to IS 383-1970, zone II used in the study. It was completely passed by 4.75 mm IS sieve. Fineness modulus and specific gravity was 2.76 and 2.3 respectively.

### Coarse Aggregate -

Locally available coarse aggregate having two fraction 20mm and 10mm sizes individually sieved was 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 60:40 respectively.

### Methods

All the building material which was required for the present study such as coarse 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 coarse 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. This 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.

### 3. RESULTS

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

Result for the analysis on the concrete cubes are as follows:-

Types of curing	Cover Hold Water	Ponding	Spraying
Testing days			
3 day	7.89 N/mm <sup>2</sup>	6.54 N/mm <sup>2</sup>	5.82 N/mm <sup>2</sup>
7 day	12.43 N/mm <sup>2</sup>	11.29 N/mm <sup>2</sup>	10.84 N/mm <sup>2</sup>
14 day	18.00 N/mm <sup>2</sup>	17.15 N/mm <sup>2</sup>	16.00 N/mm <sup>2</sup>
21 day	18.69 N/mm <sup>2</sup>	17.71 N/mm <sup>2</sup>	15.73 N/mm <sup>2</sup>
28 day	19.82 N/mm <sup>2</sup>	17.93 N/mm <sup>2</sup>	16.58 N/mm <sup>2</sup>

### 4. CONCLUSIONS

The conclusion for the present investigation is:-

- 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 balance 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 provide 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 provide 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.

## REFERENCES

- Ahmed. A.A. and. Fadi .A. I. "Strength of Concrete as Effected by Curing Conditions in Hot and Dry climate" The first MINIA International conference for Advanced Trends in Engineering, Egypt, March, 1999.
- Neville, A.M., "Properties of Concrete" John Wiley and sons, New York, 1973.
- A.C.I committee 308 "Standard Practice for Curing Concrete (ACI 308-92)" American Concrete Institute, Detroit, 1992.
- Mindess, Sidney and Young, J. Francis "Concrete Prentice-Hall Inc" 1981.
- Transportation Research Committee on Batching, Mixing, Placing and Curing of concrete "Curing of Concrete Pavements" Transportation Research Circular No.208, Transportation Research Board, Washington, June 1979.
- "2000 Annual Book of ASTM Standards" Vol .4.02, American Society for Testing and Materials, Philadelphia, PA.
- Neil Jackson & Ravindra K.Dhir (1997) "Civil Engineering Materials" 5th Edition ISBN: 033363683X Macmillan.
- B.S.1881 Part (2), (3), (4) and (5) "Method of Testing concrete".
- A.C.I. committee 224 "Control of Cracking in Concrete Structures" Concrete International: Design and Construction, Vol.2, No.10, October 1980.
- A.C.I Committee 315 "Hot Weather Concreting" A.C.I Journal, proc., Vol.74, No.8, August 1977.
- Adams, D.L. "The Measurement of Very Early Hydration Reactions of Portland Cement Clinker by a Thermoelectric Conduction Calorimeter" Cement and Concrete Research, vol.6, NO.2, pp. 293- 308, March 1976.
- Ish-Shalom, M., and Bentur, A. " Some Observations On the Effect of the Initial Temperature on the Hydration and Strength of Portland Cement with Different Aluminates Contents" Concrete and Reinforced Concrete in Hot countries, Vol.11, proceedings of International Rilem SYMPOSIM, Haifa, August 1971.
- Idorn, G.M "Hydration of Portland Cement Paste at High Temperature under Atmospheric Pressure" proceedings of the Fifth International Symposium on the Chemistry of Cement, part (III), Tokyo, December 1969.
- Taylor, H.F.W. "The Calcium Silicate Hydrates" Proceedings of the Fifth International Symposium on the Chemistry, part (II), Hydration of Cements" pp. 1-35. Tokyo, December 1968.
- Popovics, S. " Concrete Making Materials" MC Graw-Hill Book company, New YORK etc., and Hemisphere Publishing Corporation, Washington, 1979.
- Venuat, M. "Effect of Elevated Temperatures and Pressure on the Hydration and Hardening of Cement" 'A principal paper, the VI International Congress on the Chemistry of Cement, Moscow, September 1974.
- Lea, F.M. "the Chemistry of Cement and Concrete" Third Edition, Chemical Publishing Company Inc., New York, 1971.
- Meyer, L.M., and Perenchio, W.F "Theory of Concrete Slump Loss as Related to the Use of Chemical Admixtures" Concrete International: Design and Construction, Vol.1, No.1, January 1979.
- Bogue, R.H. "the Chemistry of Portland cement" Second Edition, Rheinhold Publishing Co., New York 1955.
- Klieger, P. "Effect of Mixing and Curing Temperature on Concrete Strength" A.C.I. Journal, Proc., Vol. 54, June 1958.
- Previte, R.W. "Concrete Slump Loss" A.C.I. Journal, Vol. 74, No. 8, August 1977.
- Ramakrishnan, V., Coyle, W.V., and Pande, S.S "Workability and Strength of Retempered Super Plasticized Concretes" Transportation Research Record 720, Super Politicizes in Concrete, 1979.
- Mufid A.Samarai "Hot Weather Concreting", Irbid - Jordan, October 1983.
- Popovics, S. "Phenomenological Approach to the Role of C3A in the Hardening of Portland cement Pastes" Cement and Concrete Research, Vol.6, No.3, May 1976.
- Verbeck, G.J., and Helmuth, R.H. "Structures and Physical Properties of Cement Pastes" Proceedings of the Fifth International Symposium on the Chemistry of Cement, part (III), Tokyo, December 1969.