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State of art an Overview on the Tensile Strength and Flexural Strength of Concrete in different Curing Methods

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ABSTRACT : *The concrete is made of different ingredients such as cement, fine aggregate, and coarse aggregate but it is a homogeneous material when it is in a harden concrete. The strength of concrete decides the life span of any concrete structure. The factors which affect the strength of concrete are the type of material used, size of aggregate, water cement ratio, improper compaction and improper curing. Curing is one of the major factors in the failure of concrete. Curing is defined as the process of promoting the hydration of cement. The grade used in the manufacture of concrete may be M20, M30 grade. This paper deals with the overview on the tensile strength and flexural strength of concrete when the concrete is exposed to various curing methods such as Water curing (Ponding and Immersion), Air Curing (Dry air curing), and plastic film curing at 3 days, 7 days, 28 days and 56 days. It is studied that the tensile and flexural strength of concrete during immersion method is high when compared with Air curing and plastic film curing. It is found that the water curing is the most effective method of curing with the maximum of 10% increase in tensile strength and 15% increase in flexural strength of concrete when compared with other curing methods. On comparison with self compacting concrete (SCC) and Normal cement concrete (NCC) under different curing methods the tensile strength and flexural strength of SCC is high than NCC.*

KEYWORDS : *Air Curing, Flexural Strength, Immersion Curing, Plastic Film Curing, Tensile strength.*

I. INTRODUCTION

The concrete is the soul material for the civil engineers. Many engineers and researches were involved in research to increase the strength of concrete. There are different factors which involve in the affecting the strength of concrete (i) Type of material (ii) size if aggregate (iii) water cement ratio (iv) Mix proportion (v) Improper compaction (vi) Improper curing. Nowadays the failure of structure is because the concrete cannot attain its strength due to the following above mentioned factors. Improper curing is one reason for the maximum number of failure structures. This paper deals with the state of art on the tensile strength and flexural strength of concrete in different curing methods at 3days, 7days, and 28days. Curing is the process of promoting hydration in the cement. Curing is done to prevent the loss of moisture content from the concrete, ineffective curing results in the evaporation of moisture content from the concrete which results in the shrinkage cracks and temperature cracks.

II. MATERIAL INVESTIGATION

Ajay Goel et.al, Suggested ordinary Portland cement of 43 grade conforming to IS 383:1970. The specific gravity of cement is 3.15. Fine aggregate of river sand with the fineness modulus 2.163 conforming to zone III of IS 383-1970. Coarse aggregate of crushed stone aggregate of size 10mm and 20mm is used. The specific gravity of coarse aggregate is 2.40. It is generally suggested to use M20 grade of concrete with cement of 43 grade or 53 grade, fine aggregate of size 4.75mm passing through sieve with coarse particles present with the fineness modulus of 2.65 and coarse aggregate of size 10mm and 20mm but not more than 20mm should be used.J.R. al-feel and N.S. al-saffar used limestone powder passing sieve no.200 and it is used at 8% of cement weight. The cement content of the mix used is 460 kg/m^3.

III. EXPERIMENTAL PROGRAMME

Split tensile strength is an indirect method to determine the tensile strength of concrete. The M20 grade concrete is prepared and placed in the mould (cylinder) of size 150mm x 300mm. A layer of oil or grease is applied on the walls of the mould. The concrete is placed in three layers and compacted using a tamping rod of 25 blows. Now allow the concrete in the mould to set for 24 hours, then remove the mould and place the

specimen for curing at 3days, 7days, 28days and 56days. Similarly prepare mould for different curing methods. After stipulated days test the specimens for split tensile test by applying the compressive line load along the opposite generators of the cylinder and determine the tensile strength of concrete in different curing methods at 3days, 7days, 28days and 56days. To determine the flexural strength of concrete prepare the concrete and place it in the mould of size 100mm x 100mm x 500mm and repeat the same procedure. The load is applied at the third point of the span of 400mm.

3.1 Curing methods

3.1.1 Ponding method : Ponding is one of the ideal methods for curing the slab element which ensures the slab do not lose its moisture content. The temperature of water used in Ponding should be constant. Freezing and thawing of water temperature results in thermal cracks in concrete.

3.1.2 Immersion method : In this method the concrete specimen is made to get immersed in the water, it is mostly used in the laboratory to immerse the concrete (Cube, cylinder, Prism) test specimens. The Ponding and immersion method can be done only in the horizontal surfaces.

3.1.3 Membrane Curing method: A membrane (Sealers) compound like wax, polythene sheets, chlorinated rubber etc. These materials should be laid on the surface of the concrete. The main purpose of membrane is to resist the moisture content enter into the concrete and to maintain the moisture content within the concrete. It is only possible to apply the membrane only on the horizontal surfaces not on the vertical surfaces.

3.1.4 Sprinkling Curing method: This method of curing can be done anywhere but the other methods are more effective than this method. Sprinkling method is especially for column because it is a vertical member.

3.1.5 Air Curing: The concrete will be laid on the open dry yard in order to allow the concrete to cure in its room temperature. This method is not effective when compared with water curing and membrane curing.

IV. RESULTS AND DISCUSSIONS

Ajay Goel et.al, made a study on the "A comparative study on the effect of curing on the strength of concrete" with air curing, plastic film and water curing at 3daqys, 7days, 28days, 56days and found that the average split tensile strength of concrete at 3 days in plastic film is 1.72 N/mm^2 where the split tensile strength of concrete at 3 days in water curing is 2.51 N/ mm^2 and in air curing is 1.63 N/ mm^2. It is studied that the split tensile strength of concrete at 3 days in water curing increases by 31.47%. At 7 days the split tensile strength of concrete in water curing increases by 22.79%. At 28 days, the split tensile strength of concrete in water curing increases by 30.26%. At 56 days, the split tensile strength of concrete in water curing increases by 27% as shown in table I.

Table I. shows the split tensile strength of concrete in different curing methods and the percentage difference in strength.

S.No	Days of Curing	Split Tensile Strength N/mm^2			% Difference
		Water Curing	Air Curing	Plastic Film Curing	
1	3 days	2.51	1.63	1.72	31.47
2	7 days	2.94	2.13	2.27	22.79
3	28 days	3.9	2.47	2.72	30.26
4	56 days	4.0	2.52	2.92	27

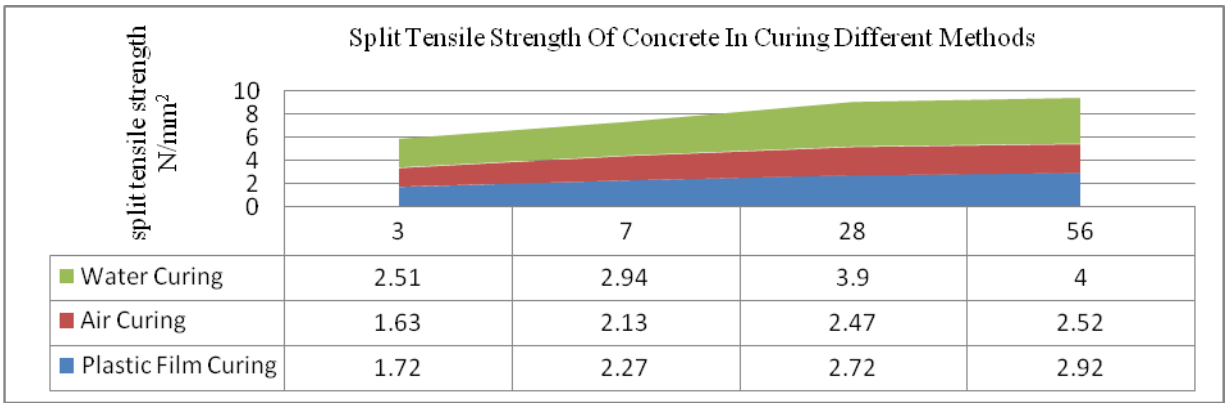

Figure 1. Shows the Split tensile strength of concrete in different curing methods.

"A comparative study on the effect of curing on the strength of concrete" by Ajay Goel et.al, with air curing, plastic film and water curing at 3daqys, 7days, 28days, 56days and found that the average flexural strength of concrete at 3 days in plastic film is 3.75 N/mm^2 where the flexural strength of concrete at 3 days in water curing is 4.12 N/ mm^2 and in air curing is 3.08 N/ mm^2. It is studied that the split tensile strength of concrete at 3 days in water curing increases by 31.47%. At 7 days the flexural strength of concrete in water curing increases by 15.33%. At 28 days, the flexural strength of concrete in water curing increases by 5.59%. At 56 days, the flexural strength of concrete in water curing increases by 5.56% as shown in table II.

Table II. Shows the flexural strength of concrete in different curing methods and the percentage difference in strength.

S.No	Days of Curing	Flexural Strength N/mm^2			% Difference
		Air Curing	Plastic Film Curing	Water Curing	
1	3 days	3.08	3.75	4.12	8.98
2	7 days	4.54	3.92	4.63	15.33
3	28 days	5.76	6.08	6.44	5.59
4	56 days	5.84	6.12	6.48	5.56

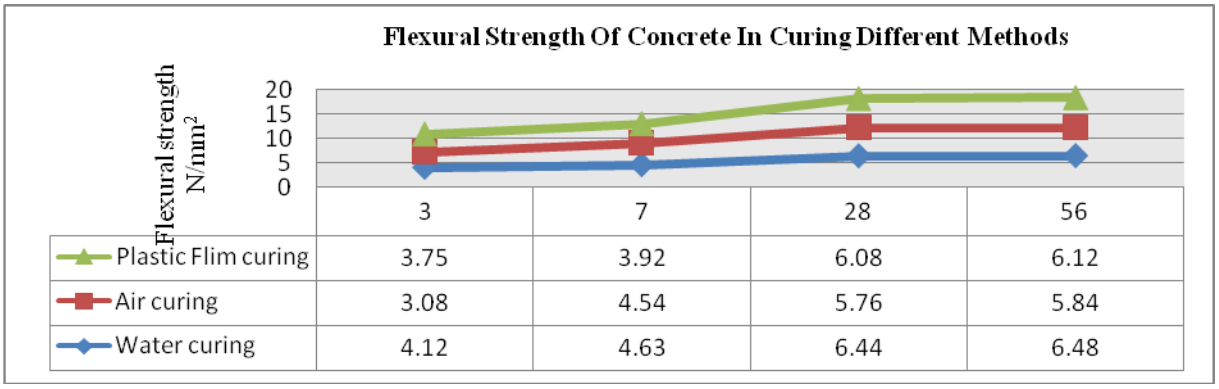

Figure 3. Shows the flexural strength of concrete in different curing methods.

J.R.Al-Feel et.al, made a study on the " Properties of self compacting concrete at different curing conditions and their comparison with properties of Normal concrete" he made a comparative study on the split tensile strength of self compacting concrete(SCC) and normal cement concrete(NCC) under different curing conditions at 7 days,14 days and 28 days. It is found that the split tensile strength of self compacting concrete is high when compared with split tensile strength of normal cement concrete at water curing method and air curing method. The values of the tensile strength of SCC and NCC are shown in table III.

Table III. Shows the split tensile strength of SCC and NCC at water curing and Air curing.

S.No	Days of Curing	Split tensile Strength N/mm^2			
		water curing		Air curing	
		SCC	NCC	SCC	NCC
1	7 days	4.45	3	3.8	2.75
2	14 days	5.1	3.65	4.45	3.35
3	28 days	5.3	3.8	4.5	3.45

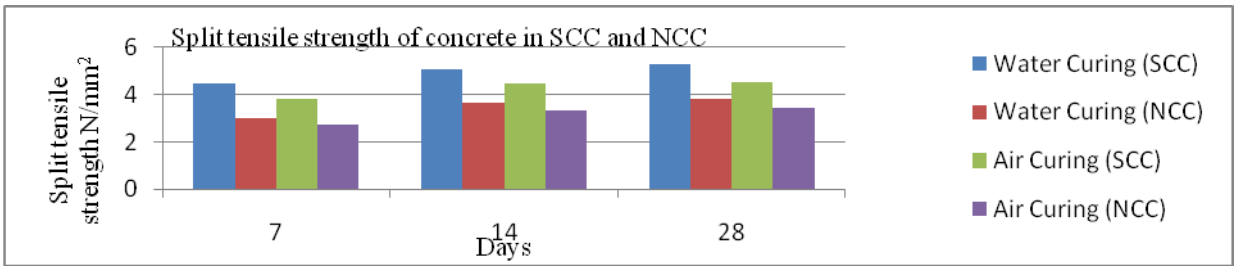

Figure 3.Shows the split tensile strength of SCC & NCC concrete in different curing methods.

J.R. Al-Feel et.al also made a study on the flexural strength of the concrete for SCC and NCC under different curing condition at 28 days. The values of the flexural strength of SCC and NCC are shown in table IV

Table IV. Shows the flexural strength of SCC and NCC at water curing and Air curing.

S.No	Days of Curing	Flexural Strength N/mm^2			
		water curing		Air curing	
		SCC	NCC	SCC	NCC
1	28 days	4.41	3.00	3.91	2.50

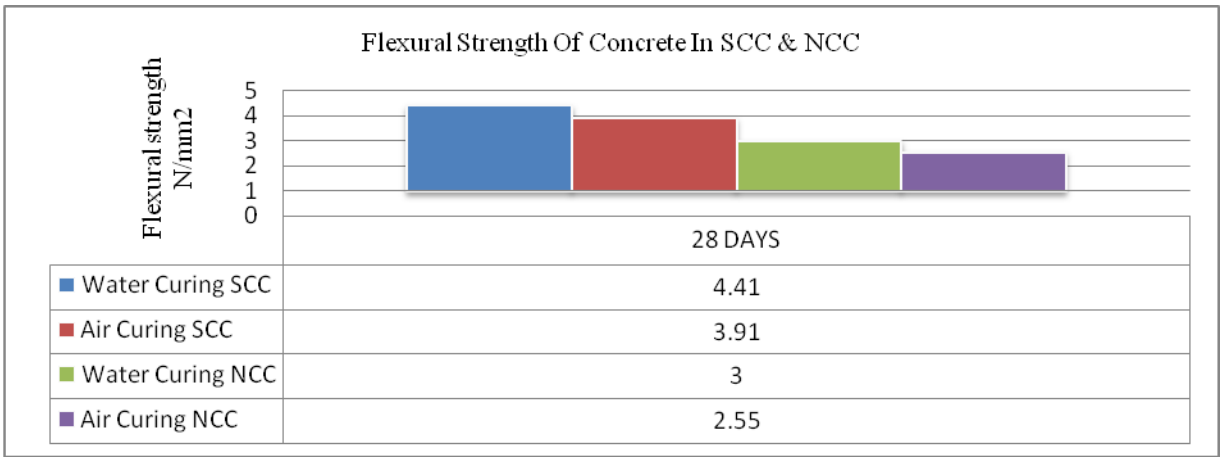

Figure 4. Shows the flexural strength of SCC & NCC concrete in different curing methods.

V. CONCLUSION

Water curing method is the most effective method for curing the concrete, since both the tensile strength and flexural strength of the concrete get increased in this curing method. This method proves effective because there is an improve in pore structure and the degree of hydration of cement reaction will not lose any moisture content from the concrete. It is found that the water curing is the most effective method of curing with the maximum of 10% increase in tensile strength and 15% increase in flexural strength of concrete when compared with other curing methods. It can be observed that the average split tensile strength at 3 days in case of air curing and plastic curing is minimum. Whereas it is maximum under water curing. The flexural strength of the concrete increase in water curing method and it is minimum in the air curing and plastic film curing. But the increase of flexural and tensile strength of concrete is not high when compared to increase of compressive strength in the concrete under different curing methods. Curing method seems to be detrimental to the development of compressive strength then to its flexural and split tensile strength.

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